XVI

Scientific Conference

FIS COMMUNICATIONS

2013 in Physical Education, sport and recreation and I International Scientific Conference

Book of Proceedings

UNIVERSITY OF NIS
FACULTY OF SPORT AND PHYSICAL EDUCATION
FSFV
1971

Niš, October 18-19th, 2013

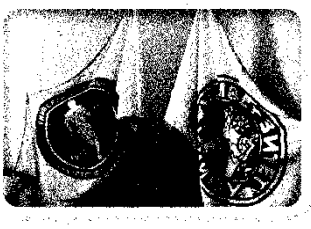
University of Niš
Faculty of Sport and Physical Education

XVI Scientific Conference
„FIS COMMUNICATIONS 2013"
in physical education, sport and recreation
and
I International Scientific Conference

(Niš, Serbia, october 18-19th, 2013)

Book of Proceedings

Niš, 2013.



XVI Scientific Conference
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Publisher:

Faculty of sport and physical education , University of Niš

For the publisher:

Faculty dean, prof. Milovan Bratić, PhD

Editor in chief:

assist. prof. Saša Pantelić, PhD

Printed by:

Medivest, Nis

Computer editor:

Predrag Zivanović

Cover design:

Dragan Radojković

Circulation:

150 copies

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

796/799(082)

SCIENTIFIC Conference "FIS Communications 2013"
in physical education, sport and recreation (16 ; 2013 ; Niš)
Book of Proceedings / XVI Scientific Conference "FIS
Communications 2013" in physical education, sport and recreation
and I International Scientific Conference, (Niš, Serbia, october
18-19th, 2013) ; [glavni urednik Saša Pantelić]. - Niš : Faculty
of sport and physical education, 2013 (Niš :
Medivest). - 524 str. : ilustr. ; 30 cm

Na vrhu nasl. str.: University of Niš. - Tiraž 150. - Bibliografija
uz svaki rad. - Saželi.

ISBN 978-86-87249-53-0
1. International Scientific Conference (1 ;
2013 ; Niš)
a) Спорт - Зборници b) Физичка култура - Зборници
COBISS.SR-ID 201698828

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FOREWORD

Faculty of Sport and Physical Education University of Nis in its 42 years long tradition organizes a scientific conference "FIS COMMUNICATIONS". This year we are organizing 16th scientific conference "FIS COMMUNICATIONS 2013", and 1st International scientific conference. Our profound years long experience in organizing of the conference has contributed to ever increasing high quality of the conference over years.

International scientific conference "FIS COMMUNICATIONS 2013" is organized by the Faculty of sport and Physical Education University of Nis under the auspices of the Ministry of Education, Science and Technological Development of the Republic of Serbia.

We are proud to announce the key speakers in our plenary sessions as eminent renowned experts in their field of expertise who are coming from the countries taking part in this conference for the first time.

This conference can boast submission of 98 papers in the form of abstracts and 86 full text papers. Upon the review process 66 papers were accepted and approved for the publication. Incorporating three papers of the invited speakers the total number of submitted papers is 69.

Papers are divided into five sessions depending on the topics investigated as follows:

Sport, Physical Education, Exercising and Health, Biomedical and Multidisciplinary session.

Organizers are satisfied with the participation of already renowned researchers and the young, oncoming authors following the thorny path of the scientific investigation, as well. Also a large number of foreign authors and thematic diversity have widen the horizon of the expert and scientific insights, put some new incentive for the cooperation and expression of the new creative efforts.

Enclosed you can find the Proceedings of the International scientific conference "FIS COMMUNICATIONS 2013" incorporating all the papers presented at the scientific conference.

We would like to express our gratitude to all the participants, especially to the authors of the papers and we expect that all this conference contributes to enhance and further the development of the scientific and expertise thought in the area of sport, physical education and recreation.

Chair of the Scientific Committee
Saša Pantelić, PhD, assist. prof.

CONTENTS:

Plenary Sesion

THE PHYSIOLOGICAL PROFILE OF THE JUDO ATHLETES

Emerson Franchini[1]

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UDC 796.853.23:159.9

INTRODUCTION

Judo is a high-intensity intermittent grappling combat sport where athletes are classified by gender, body mass and age categories (Franchini et al., 2011a). The main goal in competitive judo is to throw, to immobillize or to submitt (via strangle or joint lock techniques), scoring an *ippon* (full point). The match can also be won via lower scores (*yuko* and *waza-ari*) or penalties. As the match has a regular time-limit of 5-min, which can be complemented by an extra-time with no time-limit (i.e., the match is finished only when one of the athletes scores), judo is considered a highly physiologically demanding combat sport (Franchini et al., 2013). During this period, athletes typically engage in 20-30s effort periods interpersed by approximately 10s breaks (Miarka et al., 2012). In the effort periods, half of the time is spent in grip dispute, which is an important technical advantage to control the opponent and to execute a throwing technique (Marcon et al., 2010; Miarka et al., 2012). Judo combat can also be conducted in the groundwork, where immobilization, strangle and joint-lock (i.e., in judo only elbow locks can be applied) techniques are executed. Thus, judo demands endurance (to be able to fight more than 5-min and 4-7 times in the same day), speed (to execute the throwing techniques) and strength (to execute the powerful actions during throwing techniques and to control the opponent during the groundwork) (Franchini et al., 2013). As a consequence, the judo athletes need to undergo specific physiological adaptations to deal with the requisites of judo matches. This adaptation seems to be generated by the fighting style of each athlete, although more investigation in this area is needed to confirm this assumption. Additionally, as a simultaneous development of endurance, speed and strength results in concurrence (i.e., the development of each aspect is hampered when all of them are stimulated compared to the training directly to develop only one variable) (Docherty and Sporer, 2000), more research is necessary to provide information about the optimal combination for a judo performance. In this short review, the aerobic and anaerobic power and the capacity and strength (strength-endurance, muscle power and maximal strength) characteristics of elite judo athletes are presented.

Previous review articles recently published by our research group (Franchini et al., 2011a; Franchini et al., 2013) were used as the main references in this approach.

AEROBIC POWER AND CAPACITY

The aerobic power (VO_{2max} or $VO2_{peak}$) and capacity (indirectly evaluated by metabolic or ventilatory thresholds) are considered relevant to the judo performance (Franchini et al., 2007; Muramatsu et al., 1994), although conflicting evidence has been published concerning the influence of the aerobic fitness variables on the judo-related performance (Borkowsky et al., 2001; Franchini et al., 2005a).

Some authors suggest that a high aerobic fitness profile should be important to the judo performance due to its positive influence on the attack rate maintenance during the match, a delayed metabolite (H^+, Pi) accumulation during the combat and a faster recovery process between the consecutive matches (Castarlenas and Solé, 1997). Typically, VO_{2max} values are around 50 to 60 $mL.kg^{-1}.min^{-1}$ in male judo athletes, while values around 40-50 $mL.kg^{-1}.min^{-1}$ are found in female judo athletes (Franchini et al., 2011a). However, no significant difference was reported between the elite and non-elite judo athletes (Franchini et al., 2005a), the first and second placers in a national team (Borkowski et al., 2001; Franchini et al., 2007) or between the winners and the defeated athletes disputing a combat simulation (Suay et al., 1999). Similarly, the onset blood lactate accumulation (OBLA) velocity did not differ between the elite and the non-elite judo athletes (Franchini et al., 2005a) and the values presented by the judo athletes were in the range observed in active non-athletic groups (i.e., between 9 and 11 $km.h^{-1}$) (Franchini et al., 2011a). Conversely, Gariod et al. (1995) reported that the judo athletes with a higher VO_{2max} presented a lower accumulation of Pi during a progressive test, finished the test with higher pH and had a faster phosphocreatine resynthesis thereafter compared to the judo athletes with lower VO_{2max} and a higher anaerobic fitness. Franchini et al. (2007) found a positive and significant correlation (r = 0.79) between the estimated VO_{2max} and performance in a judo specific task (number of throws during the Special Judo Fitness Test). A similar finding was also observed by Detanico et al. (2012), who reported a significant correlation (r = 0.70) between the peak velocity in a progressive test until exhaustion and the number of throws during the Special Judo Fitness Test. However, no experimental study analyzed the influence of aerobic power improvement or aerobic power training protocol on judo-related performance or physiological markers during a judo combat. Concerning the aerobic capacity, Franchini et al. (1998) reported a significant negative correlation (r = -0.72) between the OBLA velocity and the blood lactate after combat simulation. Detanico et al. (2012) also reported a significant negative correlation (r = - 0.59) between the anaerobic threshold velocity and the peak blood lactate after a judo combat. These studies suggest a lower glycolytic activity during the combat for the athletes with higher aerobic capacity indexes. Furthermore, Detanico et al. (2012) observed a significant positive correlation (r = 0.60) between the anaerobic threshold velocity and the number of throws in the Special Judo Fitness Test. Thus, it seems that the aerobic fitness is also associated to the high-intensity intermitente performance. However, as for the aerobic power, only transversal and correlational studies were found concerning the aerobic capacity and the judo-related performance and no experimental study investigated the effects of a program directed to improve this variable on the judo-specific performance or on the physiological responses to a judo combat.

ANAEROBIC POWER AND CAPACITY

The anaerobic power and capacity are considered quite important for the judo performance, because the powerful actions performed during the throwing techniques have a strong contribution of the anaerobic power, while the grip maintenance during the match seems to be related to the anaerobic capacity (Bonitch-Góngora et al., 2012; Franchini et al., 2013). It has been reported that the high-level judo athletes present an upper-body peak power during the Wingate test in the 90th percentile of the non-athletes performing the same test using their lower-body (Franchini et al., 2011a). Both peak and mean power were higher in the elite judo athletes compared to the non-elite judo athletes (Franchini et al., 2005a) and the total work during the two consecutive Wingate tests was significant and it positively correlated (r = 0.76) with the number of the attacks during a judo combat simulation (Franchini et al., 2005b). Thus, the evidence indicates that the anaerobic power and the capacity

development are important for a judo athlete's performance.

Given the importance of these variables a judo specific test (i.e., the Special Judo Fitness Test), developed by Sterkowicz (1995), is commonly used to evaluate the judo athletes in different phases of their training. A recent physiological analysis of this test (Franchini et al., 2011b; Franchini et al., 2012) revealed that it has a high anaerobic contribution (alactic contribution = 40.4 ± 5.6%; lactic contribution = 26.7 ± 5.4%; aerobic contribution = 32.9 ± 3.3%), and can be used properly to evaluate the anaerobic profile of the judo athletes using judo-specific movements (i.e., *ippon-seoi-nage* throws). Recent reviews about this test (Franchini et al., 2010; Drid et al., 2012) and the availability of a classifcatory table (Franchini et al., 2009) provide evidence-based data to judo coaches and researchers to conduct a judo athletes' evaluation.

STRENGTH

The strength development by the judo athletes has been a focus of controversy, especially because one of the principles of judo is "maximum efficiency, minimum effort" (*seiryoku zenyo*) (Franchini and Del'Vecchio, 2008). Thus, it is not rare to find people against the strength development of judo athletes, even considering the evidence that training this variable has been an approach used by many victorious judo athletes as Masahiko Kimura, Anton Geesink, William Ruska, Yasuhiro Yamashita, Kosei Inoue, Ilias Iliadis, among others. Maybe, one of the most important evidences of the relevance of this variable for a judo performance are the weight categories introduced many years ago and the publication of the strength-related one-repetition maximum (1RM) classificatory tables (Tables 1 to 3) of the Japanese judo athletes for bench press, squat and power clean (Aruga et al., 2003). Although all the tables presented by Aruga et al. (2003) contain values not corresponding to any range of classification, they are a valuable references to compare the performance of the judo athletes being evaluated for maximal strength.

TABLE 1 Bench-press one-repetition maximum (1RM) of judo athletes from different weight categories (Adapted from Aruga et al., 2003)

Weight category/Classification	Very poor (kg)	Poor (kg)	Average (kg)	Good (kg)	Very good (kg)
<60kg	≤ 85.0	87.5-90.0	92.5-97.5	100.0-105	≥ 107.5
<66kg	≤ 87.5	90.0-97.5	100.0-115.0	117.5-125.0	≥ 127.5
<73kg	≤ 90.0	92.5-100.0	102.5-117.5	120.0-127.5	≥ 130.0
<81kg	≤ 92.5	95.0-105.0	105-120.0	122.5-132.5	≥ 135.0
<90kg	≤ 95.0	97.5-107.5	110.0-122.5	125.0-135.0	≥ 137.5
<100kg	≤ 97.5	100.0-110.0	112.5-125.0	125.5-137.5	≥ 140.0
>100kg	≤ 100.0	102.5-120.0	122.5-145.0	147.5-165.0	≥ 167.5

For the bench-press 1RM, Aruga et al. (2003) found that the <60kg weigth category presented lower values compared to all other groups, while the >100kg group had higher values compared to all the others. Additionally, the <73kg presented lower values compared to <81kg, <90kg, < 100kg and >100kg. Furthermore, it is interesting to note that the values achieved by the Japanese judo athletes are much higher than those reported in the Canadian Judo Team (100 ± 21 kg) (Thomas et al., 1989), recreational (87 ± 20 kg), national (96 ± 12 kg) and international level (96 ± 20 kg) Finish judo athletes (Fagerlund and Häkkinen, 1991), A (110 ± 25 kg), B and C (110 ± 23 kg) Brazilian National Teams (Franchini et al., 2007), while the Italian Olympic Judo Team (160 ± 30 kg) (Sbriccoli et al., 2007) would be classified as "good" in the Japanese classifcatory table.

TABLE 2 Squat one-repetition maximum (1RM) of judo athletes from different weight categories (Adapted from Aruga et al., 2003)

Weight category/Classification	Very poor (kg)	Poor (kg)	Average (kg)	Good (kg)	Very good (kg)
<60kg	≤ 102.0	105.0-117.5	120.0-135.0	137.5-152.5	≥ 155.0
<66kg	≤ 107.5	110.0-122.5	125.0-142.5	145.0-157.5	≥ 160.0
<73kg	≤ 110.0	112.5-125.0	127.5145.0	147.5-160.0	≥ 162.5
<81kg	≤ 112.5	115.0-127.5	130.0-150.0	152.5-165.0	≥ 167.5
<90kg	≤ 115.0	117.5-132.5	135.0-165.0	167.5-185.0	≥ 187.5
<100kg	≤ 117.5	120.0-140.0	142.5-172.5	180.0-200.0	≥ 202.5
>100kg	≤ 127.5	130.0-165.0	167.5-200.0	202.5-235.0	≥ 237.5

For the squat 1RM, Aruga et al. (2003) reported that the three heaviest weight categories achieved higher values compared to the three lighest ones and that the >100kg weight category had higher values compared to the <81kg and <90kg groups. For this exercise, the values are also much higher than that presented by A (104 ± 27 kg) and B-C (104 ± 18 kg) Brazilian National Teams (Franchini et al., 2007) and recreational Finish judo athletes (140 ± 36 kg) (Fagerlund and Häkkinen, 1991). However, national (166 ± 32 kg) and international (185 ± 25 kg) level Finish judo athletes (Fagerlund and Häkkinen, 1991) presented values classified as "good" for the same weight categories in the Japanese classifcatory table.

For the power-clean exercise, only Aruga et al. (2003) reported values for judo athletes. When weight categories were compared the <81kg, <90kg and >100kg weight groups presented higher values compared to the <60kg, <66kg and <73kg weight categories, and the <100kg had better results compared to the <60kg group.

TABLE 3 Power-clean one-repetition maximum (1RM) of the judo athletes from different weight categories (Adapted from Aruga et al., 2003)

Weight category/Classification	Very poor (kg)	Poor (kg)	Average (kg)	Good (kg)	Very good (kg)
<60kg	≤ 57.5	60.0-65.0	67.5-72.5	75.0-80.0	≥ 82.5
<66kg	≤ 60.0	62.5-70.0	72.5-82.5	85.0-92.5	≥ 95.0
<73kg	≤ 62.5	65.0-72.5	75.0-85.0	87.5-95.0	≥ 97.5
<81kg	≤ 67.5	70.0-80.0	82.5-92.5	95.0-105.0	≥ 107.5
<90kg	≤ 70.0	72.5-82.5	85.0-95.0	97.5-107.5	≥ 110.0
<100kg	≤ 72.5	75.0-85.0	87.5-97.5	100.0-110.0	≥ 112.5
>100kg	≤ 75.0	77.5-87.5	90.0-102.5	105.0-115.0	≥ 117.5

As judo involves the grip on the opponent's *judogi*, many studies investigated the maximal isometric handgrip strength in the judo athletes from different ages, weight categories and competitive levels (Franchini et al., 2011a). However, no difference was reported between the elite and non-elite judo athletes (Franchini et al., 2005a), and some authors suggested that due to the characteristics of the grip during a judo combat the differences should be expected in strength-endurance handgrip variables and not in the maximal isometric strength (Ache Dias et al., 2012; Franchini et al., 2011a; Franchini et al., 2011c). Indeed, Ache Dias et al. (2012) observed that the judo athletes were not stronger than the non-judo athletes, but they were more fatigue-resistant than the non-judo athletes in the handgrip task. Furthermore, when specific *judogi* grip isometric strength-endurance test was used, no difference was found between the state and national/international level judo athletes, but a

significant difference was found between these groups when a dynamic strength-endurance chin-up test holding the *judogi* was performed (Franchini et al., 2011c).

FINAL REMARKS

When the well-trained judo athletes are investigated (Franchini et al., 2011a; Franchini et al., 2013), it is normally found that they have a highly developed dynamic strength (assessed via one-repetition maximum tests), muscular endurance (assessed via general - push-up and sit-up tests - and especially during specific tests as the dynamic and isometric chin-up tests gripping the *judogi*), anaerobic power (evaluated via lower- and upper-body Wingate test peak power) and anaerobic capacity (evaluated via lower- and upper-body Wingate test mean power and number of throws during the Special Judo Fitness Test). Except for the lower body muscle power, the judo athletes seem to present a higher development in the upper-body muscle groups. Although considered relevant to a judo performance, the aerobic power (assessed via VO_{2max} tests) and capacity (evaluated via metabolic/ventilatory thresholds) are not highly developed in the judo athletes (Franchini et al., 2011a). Furthermore, little information is available concerning the weight categories and gender differences. More judo-specific tests need to be developed to improve the evaluation of the judo athletes' physiological profile and the longitudinal studies are necessary to improve the knowledge of the judo training programs on physiological markers.

REFERENCES

Ache Dias, J., Wentz, M., Külkamp, M., Mattos, D., Goethel, M., Borges Júnior, N. (2012). Is the handgrip strength performance better in judokas than in non-judokas? *Science & Sports*, *27*(3), e9-e14.

Aruga, S., Onda, T., Aso, K., Shirase, H., Yamashita, Y., Nakanishi, H., Ubukata, K. (2003). Measurement of barbell lifting capacity and making strength standards in judo players. *Tokai Journal of Sports Medicine and Science*, *15*, 7-17.

Bonitch-Góngora, J.G., Bonitch-Domínguez, J.G., Padial, P., Feriche, B. (2012). The effect of lactate concentration on the handgrip strength during judo bouts. *Journal of Strength and Conditioning Research, 26*(7), 1863-1871.

Borkowsky, J., Faff, J., Starczewska-Czapowska, J. (2001). Evaluation of the aerobic and anaerobic fitness in judoists from the Polish national team. *Biology of Sport*, *18*, 107-111.

Castarlenas, J.L., Solé, J. (1997). El entrenamiento de la resistência en los deportes de luch con agarre: una propuesta integradora. *Apunts: Educación Física y Deportes*, *1*, 81-86.

Detanico, D., Dal Pupo, J., Franchini, E., Giovana dos Santos, S. (2012). Relationship of aerobic and neuromuscular indexes with specific actions in judo. *Science & Sports*, *27*(1), 16-22.

Docherty, D., Sporer, B. (2000). A proposed model for examining the interference phenomenon between concurrent aerobic and strength training. *Sports Medicine, 30*(6), 385-394.

Drid P, Trivic T, and Tabakov S. (2012). Special judo ftiness test - a review. *Serbian Journal of Sports Sciences*, *6*(4), 117-125.

Fagerlund, R., Häkkinen, H. (1991). Strength profile of Finish judoists: measurement and evaluation. *Biology of Sport*, *8*(3), 143-149.

Franchini, E., Artioli, G.G., Brito, C.J. (2013, in press). Judo combat: time-motion analysis and physiology. *International Journal of Performance Analysis in Sport*, in press (December issue).

Franchini, E., Del Vecchio F.B. (2008). *Preparação física para atletas de judô*. São Paulo: Phorte Editora.

Franchini, E., Del Vecchio, F.B., Matsushigue, K.A., Artioli, G.G. (2011a). Physiological profiles of elite judo athletes. *Sports Medicine, 41*(2), 147-166.

Franchini, E., Del Vecchio, F.B., Sterkowicz, S. (2009). A special judo fitness test classificatory table. *Archives of Budo, 5*, 127-129.

Franchini, E., Del Vecchio, F.B., Sterkowicz S. (2010). Special Judo Fitness Test: development and results. In: *Advancements in the Scientific Study of*

Combative Sports (Sports and Athletics Preparation, Performance, and Psychology). JE Warnick, WD Martin, eds. New York: Nova Publishers. pp. 41-49.

Franchini, E., Miarka, B. Matheus, L., Del Vecchio, F.B. (2011c). Endurance in judogi grip strength tests: comparison between elite and non-elite judo players. *Archives of Budo, 7*(1), 1-4.

Franchini, E., Nunes, A.V., Moraes, J.M., Del Vecchio, F.B. (2007). Physical fitness and anthropometrical profile of the Brazilian male judo team. *Journal of Physiological Anthropology, 26*(2), 59-67.

Franchini, E., Sterkowicz, S., Szmatlan-Gabrys, U., Gabrys, T., Garnys, M. (2011b). Energy system contributions to the special judo fitness test. *International Journal of Sports Physiology and Performance, 6*(3), 334-343.

Franchini, E., Sterkowicz, S., Szmatlan-Gabrys, U., Gabrys, T., Garnys, M. (2012). Response letter. *International Journal of Sports Physiology and Performance, 7*(4), 308-309.

Franchini, E., Takito, M.Y., Bertuzzi, R.C.M. (2005b), Morphological, physiological and technical variables in high-level college judoists. *Archives of Budo, 1*(1), 1-7.

Franchini, E., Takito, M.Y., Kiss, M.A.P.M., Sterkowicz, S. (2005a). Physical fitness and anthropometrical differences between elite and non-elite judo players. *Biology of Sport, 22*(4), 315-328.

Franchini, E., Takito, M.Y, Lima, J.R.P., Haddad, S., Kiss, M.A.P.D.M., Regazzini, M., Böhme, M.T.S. (1998). Características fisiológicas em testes laboratoriais e resposta da concentração de lactato sangüíneo em três lutas em judocas das classes juvenil-A, júnior e sênior. *Revista Paulista de Educação Física*, *12*(1), 5-16.

Gariod, L., Favre-Juvin, A., Novel, V., Reutenauer, H., Majean, H., Rossi, A. (1995). Évaluation du profil énergétique des judokas par spectroscopie RMN du P31. *Science & Sports,* 10(4), 201-207.

Marcon, G., Franchini, E., Jardim, J.R., Neto, T.L.B. (2010). Structural analysis of action and time in sports: judo. *Journal of Quantitative Analysis in Sports,* 6(4), 1-15.

Miarka, B, Panissa, V.L.G., Julio, U.F., Del Vecchio, F.B., Calmet, M., Franchini, E. (2012). A comparison of time-motion performance between age groups in judo matches. *Journal of Sports Sciences,* 30(9), 899-905.

Muramatsu, S., Horiyasu, T., Sato, S.I., Hattori, Y., Yanagisawa, H., Onozawa, K., Tezuka, M. (1994). The relationship between aerobic capacity and peak power during intermittent anaerobic exercise of judo athletes. *Bulletin of the Association for the Scientific Study on Judo Kodokan, 8*, 151-160.

Sbriccoli, P., Bazzuchi, I., Di Mario, A., Marzattinocci, G., Felici, F. (2007). Assessment of maximal cardiorespiratory performance and muscle power in the Italian Olympic judoka. *Journal of Strength and Conditioning Research*, *21*(3), 738-744.

Sterkowicz, S. (1995). Test speccjalnej sprawnosci ruchowej w judo. *Antropomotoryka*, *12*, 29-44.

Suay, F., Salvador, A., González-Bono, E., Sanchís, C., Martínez, M., Martínez-Sanchis, S., Simón, V.M., Montoro, J. B. (1999). Effects of competition and its outcome on serum testosterone, cortisol and prolactin. *Psychoneuroendocrinology,* 24(5), 551-566.

Thomas, S.G., Cox, M.H., LeGal, Y.M., Verde, T.J., Smith, H.K. (1989). Physiological profiles of the Canadian National Judo Team. *Canadian Journal of Sport Science*, *14*(3), 142-147.

EATING DISORDERS IN THE JUDO ATHLETES

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UDC 796.853.23

Judo competitions are divided into age, gender and weight categories. Usually, the athletes manipulate their body weight a few days before the competition or even a few minutes before the weigh-in, in order to obtain a competitive advantage over lighter opponents (Artioli et al., 2010). To achieve a fast body weight reduction, the judo athletes use aggressive strategies which could have a high health-injury risk (Boisseau, 2006; Rauh et al., 2010). Among these strategies the literature has collected the methods used by the judo athletes to lose body weight. The most used are fasting, severe fluid and food restrictions, using saunas and exercising with rubberized suits (Artioli et al., 2010; Escobar et al., 2009). Also, the use of diuretics, laxatives, diets and self-induced vomiting are methods used by them even among the youngest (Werner et al., 2013). Approximately 60% of the judo athletes start to use such methods during theie adolescence (Artioli et al., 2010), which can negatively affect growth and development (Boisseau et al., 2005; Roemmich & Sinning, 1997). Furthermore, the judo athletes who start to reduce their body mass earlier in their careers and those who achieve higher competitive level are more commonly engaged in the more aggressive body mass reduction procedures (Artioli et al., 2010).

It is known that the 62% (Brito et al., 2012) to 86% (Artioli et al., 2010) of the male judo athletes reduce their body mass to compete, whilethe 55% (Fabrini et al., 2010) to 85.9% (Artioli et al., 2010) of the female judo athletes do so. The amount of the body weight loss is about 2-5% for males and females respectively (Artioli et al., 2010; Kowatari et al., 2001; Prouteau et al., 2006), while the higher reductions (8.5±4.2%) are also reported in the literature for the male judo athletes (Brito et al., 2012) even some judo athletes loosing up to 10% ten times or more in their careers (Werner et al., 2013). The highest amount of the body mass reduction is conducted in the last week before competition (Artioli et al., 2010; Brito et al., 2012). However, it is important to consider that Artioli et al. (2010) investigated a sample (n = 822) almost 6 times bigger than Brito et al. (2012) (n = 145). Additionally, the evidence of the competition analysis indicated that the judo athletes losing more than 5% of their body mass had a higher probability of injury during the tournament (Green et al., 2007). A higher occurrence of injuries in the judo athletes who undergo severe body weight loss procedures when training for a tournament has also been reported (Prouteau et al., 2007).

In general, these methods, to reduce body weight used by the judo athletes, at the physiological level, cause dehydration, an increased load on the cardiovascular system, changes in the regulatory system of temperature, glycogen depletion, hypoglycaemia and a reduction in proteins, electrolytes and vitamins, a reduced anaerobic power and high concentrations of creatine kinase in serum, among others (Koral et al., 2009; Opplieger et al., 1996; Timpmann et al., 2008; Wilmore, 2000). Also, psychologically speaking, the pressure to achieve a certain weight induces added stress to that of the competition itself, which can cause increased

tension, anger, fatigue and confusion, and a decreased vigour when the male athletes reduced approximately 5% of their body mass in a 7 days period (Degoutte et al., 2006; Filaire et al., 2001). Similarly, the increased tension (only for females), confusion, and decreased vigour when reductions of approximately 4% of body mass were carried out by the female and the male judo athletes in a 4-week period occurred (Koral & Dosseville, 2009). Yoshioka et al. (2006) found higher scores in tension, fatigue and vigour in the male judo athletes after a weight reduction (1 day prior to competition) than before (20 days prior to competition), while there were no significant differences in the females, not even altered attitudes to food which may lead to the eating disorders. These attitudes can be defined as a set of behaviours and strategies associated with an excessive and permanent weight concern and body shape, affecting negatively both the performance and the athlete's health (Nichols et al., 2006; Ööpik et al., 2002; Rankin et al., 1996; Umeda et al., 2004). Among these eating disorders we can highlight binge eating, anorexia and bulimia, especially in the female athletes (Fogelholm, 1994; Franchini et al., 2012; Smolak et al., 2000).

Therefore, in this speech, we will try to highlight the weight control used by the judo athletes, their connection with gender and age and the psychological consequences related to the eating disorders. Also, we would like to give some basic recommendations to improve weight management behaviours. The obtained information could be useful for coaches, parents, physicians and sport psychologists to improve their approach when dealing with the judo athletes undergoing weight reduction at this level.

REFERENCES

Artioli, G. G., Gualano, B., Franchini, E., Scagliusi, F. B., Takesian, M., Fuchs, M., et al. (2010). Prevalence, magnitude, and methods of rapid weight loss among judo competitors. *Medicine and Science in Sports and Exercise, 42*(3), 436-442. doi: 10.1249/MSS.0b013e3181ba8055.

Boisseau, N. (2006). Consequences of sport-imposed weight restriction in childhood. *Anales Nestle, 64*(2), 77-84.

Rauh MJ, Nichols JF, Barrack MT (2010). Relationships among injury and disordered eating, menstrual dysfunction, and low bone mineral density in high school athletes: A prospective study. *Journal of Athletic Training, 45*(3) 243-252.

Escobar-Molina, R., Rodríguez-Ruíz, S., Fernández-Santaella Santana, MC., Carratalá, V., Piñar, MI. (2009). Methodology used by elite judoists to reduce body weight before competition. Scientific Congress on Martial Arts and Combat Sports. Viseu-Portugal. Proceedings.

Werner, A., Thiel, A., Schneider, S., Mayer, J., Giel, K., & Zipfel, S. (2013). Weight-control behaviour and weight-concerns in young elite athletes - a systematic review. *Journal of Eating Disorders, 1*(1), 18.

Boisseau, N., Vera-Perez, S., & Poortmans, J. (2005). Food and fluid intake in adolescent female judo athletes before competition. *Pediatric Exercise Science, 17*(1), 62-71.

Roemmich, J. N., & Sinning, W. E. (1997). Weight loss and wrestling training: effects on growth-related hormones. *J Appl Physiol, 82*(6), 1760-1764.

Brito, C. J., Castro Martins Roas, A. F., Souza Brito, I. S., Bouzas Marins, J. C., Cordova, C., & Franchini, E. (2012). Methods of Body-Mass Reduction by Combat Sport Athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 22*(2), 89-97.

Fabrini, S. P., Brito, C. J., Mendes, E. L., Sabarense, C. M., Marins, J. C. B., & Franchini, E. (2010). Práticas de redução de massa corporal em judocas nos períodos pré-competitivos. *Revista Brasileira de Educação Física e Esporte 24*(2), 165-177.

Kowatari, K., Umeda, T., Shimoyama, T., Nakaji, S., Yamamoto, Y., & Sugawara, K. (2001). Exercise training and energy restriction decrease neutrophil phagocytic activity in judoists. *Medicine and Science in Sports and Exercise, 33*(4), 519-524.

Green, C. M., Petrou, M. J., Fogarty-Hover, M. L., & Rolf, C. G. (2007). Injuries among judokas during competition. *Scandinavian Journal of Medicine &*

Science in Sports, 17(3), 205-210. doi: 10.1111/j.1600-0838.2006.00552.x

Prouteau, S., Ducher, G., Serbescu, C., Benhamou, L., & Courteix, D. (2007). Gender differences in response to weight cycling in elite judoists. *Biology of Sport, 24*(2), 91-104.

Koral, J., & Dosseville, F. (2009). Combination of gradual and rapid weight loss: effects on physical performance and psychological state of elite judo athletes. *Journal of Sports Sciences, 27*(2), 115-120. doi: 10.1080/02640410802413214.

Opplier, RA., Case, HS., Horswill, CA., et al. (1996). American College of Sports Medicine position stand. Weight loss in wrestlers. *Medi Sci Sports Exerc, 28* (ix-xii).

Timpmann S , Ööpik V , Pääsuke M , Medijainen L, Ereline J (2008). Acute effects of self-selected regimen of rapid body mass loss in combat sports athletes. *Journal of Sports Science and Medicine, 7*(2) 210-217.

Wilmore, JH. (2000). *Weight category sports. In: Nutrition in Sport*. Ed: Maughan, R.J. Oxford, UK: Blackwell Science Ltd. 637-645.

Degoutte, F., Jouanel, P., Begue, R. J., Colombier, M., Lac, G., Pequignot, J. M., et al. (2006). Food restriction, performance, biochemical, psychological, and endocrine changes in judo athletes. *International Journal of Sports Medicine, 27*(1), 9-18. doi: 10.1055/s-2005-837505

Filaire, E., Maso, F., Degoutte, F., Jouanel, P., & Lac, G. (2001). Food restriction, performance, psychological state and lipid values in judo athletes. *International Journal of Sports Medicine, 22*(6), 454-459. doi: 10.1055/s-2001-16244

Yoshioka, Y., Umeda, T., Nakaji, S., Kojima, A., Tanabe, M., Mochida, N., et al. (2006). Gender differences in the psychological response to weight reduction in judoists. *International Journal of Sport Nutrition and Exercise Metabolism, 16*(2), 187-198.

Nichols, JF., Rauh, MJ., Lawson, MJ., Ji, M. & Barkai, H. (2006). Prevalence of the female athlete triad syndrome among high school athletes. *Archives of Pediatrics and Adolescent Medicine, 160*(2), 137-142.

Ööpik V, Pääsuke M, Timpmann S, Medijainen L, Ereline J, Gapejeva J, (2002). Effects of creatine supplementation during recovery from rapid body mass reduction on metabolism and muscle performance capacity in well-trained wrestlers. *The Journal of Sports Medicine and Physical Fitness*, 42 330-339.

Rankin JW, Ocel JV, Craft LL (1996). Effect of weight loss and refeeding diet composition on anaerobic performance in wrestlers. *Medicine and Science in Sports and Exercise, 28*(10) 1292-1299.

Umeda T, Nakaji S, Shimoyama T, Yamamoto Y, Totsuka M, Sugawara K (2004). Adverse effects of energy restriction on myogenic enzymes in judoists. *J Sports Sci*, XXII 4 329-338.

Fogelholm, M. (1994). Effects of bodyweight reduction on sports performance. *Sports Medicine, 18*(4), 249-267.

Franchini, E., Brito, C., & Artioli, G. (2012). Weight loss in combat sports: physiological, psychological and performance effects. *Journal of the International Society of Sports Nutrition, 9*(1), 52.

Smolak, L., Murnen, S. K., & Ruble, A. E. (2000). Female athletes and eating problems: a meta-analysis. *The International Journal of Eating Disorders, 27*(4), 371-380. doi: 10.1002/(SICI)1098-108X(200005)27:4<371::AID-EAT1>3.0.CO;2-Y [pii]

PROMOTING PHYSICAL ACTIVITY IN OLDER ADULTS: A LIFESTYLE APPROACH OR A STRUCTURED EXERCISE INTERVENTION?

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UDC 796.035:-053.9

SUMMARY

INTRODUCTION European nations face increasing numbers of older people. It is a fact that exercise/physical activity (PA) for community-dwelling as well as institutionalized older people has beneficial effects on physiological, psychological and social health. Reviews have demonstrated an overwhelming amount of evidence on the positive effects of PA on the risk of mortality, the onset of co-morbidity, and the delay of the onset of dependency and frailty. Promotion of PA in older people will contribute to maintaining and improving the quality of life and to reducing the (economic) burden of disease and disability.

One might think that –knowing the beneficial effects- older persons are lining up for exercise classes or other physical activities. However, in real life the proportion of seniors being physically active (meeting the recommended levels), decreases with advancing age. Therefore it is questioned how we can best promote physical activity in older adults.

Several studies have shown that older persons benefit from a supervised, center-based, exercise program in terms of improved functional performance and fitness (Delecluse et al., 2004; Dunn et al., 1998; Fahlman et al., 2007). However, these supervised center-based programs are expensive, which limits their implementation possibilities and hence their public health impact. Moreover, for sedentary older adults in particular, a number of important barriers exist to attend such supervised center-based exercise program, for example lack of access or transportation to the facilities, financial considerations and a lack of affinity with the culture of fitness centres (Schutzer & Graves, 2004). In order to deal with these barriers, home-based and lifestyle interventions were developed. However, it is not yet clear whether the effects of such home-based and lifestyle interventions equal the effects of the supervised center-based exercise interventions. The aim of this study was to evaluate the effects of a traditional fitness training intervention versus a home-based lifestyle intervention on physical activity, physical fitness and cardiovascular risk factors in older adults.

METHODS One hundred and eighty-six sedentary men and women aged 60 to 83 volunteered to participate and were randomized in one of three groups. A fitness training intervention (STRU, N = 60), consisting of three supervised sessions weekly, and a home-based group (LIFE, N = 60), including an individualized lifestyle program supported by a limited number of booster phone calls, were compared with an 'assessment only' control group (N = 66). Physical activity, cardio-respiratory fitness, muscular fitness, functional performance and cardiovascular risk factors were recorded before (pretest) and after 11 months of intervention (posttest).

RESULTS and CONCLUSIONS: The STRU and the LIFE intervention were equally effective in increasing physical activity in older adults. Both intervention groups improved in physical fitness, but STRU increased more than LIFE for cardio-respiratory and muscular fitness, whereas LIFE increased more than STRU for functional performance. In general however, although STRU showed a limited effect on body composition and total cholesterol/HDL ratio, eleven months of structured exercise and/or lifestyle physical activity had only limited effects on cardiovascular risk factors,. Therefore, interventions aiming to reduce cardiovascular risks should focus on long-term changes in physical activity behaviour.

REFERENCES

Delecluse, C., Colman, V., Roelants, M., Verschueren, S., Derave, W., Ceux, T. et al. (2004). Prev.Med., *39,* 823-833.

Dunn, A. L., Marcus, B. H., Kampert, J. B., Garcia, M. E., Kohl, H. W., III, & Blair, S. N. (1999). *JAMA, 281,* 327-334.

Fahlman, M. M., Topp, R., McNevin, N., Morgan, A. L., & Boardley, D. J. (2007). *J.Gerontol.Nurs., 33,* 32-39.

Schutzer, K. A. & Graves, B. S. (2004). *Prev.Med., 39,* 1056-1061.

Sport

THE RELATIONSHIP BETWEEN THE STATIC BALANCE AND THE SUCCESS ON THE BALANCE BEAM IN YOUNG GYMNASTS

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SUMMARY

Introduction: Balance is an important factor for success in many sports, but in gymnastics, it is one of the most important factors for success, because even a minimal distortion of stability affects the final score. There is little research linking the ability of balance to success in the execution of complex gymnastic elements and gymnastics composition. In most studies, the balance of gymnasts is compared to the balance of a control group of non-athletes or to the balance of other athletes.

Methods: In this study 48 young gymnasts of the international competition ranks (age 10.7 ± 1.8 years, height 140.88 ± 8.78 cm, body mass 33.83 ± 6.11 kg), from eight European countries participated voluntarily. The aim of the research is to determine the relationship between the static balance measured by the BESS test, as well as three specific balancing tests (SSRV, SSSB, SSSU) and the success on the balance beam in young gymnasts.

Results: There is no statistically significant relationship between all BESS position, as well as the total BESS test results, while significant relationship between variables SSRV and deduction ($r= 0.602$, $p < 0.01$) and the final score ($r = 0.533$, $p < 0.01$) was found. The variable SSSU significantly correlated with the start value, the final score and deduction ($r = 0.521$, $p < 0.01$; $r = 0.486$, $P < 0.01$; $r = 0.596$, $p< 0.01$, respectively) as well as variable SSSB ($r = 0.541$, $p < 0.01$; $r = 0.607$, $P < 0.01$; $r = 0.685$, $p< 0.01$, respectively).

Conclusion: There is a significant correlation between the specific static balance tests and the success on the balance beam. Although it is known that balance is one of the skills necessary to achieve the best results on the balance beam, it is necessary to monitor this skill in younger gymnasts.

Key Words: postural control, artistic gymnastics, final score, deduction

Acknowledgement: The authors would like to thank the Serbian Ministry of Education and Science for financing the project Biomechanical Efficiency of the Elite Serbian Athletes, OI 179019. We would also like to thank the international athletes who participated in this project and the Gymnastics Federation of Serbia for support.

INTRODUCTION

Balance is the ability to maintain a stable, responsive position of the body when it moves - the dynamic balance or stationary – the static balance. Balance includes coordination and control (Carr, 2004), which is indispensable in everyday life, as in sports, and can be understood not only as the ability to maintain position, but rather as the ability to quickly return to stabile position after a disturbance in the state of rest or movement. It can be defined as the ability of a person to keep the body in a balanced position and to correct the effects of gravity, which makes it difficult to maintain a balanced position acting external stimuli (active factors). The coefficient of genetic capacity is very large, and for

this reason balance is quite complex, specific and difficult to develop (Kukolj, 2006).

A large number of sports require maintaining balance by neutralizing the forces that affect sport performance. The stability or safety of a balance position is primarily related to the level of resistance of that factors that interfere with maintaining balance that the athlete shows (Carr, 2004). The indicators of the static and the dynamic balance are slightly correlated, but the balance and the physical fitness of athletes have high dependency. By improving the technique the possibility of correcting the action of gravity and other forces that disrupt the stability and a growing sense of balance becomes higher (Petkovic, 2008). Balance, along with other motor skills, plays an important role in a successful execution of sports skills, as well as the prevention of sport injuries (Sabin et al., 2010). The potential links between balance and injury resulted in an increased interest in developing the instruments (tests, assignments, exercises) to develop a program to improve balance and reduce the risk of injuries (Sabin et al., 2010; Zech, 2010). Balance training is used as a part of a rehabilitation program after injury of ankle and knee joints (Hrysomallis, 2007).

The most important factors that balance depends on are: genetic determinism , the state of the vestibular apparatus, age, area support , the height of the center of gravity of the body, the number of motor habits, their fitness, strength, coordination, flexibility, emotional state (Kayapnar , 2011). When selecting the tests of balance, attention must be paid to the age and maturity of the participants and their experience in sports, but also on demands of the task and environmental conditions (Hatzitaki et al., 2002). Since balance depends on the central nervous system and the sensory systems, fatigue also affects the ability to maintain balance (Wilkins et al., 2004).

Balance as a component of gymnastics is often associated with gymnasts. In a review study, Hrysomallis (2011) notes that in most studies, the balance of the gymnasts is compared to a control group of non-athletes balance (Asseman, 2008 ; Davlin, 2004; Vuillerme et al., 2001; Aydin et al., 2002; Carrick et al., 2007) and two studies that compare them with other athletes (Bressel et al., 2007; Davlin, 2004). Only in the study of Vuillerme et al. (2001) there was no statistical difference in the ability to balance, but the author believes that the reason is a small sample. When the test duration exceeds 20 seconds, the gymnasts perform better than non-athletes (Asseman, 2008; Davlin, 2004; Vuillerme et al., 2001; Aydin et al., 2002; Carrick et al., 2007), but not and when the test takes less than 20 seconds (Bressel et al., 2007; Davlin, 2004). This is a surprising fact because the gymnasts in their exercises have elements with balance a little longer than two seconds in that position.

In the studies done in recent years (Assemani, 2008; Bressel et al., 2007; Aydin et al., 2002) the gymnasts have superior static balance on one leg, and better dynamic balance on both feet (Davlin, 2004), but not static balance on both feet (Assemani, 2008; Bressel et al., 2007; Aydin et al., 2002). Balance on one leg can be considered challenging, but the gymnasts often have these elements in exercises (balance on the beam and floor exercises), and balance on both feet can be considered mild and nonspecific to the gymnasts.

In comparative studies, it is important to note that the gymnasts are lighter and have shorter limbs compared to other athletes, which may influence the results (Davlin, 2004). The normalization of the balance scores in relation to the height and length of the limb must be taken into account when comparing the groups with the notable differences in the body composition or body mass (Bressel et al., 2007). Research results (Davlin, 2004) indicate that compared to the football players and swimmers, the gymnasts have better balance on both feet on stabilometer. In a later study Hosseinimehr et al. (2009) found that the gymnasts have a better balance then the football players and wrestlers when tested under different conditions. Bressel et al. (2007) using the Balance Error Scoring System (BESS) and the Star Excursion Balance Test (SEBT) found no differences in the static and dynamic balance between the gymnasts and the football

players, but the gymnasts are better than basketball players. Landing in gymnastics, which requires maintaining balance after performing very complex elements (floor, beam and landing on the other gymnastic apparatus) influences the development of a superior balance compared to other athletes.

METHOD

The sample of respondents

In this study 48 young gymnasts, from international competition ranks (age 10.7 ± 1.8 years, height 140.88 ± 8.4 cm, body mass 33.83 ± 11.06 kg, BMI 16.8 ± 1.11), from eight European countries (Slovenia, Croatia, Austria, Denmark, Sweden, Romania, Bulgaria and Serbia) participated voluntarily. In cooperation with the Gymnastics Federation of Serbia and the Sokol Society "Vojvodina" in Novi Sad, the testing was performed in the small hall of the Sokol Society. Optimal conditions for testing were provided: the testing is done in the morning before the competition, the hall was prepared in advance, it had good lightning and a temperature of 20 to 22 º c; job posts and the keepers on every one of them were also prepared in advance; the participants did the test dressed in leotards and with bare feet.

The gymnasts, their coaches and parents were informed with the goals of the study and signed a consent for participation in the research. These notices were sent electronically to the gymnastic clubs that participated in the tournament.

A sample of measuring instruments

For a general assessment of the static balance the Balance Error Scoring System (BESS) was used. This test has been described in numerous studies (Bressel, 2007). The task is performed in the area of a square shape measuring 30x30 cm, which is marked with a band of 5 cm. The subjects performed three positions barefoot on a stable surface with hands on hips in 20 seconds: a two feet position within the marked area, where the feet are placed hip-width apart, and a position on the non-dominant leg within the marked area and also a position with one foot in front of the other within the marked area, with the toes of one foot touching the heel of the foot of the other leg. The BESS test result represents the total number of the errors of all three performance positions. The errors that are penalized are: moving hand from the hips, touching the ground with the free foot, hop, step and jump or any other movement of the leg or foot, lifting the heel, a higher angle of flexion or moving the body for more than 30 °. The maximal number of errors for each position is 10.

The measuring instruments for assessing specific static balance were the basic elements of gymnastics, which the gymnasts already have in their routines. The gymnasts performed the given elements on the high beam: Scale (SSRV), handstand (SSSU) and side handstand (SSSB). For the recognition of these elements by the regulation code, it is necessary to stay in the position for 2 seconds, while the time of testing was 10 seconds.

When a respondent is ready to perform the task, the examiner starts counting 10 seconds and gives the signal to stop the execution of the position. If the respondent falls from the beam, she has no right to continue to perform and the examiner records the endurance time of the element. The performance tests were filmed by a camera Casio FX and later scored with the help of an expert committee, consisting of the judges of international rank. The score of the test is the sum of the points given during the endurance of the given position (0-6 points) and the techniques (0-4 points).

The success of the beam is represented by three variables: the start value – POLO, the deduction - ODBO and the final score - KONO. The results are taken from the bulletin of the competition, where a group judges gave scores(brevet judges).

Statistical analysis of the data

The statistical analysis was performed using the SPSS statistical software version 16.0 for Windows

(SPSS Inc., Chicago, IL). For all the variables the mean values (Mean) and the standard deviation (SD) are shown. The Shapiro-Wilks test was used to determine the normality of the distribution of the results. The association between the variables was analyzed using the Pearson's correlation coefficient.

RESULTS

Table 1 shows the results of the physical characteristics of the respondents. Table 2 shows the test results of the situational balance (SSRV - scale; SSSU - handstand and SSSB - side handstand) and the BESS test. For the BESS test the results for each of the tested positions are given: the two feet position - SRSU; the position on the non-dominant leg - SRJN; the stance with one foot in front of the other - SRIZ and the total - BESS. Table 3 shows the results achieved in the beam competition (the starting value - POLO; the deduction - ODBO and the final score - KONO).

TABLE 1 The physical characteristics of the gymnasts (n=48)

	Mean	SD
Age (years)	10.73	1.80
Height (cm)	140.88	8.78
Weight (kg)	33.83	6.11
BMI (kg/m^2)	16.80	1.11

TABLE 2 The results of the tests of static balance

	Mean	SD
SRSU	.37	.56
SRJN	3.91	1.12
SRIZ	4.41	1.28
BESS	8.70	1.20
SSRV	8.23	.75
SSSU	6.66	1.70
SSSB	5.59	1.98

TABLE 3 The results obtained on the balance beam

	Mean	SD
POLO	3.34	1.04
ODBO	6.51	1.24
KONO	9.84	1.93

Table 4 shows the results of correlation analysis of a set of variables to assess static balance and success on the beam, i.e. to asses the achieved initial score, and the final score in the competition. Correlation analysis was obtained by Pearson correlation coefficient. The coefficients which were found, as well as basic statistical parameter of numerical agreement among the variables, express the linear dependence between the variables. The level of the statistical significance of correlation was calculated at 99% level ($p < 0.01$), the probability level.

There was no statistically significant correlation between the results of the BESS test and the success on the beam ($p < 0,01$). There was a significant correlation between the variable SSRV and

deduction (r = 0.602, p <0.01) and the final score (r = 0.533, p <0,01).The SSSU variable is significantly correlated with the start score, deduction and the final score (r = 0.521, p <0,01; r = 0.486, P <0,01; r = 0.596, p <0.01 respectively), as well as the variable SSSB (r = 0.541 , p <0,01; r = 0.607, P <0,01; r = 0.685, p <0.01 respectively).

TABLE 4 Correlation analysis between tests of static balance success on the beam

	SRSU	SRJN	SRIZ	BESS	SSRV	SSSU	SSSB
POLO	-.055	.083	-.051	-.004	.267	.521**	.541**
	.708	.576	.729	.980	.066	.000	.000
ODBO	.105	.066	-.129	-.026	.602**	.486**	.607**
	.477	.656	.384	.862	.000	.000	.000
KONO	.038	.087	-.111	-.019	.533**	.596**	.685**
	.798	.555	.453	.900	.000	.000	.000

**. Correlation is significant at the level of 0.01 (2-tailed).

DISCUSSION

The results of this study showed a significant correlation between the specific tests of static balance and the success on the balance beam in young gymnasts, while there is no correlation between the BESS test and the success on the beam. These results indicate that artistic gymnastics, as one of the most demanding sports, requires testing of capabilities with specific tests, even at the earliest age.

Hrysomallis (2011) presents results of the relationship between balance and the measure of performance in shooting sports, baseball, ice hockey, snowboard and golf. The author did not find any research on the connection between the balance ability and success in gymnastics. What is specific for this kind of research is a small number of the research subjects who participate in them. Mostly, they are elite athletes, who are a representative sample. Erkmen et al . (2011) examined the relationship between the results of the BESS test and the functional performance of 22 university league players. Interestingly, the correlation was found between endurance on one leg and vertical jump (r = -0.596 , p <0.05), which indicates that the explosive leg strength also affects the ability to maintain balance.

Atilgan et al. (2012) in a sample of 19 female gymnasts (ages 14:53 ± 2:20) examined the relationship between the loss of balance and the composition given on the balance beam, the anthropometric characteristics and the tests of static and dynamic balance. They found a negative correlation between the parameters of dynamic balance and the age, experience, physical training and anthropometric variables, while there was no correlation between the parameters of static and dynamic balance and the loss of balance during a series on the beam (P> 0.05). The authors conclude that the balance ability of gymnasts is equal during competition and during the tests in the laboratory.

Exercising on the balance beam includes balancing in positions (hand support and positions on feet), movements and transitions on the beam, and landing on the beam and off the beam, so the specific tests applied in this study are in aligment with the requirements of the balance beam. The fact is that for maintaining a position the optimal angles between the body segments and tone muscles are important, in order to counter the forces of the body that tend to disturb the balance. In practicing on the balance beam setting the foot area on the beam is very important. At hand support, the maintenance of balance is regulated by the increased grip. During complex gymnastic movements the mechanisms associated with the laws of moving bodies in space

are used. Keeping the direction of the movement is essential for success. Minimum compensatory movements of the body are essential to maintain balance in order to bring the center of gravity of the body above the support surface. If these movements are emphasized and accompanied by additional hand gestures, legs , torso, in order to prevent the fall of the apparatus, they are in competitions sanctioned by the judges (Petrovic et al., 1995).

CONCLUSION

To achieve top results in the Women's Artistic Gymnastics it is necessary to achieve good results on the balance beam. This discipline is, due to its specific characteristics, different from other women's equipment (vault, asymmetric bars and floor). The reduced support surface of 10 cm width and the height of 120 cm, among other capabilities necessary to perform in the artistic gymnastics, requires a high level of balance. The association between specific gymnastic tests and the success on the balance beam in young gymnasts, as determined by this study, is important for coaches, because in this way the ability of the static balance in their gymnasts can be improved.

REFERENCEs

Asseman, F., Caron, O., & Cremieux, J. (2008). Are there specific conditions which expertise in gymnastics could have an effect on postural control and performance? (Gait Posture, 27 (1), 76-81.

Atilgan, A.O.E., Akin, M., Alpkaya, U., & Pinar, S. (2012). Investigating of relationship between balance parameters and balance lost of elite gymnastics on balance beam. International Journal of Human Sciences, 9 (2): 1260-1270.

Aydin, T., Yildiz, Y., Yildiz, C., et al. (2002). Proprioception of the ankle: a comparison between female teenaged gymnasts and controls. Foot Ankle International, 23 (2), 123-129.

Bressel, E., Yonker, J.C., Kras, J., et al. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. Journal of Athletic Training, 42 (1), 42-6.

Carr, G.(2004). Sport mechanics for choaches. Human kinetics, Champaign.

Carrick, F. R., Oggero, E., Pagnacco, G., et al. (2007). Posturographic testing and motor learning predictability in gymnasts. Disability Rehabilitation, 29 (24), 1881-1889.

Davlin, C. D. (2004). Dynamic balance in high level athletes. Perceptual and Motor Skills, 98, (3):1171-1176.

Erkmen, N., Taskin, H., Sanioglu, A., Kaplan, T., Basturk, D. (2011). Relationship between balance and functional performance in football players. Journal of Human Kinetics, 26 (1), 26-29.

Hatzitaki, V., Zisi, V., Kollias, I., & Kioumourtzoglou, E. (2002). Perceptual-Motor Contributions to Static and Dynamic Balance Control in Children. Journal of Motor Behavior, 34 (2), 161–170.

Hrysomallis, C. (2007). Relationship between balance ability, training and sports injury risk. Sports Medicine, 37 (6), 547-56.

Hrysomallis, C. (2011). Balance ability and athletic performance. Sports Medicine, 41 (3), 221-232.

Kayapnar, F. C. (2011). The Effect of Movement Education Program on Static Balance Skills of Pre-School Children. World Applied Sciences Journal, 12 (6), 871-876.

Kukolj, M. (2006). Antropomotorika. Beograd; Vizartis.

Petković, D. (2008). Sportski trening, drugo dopunjeno izdanje. Niš: Univerzitet u Nišu.

Petrović, J., Bađa, P., Radojević, J., Petković, D. & Grbović, M. (1995). Sportska gimnastika II deo. Beograd: Fakultet fizičke kulture, Univerziteta u Beogradu.

Sabin, M. J., Ebersole, K. T., Martindale, A. R., Price, J. W., & Broglio, S. P. (2010). Balance performance in male and female collegiate basketball athletes: Influence of testing surface. Journal of Strength and Conditioning Research, 24(8), 2073-2078.

Vuillerme, N., Danion, F., Marin, L., et al. (2001). The effect of expertise in gymnastics on postural control. Neuroscience Letters, 303 (2), 83-86.

Wilkins, J., Valovich McLeod, T.C., Perrin, D.H., Gansneder, B. (2004). Performance on the balance error scoring system decreases after fatigue. Journal of Athletic Training, 39,156-161.

Zech, A., Hübscher, M., Vogt, L., Banzer, W., MD, Hänsel, F., and Pfeifer, K. (2010). Balance Training for Neuromuscular Control and Performance Enhancement: A Systematic Review. Journal of Athletic Training, 45(4), 392–403.

POVEZANOST IZMEĐU STATIČKE RAVNOTEŽE I USPEHA NA GREDI KOD MLADIH GIMNASTIČARKI

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SAŽETAK

Uvod: Ravnoteža je bitan faktor uspeha u mnogim sportovima, međutim, u sportskoj gimnastici ona predstavlja jedan od najznačajnijih faktora uspešnosti, jer čak i minimalno narušavanje stabilnosti utiče na konačnu ocenu. Malo je istraživanja koja povezuju sposobnost ravnoteže sa uspehom u izvođenju složenih gimnastičkih elemenata i sastava. U najvećem broju istraživanja, ravnoteža kod gimnastičara se upoređuje sa ravnotežom kontrolne grupe nesportista ili sa drugim sportistima.

Metode: U ovom istraživanju dobrovoljno je učestvovalo 48 mladih gimnastičarki internacionalnog ranga takmičenja (uzrasta 10.7±1.8 godina; visine 140.88±1.8 cm; mase tela 33.83±6.11 kg), iz osam evropskih zemalja. Cilj istraživanja je utvrđivanje veza između statičke ravnoteže merene pomoću BESS testa, kao i tri specifična testa ravnoteže (SSRV, SSSB, SSSU) i uspeha na gredi kod mladih gimnastičarki.

Rezultati: Ne postoji statistički značajna veza između svih BESS položaja, kao ni ukupnog rezultata BESS testa, dok je utvrđena značajna povezanost između varijable SSRV sa odbitkom ($r = 0.602$, $p < 0.01$) i konačnom ocenom ($r = 0.533$, $p < 0.01$). Varijabla SSSU je u značajnoj korelaciji sa polaznom ocenom, odbitkom i konačnom ocenom ($r = 0.521$, $p < 0.01$; $r = 0.486$, $P < 0.01$; $r = 0.596$, $p < 0.01$, redom), kao i varijabla SSSB ($r = 0.541$, $p < 0.01$; $r = 0.607$, $P < 0.01$; $r = 0.685$, $p < 0.01$, redom).

Zaključak: Utvrđeno je da postoji značajna povezanost između specifičnih testova za procenu statičke ravnoteže i uspeha na gredi. Iako je poznato da je ravnoteža jedna od sposobnosti koja je neophodna za postizanje vrhunskih rezultata na gredi, neophodno je praćenje ove sposobnosti u mlađim uzrasnim kategorijama

Ključne reči: posturalna kontrola, sportska gimnastika, konačna ocena, odbitak

THE APPLICATION OF POLYGON FOR THE DEVELOPMENT OF THE BASIC COORDINATION ABILITIES OF FEMALE HANDBALL PLAYERS

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UDC 796.322

SUMMARY

Introduction: For a successful realization of all movements in handball one of the most important motor abilities is coordination. The aim of this paper is to determine the differences between the initial and final testing, upon the application of polygon for the development of the basic coordination abilities of female handball players in the course of a 12 week training process. Polygons were applied in the preparatory and competitive periods, three times a week, in the first part of the training unit.

Methods: The subjects sample was comprised of 30 female handball players of the ŽRK (female handball club) Nais from Niš, aged 12 – 13. For the estimation of the basic coordination abilities a set of seven variables was used.

Results: The results of the Student t – test between the initial and final measurements have shown that there is a statistically significant difference in the five applied variables: Sideway steps, Driving the ball with the hand, Retrieving and throwing the ball while sitting, Skipping the rope and Sideway skipping.

Conclusion: On the basis of the research results it can be concluded that polygon as a training method has significantly contributed to the development of the basic coordination abilities of the female handball players.

Key Words: handball, poligon, coordination

INTRODUCTION

A handball game is characterized by the movements with and without the ball,the change of direction coupled with quick and sudden sprints, a variety of jumps and landings as well as the collisions in direct contact with the opponent. For the successful implementation of the mentioned movements coordination abilities have an important role. The same abilities are crucial for the adoption and improvement of the techniques and tactics, as well as their application in the unusual circumstances (skips, different jumps) or in the cases of imbalances (lands, quick stops, contact sports) (Bompa, 2005).

In the training process of the younger age female handball players the simple forms of work are most often used; forms such as frontal work, work in pairs, threes and small groups. Complex forms of work (work stations, circuit methods, polygons) are less frequent. When mastering some elements of the handball training techniques and perfecting the basic motor skills the most practical way is to apply the frontal type of work for the purpose of the visibility and the greater possibility of learning from others' mistakes, but then one confronts the problem of the decreased load intensities due to the ineffective "waiting for one' s turn" (Bjelobrk, Ohnjec & Gruić, 2009).

Polygon belong to a complex method of work and represents a unique exercise which is comprised a row of a certain number of exercises performed in succession one after the other, on the track of a certain length, outdoors or indoors at the practice

site (Visnjic, Jovanovic and Miletic, 2004). The combinations of various movements, natural and derived, which are performed on the established path from the beginning to the end, are to be performed in the shortest possible time on the polygon.

The polygons with barriers are used to develop coordination skills of children, to improve endurance, to investigate physical abilities, as well as for the recreational purposes (Visnjic, Jovanovic and Miletic, 2004). It was also proved that polygons are suitable as tests for the measurement of agility (Proje 1982 according to Visnjic, Jovanovic and Miletic, 2004). This form of exercise, where the athletes are required to overcome a number of obstacles by a successive execution of a number of exercises (Brankovic and Dragic 2007) is applicable in the work with the younger teams in almost all sports, including handball.

Numerous studies have demonstrated that a specifically programmed training processes according to age and biological maturity of children exerts a positive effect on the changes in the motor, specific - motor and functional abilities of male and female handball players (Kurelić et al., 1975; Bojic et al., 2007; Maksimovic, 2000 ; Azumane et al., 2002; Bompa, 2005; Bojic 2006; Krizan, 2006).

Since handball is a game which is characterized by frequent changes of the phases of attack and defense, a great number of passes, shots and feinting of the players at high speed, this very fact impacts the planning and programming of the training process in the younger selections (choice of training methods, determining the scope and intensity, and the selection of resources, etc. .). One way to increase the intensity of the training load of young female handball players is to use the method of polygon with obstacles, which is currently the problem of our research.

The aim of this study was to determine the differences between the initial and final states of the basic - coordination abilities of the young female handball players using the method of polygons (in the introductory part of the training), during the 12-week training process.

The studies which determine the influence of the training process on the motor and functional abilities in male and female handball players by applying the method of polygons in the training process are extremely scarce (Bojic, 2008; Bojic, Petkovic, and Kocić, 2010). Authors Bjelobrk, Ohnjec & Gruić (2009) in their professional work provide examples of basic, specific and situational polygons in working with young female handball players.

METHODS

Subject sample

The subject sample was comprised of 30 female handball players of the ŽRK (female handball club) "Naissa" from Niš, aged 12 – 13, with at least one year of training experience. The subjects could skip the training session three times at the most during the experimental period.

Measuring instruments sample

For the estimation of the basic - coordination abilities a set of seven variables was used.

According to Metikos et al. (1989):

- Doing the 'eight' with bending for the estimation of the whole body coordination-
- MKOOSA,
- Sideway steps, for the estimation of legs coordination - MKKUST,
- Driving the ball with the hand, for the estimation of arms coordination- MKVLRU.

According to Kules et al. (1973):

- Coordination with the bat, for the estimation of the whole body coordination -MKOPAL
- Retrieving and throwing the ball while sitting, for the estimation of the whole body coordination - MKUBLS
- Skipping the horizontal rope, for the estimation of the whole body coordination - MKPRVI.

According to Rapp & Schoder, 1977:

- Sideway skipping, for the estimation of legs coordination – МКБРЕ.

Data processing

Determining the differences between the initial and final measurements of the subjects the Student's t – test was performed, while for the statistical processing the software IBM SPSS 21.0. was used.

Experiment description

An experimental treatment for the period of 12 weeks was implemented in the sports hall in Nis. The subjects trained three times a week (total of 36 units of training) and polygons were represented in the first part of the training unit for a period of 30 min. All the movement and motor tasks within the polygon (9 - 10 obstacles) were already known by the female handball players in form and structure, and in addition to the natural and derived movements there were also some elements of the handball techniques, with and without the ball. Various props were used to mark the polygons and place the obstacles (cones, hoops, "the Swedish box", crotch rope, benches, low beams, etc..).

At the beginning of each training unit, the players had the first 10 minutes of the introductory warm up of the body (light jogging and stretching exercises), and then they approached the polygon exercises. The motor tasks as well as the obstacles on the polygons were changed, both during one training session and every week. The number of the repetitions of the polygon crossing by the female players was limited to 5 - 6, after which they changed the tasks and obstacles on the polygon. Figures 1, 2, 3 and 4 show only some of the examples of polygon obstacles with and without the ball.

ПОЛИГОН 1

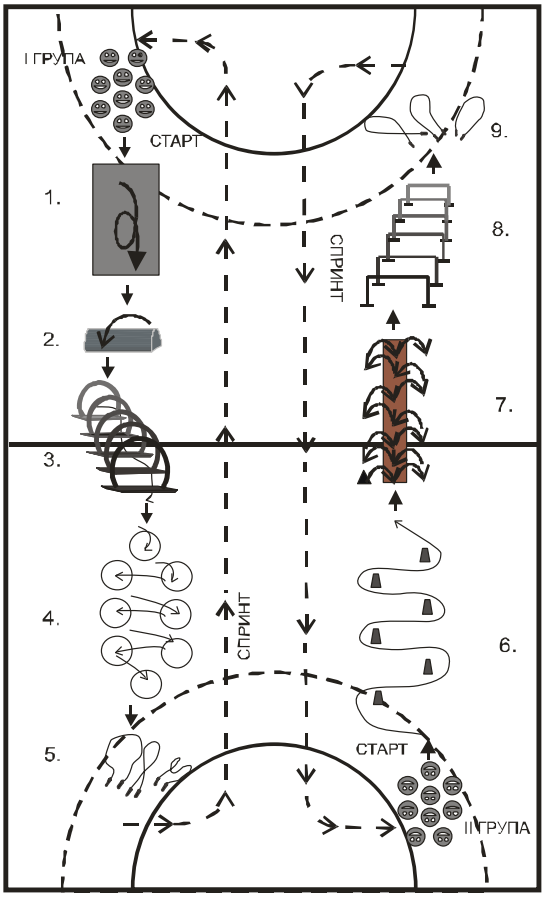

Fig.1

1. Forward and backward Roll
2. Hopping – one leg, both legs
3. Passing through
4. Hoop Jumps leg to leg, sideways
5. Rope jumps, leg to leg, one leg, alternating
6. Slalom face front, back behind, sideways
7. Bench running, lateral jumps bench front, one leg jumps, hop over,
8. Jumps from leg to leg,skip
9. Rope one leg, running

ПОЛИГОН 2

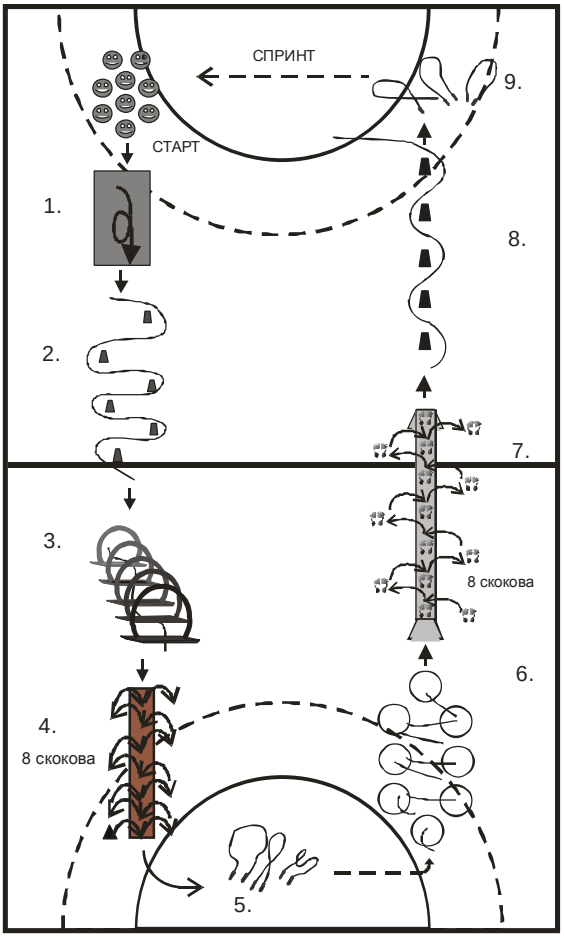

Fig. 2

1. Forward and backward Roll
2. Slalom face front, back behind, sideways
3. Passing through hoops
4. Bench overjumps, cross jump, bench running
5. Rope jumps, leg to leg, one leg
6. Hoop Jumps flying, sideways
7. Low bench running, sideway, crcross jump hops
8. Rope one leg slalom, rope backward flip

ПОЛИГОН 8 (Са лоптом)

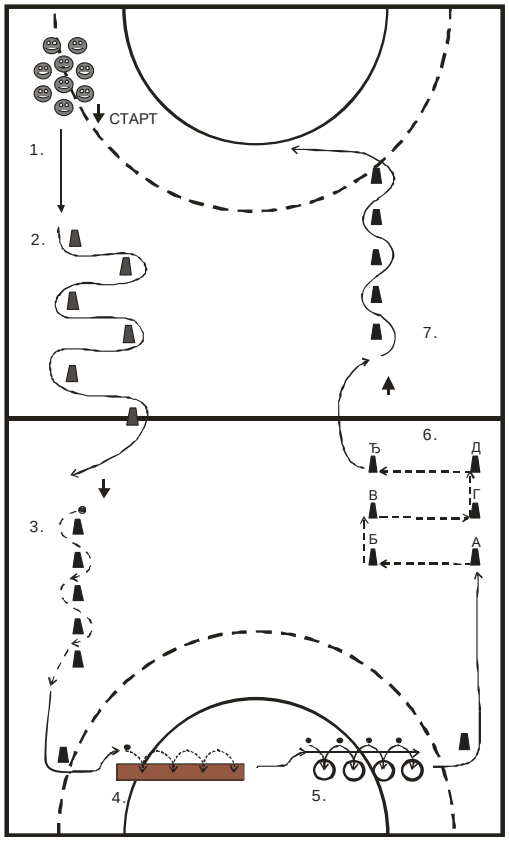

Fig. 3

1. Linear ball drill,slalom,
2. Ball rolling between the pins,
3. A player runs next to bench and drills the ball along the bench,
4. Running next to hoop,
5. Ball drillin in the hoop,
6. Ball drillin A-b sideways leg moving, V-G sideways leg movement, D-DJ sudeways leg movement, B-V direction running, G-D direction running,
7. Ball drilling while running, in slalom, in sprint

ПОЛИГОН 9 (Са лоптом)

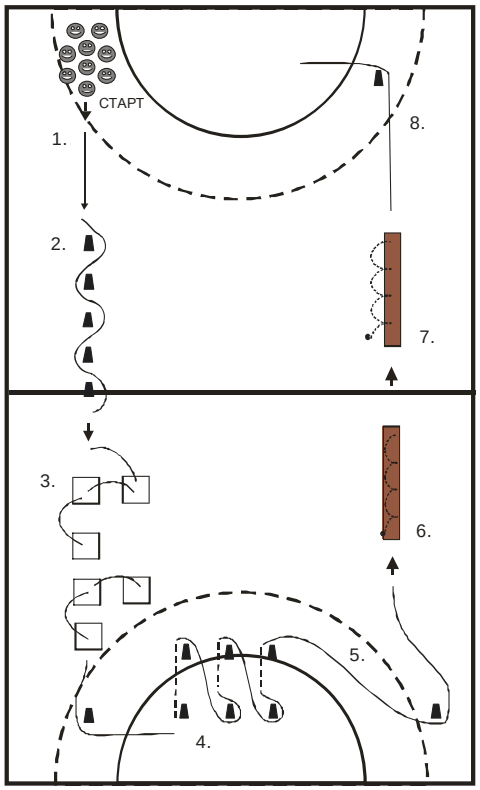

Fig. 4

1. Sprint,
2. Ball drilling in slalom,
3. Oneside feint with false jumpshot,
4. Ball drilling in moving sideways to leg and direction diagonal running,
5. Sprint,
6. Running on the bench and ball drilling on the bench,
7. Running on the bench and ball drilling along the bench,
8. Ball drilling in backwards running

RESULTS

The essence of the Student's t-test is determining how many times the difference between the arithmetic means is greater than the standard error of their differences.

Table 1 shows the difference of the applied variables of the basic coordination abilities between the initial and final measurement of the female handball players.

By comparing the mean values at the beginning and the end of the experiment using the Student's t-test, the differences have been found in almost all the applied variables of the basic - coordination skills. Statistically significant differences were obtained in the values of the five applied variables: sideway steps - MKKUST (.002), driving the ball with the hand - MKVLRU (.013), retrieving and throwing the ball while sitting - MKUBLS (.000), skipping the horizontal rope - MKPRVI (.033) and sideway skipping - MKBPRE (.000).

The statistical significance of the differences was not obtained only in the variable doing the eight with bending - MKOSSA and coordination with the bat - MKOPAL.

TABLE 1 The testing of the differences of arithmetic means

Paired Samples Test									
		Paired Differences					t	df	Sig.
		Mean	SD	Error	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Doing the 'eight' with bending MKOOSA	-,18	1,27	,23	-,66	,29	-,79	29	,434
Pair 2	Sideway steps MKKUST	-,88	1,39	,25	-1,40	-,35	-3,44	29	,002
Pair 3	Driving the ball with the hand MKVLRU	,27	,56	,10	,06	,48	2,65	29	,013
Pair 4	Coordination with the bat MKOPAL	,90	2,51	,46	-,03	1,84	1,97	29	,059
Pair 5	Retrieving and throwing the ball while sitting MKUBLS	-1,76	1,75	,32	-2,42	-1,11	-5,51	29	,000
Pair 6	Skipping the horizontal rope MKPRVI	-2,47	6,03	1,10	-4,72	-,214	-2,24	29	,033
Pair 7	Sideway skipping MKBPRE	-3,60	3,21	,59	-4,80	-2,40	-6,14	29	,000

DISCUSSION

On the subject sample comprised of 30 female handball players aged 12 – 13, the differences in the basic-coordination abilities after 12 week experimental training process where polygons as the form of work in the introductory part of the training unit were used, were noticed.

The results obtained by testing the differences between the initial and final measurements applying the Student's t – test (Table 1), have shown that there were noticed statistically significant changes in almost all of the investigated variables.

A hndball game is a sports game dominated by the frequent changes of direction coupled with quick and sudden sprints, a variety of jumps and landings as well as varied feints of the players. For the successfull realization of all these activities among other abilites, Bompa emphasises leg coordination (Bompa, 2005).

In our study the subjects have, at the end of the experimental treatment, achieved significantly better results in the tests for the estimation of leg coordination (MKKUST $p \leq .000$ and MKBPRE $p \leq .000$). Also, statistically significant changes were achieved by the players in one test for the estimation of hand coordination ($p \leq .05$). One of the reasons of such results may be attributed to the use of specific obstacles and motor tasks on polygon in the experimental treatment. Similar to our results, determining the effects of a specifically programmed training process on the coordination of the legs of young athletes, were obtained by some other authors in their researches (Thomas, Philip & Duncan, 2009; Azumane et al., 2002, Bojic, 2008; Bojic, Petkovic & Kocic, 2010).

When considering the coordination of the whole body female handball players have obtained statistically better results in the following tests: retrieving and throwing the ball while sitting ($p \leq$ MKUBLS and skipping the horizontal rope - MKPRVI $p \leq .05$).

Positive changes in these abilities in female handball players at the end of the treatment can be explained by the influence of polygon as a form of exercise, but also by the effect of the training process, which includes the technical - tactical elements of handball.

Significant changes at the end of the experiment were not found only in two tests for the estimation of the whole body coordination, which can be attributed and explained by the tests performance difficulties, or by the influence of puberty on the growth and development of the subjects. The age of the subjects (12 -13 years) belongs to the early adolescent period which is characterized by an intensive growth (annually up to 8 cm in girls) and by a sharp growth of the lower extremities in relation to the body and the head, which disrupts the coordination of children (Đurašković, 2009).

The research on the use of polygon as a method of experimental treatments in handball is very scarce. Authors Bojic, Petkovic, and Kocić (2010) in their papers investigate the effect of different training programs on the basic coordination skills of young female handball players and in one of them they used the polygon method. The results obtained at the end of the experiment indicated positive changes in the tested variables for the estimation of the basic coordination.

Since polygon as a form of exercise was used in the introductory parts of the training units (about 30 min.), thus obtained results can be also explained by the influence of other training contents, as well as by the technical - tactical preparation in the normal training process of the researched subjects.

CONCLUSION

The aim of our research study was to determine the differences between the initial and final state of the basic coordination abilities of young female handball players by applying the polygon method, in the course of 12 week training process. On the subject sample of 30 female handball players aged 12 – 13 a set of seven variables was used for the estimation of the basic - coordination abilities. The statistical significance of the differences on the final, in relation to the initial testing was determined by the Student t – test.

The results of the t – test have shown that there were statistically significant differences in coordination of legs (MKKUST .002, MKBPRE .000), coordination of hands (MKVLRU .013) and coordination of the whole body (MKUBLS .000, MKPRVI .033) of the young female handball players. On the basis of thusly obtained changes at the end of the experimental period of the treatment, the analyses performed and the discussion of the research results gained, one can conclude that polygons as a form of exercise can significantly contribute to the development of the basic coordination abilities of young female handball players and that one should use them more often in the work with these groups.

REFERENCEs

Azumane, A., Takeuti, T., Kubota, Y., Hamano, K., Nagase, M., & Hasegawa, N. (2002). The effect of coordination training and dousa-hou on coordination ability in male university hand ball players. *Journal of Health and Sports Science, 6,* 117.

Bjelobrk,M., Ohnjec, K., Gruić, I. (2009). Primjena poligona prepreka u radu s rukometašicama mlađih dobnih skupina. U Ur. Neljak B., *18. ljetna škola kineziologa Republike Hrvatske*, (262 – 267). Zagreb: Hrvatski Kineziološki Savez.

Bojić, I. (2006). Connection between morphological characteristics and situational mobility of handball players. *Physical Education, 2,* 80-82.

Bojić, I., Đurašković, R., & Mladenović-Ćirić, I. (2007). Changes of certain anthropometric characteristics, basic mobility and specific mobility in young female handball players. U Ur. Nusret Smajlović, *The Second International Convention of New Technologies in Sports – 'NTS Sarajevo 2007',* (121-127). Sarajevo: Faculty of Sport and PE.

Bojić, I. (2008). *Effects of specially programmed training process on basic coordination and specific mobility in young female handball players*. (PhD thesis). Skoplje: Faculty of Physical Education.

Bojić, I., Petković, D., Kocić, M. (2010). Influence of different training programmes on basic coordination of female handball players. *Acta Kinesiologica 4* (1), 71-74.

Bompa, T. (2005). *Comprehensive training for young*. Zagreb: Gopal.

Branković, N., Dragić, B. (2007). *Metodika fizičkog vaspitanja.* Niš:*SIA.*

Đurašković, R. (2009). *Sportska medicina.* Niš: *Centar za izdavačku delatnost Fakulteta sporta i fizičkog vaspitawa Univerziteta u Nišu.*

Križan, M. (2006). The efficiency of model sports preparation in the handball class, *Acta Facultatis Educationis Physicae Universitatis Comenianae, 57, 97-98.*

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, D.J., & Viskić-Štalec, N. (1975). *Structure*

and development of morphological characteristics and mobility of young people. Belgrade: The Faculty of Physical Education, The Institute for Scientific Research.

Maksimović, S. (2000). Effects of two different training programmes in handball on the fifth grade elementary school students. *Physical Education, 54*(1-4), 13-24.

Thomas, K., Duncan, F., Philip, H. (2009). The effects of two plyometric training techniques on muscular power and agility in youth soccer players. *Journal of strength and conditioning research, 23* (1), 332 – 335.

Višnjić, D., Jovanović, A., Miletić, K. (2004). *Teorija i metodika fizičkog vaspitanja.* Beograd: SIA.

PRIMENA POLIGONA ZA RAZVOJ BAZIČNIH – KOORDINACONIH SPOSOBNOSTI RUKOMETAŠICA

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SAŽETAK

Uvod: Za uspešnu realizaciju svih kretanja u rukometu jedna od značajnih motoričkih sposobnosti je koordinacija. Cilj ovog rada je da se utvrde razlike između inicijalnog i finalnog testiranja, nakon primene poligona za razvoj bazične koordinacije rukometašica tokom 12 – to nedeljnog trenažnog procesa. Poligoni su bili zastupljeni u pripremnom i takmičarskom periodu, tri puta nedeljno, u prvom delu trenažne jedinice.

Metode: Uzorak ispitanika činilo je 30 rukometašica ŽRK Naisa iz Niša, uzrasta 12 – 13 godina. Za procenu bazičnih - koordinacionih sposobnosti primenjen je set od sedam varijabli.

Rezultati: Rezultati Studentovog t – testa između inicijalnog i finalnog merenja su pokazali da postoji statistički značajna razlika kod pet primenjenih varijabli: Koraci u stranu, Vođenje lopte rukom, Uzimanje i bacanje lopte u sedu, Preskakanje horizontalne vijače i Bočni preskoci.

Zaključak: Na osnovu ovako dobijenih rezultata može se zaključiti da je primena poligona kao metoda treninga značajno doprinela razvoju bazične koordinacije rukometašica.

Ključne reči: Bazično – koordinacione sposobnosti, rukometašice, poligoni, t - test

THE DIFFERENCES IN THE METHODS OF FREE KICK PERFORMANCE OF THE FINALISTS AND SEMI-FINALISTS OF THE 2010. WORLD CUP

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UDC 796.332.6

SUMMARY

Introduction: The objective of this study is to determine the differences in the presence of the methods of free kicks in the semi final and final matches at the 2010 World Championship.

Methods: The DVD recordings of seven matches played by each of the following teams: the Representation of Spain, the Netherlands, Germany and Uruguay, in total 28 matches, were analyzed. We recorded the frequencies of 3 basic types of free kicks: direct blow to attack the opponent, pass in the box and adding the ball low "Combination." Testing the differences between the teams in different types of free kicks was done using the Kruskal Wallis test and the differences between pairs of teams using the Mann Whitney test.

Results: Based on the value of Kruskal Wallis test for all three observed variables it can be concluded that between four observed Representations there are statistically significant differences in the representation of some methods of free kicks performance in their matches. The value of the level of significance of free kick with direct blow to the goal of the opponent is 0.019, for free kick with cross shot into the opposition's box is 0.047, and for free kick with low ball pass so-called ''combination'' is 0.046. To determine the differences between some team pairs the Mann Whitney U test is applied and according to the pe value it can be oserved that between the Spanish team of and that of the Netherlands and Uruguay no specifically important statistical differences regarding the performance of free kicks exist. Between the Teams of Spain and Germany there is a significant difference in the performance of free kicks with direct blow to the goal of the opponent , where the p is 0.016. The middle rank of the Spanish team is 10.14., and that of the Germany 4.86. Between the Teams of the Netherlands and Germany there is a significant statistical difference in the free kicks performed with direct blow to the goal of the opponent , were the pe is 0.043. Between the Team of Spain and Uruguay there is a significant statistical difference in all three methods of free kicks performance. For the first variable p is 0.028, for the second 0.027, and for the third 0.004. Between the National team of Germany and Uruguay there is a significant difference in free kicks with direct blow to the goal of the opponent the p is 0.043.

Conclusion: No significant differences in the observed variables were expected, due to the ranking of the national teams. However, the results of the research showed that differences indeed do exist, and that they are statistically significant. In all of the teams that were observed, free kicks were most often performed with a low pass of the ball, and the lowest number of shots was made towards the goal of the opponent. The Spanish team showed, through the overall number of the free kicks performed on the opponents' side of the field, as one significant determiner of the difference in their presence on the field, their technical-tactical domination on the field shown through ball possession.

Key Words: game interruptions, football. Differences.

INTRODUCTION

With the analysis of the games on the World Championship we came to important data concerning the playing characteristics of the participants who were entitled to participate on the basis of their previously demonstrated result successes in the competition on the world regions and groups. Only the host of the World Championship 2010 Representation of South Africa participated without playing qualifying matches. 32 Representations participated and there were played 64 matches. There were achieved 145 goals, an average per match 2.27.

We were interested in what is the distribution of certain ways of free kicks in the game of the four first ranked Representations on the World Championship 2010. The aim of this study was to establish the differences in the prevalence of certain was of free kicks in the way of playing of the Representation of Spain, the Netherland, Germany and Uruguay.

Those four teams have different contact index in their way of playing. The contact index is an indicator with how much average ball touches per ball possession one team, one individual player or one line of players are playing. This can be defined as deviation from the theoretically simplest way of playing concerning the number of ball touches when playing the ball. In theory the simplest is, concerning the number of ball touches, to play with one touch so called ''first ball''. In this case, the contact index would be one and there would not be any deviation, and the deviation is in numbers 0.

The contact index in the play of the Representation of Spain on the matches of World Championship 2010 was 2.25, of the Netherlands 2.10, of Germany 2.16 and of Uruguay 1.87 (Đošić, 2011, 2012, 2013 a, b).

The average hit of the football player of Barcelona Messi on the observed matches of Champions League 2008/2009 was 3.10 per ball possession (Đošić, 2010). On the games played in 2009. between the Representations of France and Argentina in Marseille the same football player had 2.93 average numbers of ball contacts per ball possession (Birman, 2011).

The Representations of Spain and the Netherlands differs also by representation in their playing of reversal balls with one touch to the same player from whom the ball is received in the attack zone and in the final zone on the games in South Africa. In the attack zone *p* was 0.046, and in the final attack zone *p* was 0.009. In the defense zone is not defined the statistically significant difference by playing of reversal balls to third player in all three field zones (Đošić, 2013).

On the World Championship held in 1998. in France from totally 171 achieved goals, 21 is achieved from free kick (Bray, 2006) what represents in percentage 14.62 %.

METHOD

RESPONDENT SAMPLE

The entity sample were 28 games played on this Competition by the Representations of Spain, the Netherlands, Germany and Uruguay and that 7 games per Representation. In the observed list are evidenced frequencies of certain modes of free kicks.

SAMPLE OF MEASURING INSTRUMENTS

In the watchlist are evidenced frequencies of some way of free kicks. For the analysis three variable were defined:

fkd - free kick with direct blow to the opponent's goal.

fkc - free kick with banana kick to the opponent's penalty area.

fkl - free kick with low ball pass so-called ''combination".

There were evidenced free kicks on the opponent's half of field where there is a real opportunity to achieve a goal with direct shot at the goal or the actions after performance of free kick.

STATISTICAL ANALYSIS

Data processing was done using the statistical software SPSS 15. To determine the total difference between the observed Representations in certain variable is used the Kruskal Wallis test, and to test

differences between some Representation pairs is used the Mann Whitney test.

RESULTS AND DISCUSSION

On 28 observed games played on the World Championship 2010 played by the first four ranked Representations is recorded a total of 192 free kicks performed in so called '' opponent's half part of field''. From this number of free kicks with low ball passing, short or long ball passing it was performed 99 (51.56%), and with banana kick in the opponent's penalty area were performed 58 (30.21%). There were performed at least numerically and in percentage free kicks with direct shot to the opponent's goal and that 35 i.e. 18.23 %.

In table 1 are presented the test results of the differences between the Representations in the way of free kicks performance. We can see on basis of X^2 and calculated levels of statistical significance, that there are statistically significant differences in the presence of certain ways of free kicks performance in the game of the four watched Representations. For free kicks performed by direct shot to the opponent's box $p = 0.019$. For free kicks performed with banana kick to the opponent's penalty area $p = 0.047$ and free kick with low ball pass so-called ''combination" $p = 0.046$. For all three variables the significance level is below the limit of $p = 0.05$.

TABLE 1 Kruskal Wallis test of the free kicks performance

Variable	Representation	X^2	p	df	middle rank
	Spain				11.07
fkd	The Netherlands				17.36
	Germany	9.934	**0.019**	3	8.93
	Uruguay				20.64
	Spain				
fkc	The Netherlands				19.93
	Germany	7.959	**0.047**	3	17.00
	Uruguay				8.79
					12.29
	Spain				
fkl	The Netherlands				21.36
	Germany	7.989	**0.046**	3	14.07
	Uruguay				13.21
					9.36

Legend
fkd - free kick with direct shot to opponent's goal
fkc - free kick with banana kick into the opponent's penalty area
fkl - free kick with low ball pass so-called ''combination"

On the observed matches the average number of free kicks with direct shot to the opponent's goal was 1.25, with banana kick to the opponent's penalty area 2.21, and with low ball passing so called ''combination'' 3.39. The average number of performed free kicks on so called '' opponent's half part of field'' per game was 6.86.

The Representation of Spain performed 6 free kicks with direct shot to the opponent's goal (9.38 %), with banana kick to the opponent's penalty area in total 21 (32.81 %) and with low ball passing to the teammate were evidenced 37 (57.81 %).

The Representation of the Netherlands performed 12 free kicks with direct shot to the

opponent's goal (21.82 %), with banana kick to the opponent's penalty area in total 19 (34.55 %) and with low ball passing to the teammate were evidenced 24 (43.64 %).

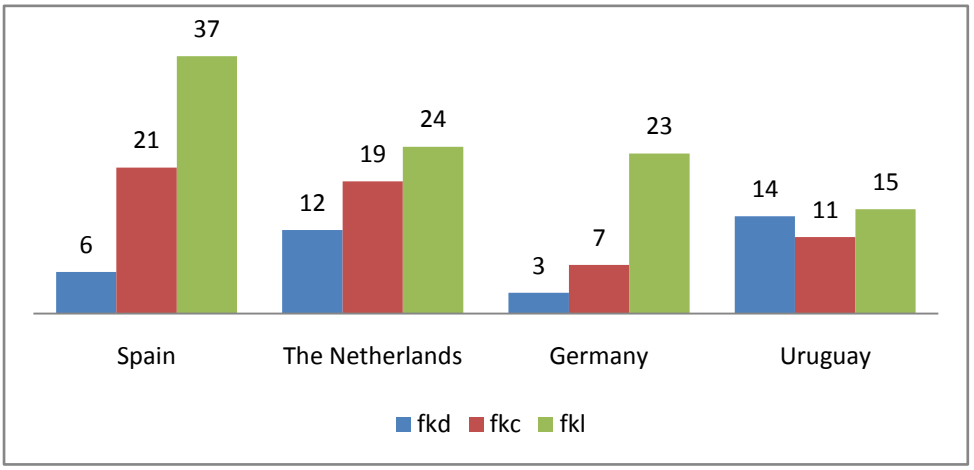

Chart 1. The numerical representation of different models of free kicks

The Representation of Germany performed 3 free kicks with direct shot to the opponent's goal (9.09 %), with banana kick to the opponent's penalty area in total p 7 (21.21 %) and with low ball passing to the teammate were evidenced 23 (69.70%).

The fourth ranked Representation of Uruguay performed 14 free kicks with direct shot to the opponent's goal (35 %), with banana kick to the opponent's penalty area in total 11 (27.60 %) and with low ball passing to the teammate were evidenced 15 (37.4%).

In table 2 according to Z value and significance level, we can see that between the Representations of Spain and the Netherlands were no statistically significant differences in the way of free kicks performance.

TABLE 2 U test way of free kicks performance of Spain and the Netherlands

variable	Representation	Z value	middle rank	p
fkd	Spain	-1.473	5.93	0.141
	The Netherlands		9.07	
fkc	Spain	-0.389	7.93	0.697
	The Netherlands		7.07	
fkl	Spain	-1.886	9.57	0.059
	The Netherlands		5.43	

In table 3 we can see that between the Representations of Spain and Germane there is a statistically significant difference in the free kick performance into the opponent's penalty area (p= 0.016), while in the two other free kick performances there are no statistically significant differences.

TABLE 3 U test way of free kicks performance of Spain and Germany

variable	Representation	Z value	Middle rank	p
fkd	Spain	-0.524	8.00	0.600
	Germany		7.00	
fkc	Spain	-2.415	10.14	**0.016**
	Germany		4.86	
fkd	Spain	-1.498	9.14	0.134
	Germany		5.86	

In table 4 we can see that between the Representations of Spain and Uruguay there is a statistically significant difference in the three ways of free kick performance . For free kicks with direct shot to the opponent's goal p = 0.028, for banana kick to the opponent's penalty area p = 0.027 and with low ball passing to the teammate p = 0.004. During the qualifications for the World Cup 2010 the Representation of Serbia has made 20 % effective attacks started after free kicks (Janković et al. , 2010).

TABLE 4 U test way of free kicks performance of Spain and Uruguay

variable	Representation	Z value	Middle rank	p
	Spain	-2.192	5.14	**0.028**
fkd	Uruguay		9.86	
fkc	Spain	-2.208	9.86	**0.027**
	Uruguay		5.14	
fkl	Spain	-2.852	10.64	**0.004**
	Uruguay		4.36	

From the results presented in table 5 we can conclude that between the Representations of the Netherlands and Germany there is a statistically significant difference in the way of free kicks performance with direct shot to the opponent's goal (p= 0.043). In the way of performance with banana kick to the opponent's penalty area and with low ball passing there were no statistically significant differences.

TABLE 5 U test way of free kicks performance of the Netherlands and Germany

variable	Representation	Z value	Middle rank	p
fkd	The Netherlands	-2.022	9.64	**0.043**
	Germany		5.36	
fkc	The Netherlands	-1.697	9.36	0.090
	Germany		5.64	
fkl	The Netherlands	-0.390	7.93	0.697
	Germany		7.07	

In the last 16 matches of the World Championship Final in France in 1998. (from the quarter final to the final) there were not statistically significant differences between the winner and the defeated teams in the performance of cross from game interruption (Smajić, 1999).

In table 6., based on the value of the significance level we can conclude that in all three variables there was no significant difference between the Representations of the Netherlands and Uruguay. The value of the significance level is greater than the limit value p=0.05 for all three observed variables.

TABLE 6 U test way of free kicks performance of the Netherlands and Uruguay

variable	Representation	Z value	Middle rank	p
fkd	The Netherlands	-0.809	6.64	0.419
	Uruguay		8.36	
fkc	The Netherlands	-1.027	8.57	0.304
	Uruguay		6.43	
fkl	The Netherlands	-1.121	8.71	0.262
	Uruguay		6.29	

From the results presented in table 7 we can conclude that by performance of free kicks with direct shot to the opponent's goal there is a significant difference between the Representations of Germany and Uruguay (p= 0.005). By variable for free kicks to the opponent's goal and free kicks performed with low ball passing there were no statistically significant differences.

Serbia's National team in the qualifications on the World Championship 2010 performed 45 % effective attacks after standard situations – game interruption and on the World Championship our team did not even make one effective attack in this way (Janković et al., 2010).

TABLE 7 U test way of free kicks performance of Germany and Uruguay

variable	Representation	Z value	Middle rank	p
fkd	Germany	-2.797	4.57	**0.005**
	Uruguay		10.43	
fkc	Germany	-1.150	6.29	0.250
	Uruguay		8.71	
fkl	Germany	-0.736	8.29	0.462
	Uruguay		6.71	

CONCLUSION

Based on the results obtained processing the collected data, it can be concluded that there are significant differences in the representation of certain ways of free k icks performance in the play of the four first ranked teams on the World Championship 2010. It was expected, taking into consideration the standings of the teams, that there will not be significant differences in the observed variables. The results revealed that by all observed Representations the most frequent way of free kicks performance is that with low balls and the least used is that with direct shot to the opponent's goal. The

Representation of Spain according to the total number of executed free kicks to the opponent's half part of field, as one of the indicator of force on the field, confirmed their widely known technical and tactical dominance on the field expressed with their ball possession.

A deeper investigation level of the same problem could be obtained by recording the same variables but by field zones.

It would be interesting for theory and practice of football game to determine in a future study the outcomes and effectiveness of free kicks of the same Representations and to compare the received results from previous major competitions such as the World and European Championships.

REFERENCES

Birman, K. (2011). *Football matrix* . Laguna: Belgrade.

Bray, K. (2006). *How to achieve a goal*. Zagreb: V.B.Z. Library Ambrozija.

Gustav B and Krneta, Ž. (2007). *Application of basic statistical methods in kinesiology*.

Novi Sad: Faculty of Sport and Physical Education.

Đošić, N. (2010). Possibility of measure of situational speed in competitive conditions by contact index. In the works I. Jukić, L. Milanović, C. Gergov, S. Šalaj & T. Trošt.Boboć , Proceedings of international scientific symposium *'' Conditioning of athletes 2010''* (pages 211-214). Zagreb : Kinesiology University of Zagreb and Croatian Association of fitness trainer

Đošić, N. (2011). Pass precision in football game depending on the number of touches in case of ball handover. 7. International conference, *''management in sport'''* Belgrade: Faculty of Sports management. ALFA University.

Đošić, N. (2012). Representation of reversal balls in modern football game. 5. International interdisciplinary scientific and professional conference *''Educational and sport horizons''* (pages 93-99). Subotica: High school of vocational education studies for teachers and coaches.

Đošić, N. (2012). Representation of reversal balls in Dutch football. 8. *International conference-Management in sport''* (pages 108-115). Belgrade : Sports Management Faculty. Alfa University

Đošić, N. (2012). Contact index in the way of playing of the Representation of Spain on the games on the World Championship 2010. 20.International Interdisciplinary Symposium *''Ecology, sport, physical activity and health of young people''* (Proceedings in press) Novi Sad: University in Novi Sad and Novi Sad marathon

Đošić, N. (2013). Contact index in the way of playing of the Representation of the Netherlands on the games on the World Championship 2010. 3.International Conference *"Sports science and health''* .Banja Luka : Faculty of Sport Sciences. Pan-European University Apeiron.

Đošić, N. (2013). Differences in playing reversal balls on matches of the finalists on the football World Championship 2010. 3rd International Scientific Conference *„Exercise and Qvality of Life".* Novi Sad: Faculty of Sport and Physical Education.

Đošić, N. (2013). Contact index in the way of playing of the Representation of Germany on the games on the World Championship 2010. 7. International conference, *"Management in sport"* (Proceedings in press). Belgrade: Faculty of Sports management. ALFA University.

Janković, A. Jelušić, V. Leontijević, B. and Mićović, B. (2010). Impact of successfully performed

attacks on achieving positive results of the National team of Serbia on the World Championship 2010 in South Africa (analysis of standard situations – game interruptions). 14. International Scientific conference 2010 *FIS Communication* 2010 in sport, physical education and recreation(pages 496-502) Niš: Faculty of Sport and Physical Education

Smajić M. (1999). The success of football game in attack depending from the technical and tactical elements. Master thesis, Novi Sad: Faculty of Sport and Physical Education

RAZLIKE U NAČINU IZVOĐENJA SLOBODNIH UDARACA FINALISTA I POLUFINALISTA SVETSKOG FUDBALSKOG PRVENSTVA 2010.GODINE

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SAŽETAK

Uvod: Cilj ovog istraživanja je bio da se utvrde razlike u zastupljenosti pojedinih načina izvođenja slobodnih udaraca u igri polufinalista i finalista Svetskog fudbalskog prvenstva 2010. godine.

Metode: Analizirani su snimci po sedam utakmica reprezentacija Španije, Holandije, Nemačke i Urugvaja, ukupno 28 utakmica. Evidentirane su frekvencije 3 osnovne vrste slobodnih udaraca: direktnim udarcem prema golu protivnika, centaršutom u šesnaesterac protivnika i niskim dodavanjem lopte tzv.“kombinacija“. Testiranje razlika između ekipa u pojedinim vrstama slobodnih udaraca urađeno je primenom Kruskal Wallis testa a razlike između pojedinih parova ekipa primenom Mann Whitney testa.

Rezultati: : Na osnovu vrednosti Kruskal Wallis testa za sve tri posmatrane varijable može se zaključiti da između četri posmatrane reprezentacije postoji statistički značajna razlika u zastupljenosti pojedinih načina izvođenja slobodnih udaraca u njihovoj igri. Nivo značajnosti za slobodne udarce izvedene direktnim udarcem prema golu protivnika iznosi 0.019, za slobodne udarce izvedene centaršutom u šesnaesterac protivnika 0.047 a za slobodne udarce izvedene niskim dodavanjem lopte tzv.“kombinacija“ 0.046. Za utvrđivanje razlika između pojedinih parova reprezentacija primenjen je Mann Whitney test. Utvređeno je da između reprezentacija Španije i Holandije i Holandije i Urugvaja nema statistički značajne razlike u zastupljenosti pojedinih načina izvođenja slobodnih udaraca. Između reprezentacija Španije i Nemačke postoji statistički značajna razlika kod slobodnih udaraca izvedenih centaršutem u šesnaesterac protivnika (p=0.016). Između reprezentacija Holandije i Nemačke postoji statistički značajna razlika kod slobodnih udaraca izvedenih direktnim šutom prema golu protivnika (p=0.043). Između reprezentacija Španije i Urugvaja postoji statistički značajna razlika kod sva tri načina izvođenja slobodnih udaraca. Za prvu varijablu p=0.028, za drugu p=0.027, a za treću p=0.004. Između reprezentacija Nemačke i Urugvaja postoji statistički značajna razlika kod slobodnih udaraca izvedenih direktnim šutom prema golu protivnika (p=0.043).

Zaključak: Očekivalo se, s obzirom na plasman reprezentacija, da neće biti značajnih razlika u posmatranim varijablama. Međutim, rezultati istrživanja su pokazali da razlike postoje i da su statistički značajne. Kod svih posmatranih reprezentacija najzastupljeniji je način izvođenja slobodnih udaraca niskim dodavanjem lopte, a najmanje je direktnih šuteva prema golu protivnika. Reprezentacija Španije je i po ukupnom broju izvedenih slobodnih udaraca na protivničkoj polovini terena kao jednom od pokazatelja odnosa snaga na terenu potvrdila svoju opšte poznatu tehničko-taktičku dominaciju na terenu izraženu kroz posed lopte.

Ključne reči: prekidi igre, fudbal, razlike

THE UNIFIED METHODOLOGY FOR APPLYING LABORATORY AND FIELD TESTS FOR DIFFERENT GYMNASTICS DISCIPLINES

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UDC 796.01

SUMMARY

Introduction: Over the past few years FIG had the tendency to unify the structure of the routines in different gymnastics disciplines with all of them keeping their specific content. The most visible changes in the unification of the Code of Points are the duration of the routine and its dynamics. This outlines the directions of our work. The aim is to develop and apply a unified set of functional (laboratory and field) tests.

Methods: This publication is part of a two-year major project coordinated with the National Sports Academy and financed by the Bulgarian Ministry of Education. Sixty high level athletes from rhythmic gymnastics, acrobatics, aerobics and aesthetic group gymnastics have been tested during the two main periods – preparatory and competitive. These include two laboratory and three field tests:

VO2max

Submaximal test on treadmill (95% of the maximal test)

Two minute shuttle test

Specific modified gymnastics routine

Competitive routine.

Results: Through this set of tests we can compare the load in different gymnastics disciplines during different periods of the preparation as well as the current functional state of the gymnasts. Due to the specifics of the gymnastics disciplines, it is hard to determine the current functional state of the athletes with the commonly used tests. The need for new, objective tests provoked this investigation and the tests by two authors were created and applied in it – one in the laboratory and one in the field conditions.

Conclusion: The analyzed and systematized data from the research will be used for the creation of a massive data base and the determination of the physiological profile of the gymnastics disciplines.

Key Words: physiological profile, functional tests, gymnastics,

INTRODUCTION

All gymnastics disciplines are judged upon their accuracy of execution, upon how well the gymnasts perform, and not on their abilities. Obscured by routine, with beauty, skills and effortlessness, it could easily be decided that gymnastics don't require much effort from the gymnast. Due to the specifics, it is hard to determine the load and its effect which represents the aim of the sport training. The need for an objective functional fitness test in gymnastics disciplines still remains. The anaerobic system is considered to be the main energy supplier of most of gymnastics competitive events/routines (Jemni et al., 2011). Although there are authors (Sawczyn & Zasada, 2007) who consider the aerobic capacities a key for a successful training in young gymnasts and the training sessions are proven to be in an aerobic regime of work (Gateva, 2008), we strongly believe that the anaerobic power is dominant and the energy cost is described by a great value (Dobreva, 2007; Baldari & Guidetti, 2001 Guidetti et al., 2000).The

most standard and frequently used tests in gymnastics disciplines which estimate the mechanical power output are the Force–Velocity test and the Wingate test (Jemni et al., 2006).

The aims of our research are to estimate a physiological profile of gymnastics disciplines and to develop and apply a unified set of functional (laboratory and field) tests.

METHODS

The study is a two-year major project coordinated with the National Sports Academy and financed by the Bulgarian Ministry of Education.

Subjects

Sixty high level athletes (age 14 to 18) from rhythmic gymnastics, acrobatics, aerobics and aesthetic group gymnastics took part in this investigation. Each group (discipline) was comprised of 12 athletes (female), for acrobatics both males and females were tested (24 in total). A written consent was obtained from all subjects. The investigation took place twice – during the preparation period and during the competitive period. All subjects had their individual training regimes.

Preparation

During the preparation period the testing was performed within a month's time – 12th November to 8th December 2012. The second testing was performed in the competitive period, from 8 April to 12 May, 2013. Taking into consideration the main competition (Europe Championship or national Championship) and the training tasks of the gymnasts, we planned our research around them.

Description of the tests

The entire investigation includes five tests – two in laboratory and three in field conditions:

- ✓ VO_2max
- ✓ 2 min Submaximal treadmill test (95% of the maximal test)
- ✓ 2 min Shuttle test
- ✓ 2 min Specific modified gymnastics routine
- ✓ Competitive routine.

1. **VO_2 max**– The increase of the incline of the treadmill with 0,6° (starting from 0°) on each 30 sec. The speed during the test was constant – 8,4 km/h.

2. **2 min Submaximal treadmill test (95% of the maximal test)(authors' test)** –The test requires a 2 min run on a treadmill with a constant speed of 8,4 km/h and individually set the incline of 95% of the maximum for each athlete. The maximal incline is based upon:

- theoretical maximal pulse,
- reached HR and incline during the maximal test,
- extrapolation of the incline as 100% from the theoretical maximal pulse and calculation of the 95% of the incline for each gymnast.

3. **2 min Shuttle test** – set distance of 10 m with two lines. Each time the subject is asked to touch outside the lines. The covered distance in meters (with accuracy of up to 0,5 m) is measured for 2 min. Athletes start in pairs.

4. **2 min Specific Modified gymnastics routine (authors' tests) –** A 2 min routine executed with the typical basic exercises for each discipline. All of the specific exercise groups are displayed in this routine with low level of difficulty and structure close to the competitive one. Each of the gymnastics disciplines has a different routine considering its specifics (full description of the tests in following publications).

5. **Competitive routine** – for each of the gymnastics disciplines a routine is performed. For rhythmic gymnastics – individual one, for acrobatics – balance and tempo routine, for aerobics and aesthetic group gymnastics – standard (they have only one routine).

Methods

The methods used for each one of the 5 tests are heart rate monitoring and the concentration of the blood lactate. Based on those two indicators it is possible to perform a comparison of the load during all the tests.

For laboratory testing gas exchange, blood pressure and other associated metabolic and cardiovascular functions indicators were used.

Procedure and protocol of the testing

Laboratory testing

The subjects undertook a maximal gradual exercise test on a treadmill enabling the assessment of their VO_2 max.

The 2 min submaximal laboratory test was performed 24 hours after the maximal one took place.

The start of each of the laboratory tests was preceded by a three minute light warm up. After completing each test the subjects were asked to have a passive recovery period for 10 min.

Gas exchange and heart rate were monitored during and 10 min after the exercise (load). Breath by breath gas exchange was measured continuously using OxiconPro (Yeger, Germany).

Heart rate was recorded by POLAR RCX3. The recording started at rest and continued until 10 min post exercise (recovery period).

A blood sample was taken from the fingertip to assess the blood lactate using an Accutrend Plus Roche. Lactate was taken before and on the 3rd, 5th and the 9th min during the recovery period.

Field testing

All 3 field tests were done in one day oF the same week of the laboratory testing.

In the beginning of the field testing session, a basic warm up was performed, followed by a 10 min specific warm up prior to each one of the three field tests. After the completion of each test the subjects were asked to have a passive recovery period for 10 min. The next field test was done after 20 min. The testing order was:

1. 2 min shuttle test
2. 2 min specific modified gymnastics routine
3. Competitive routine.

RESULTS

Summary of the tests used into the project "Physiological profile of the gymnast' disciplines and applying specialized tests into practice"

Test	VO_2max	2 min Submaximal treadmill test	2 min Shuttle test	2 min Specific modified gymnastics routine	Competitive routine
Number of measured indicators	20	20	4	2	2
Number of tested athletes	60	60	60	60	60
Periods of testing	Once – in the PP*	Twice – in the PP* and in the CP**	Twice – in the PP* and in the CP**	Twice – in the PP* and in the CP**	Twice – in the PP* and in the CP**
What does it measure?	Aerobic capacity	Submaximal anaerobic-aerobic capacity	Submaximal anaerobic-aerobic capacity	Submaximal anaerobic-aerobic capacity	Submaximal anaerobic-aerobic capacity

*PP – preparation period

**CP – competitive period

DISCUSSION ON THE CHOICE OF TESTS

VO_2 max – the gold standard for the determination of the aerobic capacity. The choice of the protocol for the test – constant speed with load increase through increasing the incline of the treadmill was made considering the subjects' age (14-18). The test was necessary for the calculation of the following submaximal laboratory test. The test was performed only once – in the preparation period.

2 min submaximal treadmill test - only several cases of reaching the theoretical maximal pulse and respective incline were recorded during the VO_2 max test. For most of the subjects the greater incline was on their second (submaximal) test.

Why did we choose the 2 min submaximal test on a treadmill:

- Duration is comparable with all gymnastics disciplines – rhythmic gymnastics up to 1,30 min for individual, up to 2,30 min for group routine; acrobatics – up to 2,30 min; sport aerobics – up to 1,30 min; aesthetic group gymnastics – up to 2,45.
- Intensity and effort are similar to the actual gymnastics routine – 95% of the maximum. Gymnastics is known to be a sport with a competitive program (routine) load described as a submaximal close to the maximal (Gateva, 2008).
- It is expected to measure the anaerobic capacity and the beginning of aerobic capacity (same as gymnastics).
- It is set up individually for each subject.
- It is expected to be more adequate, precise and responding to the need of having a specific test in the gymnastics disciplines.

2 min shuttle test – the reason for its positioning in the 5 test set is to be the comparison and transition from the laboratory to field testing. This test is the closest to the one in the laboratory – same exercise for the same amount of time. Dosage could be compared through the body's response to the run based on the RH and La values. This test is a unified method in field conditions to compare different gymnastics disciplines. In a lab we can follow the cardiovascular and respiratory system, but not in field conditions, but based on the two indicators (HR and La) we can compare the load. The distance of 10 meters was set according to the need of a constant change of the direction. In aerobics for example to measure the specific endurance a 7 metres shuttle test is used (Mineva, 2011; Peeva, 2005; Tarnichkova et al., 2007) which we changed to 10 m taking into consideration the size of all gymnasts floors (aerobics – 10 m; rhythmic and aesthetic gymnastics – 13 m. acrobatics – 12 m).

2 min Specific test – specially developed 2 min routine which could be used once as a tool for developing the specific endurance and also as an adequate control for the same ability which can be easily applied in the field by coaches. It gives a quick response without the necessity of expensive equipment. The results of this test are directly connected with the current functional state of the gymnast. Also the load (dosage) is set by the typical exercises for each discipline which is opposite to the shuttle run test and other tests which have different structure of the muscular effort.

Routine – this is a control tool for the real load of each one of the gymnastics disciplines. It gives us the starting point for determination of the regime of specific work (anaerobic – submaximal). The routines are limited by the short time for execution and the specific requirements (character, structure of the exercises) which determine almost the same volume and intensity of the dosage – direct training effect. Nevertheless, studying the physiological exertion (tension) in gymnasts' body during the execution of the competitive routine is necessary for a better understanding of the adaptation of the body's systems towards the intensity and the volume of the competitive impact. (Gachev & Djarova, 1992; Weltman, 1995; Grancharov, 1997; Gateva & Andonov, 2006; Jemni et al., 2011).

CONCLUSION

Through this set of tests we can compare the loading in different gymnastics disciplines during different periods of the preparation as well as the

current functional state of the gymnasts. Due to the specifics of the gymnastics disciplines, it is hard to determine the current functional state of the athletes with the commonly used tests. The need for new, objective tests provoked this investigation and two author created tests and applied in them – one in the laboratory and one in the field conditions. The analyzed and systematized data from the research will be used for the creation of a massive data base and the determination of the physiological profile of the gymnastics disciplines.

REFERENCES

Гатева, М. & Андонов, К. (2006). Анализ на тренировъчните планове на водещите софийски клубове по художествена гимнастика. Годишна научна конференция, *Спорт и наука, Изв. бр.1*, (6), стр. 132-135. Gateva, M. & Andonov, K. (2006). Analysis of the training plans in leading rhythmic gymnastics clubs in Sofia. *Sport & science, extra edition 1* (6), pp. 132-135.

Гатева, М. (2008). *Изследване на тренировъчното натоварване в художествената гимнастика и усъвършенстване методиката на обучение.* София: НСА, катедра Гимнастика. Gateva, M. (2008). *Examination of the training loading in rhythmic gymnastics and perfecting the training methods.* Sofia: NSA, Department Gymnastics.

Гачев, Е., Джарова, Т. (1992). *Биохимия.* София, Наука и изкуство. Gachev, E. & Djarova, T. (1992). *Biochemistry.* Sofia, Nayka & Izkystvo.

Грънчаров, Н. (1997). *Анаеробния праг, същност и приложна стойност в спорта.* София, НСА ипб. Grancharov, N. (1997). *Anaerobic threshold, the essence and applied value in sport.* Sofia, NSA ipb.

Добрева, Цв. (2007). *Подготовката в спортната гимнастика: В помощ на треньора.* София: Бинс. Dobreva, Ts. (2007). *Preparation in artistic gymnastics: Help for the coach.* Soria: Bins.

Минева, М. (2011). *Спортна аеробика – теория и практика.* София, НСА ПРЕС. Mineva, M. (2011). *Sports aerobics – theory and practice.* Sofia, NSA Pres.

Пеева, М. (2005). Система за оценка на физическата дееспособност на състезатели по аеробна гимнастика (12-14г. и 15-17г.). *Спорт и наука, изв. бр.2.* стр. 151-158. Peeva, M. (2005). System of evaluation of the physical activity amongst the aerobic gymnastics competitors (12-14г. и 15-17г.). *Sport & science, extra edition 2,* pp. 151-158.

Търничкова, М., Николова, И. (2007). Динамика на развитие на физическите качества при състезатели по спортна аеробика 7-17год. *Спорт и наука, 4*, стр.15-19. Tarnichkova M. & Nikolova, I. (2007). Dynamics of physical abilities' development amongst the aerobic gymnastics competitors (7-17years old). *Sport & science, 4*, pp. 15-19.

Baldari, C. & Guidetti, L. (2001). VO2max, ventilatory and anaerobic thresholds in rhythmic gymnasts and young female dancers. *Journal of Sports Medicine and Physical Fitness, 41 (2),* pp. 177-182.

Guidetti, L., Baldari, C., Capranica, L., Persichini, C., & Figura, F. (2000). Energy cost and energy sources of ball routine in rhythmic gymnasts. *Int J Sports Med, 21*(3), pp. 205-209.

Jemni, M., Sands, W., Friemel, F., Stone, M., & Cooke. C. (2006). Any effect of gymnastics training on upper-body and lower-body aerobic and power components in national and international male gymnasts? *The Journal of Strength and Conditioning Research, 20*(4), pp. 899-907.

Jemni, M., Sands, W., Salmela, J., Holvoet, P., & Gateva, M. (2011). *The science of gymnastics.* London and New York: Routledge Taylor and Francis Group.

Sawczyn, S. & Zasada, M. (2007). The aerobic and anaerobic power of best young gymnasts – indication of training endurance capabilities. *Research yearbook, 13* (1), pp 86-91.

Weltman, A. (1995). *The blood lactate response to exercise (monograph number 4)* - Champaign: Human kinetics.

STATUS AND TRENDS OF DEVELOPMENT IN THE DISCIPLINE 110 M HURDLE RUNNING FOR BOYS U18 AND U20 IN BULGARIA

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UDC 796.422.093.352

SUMMARY

Introduction: Undisputedly the discipline 110 meter hurdle running for men is one of the most attractive and also technically sophisticated in the athletics program. But for achieving high results in the men age group competitors first have to pass through the age groups youth (U18) and junior (U20).

Methods: The following study aims to give current data about the development of the 110 meter hurdle running for youth and junior age groups in Bulgaria. That is why we analyzed the National Championships (NC) for a period of 8 years (2006 – 2013). We analyzed separately the heats and the finals during the examined period with the help of variance analysis.

Results: In the youth age group we are witnessing several changes of the national record. The weakest results from the heats are around 16,44 – 23,21 sec. which means of weak training preparation of those competitors. The average value is around 15,28 – 17,81 in the different years again in the heats. The range differs from 2 – 3 sec. in the finals to 6 – 8 sec. in the heats during the analyzed period. In the junior age group we are witnessing again several national records. The last is set by K. Stoychev in 2013 – 13,92 sec. The tendency found here is that the range is visibly narrow compared to the youth age group. But again there are very weak results (close to 20 sec.) but here they are exceptions.

Conclusion: By analyzing the youth and junior age group we can give the tendency of development in the men age group in the following few years. Also we see upward trend in the results in the final runs during the 8 year period. Also if a competitor wants to win the NC he must register time close to the national record. Also this progress is due to 4-5 gifted talents from which the Bulgarian Athletics Federation expects high results in the man age group during the following years.

Key Words: 110 hurdles, status and trend in development, junior, youth

INTRODUCTION

Without any hesitation we can say that the discipline 110 meters hurdle running for men is one of the most attractive and difficult disciplines in the track and field program. But for reaching high level sport results in the men age group the future athletes must first go through the U18 and U20 age groups.

In the last 20 years we are witnessing a retreat in the level of all kinds of sports in Bulgaria. This is due to the many years "transition" which includes structure changes on all levels of the national sports system. The track and field was also affected by this

negative tendency despite the success of elite Bulgarian athletes in the past few years: Ivet Lalova (100 and 200 m), Daniela Yordanova (1500, 3000, and 5000 m), Georgi Ivanov (shot put) and etc. But we can draw a general conclusion that we are returning to all the disciplines (especially if we speak about the number of participants). Despite this negative tendency we mark the good performance showed by several young and very perspective athletes: Denis Dimitrov (100 and 200 m), Mirela Demireva (high jump), Mitko Cenov (3000 m steeplechase), Karin Okolie (100, 200 and 400 m), Galina Nikolova (100 and 200 m), Petar Kremenski (100 and 200 m), Radoslava Mavrudieva (shot put) and many others. We think that they possess the talent to reach high level results in their disciplines.

The following study aims at the 110 m hurdle running for boys in the age groups U18 and U20. Before we start a detailed analysis we must mention the names of the best young hurdlers in the last few years: Martin Arnaudov, Zlatko Lefterov, Krasimir Stoychev and etc. They made several corrections of the national record in the discipline in the age groups U18 and U20.

Also after a detailed analysis of the discipline we can conclude that several training centers for hurdlers are formed: Sofia, Plovdiv, Stara Zagora, Varna, Gabrovo, Pleven, Bourgas and etc.

We also must note the difference in the competition rules between the two age groups. In both age groups the running distance is 110 meters, the number of the hurdles is 10, the distance from the start to the first hurdle is 13,72 m, the distance between the hurdles is 9,14 m and the distance from the final 10th hurdle to the finish line is 14,02 m. The only difference is the height of the hurdles – for the U18 it is 91,4 cm, and for the U20 it is 99,00 cm.

METHODS

The aim of the following study is to give the current information on the status and trend of the development in the discipline 110 m hurdle running for the age groups boys U18 and U20 in Bulgaria. For achieving this aim we analyzed the Bulgarian National outdoor championships for U18 and U20 for an 8 year period (from 2006 to 2013). With the help of the variance analysis we have made conclusions about the dynamics and the trends of development. The object of the following study was the level the sport results of the 110 m hurdlers in Bulgaria. This was established by analyzing the results of the participants in the Bulgarian National outdoor championship in the age groups boys U18 and U20. The total number of the hurdlers examined is 268, from which 141 are in the age group U18 and 127 are in the age group U20.

RESULTS

General information for the age group boys U18 is shown in table 1. Also some of the data is also shown in figures 1 (for the heats) and figure 2 (for the final).

When we analyzed in details the data we noted that the range (R) in the heats varies between 4,60 and 8,93 sec. This is due to the fact that a part of the competitors, mainly in the second half of the timetable, lacks both technical and physical training. This is supported by the fact that are registered results at around 18,35 (from 2013) and 23,21 sec. (2012). Also we noted that the numbers showing the average value were interesting for us. They vary between 17,81 sec. (from 2008) to 16,10 (from 2011). Also we noted the best results registered by the boys U18 – vary around 14,07 sec. (from 2013) and 15,35 (from 2007) (shown in table 1 and figure 1). Figure 1 generalizes the analyzed number above. We are witnessing better results in 2006, after that we clearly see a retreat and after that in the following years again there is a notable improvement in the results. From 2009 the top results in the heats are constantly improving compared to the year before.

TABLE 1

110 m hurdle running boys U18							
	N	R	min.	max.	Mean		Std. Dev.
					Statistic	Std. Error	
2006 heats	19	4,60	14,33	18,93	16,54	,29464	1,28430
2006 final	8	2,08	14,56	16,64	15,66	,24550	,69438
2007 heats	16	6,59	15,35	21,94	17,78	,52278	2,09111
2007 final	8	3,54	14,75	18,29	16,17	,38828	1,09822
2008 heats	26	7,14	15,07	22,21	17,81	,34480	1,75812
2008 final	8	2,79	15,18	17,97	16,38	,35329	,99925
2009 heats	16	6,60	15,14	21,74	17,26	,48139	1,92556
2009 final	8	2,52	14,97	17,49	16,02	,28153	,79629
2010 heats	14	7,12	14,62	21,74	17,25	,51027	1,90925
2010 final	7	2,08	14,90	16,98	16,01	,29201	,77259
2011 heats	13	5,27	14,57	19,84	16,10	,41246	1,48716
2011 final	8	5,18	14,52	19,70	15,75	,59737	1,68961
2012 heats	19	8,93	14,28	23,21	17,66	,60770	2,64890
2012 final	8	2,68	14,07	16,75	15,29	,33007	,93358
2013 heats	17	4,28	14,07	18,35	16,60	,28572	1,17803
2013 final	8	2,41	14,03	16,44	15,62	,29979	,84795

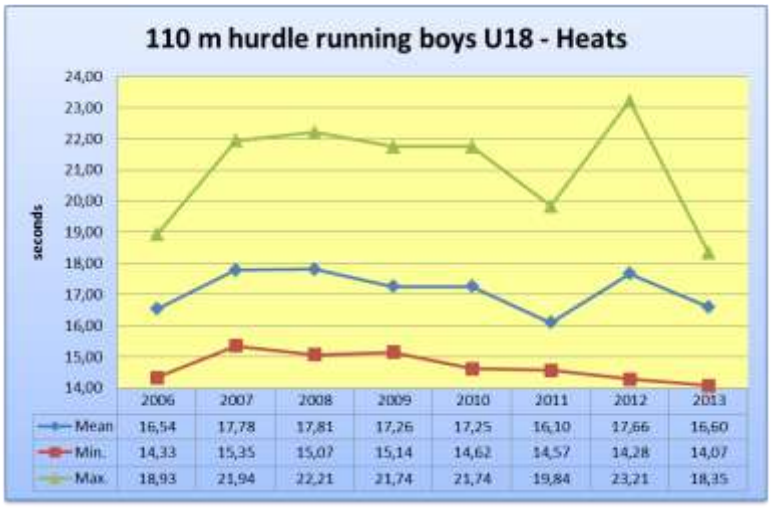

Figure 1

In general, it means that the data from the heats is relatively similar to this from the final runs during the examined period. The difference is that the results from the final runs are better due to the small number of analyzed hurdlers (8), and also due to their technical and physical abilities. (table 1 and figure 2)

The first thing that makes an impression is the smaller value of the range – between 2,08 and 3,54 with the exception of 5,18 sec. from 2011 due to the falling and continuing running of a hurdler. The average values of the results from the final runs are between 15,29 sec. (from 2012) and 16,38 sec. (in 2008). One of the best results achieved during the National Championship in the separate years are between 14,00 and 14,50 sec. which most of the times is enough for winning the gold medal. In other years result around 14,90 – 15,18 guarantees a gold medal (due to the bad weather conditions). The last places in the final runs are with times around 16,44 and 19,70 sec. (pretty wide gap).

Figure 2

In table 2 is shown the data from the variance analysis for the age group hurdlers U20. Also some of the important information in short variant is visible on the tables 3 and 4.

By examining the results we can see that the range of the results vary between 4,08 sec. (from 2010) and 6,42 sec. (from 2008). This is the evidence for big gap between the participants taking part in the second run and the weakest hurdlers taking part only in the heats. The average values are between 17,47 sec. (from 2008) and 16,40 sec. (from 2013). We consider that it is the objective index showing the potential of the Bulgarian hurdlers from the middle and low levels of qualification. Reviewing the best results in the examined period we were impressed by the results 13,92 sec. (from 2013) and the relatively low results around 14,99 sec. (from 2008 and 2010). The weakest result in the examined period in the heats for boys U20 is 21,41 sec. from 2008.

TABLE 2

110 hurdle running Boys U20							
	N	R	min.	max.	Mean		Std. Dev.
					Statistic	Std. Error	
2006 heats	16	5,24	14,94	20,18	16,43	,36136	1,44543
2006 final	8	,44	14,99	15,43	15,15	,05541	,15673
2007 heats	18	5,09	14,49	19,58	17,09	,41035	1,74095
2007 final	8	1,85	14,42	16,27	15,23	,25939	,73366
2008 heats	13	6,42	14,99	21,41	17,47	,59589	2,14852
2008 final	8	3,07	14,67	17,74	15,93	,43208	1,22210
2009 heats	17	5,53	14,37	19,90	17,34	,40780	1,68141
2009 final	7	2,81	14,04	16,85	15,60	,37928	1,00347
2010 heats	13	4,08	14,99	19,07	16,65	,35708	1,28747
2010 final	8	2,03	14,85	16,88	15,88	,24694	,69846
2011 heats	16	6,07	14,47	20,54	16,88	,33905	1,35620
2011 final	8	2,36	14,30	16,66	15,74	,26825	,75873
2012 heats	17	6,33	14,26	20,59	16,74	,48955	2,01846
2012 final	8	1,95	13,95	15,90	15,11	,23236	,65721
2013 heats	16	4,98	13,92	18,90	16,40	,39123	1,56492
2013 final	8	3,55	14,25	17,80	15,70	,42093	1,19058

In the final run we also see the same tendencies as the heats for the separate years. The range varies between 0,44 sec. registered in 2006 (where average results is 15,15 sec.) which is proof for close results. The average values for the final run is from 15,11 sec. (from 2012) to 15,93 sec. (from 2008 sec.). We

can note that for winning a medal the hurdlers must achieve results below 15,00 sec. The best results in the final run during the examined period are from 15,43 sec. (in 2006, where R=0,44 sec. and the average result is 15,15 sec.) to 17,80 sec. (from 2013). In 2013 the gold medalist ran in the heats 13,92 sec. and in the final run 14,25 due again to the bad weather conditions. (table 2)

From the data shown in figure 3 we can generalize that there is a current tendency of improving the average result during the years and this tendency is valid for the full 8 year period of our study. We do not find any tendency connected with the weakest results. (figure 3)

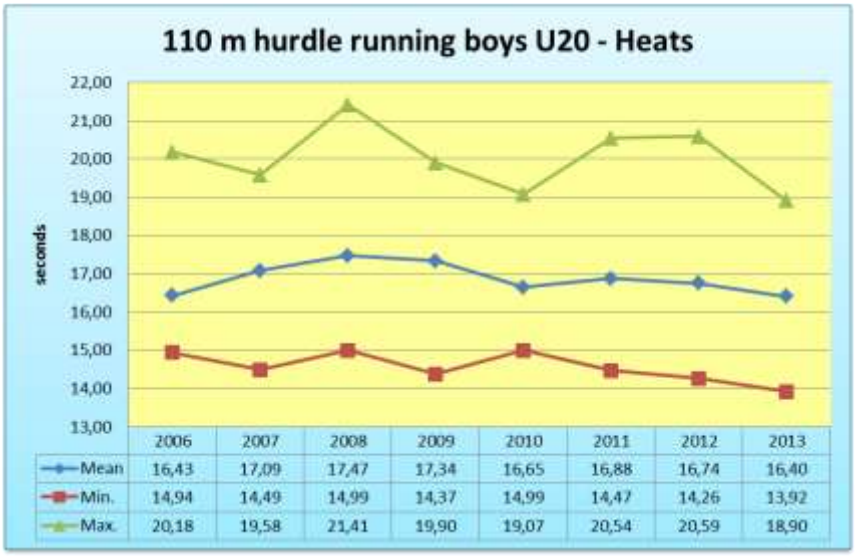

Figure 3

In figure 4 the retreating of the results registered in the final runs is clearly visible. We see one period of improvement during the years 2010 and 2012, and in 2013 again we see weak results in the final run. Comparing the results 2008 and 2013 are very similar. The average data curve is due to the weak results of the hurdlers qualified on the places below 5th – 6th in the final run.

Figure 4

The number of participants in different years for boys U18 is shown in figure 5, and for boys U20 in figure 6. There is a notable drop in the age group U18 in the period 2010 – 2011, and after that the number of participants in the National Championship is raising again. (figure 5)

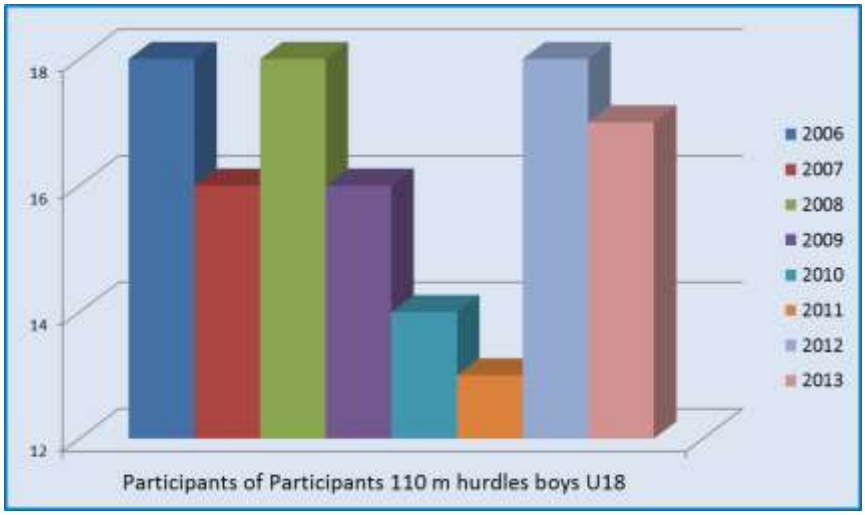

Figure 5

We note a relatively low number of participants in the age group U20 compared to the U18 age group. Here, the lowest number of hurdlers is registered in two inconsecutive years: 2008 and 2010. In another year the number of boys taken part in the Bulgarian National Championship is around 16.

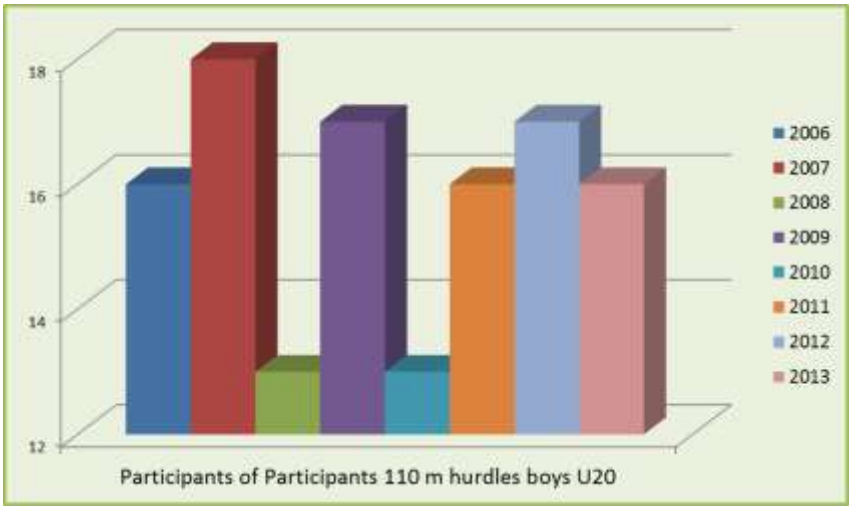

Figure 6

CONCLUSION

Beside the fact that we get information about the actual condition of the discipline 110 meter hurdle running for boys U18 and U20 we also can conclude that this analysis is a solid base for making prognosis for the future of this discipline in the near future.

It is a clearly visible ascending tendency of improving the results which is highlighted in the final runs. The number of participants varies between 15 and 25 in different years and in

different age groups. For winning a gold medal in the 110 m hurdle running in the age group U18 and U20 you need to register time close to the national record.

Also we can note that there are several "weak" years with a small number of participants and lower results. But sometimes this is due to the negative influence of the weather conditions.

REFERENCES

Bulgarian Athletic Federation Competition Rules, 2013;

Karapetrova, R., Anthropometrical characteristics of the contemporary women javelin thrower, International congress "Sport, stress, adaptation", 2012;

Karapetrova, R., Dissertation, 2011, National Sports Academy "Vasil Levski", Sofia, Bulgaria;

Njagin, Pl., Dissertation, National Sports Academy "Vasil Levski", Sofia, 2009;

Stoykov, G., Study on the modification of anthropometry of tennis players aged 12 – 18 years, 2012;

http://www.bfla.org/ - Bulgarian Athletics Federation official web page;

THE DIFFERENCES IN THE ANTROPOMETRIC CHARACTERISTICS IN YOUNG SOCCER PLAYERS OF DIFFERENT RANK

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UDC 796.012

SUMMARY

Introduction: The research problem is to define the morphological types of players between the federal league and regional rank aged 14-16. A general hypothesis H_1 is defined - There are statistically significant differences in anthropometric characteristics between the federal league players aged 14 to 16 years and regional rank players aged 14 to 16 years and four partial $H_{1.1}$ - There are statistically significant differences between the longitudinal dimension of the federal league players and regional rank players aged 14 to 16 years, $H_{1.2}$ – There are statistically significant differences between the transverse dimension of the federal level players and regional players rank between 14 and 16 years, $H_{1.3}$ – There are statistically significant differences in the volume and body mass between the federal league players and regional rank players aged 14 to 16 years, $H_{1.4}$ - There are statistically significant differences in body fat between the federal league players and regional rank players aged 14 to 16 years.

Methods: The examinees sample consists of 20 players from the football club "Radnički" in Niš, who compete at the federal level and 20 players from the football club "Železničar" from Nis, who compete at the Serbian regional level. The measuring instruments that are used in the measurement are: anthropometer, measuring tape, a scale to measure weight and the caliper measurement of skin-folds. Data were analyzed by statistical methods for determining the central and dispersive parameters, variables, and the T-test for small independent samples was performed to determine the differences between the federal league players and regional rank players aged 14 to 16 years.

Results: There is a statistically significant importance between young soccer players in the following variables: AVIST - height, ADUNO - leg length, ASIKU - the width of the hips, AKKNA - upper arm skin fold, mostly the measures of the volume and body mass, AOGKS - chest circumference, AONAD - upper arm circumference, AOBUT - the thigh circumference, and AMAST - body mass.

Conclusion: It is possible to assume that the development of anthropometric characteristics does not receive enough attention in the athletes of regional ranking. After processing the data obtained it can be concluded that the federal league coaches pay more attention to the development of anthropometric characteristics than regional rank coaches. Based on these results it is necessary to create a specific program of action that will influence the further development of the anthropometric characteristics of the examinees.

Key Words: soccer, anthropometry, federal league, regional rank

INTRODUCTION

The anthropometric and morphological characteristics are extremely important for success in a variety of sports including soccer. Soccer is an anaerobic-aerobic sport with alternating phases of high loads such as sprints, quick change of direction, jumping, and sudden stops. Football is characterized by a continuous course of activities with intermittent intensity of a game and a very low success ratio (the number of achieved goals) according to a possession

of a ball (Reilly et al, 1993). Soccer is one of the most widely played and complex sports in the world, where players need technical, tactical, and physical skills to succeed (Joksimović et al., 2009). Today's top soccer requires strong endurance players with good anthropometric and motor skills and a sense of improvisation and collective performance. Creating top football players is a long-term process which includes identification, development and selection of the talents (Reilly et al., 2000). Because of that, the identification and development of young football players have become very important for the majority of the top-level teams (Williams and Reilly, 2000). A variety of movements typical for soccer affects the whole body, increasing its firmness and resistance to external factors. Remarkable changes are, however, occurring on the skeletal and muscular apparatus of the lower limbs, which is related to the specificity of the load it puts on players. Football players are therefore characterized by strong leg and lower leg bones. Working with the players of 14-16 years should be the final selection and the start of a much more intensive organic load. Research in the field of anthropometric characteristics of players are countless in the world and in our country (Gil et al., 2005; Kymahugotis et al ., 2005; Krsmanovic et al., 2007; Popovic et al., 2009a).

Definition of basic concepts

Anthropometry is a method of measuring the human body and certain parts of the body, which can quantitatively determine the morphological characteristics and perceived fair view of the state of development of the examined person. Federal league is the highest level of competition at that age called the Cadet League of Serbia. Regional level is a lower football ranking, known as the Serbian League FSRIS South.

METHODS

The examinees' sample consists of 20 players from the football club "Radnički" from Niš, which competes in the federal range and 20 players from the football club "Železničar" from Niš, who compete on the Serbian regional level. All subjects agreed to the trial and during this period were clinically healthy. The sample of variables consisted of 13 anthropometric measurements: body height in cm (AVIST), leg length in cm (ADUNO), arm length in cm (ADURU), shoulder width in cm (ASIRA), pelvic width in cm (ASIKA), the width hips in cm (ASIKU), chest circumference in cm (AOGKS), the upper arm stretched hands in cm (AONAD), the thigh circumference in cm (AOBUT), body weight in kg (AMAST), upper arm skin fold in mm (AKNNA), skin fold of back in mm (AKNLE), abdominal skin fold in mm (AKNTR). A sample of measuring instruments are instruments for measuring anthropometric measures: Anthropometer by Martin with an accuracy of 0.1 cm, measuring tape with an accuracy of 0.1 cm, a scale of measurement with an accuracy of 0.5 kg and a range of up to 130 kg, the caliper measurement of skinfolds by John Bull , with an accuracy of 0.2 mm. All results have been analyzed in the statistical program Statistica 19.0. For all variables basic parameters of the descriptive statistics were calculated: Range (R), the minimum score (MIN), maximum score (MAX), mean (M), standard error (Er), standard deviation (SD), skewness (Skew) and kurtosis (Kurt). To determine a statistically significant difference between the groups for each variable was used a T-test, where for the statistical significant difference the value of the significance level to 0.05 ($p \leq 0.05$) was taken.

RESULTS

In tables 1. and 2. are given descriptive parameters for the regional and federal players. Analyzing both tables, it can be observed that the value of basic, central and dispersion parameters in the intervals of minimum and maximum results, do not contain five or more standard deviation (STD) for any of the variables, based on which their sensitivity can be noticed.

TABLE 1 Descriptive statistics of the regional ranking players aged 14 to 16 years

	R	MIN	MAX	AS	Er	SD	Skew	Kurt
AVIST	30	154	184	170.95	1.755	7.85	-0.379	-0.302
ADUNO	20	89	109	101.35	1.265	5.659	-0.775	0.021
ADURU	15	66	81	73.55	1.003	4.489	-0.043	-0.549
ASIKA	10	19	29	23.50	0.650	2.910	0.171	-0.972
ASIRA	9	34	43	37.95	0.540	2.416	0.040	-0.431
ASIKU	8	26	34	29.60	0.455	2.036	-0.015	0.049
AOGKS	16	73	89	80.80	1.050	4.697	-0.121	-0.862
AONAD	6	21	27	24.25	0.422	1.888	-0.036	-1.155
AOBUT	13	45	58	50.15	0.850	3.801	0.191	-0.845
AMAST	27	47	74	59.20	1.699	7.599	-0.030	-0.982
AKNNA	15	6	21	13.05	0.723	3.235	0.126	1.316
AKNLE	20	6	26	13.05	1.294	5.789	0.568	-0.540
AKNTR	30	6	36	13.05	1.799	8.049	1.876	3.064

TABLE 2 Descriptive statistics of the federal level players aged 14 to 16 years

	R	MIN	MAX	AS	Er	SD	Skew	Kurt
AVIST	34	159	193	176.90	1.577	7.055	-0.289	1.964
ADUNO	27	92	119	105.55	1.212	5.423	0.078	2.644
ADURU	11	70	81	75.20	0.655	2.93	0.144	-0.340
ASIKA	7	20	27	23.75	0.403	1.802	-0.064	-0.520
ASIRA	8	35	43	39.35	0.514	2.300	-0.593	-0.419
ASIKU	6	25	31	27.80	0.394	1.765	-0.174	-0.796
AOGKS	19	78	97	87.20	1.050	4.697	0.168	0.125
AONAD	6	24	30	27.65	0.371	1.663	-0.673	-0.121
AOBUT	10	47	57	52.85	0.621	2.777	-0.762	-0.630
AMAST	21	54	75	67.85	1.431	6.407	-1.316	0.786
AKNNA	11	7	18	10.50	0.604	2.704	0.878	1.741
AKNLE	11	6	17	10.85	0.666	2.978	0.307	-0.586
AKNTR	20	6	26	14.30	1.183	5.292	0.556	-0.132

TABLE 3 The significance of the differences between groups - measure longitudinal dimension

		AS	SD	t	p
AVIST	REG.	170.95	7.85	-2.521	0.016
	SAV.	176.90	7.05		
ADUNO	REG.	101.35	5.65	-2.396	0.022
	SAV.	105.55	5.42		
ADURU	REG.	73.55	4.48	-1.376	0.177
	SAV.	75.20	2.93		

TABLE 4 The significance of the differences between groups - measure transversal dimension

		AS	SD	t	p
ASIKA	REG.	23.50	2.91	-0.327	0.746
	SAV.	23.75	1.80		
ASIRA	REG.	37.95	2.41	-1.877	0.068
	SAV.	39.35	2.30		
ASIKU	REG.	29.60	2.03	2.987	0.005
	SAV.	27.80	1.76		

TABLE 5 The significance of the differences between groups – measures of the volume and body mass

		AS	SD	t	p
AOGKS	REG.	80.80	4.69	-4.309	0.000
	SAV.	87.20	4.69		
AONAD	REG.	24.25	1.88	-6.043	0.000
	SAV.	27.65	1.66		
AOBUT	REG.	50.15	3.80	-2.565	0.014
	SAV.	52.85	2.77		
AMAST	REG.	59.20	7.59	-3.893	0.000
	SAV.	67.85	6.40		

TABLE 6 The significance of the differences between groups - measures of subcutaneous adipose tissue

		AS	SD	t	p
AKNNA	REG.	13.05	3.23	2.704	0.010
	SAV.	10.50	2.70		
AKNLE	REG.	13.05	5.78	1.511	0.139
	SAV.	10.85	2.97		
AKNTR	REG.	13.05	8.04	-0.580	0.565
	SAV.	14.30	5.29		

The results of the T-test in Tables 3., 4., 5. and 6. indicate a statistically significant difference between the federal league and regional rank players aged 14 to 16 years in eight anthropometric measures; thereby, the difference is in favor of the federal level players. The biggest difference between the players is in AVIST (.016), ADUNO (.022), ASIKU (.005), all measures of volume and body mass AOGKS (.000), AONAD (.000), AOBUT (.014), AMAST (.000) and in AKNNA (.010).

DISCUSSION

The current research has been conducted in order to analyze the anthropometric characteristics of young soccer players of different rank. According to Joksimovic et al. (2008) an improvement in the results of anthropometry space from the lower to the higher ranks of the competition can be observed. After the analysis of longitudinal dimensionality differences between the federal and regional players rank between the ages of 14-16 years we can see significant statistical differences in the variable

length legs ADUNO (.022), which is largely attributable to the differences in height AVIST (.016), which is also significant in favor of the federal level players. It is known that these anthropometric measures are genetically determined and could not affect their training process. In the transversal dimensionality measures and measures to assess subcutaneous fat tissue there is one significant difference between the two levels of competition, the width of hips ASIKU (.005) and upper arm skin fold AKNNA (.010). The analysis of the differences between the groups for measures of the volume and body mass it is clear that the players at the federal level have statistically better results in all variables - chest circumference AOGKS (.000), arm circumference AONAD (.000),thigh circumference AOBUT (.014) and body mass AMAST (.000) compared to regional players rank. Those who came to the same conclusions are Joksimović, S. (1981), Jerković, S. (1986), Lolić, V. (2002), Joksimović, A. et al., (2004), Hamidović, M. (2007). Despite the fact that the subjects are in a period of intense growth and development, however the analyzed measures show that there is a difference because of the influence of the intensity of training activities. The development and strengthening of the musculature at this age is much more intense.

CONCLUSION

The results of the descriptive analysis in the area of anthropometry showed a statistically significant difference between the federal league players and regional rank players aged 14 to 16 years. This difference is defined with significantly better values results in anthropometric measures in favor of the federal level players, thus partially confirming hypothesis H_1 as follows: There are statistically significant differences in anthropometric characteristics between the federal league players aged 14 to 16 years and regional rank players aged 14 to 16 years. The results of the longitudinal dimension were significantly different in body height and leg length, but there is no difference in the arm length, which partially confirms the hypothesis $H_{1.1}$ which states: There are statistical significant differences between the longitudinal dimension of the federal league players and regional rank players aged 14 to 16 years. The results of the transversal dimensionality statistically are significantly different at variable width hips, but no differences in variables of pelvic width and shoulder width, thus partially confirming the hypothesis $H_{1.2}$ which states: There are statistically significant differences between the transverse dimension of the federal level players and regional players rank between 14 and 16 years. The results for volume and body weight were significantly different for all variables, the circumference of the chest, upper arm circumference, thigh circumference and body mass, which fully confirms the hypothesis $H_{1.3}$ which states: There are statistically significant differences in the volume and body mass between the federal league players and regional rank players aged 14 to 16 years. The results of the measured skin fold thickness were significantly different in the upper arm skin fold, but no differences in the variables of the skin fold on the back, abdominal skin fold, which partially confirms the hypothesis $H_{1.4}$ which states: There are statistically significant differences in body fat between the federal league players and regional rank players aged 14 to 16 years. The obtained results should represent important information for the coaches when there is a selection of players, but not as the only determining factor. In general, this research suggests the need for further investigation of this issue given its importance for the development and promotion of sport practice which has been repeatedly confirmed.

REFERENCES

Gil, S.M., Gil, J., Irazusta, A., Ruiz, F. & Irazusta, J. (2005). Anthropometric and Physiological Profile of Successful Young Soccer Players. *Science and Football V*, 1(8), 434-441.

Hamidović, M. (2007). *Komparativna analiza morfoloških karakteristika i motoričkih sposobnosti sportista fudbalera i nesportista.* Doktorska

disertacija, Novi Sad: Fakultet sporta i fizičkog vaspitanja.

Jerković, S. (1986). *Relacije između antropometrijskih, dinamometrijskih i situaciono-motoričkih dimenzija i uspeha u nogometnoj igri.* Doktorska disertacija, Zagreb: Fakultet fizičke kulture.

Joksimovic, A., Stankovic, D., Ilic, D., Joksimovic, I. & Jerkan, M. (2009). Hematological Profile of Serbian Youth National Soccer Teams. *J Hum Kinetics*, 22, 51-60.

Joksimović, A., Joksimović, I. & Joksimović, S. (2004). Antropološke karakteristike fudbalera s obzirom na rang takmičarske aktivnosti i ponašanja tih karakteristika u jednom takmičarskom periodu. *XLIII Kongres antropološkog društva Jugoslavije, Čačak.*

Joksimović, I., Joksimović, A. & Joksimović, S. (2008). Antropološke karakteristike fudbalera u odnosu na rang takmičenja. *Glasnik Antropološkog društva Srbije,* 43, 271-282.

Joksimović, S. (1981). *Antropološke karakteristike fudbalera s obzirom na rang takmičarske aktivnosti i ponašanje tih karakteristika u jednom takmičarskom periodu.* Doktorska disertacija. Niš: Fakultet fizičke kulture.

Krsmanović, B. & Krulanović, R. (2007). Antropometrijske karakteristike i funkcionalne sposobnosti fudbalera starih 17 godina. *Glasnik Antropološkog društva Srbije*, 42, 353-368.

Kymahugotis, H., Dulgeridis, P. & Panajotis P. (2005). Uticaj morfoloških karakteristika i bazično-motoričkih sposobnosti na specijalne motoričke sposobnosti fudbalera. *Glasnik Antropološkog društva Jugoslavije*, 40, 275-282

Lolić, V. (2002). *Promena nekih antropometrijskih dimenzija fudbalera u toku takmičarske sezone.* Doktorska disertacija, Niš: Fakultet fizičke kulture.

Popović, S., Molnar, S. & Mašanović, B. (2009a). The differences in some anthropometric characteristics between top football players and recreational players. *Sport Scientific and Practical Aspects*, 6(1), 13-18.

Reilly, T., Clarus, J. & Stibbe, A. (1993). *Science and Football II*. New York: E&FN Spon.

Reilly, T., Williams, A.M., Nevill, A. & Franks, A. (2000). A multidisciplinary approach to talent identification in soccer. *J Sport Sci*, 18, 695-702.

Williams, A.M. & Reilly. T. (2000) Talent identification and development in soccer. *J Sport Sci,* 18, 657-667.

RAZLIKE U ANTROPOMETRIJSKIM KARAKTERISTIKAMA KOD MLADIH FUDBALERA RAZLIČITOG RANGA

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SAŽETAK

Uvod: Problem istraživanja je definisanje morfoloških tipova između fudbalera saveznog ranga i regionalnog ranga uzrasta od 14-16 godina. Definisana je jedna opšta hipoteza H_1 - Postoje statističke značajne razlike u antropometrijskim karakteristikama između fudbalera saveznog ranga uzrasta od 14 do 16 godina i fudbalera regionalnog ranga uzrasta od 14 do 16 godina i četiri parcijalne $H_{1.1}$ - Postoje statističke značajne razlike u longitudinalnim dimenzionalnostima između fudbalera saveznog ranga i regionalnog ranga uzrasta od 14 do 16 godina, $H_{1.2}$ - Postoje statističke značajne razlike u transferzalnim dimenzionalnostima između fudbalera saveznog ranga i regionalnog ranga uzrasta od 14 do 16 godina, $H_{1.3}$ - Postoje statističke značajne razlike u volumenu i masi tela između fudbalera saveznog ranga i regionalnog ranga uzrasta od 14 do 16 godina, $H_{1.4}$ - Postoje statističke

značajne razlike kod potkožnog masnog tkiva između fudbalera saveznog ranga i regionalnog ranga uzrasta od 14 do 16 godina.

Metode: Uzorak ispitanika čine 20 fudbalera fudbalskog kluba "Radnički" iz Niša, koji se takmiči u saveznom rangu i 20 fudbalera fudbalskog kluba "Železničar" iz Niša, koji se takmiče u regionalnom rangu Srbije. Merni instrumenti koje smo koristili u merenju su: antropometar, merna traka, vaga za merenje telesne težine i kaliper za merenje kožnih nabora. Podaci su obrađeni statističkim postupcima za utvrđivanje centralnih i disperzivnih parametara varijabli, a T-test za male nezavisne uzorke je primenjen radi utvrđivanje razlika između fudbalera.

Rezultati: Postoji statistička značajnost između mladih fudbalera i to u sledećim varijablama: AVIST - telesna visina, ADUNO - dužina noge, ASIKU - širina kukova, AKKNA - kožni nabor nadlakta, a najviše kod mera za voluminoznosti i mase tela, AOGKS - srednji obim grudnog koša, AONAD - obim nadlakta, AOBUT - obim butine i AMAST - masa tela.

Zaključak: Moguće je predpostaviti da na razvoj antropometrijskih karakteristika nije posvećeno dovoljno pažnje kod sportista regionalnog ranga. Nakon obrade i dobijenih podataka može se zaključiti da treneri saveznog ranga više pažnje posvećuju razvoju antropometrijskih karakteristika nego treneri regionalnog ranga. Na osnovu ovakvih rezultata potrebno je kreirati posebne programe rada koji će uticati na dalji razvoj antrpometrijskih karakteristika kod ispitanika.

Ključne reči: fudbal, antropometrija, savezni rang, regionalni rang

THE RELATION BETWEEN THE TETHERED SWIMMING AND THE SWIM SPEED AT 50M BREASTSTROKE

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SUMMARY

This study was conducted on the sample of 20 active male swimmers of the swimming club "Nis 2005" and the swimming club "Sveti Nikola" from Nis, age 16-18, in *classic-breaststroke style.* The aim of the study was to determine the magnitude of the impact of the force expressed in the tethered swimming on the swimming speed at 50m breaststroke. 12 predictor variables were applied in the study, as well as the swimming speed at 50m breaststroke as the criterion variable. To determine the influence of strength (predictor variable) on the results of the swimming speed at 50m classic-breaststroke style (criteria variable) we use the regression analysis. The obtained results point out that there is an impact force manifested in the tethered swimming at the 50m breaststroke swimming speed.

Key Words: swimming, breaststroke, relation

INTRODUCTION

Swimming is the use of the body where the power of man overcomes the power of water allowing the man to perform a safe motion in a desired direction on the water surface or beneath it. Speaking about sports or competitive swimming we can say that swimming is one of the cyclic sports in which the form and manner of the performance is dominated by the relatively simple motions, that are constant and that the same is repeated alternately during certain swimming techniques (Okicic et al., 2007). There are 4 basic techniques in sports swimming: freestyle, breaststroke, backstroke and butterfly.

The motor control is one of the main factors of motion and movement of a man. They contribute to the resolution of the motor tasks and enable a successful move, regardless of whether or not any training is acquired. (Malacko & Radjo, 2004). Strength is one of the 7 basic motor abilities. The strength or muscle strength is the capability of producing the maximum peak force *Fmm.* In mechanics and physics, force is defined as the measure of interaction of two bodies. Force is manifested when the body is deformed or moving. Force is a vector quantity characterized by: a) intensity, b) direction, c) offensive point (Zatsiorky & Kraemer, 2009). Talking about strength, we should distinguish the muscle strength and the athlete's strength. Muscle strength is determined by the absolute and the relative strength. By *absolute strength* we mean the maximal stress that a muscle develops when it is no more able to lift some weight. The relative strength of the muscle is equal to the ratio of the absolute muscle strength measured in

Newton (N), and the surface area of the muscle physiological cross-section in square centimeters (cm^2). Namely, to compare the strength of different persons, we must calculate the strength per kilogram of the body weight or the *relative strength* (Zatsiorky & Kraemer, 2009).

Tethered swimming aims to assess the strength of the swimmers, or the propulsive force, but its relation to the performance is still a subject of controversy in literature. Some authors argue mainly due to the different activity of the arms and hands (Barbosa et al., 2010; Morouco et al., 2008; Bollens et al., 1988). Thanopoulos et al. (2010) have found a high level of correlation between strength and swimming speed. Better swimmers produce greater power in specific moves (Zatsiorky & Kraemer, 2009).

The performance over short distances is largely dependent on the muscle contraction to undertake the swimmers' external load. There are also other factors that contribute to the final result of the competition as well as the technique, the speed and the stroke length, the contribution of the legs, the swimming age and maturity, the biography of the training swimmers and the swimming disciplines (Yeater et al., 1981).

The aim of this study is to determine the size of the impact, force expressed with tethered swimming in the breaststroke techniques, with hands, legs and the coordination of the swimming speed at 50m breaststroke.

METHOD

The sample for this study consisted of 20 active male swimmers of the swimming club "Nis 2005" and the swimming club "Sveti Nikola" from Nis, age 16-18. The achieved result at 50m breaststroke in an Olympic size pool ranged from 600 to 700 FINA points.

To assess the basic characteristics of the pulling force in this study, we used the tethered swimming method with the maximal intensity of 30 seconds breaststroke, hands, legs and coordination. The dependable variable was the achieved time at 50m breaststroke in an Olympic size pool, which took place before the test which involved all swimmers. A set of predictor variables accounted for the following battery of tests:

1. (rFmax)-, Maximal pulling force value achieved by tethered swimming , only by hands (N\s),
2. (rFmean)-Medium pulling force value (difference between max. and min. value) achieved by tethered swimming only by hands (N\s),
3. (nFmax)-Maximal pulling force value achieved by tethered swimming only by legs (N\s),
4. (nFmean)-medium pulling force value (difference between max. and min. value) achieved by tethered swimming only by legs (N\s),
5. (kFmax)- Maximal pulling force value achieved by tethered swimming by coordination (N\s),
6. (kFmean)- Medium pulling force value (difference between max. and min. value) achieved by tethered swimming by coordination (N\s).

The relative pulling force values are covered with the same procedure.

To assess the ability of the tethered swimming (Dopsaj et al., 2003) the Japanese digital force meter IMADA Z2H-1100 with the program Win Wedge 3.4. has been used.

To get to certain conclusions, all the obtained data were statistically analysed in the program „STATISTICA 17''.

To determinate the influence of strength (predictor variables) on swimming speed results at 50m classic-breaststroke (criteria variable) we have used the regressive analysis. At the same time we have calculated: the multiple correlation coefficient (R), the determination coefficient (R Square), the significance level (p). For each predictor variable we have calculated: the partial regression coefficient (BETA) and his significance (p), the correlation

coefficient (R) and the partial correlation coefficient (Part-R).

RESULTS AND DISCUSSION

TABLE 1 The regressive analysis for the 50m breaststroke (the absolute force values variables' influence on the 50m swim breaststroke results)

varijable	R	Part-R	Beta	t(13)	p
nFmax	0.632453	0.526714	8.72114	2.23412	**0.04**
nFmean	0.657301	-0.515723	-8.16901	-2.17036	**0.05**
rFmax	-0.348504	-0.425961	-2.93122	-1.69753	0.11
rFmean	-0.361477	0.213198	1.21909	0.78679	0.44
κFmax	0.471223	-0.902803	-7.51112	-7.56905	**0.00**
κFmean	0.467318	0.923620	8.07914	8.68789	**0.00**

R= 0.98 R^2= 0.96 F(6.13)=56.702 p=0.00

TABLE 2 The regressive analysis for 50m breaststroke (the influence of relative force values on swimming at 50m breaststroke)

varijable	R	Part-R	Beta	t(13)	p
nFmaxRel	0.791628	0.028708	0.12829	0.10355	0.92
nFmeanRel	0.812246	0.239859	0.95548	0.89083	0.39
rFmaxRel	0.097125	-0.377136	-0.59037	-1.46820	0.16
rFmeanRel	0.219747	-0.216133	-0.27798	-0.79814	0.44
κFmaxRel	0.797669	-0.614396	-5.96256	-2.80766	**0.01**
κFmeanRel	0.791236	0.649259	6.14889	3.07788	**0.01**

R= 0.93 R^2= 0.87 F(6.13)=14.284 p=0.00

The results in Table 1 indicate a statistically significant influence of the variables for the evaluation of strength, on the swimming result for 50m breaststroke (p=0.00). This is confirmed also by high values of the multiple correlation coefficient (R=0.98) thereby common variability is explained with 96% (R^2=0.96). Among all tested predictor variables, individually, statistically significant influence on criteria variable have following variables: nFmax (p=0.04), nFmean (p=0.05), kFmax (p=0.00) and kFmean (p=0.05).

The results in Table 2. indicate that there is statistically significant influence of variables for strength evaluation on swimming result for 50m breaststroke (p=0.00). This is confirmed also with a high value of the multiple correlation coefficient (R=0.93), thereby the common variability is explained with 87% (R^2=0.87). Individually, a statistically significant influence on the criteria variable have the following variables: kFmaxRel (p=0.01) and kFmeanRel (p=0.01).

Previous research has shown that the swimming result in the 50m freestyle done by the elite swimmers is most correlated to the values of the impulse forces which a swimmer can achieve with tethered swimming, as for 10 sec, (Dopsaj & Matkovic, 2001), so as for 20sec (Dopsaj et al., 2000).

In the case of swimming, the accomplished work and its cost-effectiveness is directly related to the body mass, also it is directly related to the resistance of the body which goes through water, therefore it is directly related to the length and the area of the body (Chatard et al., 1990; Kolmogorov et al., 2000; Kjendlie et al., 2003), which leads to the relation between the relative coordination values and the observed speed. The swimmer's abilities to achieve and transfer as great a force as he can using hand strokes and kicks while swimming, or as many potential movements per kilogram of body weight, ie. per unit volume, will provide the body an adequate amount of potential energy, which will consequently provide greater speed.

CONCLUSION

Many researchers have shown a direct positive correlation between the forces of an anaerobic work out achieved with tethered swimming as well as the swimming speed achieved by swimming in motion (Rohrs et al., 1990). Our goal was to answer the basic research problem analysing the results of this study, precisely what is the impact of the force expressed by a tethered swimming segmentary, only with hands, legs, and coordination, on the swimming speed at 50m breaststroke.

Based on the results of this research, we can conclude: the greatest impact on the analysed swimming speed at 50m breaststroke have the absolute capacities, achieved through the maximum and the average values of the force kicking by leg and coordination, and the relative maximum and average values of the developed force but only through coordination.

Such results point to the irrelevance of the hands, which of course is not true. It is assumed that the differentiation of the quality parameters of the swimmers is not done based on the potential for achieving force by hand strokes. However, it is still possible to make a conclusion that those swimmers, who are able to convert their separately developed their arm and leg potentials, into the swimming force achieved through the coordination of breaststroke swimming will have better results.

REFERENCE

Barbosa, A. C., Dopsaj, M., Okicic, T., & Andries Junior, O. (2010). The usefulness of the fully tethered swimming of 50m breatstroke performance predicition. *Biomechanics and Medicine in Swimming XI.* Oslo. 47-49.

Bollens, E., Annemans, L., Vaes, W., & Clarys, J.P. (1988). Peripheral EMG comparison between fully tethered and free front crawl swimming. In: Ungerechts BE. Wilke K. Reischle K (Ed). *International series on sports science- Swimming V, 18*, Champaign: Human Kinetics, 173-181.

Chatard, J., Collomp, C., Maglischo, E., Maglischo, C. (1990). Swimming skill and stroking characteristics of front crawl swimmers. *International Journal of Sports Medicine*, 11(2):156-161.

Dopsaj, M., Matković, I., & Zdravković, I. (2000). Povezanost karakteristika sile vuče merene plivanjem u mestu na 50m kod plivača: Novi aspekt merenja. *Facta Universitatis Series: Physical Education and Sport,* 1(7), 15-22.

Dopsaj, M. (2000). Pouzdanost osnovnih mehaničkih karakteristika sile vuče i kinematičkih pokazatelja kraul tehnike merene metodom plivanja u mestu maksimalnim intenzitetom za 10 sekundi. *Fizička kultura*, 1-4(54), 35-45.

Dopsaj, M., Matkovig, I. (2001). Predikcija takmičarskog rezultata na 50m kraul kod plivača delovanjem karakteristika sile vuče realizovane metodom plivanja u mestu: Pilot studija, u "Fizička aktivnost – Teorija i praksa: 01 - Takmičenje", zbornik sažetaka Simpozijuma sa međunarodnim učešćem, Fakultet sporta i fizičkog vaspitanja Univerziteta u Beogradu, Beograd, 12. decembar 2001, str. 5.

Dopsaj, M., Matković, I., Thanopoulos, V., & Okičić, T. (2003). Reliability and validity of basic kinematics and mechanical characteristics of pulling force in swimmers measured by the method of tethered swimming with maximum intensity of 60 seconds. *Facta Universitatis Series: Physical Education and Sport, 1*(10):11-22.

Kolmogorov, S., Lyapin, S., Rumyantseva, O., Vilas-Boas, P. (2000). Technology for decreasing active drag at the maximal swimming velocity, in "Proceedings of XVIII International Symposium of Biomechanics in Sport: Applied Program-Application of biomechanical study in swimming", editet by Youlian Hong & David P. Johns, Dept. of Sports Science & Physical Education, The Chinese University of Hong Kong, p. 39-47.

Kjendlie, P. L., Stallman, R. K., Stray-Gundersen, J. (2003). Swimming economy should be normalised to body length. *Medicine and Science in Sports and Exercise*, 35(5):S24 (Suppl. 1).

Malacko, J., & Rađo, I. (2004). *Tehnologija sporta i sportskog treniniga.* Sarajevo: Fakultet sporta i tjelesnog odgoja.

Morouco, P., Alves, S., Villas –Boas, J. P. & Fernandes, R. (2008). Association between 30sec maximal tethered swimming and swimming performance in front crawl. *Proceeding of the XIII North American Congress on Biomechanics,* Abstract, 380.

Morouco, P., Soares, S., Vilas-Boas, J.P., & Fernandes, R. (2008). Corelation of tethered swimming with swimming performance. *Archivos de medicina Del Porte*, 25 (6).

Okičić, T., Madić, D., & Aleksandrović, M. (2007). *Plivanje - praktikum.* Niš: SIA.

Rohrs, M., Mayhew, J., Arabas, S., Shelton, M. (1990). The relationship between seven anaerobic tests and swim performance. *Journal of Swimming Research*, 6(4):15-19.

Thanopoulos, V., Georgija, R., Dopsaj, M., & Okičić, T. (2010). Relation between pulling tethered swimming force and 100m freestyle results in competitive level swimmers. *Fis komunikacije,* 438-446.

Yeater, R., Martin, B., White, M-K., Gilson, K. H. (1981). Tethered swimming forces in the crawl, breast and back strokes and their relationship to competitive performance, *Journal of Biomechanics, 14*(8):527-537.

Zatsiorky, V. M., & Kraemer, W. J. (2009). *Nauka i praksa u treningu snage*. Beograd: Datastatus.

RELACIJE PLIVANJA U MESTU I BRZINE PLIVANJA NA 50M PRSNIM STILOM

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SAŽETAK

Istraživanje je sprovedeno na uzorku od 20 aktivnih plivača Plivačkog kluba „Niš 2005" i Plivačkog kluba „Sveti Nikola" iz Niša, starosti od 16 do 18 godina, muškog pola. Njihov osnovni stil je *klasično-prsni*. Cilj istraživanja je utvrditi veličinu uticaja sile izražene plivanjem u mestu na brzinu plivanja 50m prsnim stilom. Primenjeno je 12 varijabli prediktorskog skupa i brzina plivanja na 50 metara prsnim stilom kao kriterijumska varijabla. Za utvrđivanje uticaja snage (prediktorske varijable) na rezultate brzine plivanja na 50m klasično-prsnim stilom (kriterijumska varijabla) koristi se regresiona analiza. Dobijeni rezultati ukazuju da postoji uticaj sile ispoljene plivanjem u mestu na brzinu plivanja 50m prsnim stilom.

DATA MODEL OF THE INFORMATION SYSTEM OF A VOLLEYBALL CLUB

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SUMMARY

Introduction: The application of information technology in sport is increasingly present in our country. Sports clubs, which are the basic organizational form of sport in our country, have more and more of its activities related to information technology, especially in the area of communication and business. However, it is obvious that these technologies are rarely used in the sports functions of a club. The main objective of this study was to define a common data model to support the information system of a volleyball club. In addition, we began with the hypothesis that the level of computerization of our volleyball clubs is at a low level.

Methods: The level of computerization in volleyball clubs was estimated using a specially designed questionnaire based on a modified method of the Logical Scoring of Preferences (Dujmovic, 1996). From 112 Volleyball clubs, first and second leagues, the survey included 42 clubs. In the creation of the data model of the information system of a volleyball club we used the methodology of the ''Life cycle''. The realization of the modeling was achieved by applying the structural modeling using the appropriate CASE tools.

Results: The assessment of the level of computerization of our volleyball clubs showed that the overall level of computerization, based on the defined scale assessment: from .25 to .50 low, from .50 to .75 moderate and from .75 to 1.00 high, can be assessed as moderate (.64). Out five defined preferences, the lowest preference has been recorded for *Status and plans* and the *Degree of implementation*. We found a significant difference between the clubs of different degrees of competition, because the clubs at a higher degree of competition showed a significantly higher level of computerization.

Conclusion: The proposed model of the Volleyball Club information system, provides adequate coverage of all of the most important functions of the club, especially since the sports subsystem is the least covered by information technology.

Key Words: volleyball, data, model, information

INTRODUCTION

The application of information technology in sport dates back to the very beginning of the development of computer science as a scientific discipline. The beginnings are tied to sporting events, monitoring and analysis. Given the popularity of the sporting events and their media coverage, it is understandable that information technologies have found their greatest application in precisely the area of the organization of major sporting events like the Olympic Games, World or Regional competitions. From a single and simple application of information technology in the organization of sporting events, today we have comprehensive and integrated solutions based on the latest developments. Today, not one major sporting event can be imagined without the logistical support of information technology in all aspects and functions of these events.

At the level of the sports clubs in our country, to our knowledge, integrated solutions in the form of specially designed information systems have not yet been applied. We applied partial solutions which

covered some club functions, primarily business and marketing functions. Few clubs have actually applied, to a greater extent, information technology in their operations. In this respect the sport segment of the functioning of a club is least covered, where IT cover almost exclusively the analysis of the competitive activities (scouting).

The main objective of this study was to define a common data model to support the information system of a volleyball club. In addition, we began with the hypothesis that the level of computerization of our volleyball clubs is at a low level and the method of collecting information under covers the most important segments of the sport club.

METHODS

The contemporary approach to the design of information systems is based on the use of modeling as a basic method of the process. Modelling must allow the information system to, as objectively as possible, depict the real world, its former and current situation, to enable the prediction of future behavior of the system and to ensure its continued development. In the modeling process the details of a system under study are eliminated and the most important elements and functions of the information system are highlighted. The starting point is its integrated presentation in the form of a contextual diagram that graphically shows the basic activities of the system, its control functions and mechanisms of action, and the main output structures of the system. The decomposition of the system to lower levels with more details is then performed, so that it emphasizes only the most important details for the functioning of the system. The relations of the system elements are defined, their rules and working conditions, so as to consider all the relevant information that occurs in the system. Through the modeling processes and activities of the information system, the defining of a data model that will describe the system and ensure its functioning in the real environment is achieved, especially its dynamic development and function. In this sense, an adequate database is developed, an appropriate system for managing the database is implemented, all in order to support the basic functions of the club.

The level of computerization of volleyball clubs, as a prerequisite for observation of information needs of volleyball clubs, was evaluated using a specially designed questionnaire based on a modified method of Logical assessment preferences (Dujmovic, 1996). Out of 112 Volleyball clubs belonging to the first and second leagues, the survey included 42 clubs, which responded to the survey. The questionnaire comprised of five main indicators consisting of a number of basic criteria in the form of questions (items): *Hardware resources* - to determine the state of the material basis of clubs available in the form of computer equipment (4 items); *Communications* - to assess to what extent and at what level clubs use information resources for the realization of communication (3 items); *Software base* - to determine what applications clubs use in their work (3 items); *Status and plans* - to examine the current state of business automation at the clubs and the existence of plans (2 items); *The degree of application* - to analyze the degree to which the clubs use existing information resources (3 items).

At each elementary criterion a four step scale in the form of a sub-questions set by the intensity of agreement or representation of those characteristics is defined. Elementary criteria are normalized to the values from a defined range of values from .25 to 1.00. The first answer offered in the elementary criteria always received a value of 1 and each following was reduced by .25, and the value received was .75, .50 or .25. The global preference is determined by summing up the individual normalized values of elementary criteria, and the average value by dividing that value with the total number of criteria. The evaluation of the level of computerization of the clubs is determined by the criterion that the level is low if the value of the global preference is lower than .50, it is moderate if it the global preference is in the range of .50 to .75 and it is high if the global preference is greater than .75.

The development of a model of the information system for a volleyball team was done using the

methodology of ''life cycle''. The realization of the production of the data model was actualized by applying structural modeling using the ERWIN CASE tools.

RESULTS

To get a more accurate picture of the progress in the computerization of our volleyball clubs, the global preference of computerization was established, according to the previously described methodology. The global preference value is a positive value in the range from .25 to 1.00. Given that the global preference is basically a composite variable type, we did a test of the normal distribution of these variables using the Kolmogorov-Smirnov test, which showed no statistically significant deviation from the normal distribution (Z=1.01; p=.26).The value of the mean global preference of .64 does not reflect the high level of the computerization of the clubs (Figure 1). According to the previously defined criteria, the achieved level of computerization can be described as moderate.

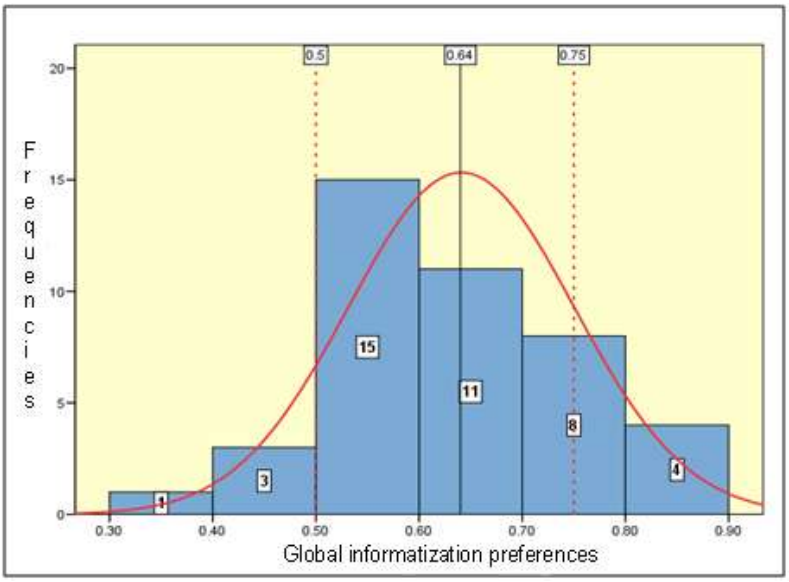

Figure 1 *Distribution of global informatization preferences volleyball clubs*

The analysis of the data on the value of the global informatization preferences for the clubs with different levels of competition (first division .69; secund division .59) showed that, as expected, the value of preferences in the first league clubs is higher. Yet even this value does not exceed the limit of the high level of the computerization score of .75. Only 7 teams, mostly members of the Serbian Superleague, cross the border of the high grade global preferences of computerization. Testing the values of the individual performance assessment for the clubs with different levels of competition, showed that there were statistically significant differences in the degree of implementation of performance evaluation and state and plans at the level of $p<.01$, and in the performance of hardware resources and software basics at the level of assessment of $p<.05$. Only the performance of communications showed no statistically significant differences.

DISCUSSION

The reported results indicate that the achieved level of computerization of volleyball clubs in Serbia is not at the desired level, especially in the field of

planning and the integral development of information resources and the automation of data and information processing. The survey results also showed that in the business functioning of our volleyball clubs the information systems have not been implemented in order to consolidate the flow and processing of information in them. This especially refers to the application of information technology in the sports segment of the functioning of teams.

The analysis of the computerization of volleyball clubs in Serbia was necessary to assess the situation and needs of the clubs in the sphere of information, in order for the data model to be modelled as best as possible and implemented in practice. On the other hand, the lack of implemented models of information systems, required defining a hypothetical model of information system at the level of a volleyball club.

Hypothetical model of information system of a Volleyball Club

A hypothetical model of the information system of a volleyball club is composed of a sports subsystem, a business subsystem and a management subsystem. The graphical representation of the initial information system model of a Volleyball Club (Figure 2), each defined subsystem is represented by an ellipse overlapping (A - Sport, B - Business, F - Administrative), suggesting common functions of these subsystems. All three subsystems individually and the system as a whole, perform intensive communication and information exchange with the environment.

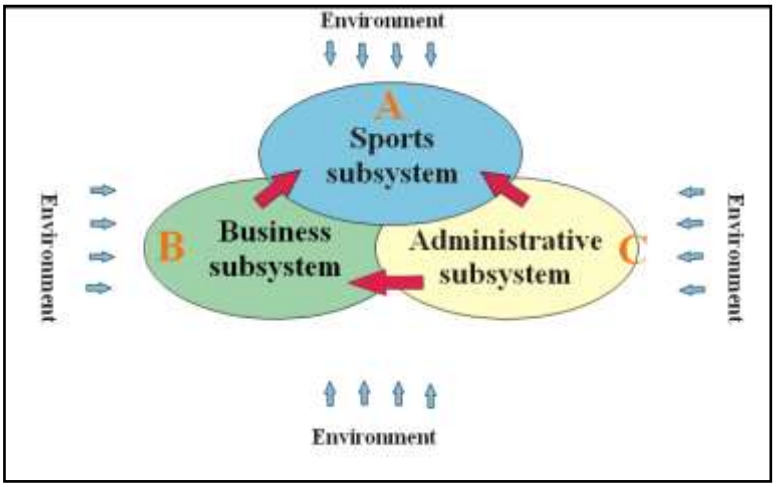

Figure 2 *Hypothetical model of information system of the Volleyball Club*

Between the subsystems a constant dynamic exchange of information in both directions is performed, and each subsystem exchanges information with the outside world. In the diagram of an information system model of a Volleyball Club, the Sports Subsystem has a central position, which includes the basic functions of the club, especially the competition and training activities. The Business and Management subsystems include activities that support the Sports Subsystem. The interaction between these three sub-systems is supposed to provide optimal conditions for the realization of sporting results and a constant exchange of information with the environment and adapting to the IS requirements of that environment. At the heart of the information system of a Volleyball Club are the members of the club who are direct actors of the sports activities which ensure the functioning of the club in its primary segment - competition.

In accordance to the "life cycle" methodology of information systems, this model has been decompossed to its structural elemenst during modeling:

1. *The Sports subsystem* includes basic functions and club activities related to sports facilities. These activities are classified into four main functional areas: the training , competitions , diagnosis and selection .
2. *The Business subsystem* includes all functions and activities related to the business segment of the club. These activities are also classified into 4 areas: management, marketing, finance and public relations .
3. *The Administrative subsystem* includes all the functions and activities of the club for planning work, representation and development in all the areas of the club. In this system we have included three main areas: strategic planning and control, professional and pedagogical account executive and administrative activities.

The presented analysis of the basic organizational segments of the club, through the defined subsystems information system model, served as a basis for further decomposition of the models of the subsystems of the information system.

In accordance with the IDEF0 standard, we started from the top level, by defining the Context Diagram of the model (Figure 3). The context diagram shows the model of the information system in its most general form and includes the input, output and control activities and the mechanisms responsible for the operation of the information system.

The input information compiles all the information as required for the initial operation of the system or, in certain cases, are generated and appear as input values in the system. The mechanisms occur in the system as a person, institution, or other systems or subsystems, which to some extent regulate and control the flow of information in the system. The control activities occur in the system in the form of regulation and legislation, technology, labor, scientific knowledge, and so on. The output information is the core of the functioning of the system and includes the results of the functionin of the system, defined by various documents, achieved states or previosly established processes.

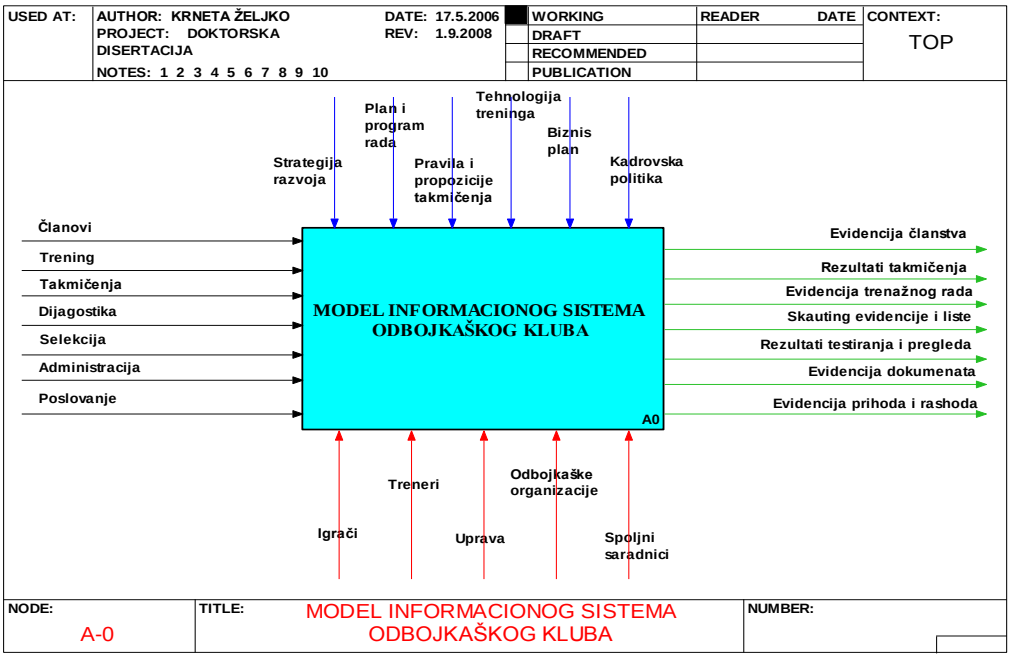

Figure 3 *The context diagram of the structure of information system of theVolleyball Club*

A model of the information system of the Volleyball Club

Based on the previously described activities of functional and information modeling, primarily via the defined diagrams of basic processes and activities carried out in the club, and data flow diagrams, by applying the software tool - Erwin data modeler, the basic scheme of the data model was created. It is also the basis for the construction of an adequate database to support the information system of the volleyball club .

In the data model shown in Figure 4, each table of data represents one of the defined entities of the information system and is represented by the rectangle above which is the table name. Inside the rectangle, a separate section is reserved for displaying the name of the primary key and is indicated in red. In the body of the rectangle, below the primary key, are listed first the name of the transferred-foreign key (foreign key - FK), if it / they too are indigated in red, and then the names of all the columns (attributes) of the table. The relations between the data tables are indicated by dashed lines, as the notation IDEFX1 methodology indicates the non-indentified connections that are formed in the present model.

The referential integrity of the data in the model, is represented by the letters at the beginning and the end of the line that indicates the relationship of the tables of data, or rather with the parent and child entities (tables). Referential integrity is defined for the sake of the insert operations (insertion - I), delete (delete - D) and update (update - U) of data. Referential integrity in its foundation ensures that the data is correctly linkied with the entities in the model (base), connecting according to the properties of the entities and their interdependencies.

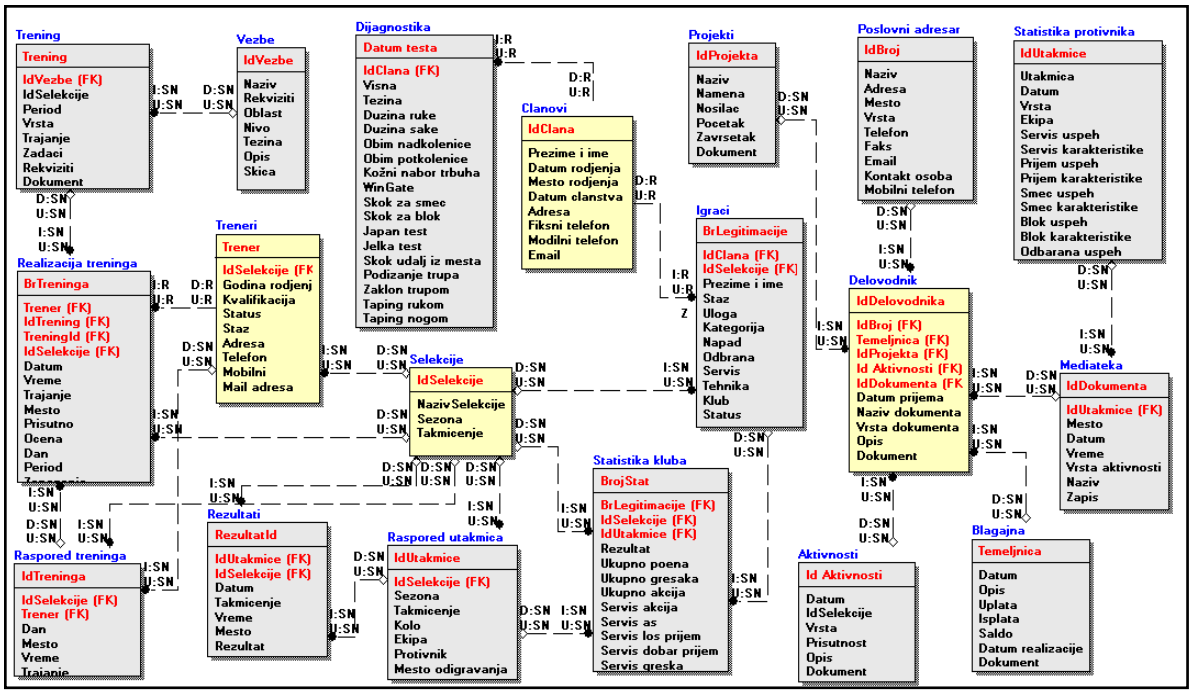

Figure 4 *Scheme of the data model with the basic rules of relationships and connections*

Basic tables (entities) of a defined data model are:

1. *Members* - includes basic and extended information about the members of the club and represents what a basic record of a volleyball team should look like. A primary key (PK) table IdČlana is in fact a unique identification number or social security number, that every citizen receives upon birth. The table "Members" in the data model of a Volleyball Club is a parent table in relation to the child table to "Players" in which the transfer key (FK) is the field IdClana. It is a non-identifying relation to existential dependence, which means that anyone who is not a member of the club could not be registered as a player in the club or that a player must be registered as a member of the club. At the same time not every member of the club has to be an active player in the club, as a person can become a club member on other grounds (board member, honorary member, supporter, etc.). In addition to these basic relations, the table "Members" is as the parent table linked with the Team statistics and Diagnostics, which also transmits IdČlana key (FK), which provides a transfer of data to a set of data related to the diagnostic procedures and monitoring of the statistical parameters of a member's performance. These relations are non-identifying and also have the force of existential dependency of information. On the side is a child table in the tables Diagnostics and Statistics of the club, which means that no instance in these tables can be of value if there is not a corresponding instance in the table Members, or rather that only the members of the club may have their data in these tables. On the other hand, not all members of the club have the data in the tables Diagnostics and Statistics club.
2. *Players* - the primary key field is BrLegitimacije (PK), the number that a player gets when he/she registers for the club with the competent registration authority of the Volleyball Association. This number is unique to the player and is his for the entirety of his time as an active member of the club. Other fields in the table are the data related to the general characteristics of the players (experience, role in a game - specialization, age groups, and the status he has in the club) and the technical and tactical characteristics of his game (offense, defence, serve, technique). This table is still in relation to the table Selections from which it receives its other transfer key, IdSelekcije field (FC). This relationship belongs to the non-identifying relations without the existential dependence, which means that not every player has to be a registered member of a club selection, as is the case with beginners or players who are currently out of opportunities to perform due to an injury or for some other reason. However, all selections are recorded in the table *Teams* and consist of the players who are registered and listed in the Table Players of the data model.
3. *Team statistics* - contains a number of summary statistical parameters covering the monitoring of the effectiveness of the game in basic technical and tactical elements: serve, serve reception, setting, spike, block and field defence, as well as the error log, the results and the number of the points played. The primary key of the table is an array BrojStat (PK) that uniquely defines the recording of the statistics in the table, while the three formed keys are transferred from the table Players the BrLegitimacije field (FC), from the table Selections the IdSelekcije (FC) field and from the Fixtures table IdUtakmice field (FK). Through these transferred keys non-identifying non existential data dependencies are formed of related tables. They allow the integration of the data related to the monitoring of the game efficiency of the teams/selections and individual players in official and other games.
4. *Diagnostics* - in this table the results of the motor tests are recorded, the anthropometric measurements, and some indicators of their functional abilities. A primary key in the table is the *Datum testa* (PK) that contains information about the date of testing or measurement. The table Diagnostics is in relation to the table Members as a child table and, therefore, receives the transmitted key IdClana from this table. The connection is non-identifying with no existential dependence, which means that data can be recorded for the club members only, while not all members of the club need to have the recorded diagnostic data.
5. *Selections* - the primary key field is IdSelekcije (PK), which represents a unique number of the

selection that is registered. In addition to this field, the table *Selections* has only two fields, which are *NazivSelekcije* and *Season*, the latter signifying the season in which the teams compete. This table is defined by its relation to a larger number of tables in the model, especially in the competitive and training segment of the sports subsystem of the information system of a Volleyball Club. In addition to the above mentioned relation with the table Players, this table is in relation with the tables: *Statistics, Match Schedule, Results, Training Schedule, Training realization* and *Trainers.*

6. *Match Schedule* - the primary key is the field *IdUtakmice* (PK) containing a unique identification number of the match. This table has a defined relationship of a non-identifying type without the existential conditions with the table *Selections*, from which it transferres the key field *IdSelecije* (FC). This allows the selection of the records and matches that are not fixed but are formed for a particular event or a particular game. Other fields allow the table to record on things such as the season and type of event, date and place of the game, and the opponent. This relation, along with the relation of the table *Selections* and the *Results tables*, forms the backbone of the records and analyses of the results of all teams competing at the club.

7. *Results* – the primary key is the field *RezultatId* (PK), which is a simple identification number of the results that are recorded. The key *IdUtakmice* from the *Match Schedule* and the key *IdSelekcije* for the *Selections* were transferred to the table *Results*, establishing non-identifying relations of these tables without existential dependence. These relations enable the integration of the data on the competitive performance of some club selection. Other fields in the table cover general information on the game that was played (date, place, time ...) and record the results of the sets and the final result of a match.

8. *Training Schedule* - is a simple table in which the data on when and where the training is held, what time and how long it is, which selection and which coach is stored. The primary key in the table is the field *IdTreninga* (PK), which represents a simple serial number of the training. The transfered keys are the field *IdSelekcije* (FC) from the table *Selections* and the field *Coach* (PK), name of the coach who realizes the training. These two keys are a part of the relation that this table has with the tables *Selections*, *Training Realization* and *Trainers,* which allows the integration of the data on the training activities of individual selections.

9. *Coaches* - contains basic personal and contact details of the coaches who work at the club. The primary key of the table is the field *Coach* (PC), meaning the name of the coach. As a child table this table is in relation to the *Selection* table from which it gets the key field *IdSelekcije* (FC). At the same time this table is in the parent table relation with the tables *Training Schedule* and *Training Realization* to which it transfers the key field *Coach*.

10. *Training Realization* - the primary key is the field *BrTreninga* (PK), which provides the number of the training being realized. This table has rich relations with other tables in the system. It is in realtion with the table *Coaches* from which it receives the key field *Coach* (FK), with the table *Training Schedule* from which it receives the key field *IdTreninga* (FK), with the table *Selections* from which it receives the key field *Selection* (FK) and the table *Training* from which it receives the key field *TreningID* (FK). All of these relations allow for the full integration of the data on distribution, preparation and implementation of the teams in the club.

11. *Training* - The primary key is the field *IdTreninga* (PK) which contains the serial number of the training being recorded. The field *Author* contains the name of the author of the training that has been recorded and it can be a coach (selects the coach), or another expert who prepared the training and released it to public use (the author's name is added). Other fields define more closely the type of training, the group of players with which it would be good to optimally realize the training, the period of preparation, the duration in minutes, the description of the basic goals and objectives and the necessary equipment to realize the training. The last field *Contents* contains the link-path to the digital document of the training. The document can be prepared in a word processor (eg MS Word) program, scanned in PDF format or as an image(BMP) and the like.

12. *Exercises* - the primary key is also a simple identification number contained in the field *IdVezbe*. Other field's details are the name of the exercise, the props required to perform the exercise, the area of sport preparation in which it can be used, the difficulty level of the exercise, the optimal number of players for the exercise, a basic description with indications of the purpose and primary function of the exercises and at the end the field *Document* which contains a link to the digital document containing the draft, a wider description, photograph or video of the exercise that is recorded.

13. *Opponents Statistics* – the primary key is defined by the field *IdUtakmice* (PK), which is a simple identification number of the match being followed. General information about the game is defined by the fields *Match, Date, Type* and *Team*, which determine which game was followed, the date of the match, the type of the match and the name of the team that was followed. The data on the performance of the team being monitored include basic technical and tactical elements of the game (serve, reception of serve, setitng , spike, block and field defence). Data is recorded in two areas, one related to a general assessment of the success of the manifestation of that elements in the game (% success rate, performance evaluation) and, second, which refers to the characteristics of the observed realization of the technical and tactical elements, in the form of descriptive findings and conclusions as to the team as a whole and for individual players who are key facilitators of individual technical and tactical elements of the game. The last two fields, *Attack Direction* and *Combinations*, refer to the recording of the data on the teams' tactical operations in offense, especially the distribution of the ball across the pace and attack zones, the routes of attack and the opportunistic use of the combined attacks.

14. *Mediatheque* – the primary key is the field *IdDokumenta* (PK), which contains the serial number of the document to be recorded. Other fields define the basic information about the document such as the name, place of activity that is in the document, the date, time and description of the event. The field *Record* contains the link-path to the file that is stored on a storage device.

15. *Business Directory* - the primary key of the table is defined as the field *IdBroj* (PK) containing a unique identification number of the subject being recorded. The fields *Name* and *Description* contain the name of the subject and a closer description of its business activities, while the field *Type* groups the businesses by type of activity (clubs, companies, associations, etc...) to make it easier to use the recorded data. Most of the fields *Address, City, Telephone, Fax, Email* and *Web address*, congregate the contact information of a business entity. Data related to the business activity are contained in the fields of Account, Bank, Tax and Registration Number, while the fields Contact Person, MobileOfContPer, PersonAccountable, AccountPerTelephone and AccountPerMobilePhone contain basic information about the persons responsible for the business entity with which it makes contact with the club.

16. *Recordkeeping* - in this table the information about the documents that are created in the club, or coming into the club, are stored. The primary key in the table is the field *IdDelovodnika* (PK), which contains the unique identification number of the document, while in fact it is a text field with a combination of numbers and text characters. We marked this table as a table of special importance as it unites all the information on the documents in the club. Therefore, it has a number of relations with other tables in the model. The first being the relation with the table *Business Directory* of a non-identifying type, from which the key field *IdBroj* (FC) is transferred, which allows the connection of data from these tables one-to-many and integration of data entered.

17. *Checkout* – In the data model it has the of accepting the basic data on financial transactions of the club, both on the outgoing and incoming transactions to the club's bank account. The intention of these records is not performing accounting and bookkeeping tasks for the club, that is left to teh specialized professional organizations, but enabling the monitoring of financial resources and their flow, making specific and periodic financial statements. The primary key in the table is the

field *Journal entry* (PK) of the textual type, which contains a unique number. This field is transferred as a key to the table *Recordkeeping*. In addition to this field there are fields that detail the transaction such as *Date, Name* and *Description*, when it was performed, who is responsible for the transaction and a short description of the transaction. The following three fields determine the amount of dinars to be paid or received, and the account to which the transaction type belongs. At the end of the field *Document* the possibility for a link to a document that is related to the transaction is added (invoice, list, receipts, etc.).

18. *Projects* – is yet another in a series of tables that support the business and administrative functions of the club. This table is intended as a basis for recording all activities that concern the marketing team of the club, both internal projects within the club, and those that are implemented in collaboration with other actors in the region, through competition or cooperation with the sponsors of the club. The primary key of the table is the field *IdProjekta* (PK) that contains a unique identification number of the project. Other fields detail are the name of the project, its purpose, who is responsible for the project, when it starts and when it ends and a link to a digital document that contains details about the project.
19. *Activity* - it is intended to record all those activities that do not already belong to one of the existing forms (competition, training, projects, financial transactions, etc..). In this table, the primary key is also defined as a text field that contains the number of the activities contained in the field *IdAktivnosti* (PK). Other fields further define who is responsible for the activities, when they are realized, how many people participated, a wider description of the activities and a link to an associated digital document, if any. This table is in relation to the tables Members, Business Directory and Recordkeeping, thus achieving the integration of the data related to holders and realizers, and their recording in a single register.

CONCLUSION

The proposed model of the information system of a Volleyball Club, provides adequate coverage of all the most important functions in the club, especially in the sports subsystem as it is the least covered by information technology. He has served as the basis for the construction of an adequate database and applications to work with the stored data. It is a relational database that provides data integrity, all the necessary tools to manipulate data (input, search, update, delete, etc..) and most importantly, connection of all the relevant data that are generated in a volleyball club into one integrated whole. Undoubtedly, the proposed model is only one of the possible solutions, given the diversity of the needs and requirements that, in practice, volleyball clubs have. However, it can serve as a good base for a further elaboration of the elements of the system in all its segments.

REFERENCES

Veljović, V.A. (2003). *Projektovanje informacionih sistema – U praksi.* Čačak: Kompjuter biblioteka.

Dujmović, J.J. (1996). A Method for Evaluation and Selection of Complex Hardware and Software Systems. *The 22nd International Conference for the Resource Management and Performance Evaluation of Enterprise Computing Systems*. CMG 96 Proceedings, 368-378.

Kerschberg, L. & Weishar, J.D. (2000). Conceptual models and architectures for advanced information systems. *Applied Intelligence*, 13, 149-164.

Keng, S. & Rossi, M. (1998). Evaluation of information modeling methods-a review. *System Sciences*, 5, 314-322.

Krneta,Ž. (2010). *Metodologija razvoja informacionog sistema odbojkaškog kluba (doktorska disertacija)*. Novi Sad: Fakultet sporta i fizičkog vaspitanja.

Rogers, E.M. (2000). Informatization, globalization, and privatization in the new millennium. *The Asian Journal of Communication*, 10 (2), 71-92.

MODEL PODATAKA INFORMACIONOG SISTEMA ODBOJKAŠKOG KLUBA

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SAŽETAK

Uvod: Primena informacionih tehnologija u sportu je sve više zastupljena u našoj zemlji. Sportski klubovi, koji su osnovni organizacioni oblik sporta kod nas, sve više svoje aktivnosti vezuju za informacione tehnologije, posebno u segmentu komunikacija i poslovanja. Međutim, evidentno je da se ove tehnologije malo koriste u sportskim funkcijama kluba. Osnovni cilj ovog rada je bio da se definiše jedan opšti model podataka kao podrška informacionom sistemu sportskog kluba. Pri tome, pošli smo od hipoteze da je nivo informatizacije naših odbojkaških klubova na niskom nivou.

Metode: Nivo informatizacije odbojkaških klubova procenjen je primenom posebno konstruisanog upitnika na osnovu modifikovane metode Logičkog proračuna preference (Dujmović, 1996). Od 112 odbojkaških klubova prvih i drugih liga, anketom je obuhvaćeno 42 kluba. U samoj izradi modela podataka informacionog sistema odbojkaškog kluba korišćena je metodologija ''Životnog ciklusa''. Realizacija izrade modela ostvarena je primenom strukturnog modeliranja uz korišćenje odgovarajućeg CASE alata.

Rezultati: Procena nivoa informatizacije naših odbojkaških klubova pokazala je da se opšti nivo informatizacije, na osnovu definisane skale procene: od 0,25-0,50 nizak; od 0,50-0,75 umeran i od 0,75-1,00 visok, može oceniti kao umeren (0,64). Od pet definisanih preferenci, najniži nivo preference je zabeležen za *Stanje i planovi i Stepen primene*. Konstatovana je i statistički značajna razlika između klubova različitog stepena takmičenja, jer su klubovi višeg stepena takmičenja pokazali značajno viši nivo informatizacije.

Zaključak: Predloženi model podataka informacionog sistema odbojkaškog kluba, obezbeđuje adekvatnu pokrivenost svih najvažnijih funkcija kluba, posebno sportskog podsistema koji je najslabije pokriven informacionim tehnologijama.

Ključne reči: odbojka, podaci, informacije,model

AN ANALYSIS OF THE SCORING TECHNIQUES IN THE FUNCTION OF THE SCORE OF THE FENCERS' MATCHES AT THE 25TH UNIVERSIADE IN BELGRADE 2009.

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UDC 796.86

SUMMARY

Introduction: The aim of the study was to determine the differences of scoring techniques between the winners and the defeated fencers in epee at 25th Universiade in Belgrade 2009.

Methods: The sample consisted of the 32 best fencers whose scoring techniques were analyzed in 31 bouts. The measurement range was defined by 11 variables which were represented through the modality of scoring techniques.

Results: The results of the T-test showed that the three techniques had statistically significant difference in favor of the winners and that was the technique of lounge, $P<0.008$, technique of fleche, $P<0.042$, and technique of direct strike, $P<0.046$.

Conclusion: Given results can be useful for coaches during the planning of technical and tactical preparation, but it would be necessary to conduct a research on a larger sample to verify those results.

Key Words: fencing, scoring techniques, university games, epee

INTRODUCTION

A competitive activity in various sports is determined by the nature of those sports. Simpler sports, which are called monostructural cyclic and monostructural acyclic, are much easier for studying in terms of the competitive activity. Polystructural and complex events are considerably more complex. Martial arts have a special place (Jovanovic et al., 2009), fencing being one of them. Fencing as a sport, characterized by a varying intensity, changes of pace and rhythm of the bout, changes the level of the neuromuscular stress, bouts of active and passive phases, dynamic changes in the athletes, his environment and in his opponent (the use of different techniques, changing tactics, fatigue), etc. (Czajkowski, 2005; Barth & Beck, 2007; Milic et al., 2013). The aim of this study was to determine whether there are certain differences in the prevalence of scoring techniques between the winners and losers in the epee fencers at the 25th Universiade held in Belgrade 2009.

METHOD

The sample consists of 32 top-ranked fencers whose scoring techniques are analyzed in 31 bouts. Measuring range is defined on the basis of 11 variables which are represented through the process of scoring techniques, including: KNA - a step forward; KNZ - step back; SKNA - jump step forward; SKNZ - jump step back; ISP - lounge; KISP - step lounge; FLS - flash; BDIR - point directly; BIND - point indirectly; VEZ - binding; PR - parade riposta (defense-counterattack). Data collection was conducted by monitoring video material from the

contest, with the help of Kinovea software. Since there is no effect on the studied phenomenon, but the results are examined in real conditions, this study has the characteristics of an "ex post facto" research. The data processing was applied by a descriptive statistical analysis, while the verification of the significance of the differences of the means was applied by a t-test.

- The arithmetic mean (Mean) of the performed scoring techniques;
- The average deviation of the empirical values of the mean (SD);
- The coefficient of variation (CV);
- Minimum number of the performed scoring techniques (Min);
- Maximum number of the performed scoring techniques (Max).

RESULTS AND DISCUSSION

Tables 1. and 2. show the following descriptive data:

TABLE 1 Descriptive indicators of the winner

	Mean	*SD*	*cV%*	*Min*	*Max*
KNA	2.10	1.51	72.23	1	7
KNZ	2.88	1.93	66.74	1	7
SKNA	1.31	0.48	36.47	1	2
SKNZ	1.88	1.05	55.98	1	4
ISP	4.19	2.15	51.39	1	8
KISP	1.90	0.91	48.00	1	4
FLS	3.81	2.54	66.65	1	11
BDIR	8.45	3.17	37.52	2	13
BIND	3.24	2.29	70.76	1	9
VEZ	2.18	1.13	51.97	1	4
PR	2.64	1.82	69.05	1	8

TABLE 2 Descriptive indicators of defeated

	Mean	*SD*	*cV%*	*Min*	*Max*
KNA	2.20	1.15	52.49	1	5
KNZ	2.71	1.71	62.89	1	7
SKNA	1.60	0.84	52.70	1	3
SKNZ	2.15	1.95	90.60	1	8
ISP	2.79	1.50	53.83	1	6
KISP	2.35	1.80	76.53	1	7
FLS	2.47	1.60	64.77	1	7
BDIR	6.90	2.74	39.78	1	14
BIND	3.00	1.50	49.89	1	7
VEZ	1.89	0.93	49.13	1	4
PR	1.95	1.17	60.08	1	4

To determine the statistically significant differences between the winner and defeated a t-test was conducted. The T-test results are shown in Table 3.

TABLE 3 Results of the T-test

	Mean Winner	*Mean Defeated*	*Difference (%)*	*t-test*
KNA	2.10	2.20	-4.54	P < 0.796
KNZ	2.88	2.71	5.90	P < 0.750
SKNA	1.31	1.60	-18.13	P < 0.344
SKNZ	1.88	2.15	-12.56	P < 0.656
ISP	4.19	2.79	33.41	P < 0.008
KISP	1.90	2.35	-19.15	P < 0.360
FLS	3.81	2.47	35.17	P < 0.042
BDIR	8.45	6.90	18.34	P < 0.046
BIND	3.24	3.00	7.41	P < 0.643
VEZ	2.18	1.89	13.30	P < 0.495
PR	2.64	1.95	26.14	P < 0.129

After reviewing the results of the t-test, statistically significant differences at a significance level of p <0.05 were determined at variables ISP, P <0.008, FLS, P <0.042 and BDIR, P <0.046. This leads to the conclusion that the winners mostly used lounge, flash and direct hit Also, as an attachment result of the t-test, there was a numerical comparison of the arithmetic means of the analyzed variables of both groups, which is expressed as a percentage. It is interesting that in numerical terms the differences are significant regarding these variables, especially for those variables with determined statistically significant differences. The minus sign in some variables indicates a higher number of the performance of the scoring techniques of the defeated combatants. Based on that, we can only assume that the defeated contestants scored in larger percentage from the technique step lounge, jump forward, jump backward and step forward, because in that case these variables did not demonstrate significant differences.

Previous studies (Milic et al., 2013) show at least similar findings, where the same techniques were distinguished by frequency, and on that occasion a comparative statistics was not performed; instead of that, the values were expressed only numerically and in percentage. For this reason, this study has its own significance as it demonstrates statistically significant difference in the use of some scoring techniques between the winners and defeated.

CONCLUSION

After the research of differences of scoring techniques between the winner and defeated, out of 11 tested variables 7 variables showed a numerical difference in favor of the winner, of which the variables of the ISP, FLS and BDIR showed also a statistically significant difference. On the other hand, in 4 variables a numerical but not statistically significant difference in favor of the defeated was present, which can only indicate the potential for a greater use of these techniques by the defeated competitors. Finally, we conclude that the results obtained may be useful for coaches especially during the planning of technical and tactical preparation of their fencers, but in any case for further confirmation of the results it is desirable to conduct the research on a larger sample.

REFERENCE

1. Barth, B. & Beck, E. (2007) *The Complete Guide to Fencing*. Oxford: Meyer & Meyer Sport (UK) Ltd.

2. Czajkowski, Z. (2005) *Understanding Fencing*. New York: SKA Swordplay Books.

3. Jovanovic, S., Koprivica, V., Cirkovic, Z., Koropanovski, N. (2009) The theoretical approach to the study of model characteristics of competitive activity in the martial arts. Proceedings - International Conference - Theoretical, methodological and methodical aspects of sports

training and competition (p. 180-184). Belgrade: Faculty of sport and physical education

4. Milic, M., Jovanovic, S., Kasum, G. (2013) Analysis of fencer competition activities in the discipline epee on 25th Universities games in Belgrade. *Yearbook 18* (p. 83-96). Belgrade: Faculty of sport and physical education.

ANALIZA ZASTUPLJENOSTI POENTIRAJUĆIH TEHNIKA U FUNKCIJI REZULTATSKIH ISHODA BORBI MAČEVALACA NA 25. UNIVERZIJADI U BEOGRADU 2009.

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SAŽETAK

Uvod: Cilj ovog istraživanja je da se utvrdi da li postoje razlike u zastupljenosti poentirajućih tehnika između pobednika i poraženih mačevalaca u disciplini mač na 25. Univerzijadi održanoj u Beogradu 2009.

Metode: Uzorak ispitanika su predstavljala 32 najbolje plasirana mačevalaca čije su poentirajuće tehnike analizirane u 31 borbi. Merni opseg je definisan na osnovu 11 varijabli koje su predstavljene kroz modalitete poentirajućih tehnika.

Rezultati: Rezultati T-testa su pokazali da su sve tri tehnike izdvojile po statistički značajnoj razlici u korist pobednika, i to tehnika ispad, $P<0.008$, tehnika fleš, $P<0.042$ i tehnika bod direktno, $P<0.046$.

Zaključak: Dobijeni rezultati mogu biti korisni trenerima u toku planiranja tehničko-taktičke pripreme mačevalaca, ali bi za potvrdu dobijenih rezultata bilo poželjno sprovesti istraživanje na većem uzorku ispitanika.

Ključne reči: mačevanje, poentirajuće tehnike, univerzijada, disciplina mač

THE TECHNICAL AND THE TACTICAL CHARACTERISTICS OF THE 400 M HURDLE RUNNING

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SUMMARY

Introduction: The 400 m hurdle running is one of the most difficult in technical and tactical aspect discipline in the track and field program. One of the main problems in the training process and in the competition is the synchronization between the tactical and the technical aspect of the discipline.

Methods: Due to the problems of the influence of the different aspects of the discipline 400 m hurdle running we tried to make a model of technical and tactical characteristics.

Results: The tactics in sports is special knowledge and skills aimed at solving big number of tasks, analysis, information and taking decisions for optimizing the composition and the structure of the basic competitive exercise. In our case the tactics are related with the sport results in the 400 meters hurdle running. The technique in the 400 m hurdle running is also specific. For more detailed view we split the distance to separate parts: start and start acceleration, running on the distance, clearing the hurdles and finishing. The indexes of the hurdle running technique are used to determine the efficiency of the running and achieving sport results. We used special tables to show the basic indexes of clearing the hurdles in 13 and 15 stride running rhythm. Also we use time splits to control the speed and rhythm during the running in the competition distance. Indexes are also used for determining the level of technical excellence.

Conclusion: After analyzing all the data and summarize all specialized literature we concluded that the best way to control the technical excellence of the 400 hurdler is the comparing the time between the 400 m hurdle running and 400 m without hurdles

Key Words: 400 m hurdles, technical and tactical characteristics

INTRODUCTION

The 400 m hurdle running is one of the most difficult disciplines, in the technical and tactical aspects, in the track and field program. One of the main problems in the training and competition processes is the synchronization between the tactical and the technical aspects of the discipline.

In the sports theory the definition of the "sport tactics" is interpreted in different ways. It is connected with the complexity of examining this problem. In tactics, the exactly measured results are absent. The indexes of the tactical actions cannot be measured in seconds, meters or kilograms. Many actions are hidden to the external perception or evaluation.

For a long period of time the tactics were defined as an art for conducting a sport contest. This includes: a wide circle of knowledge, skills and analyzed information, taking decisions, the level of motor abilities revealing and also the level of

functional training. Also we can say that it is ability for distributing motor potential during the competition and the control of movements, their correction and having and influence on your opponent. In different sports the tactics is widely interpreted.

The main aim of the tactics is to reach a good result in sports. The resources for achieving this are displayed in all the aspects of the athlete training. This includes the behavior of the athletes (incl. even the warm up before competition) – the ability of psychical influence and the ability to distribute one's own resources.

For us, the sport tactics is a system of special abilities and knowledge aimed at solving a sum of tasks and the analysis of information, taking decisions, all aimed at optimizing the structure of the basic competition exercises in different situations during the interaction with the opponent.

The technique in the 400 meters hurdle running has its own specifics. For a detailed examination of its structure we divide it in phases: start, start acceleration, running on distance with clearing hurdles, and finishing.

The distance of the 400 meters with hurdles is overcome with a high velocity (around 92 – 96% from the speed of overcoming 400 m without hurdles).

The technique for clearing the hurdles in the 400 m hurdle running has its basic specifics but it does not differ greatly from the technique of clearing the hurdles in the shorter hurdle sprint disciplines.

METHODS

Due to the problems of the influence of the different aspects of the discipline 400 m hurdle running we tried to make a model of the technical and tactical characteristics.

RESULTS

Start and start acceleration: Many specialists believe that the start in the 400 m hurdle race does not differ greatly from the start in the 400 meters. The same is only the starting posture, but after leaving the starting blocks the athlete must make the exact count of the running strides towards the first hurdle.

The distance between the start line and the first hurdle is 45 meters and the elite hurdlers cover this distance in 20 – 22 running strides. The hurdlers with a lower qualification cover it in 23 – 24 running strides.

The length of the strides changes depending on its number. In 20 running strides to the first hurdle the stride length must be around 225 cm, in 21 running strides – around 219 cm, in 22 running strides – around 202 cm, in 23 running strides – around 195 cm, in 24 running strides – around 185 cm. In the example given the stride length change in 21 running strides is as follows: 60 cm, 120 cm, 135 cm, 150 cm, 165 cm, 180 cm, 195 cm, 210 cm, 222 cm, 218 cm. When an athlete shows a good distribution of the running strides he must reach the optimal stride length around the 10th – 11th stride.

The height of the 400 m hurdles gives the opportunity to change insignificantly the structure of a hurdle stride. This is due to the low incline of the body and a wide amplitude movement of legs.

Thrust back phase and clearing the hurdles: The foot posture during the thrust back is on its outside part a little in from the center of the body mass. After that, the foot touches the ground completely. There are no distinctive differences from the 110 m hurdle running. The hurdler leaves the vertical with a slight bend in the knee leg and raises the trail leg, slightly bended in the knee joint. The passing of the hurdle by the trail leg starts after the center of the body mass passes over the point of support and ends in the moment of taking up the trail leg in front of the athlete.

The end of the trust back phase coincides with the increase of the body lean, the movement of the opposite hand in a forward direction and the begging of the active extend of the trail leg.

The four hundred meters hurdlers swing their trail leg with greater amplitude and start its allocation towards the support after the passing of

the back surface of the thigh. With this starts the significant raise of the trail leg. Its fast movement is accompanied by the movement of the opposing hand backwards.

Landing: The trail leg during the hurdle clearance is relaxed (that is why in the first phase of landing it is bended in the knee joint). That is why the foot is ready for the active support phase. The athlete land around 125 – 145 cm after the hurdle but significant amortization in the knee joint. The movement of the hands is in a forward – backward direction with the active movement of the trail leg. This way it is easier for the hurdler to continue running after clearing the hurdle. A good hurdle clearance technique is characterized by a quick flight phase and also a fast support phase after clearing the hurdle.

Running between the hurdles: The hurdlers running on the 13 strides between the hurdles have a longer support and flight phase compared to the athletes running on the 15 stride rhythm between the hurdles. This is due to the fact that most of the competitors artificially shorten their stride length to take the distance between the hurdles in the first half of the distance (in 15 strides).

It is important to note that no matter what the stride rhythm is between the hurdles, the support phase during the push back exceeds the landing support phase. The main index is the flight time during the hurdle clearance.

The running rhythm between the hurdles many times depends on the eye correction by the athlete during running. The eye correction of the running rhythm changes with a different stride rhythm. The experienced athletes often change the running rhythm between the hurdles (mostly in the second half of the distance).

When running in the 15 stride rhythm in the first half of the 400 meters hurdle distance (first 5 or 6 hurdles) the athletes try not to make big changes (they shorten the thrust back place). In the beginning of the second half of the distance the athlete increases the trust back power, and in the end of the running distance uses the maximal abilities of his muscles.

Finishing: The last part of the competition distance (around 40 meters – 1/10th of the total distance) is overcome with the full muscle mobilization with acceleration similar to sprint running. Usually this distance is covered in 15 – 17 running strides (men) and 17 – 20 running strides (women).

The time schedule for clearing the hurdles in the 400 meters hurdle running for the hurdlers with different qualifications is shown in tables 1 and 2.

TABLE 1 Time schedule for 400 m hurdle running – men.

hurdles										10^{th} h - final	result
1	2	3	4	5	6	7	8	9	10		
5,9	9,7	13,5	17,4	21,3	25,3	29,5	33,8	38,2	42,7	5,3	48,0-48,5
6,0	9,9	13,8	17,7	21,7	25,8	30,1	34,5	39,1	43,6	5,4	49,0-49,5
6,0	10,0	14,0	18,1	22,2	26,4	30,8	35,3	39,9	44,5	5,5	50,0-50,5
6,1	10,2	14,3	18,5	22,7	27,0	31,4	35,9	40,6	45,9	5,6	51,02,0

TABLE 2 Time schedule for 400 m hurdle running – women.

hurdles										10^{th} h - final	result
1	2	3	4	5	6	7	8	9	10		
6,8	11,2	15,6	20,0	24,4	29,0	33,7	38,5	43,3	48,2	6,3	54,0—55,0
7,0	11,5	16,0	20,6	25,4	30,2	35,1	40,0	45,0	50,0	6,5	56,0—57,0
7,9	11,7	16,4	21,1	25,9	30,8	35,9	41,1	46,2	51,8	6,7	58,0-59,0

The indexes of the hurdle running technique are used for defining the efficiency of the athlete's actions when reaching a certain result. We must keep in mind that the technique in the hurdle running includes not only the structure – the technical excellence of the sport action as a whole but also the factors and the characteristics which take part in the control and regulation of the technical actions of the hurdlers achieving high results. In table 3 we show the basic technic indexes for clearing the hurdle in different distances.

TABLE 3 Technique indexes in the hurdle running.

indexes	distance (m)			
	100 (n=24)	110 (n=27)	400* (women n=16)	400** (men. n=28)
1. distance from take away place to hurdle (cm)	205,9	209,9	200,7	225
2. distance from hurdle to landing place (cm)	103,5	145,2	115,2	141,1
3. the highest place of CBM during clearing the hurdle (cm)	120,9	134,6	106,1	116,4
4. distance between CBM and hurdle (cm)	37,1	13,9	30,2	38,2
5. angle of body incline during the hurdle attack (degrees)	68,9	69,9	66,6	65,5
6. angle of body incline when body is over the hurdle (degrees)	40,1	41,9	30	32
7. angle of body incline during landing (degrees)	23,6	27	22,7	24,4
note: * - parameters for 15 running strides rhythm between the hurdles; ** - parameters for 13 running strides rhythm between the hurdles;				

The integral evaluation of the technique effectiveness is the difference between the 400 m hurdle running and the 400 meters. In table 4 we see the level of the technique (the level of the hurdle clearing technique and the running rhythm between the hurdles) for the 400 m hurdlers.

TABLE 4 Technical skills of hurdlers - evaluation.

distance (m)	result 400 m hurdles	result 400 m	hurdler technique
400 m men	53,0	49,5	3,5
	54,0	50,0	4,0
	55,0	50,5	4,5
	56,0	51,2	4,8
400 m women	48,0	45,5	2,5
	50,0	47,0	3,0
	52,0	48,0	4,0
	54,0	49,5	4,5

CONCLUSION

1. The hurdle running is one of the most complex disciplines in the track and field program – especially when we speak about coordination. Together with the high velocity abilities, the athletes need a high level of technical preparation for which they need good coordination of movement, flexibility and joint mobility.

2. A contemporary technique gives the athletes an opportunity to use the high running velocity between the hurdles and during their clearance.

3. Even small mistakes during the hurdle clearing may lead to the time lost. That is why the hurdlers must keep the time lost at a minimum, in all the movements.

REFERENCES

Gutev, G., 400 meters hurdle running men – status and trends in development, 19th International Congress of Physical Education and Sport, Komotini 20 – 22 May 2011, (organized by the Democritus University of Thrace – Department of Physical Education and Sport Science, Greece), Komotini, 2011, (page 163).

Gutev, G., Study on the sport result factors in the discipline 110 m hurdle running, Track and Field and Science, Sofia, 2010;

Karapetrova, R., Dissertation, 2011, National Sports Academy "Vasil Levski", Sofia, Bulgaria;

A CANONICAL CORRELATION ANALYSIS OF THE MORPHOLOGICAL CHARACTERISTICS AND TECHNICAL-TACTICAL SKILLS OF HANDBALL PLAYERS COMPETING AT VARIOUS LEVELS

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SUMMARY

Introduction: Bearing in mind that on the court a handball player has to solve numerous problematic situations which require evaluation, prediction and reactions to the constant changes in the situations, it is assumed that the analysis of the relations between the individual abilities and the characteristics of the handball players can be one of the more important indicators of their anthropological status and integrated functioning. The aim of the current research is to determine the statistically significant relations between the system of variables of the motor characteristics and technical-tactical skills of the selected sample, in order to determine the influence and control of the transformation process of the relevant anthropological characteristics.

The method: A sample of 120 handball players who are the members of the premiere and national handball league of Serbia was included in the study. A system of 27 variables was applied on the sample (24 anthropometric, 3 technical-tactical variables). When calculating the relations, the canonical correlation analysis was used.

Results: In the data processing we identified two statistically significant canonical factors (p=.00, p=.00), among the handball players competing as a higher rank competitors and a statistically significant structure of the canonical factors (p=.00), and among the lower-rank handball players, on the one hand in the system of anthropometric variables, and on the other in the system of technical-tactical variables.

Conclusion: In the general conclusion of this paper it is important to point out that the results have indicated how in the training and competitive process of elite handball players the training content, in the optimum extent, was focused on the development of relevant abilities and characteristics which correlate both with technical abilities and rank on the one hand. On the other hand, among the lower-rank handball players the morphological characteristics do not correlate with the technical-tactical abilities but only with the rank achieved during a competition.

Key Words: handball players, anthropometry, quasi-motor skills, relations

INTRODUCTION

The application of kinesiological knowledge in the sub-fields of sport depends primarily on the current level of kinesiological science and the position it holds as a science in general, and especially its position as a part of the anthropological sciences. There are numerous problems which are the subject matter of kinesiology. Among them the especially numerous and especially significant ones are those that refer to sports practice and the effects of the application of various kinesiological treatments and the improvement of motor skills and morphological features (Bala, 1981; Stanković & Popović, 2009). Motor and pseudo-motor skills and morphological features, as segments of the group of psycho-somatic features of athletes, do not exist independently but

manifest themselves through a complex interaction with other abilities and features (Živanović et al., 2011). The co-variability of different abilities is caused by the activity of various functional structures which are to a greater or smaller extent inter-dependent (Stanković, 2001; Stanković & Malacko (2011). Bearing in mind that the handball player in the field solves numerous problematic situations, which require the evaluation, prediction and reaction to the constantly changing situations, it is assumed that the analysis of the relations between certain skills and characteristics of handball players could be one of the important indicators of their anthropological status and inter-relationship. The aim of the current research was to use a sample of handball players of various ranks to determine the statistically significant relations between the system of variables of morphological features and technical-tactical abilities in order to gain insight into the influence and control of the transformational process of the relevant anthropological characteristics.

METHOD

The sample of participants

A system of 27 variables (24 anthropometric, 3 technical-tactical variables) was used on a sample of 120 handball players (divided into two sub-samples of 60 participants each) which compete in the premiere and national handball league of Serbia.

The sample of measuring instruments

In order to evaluate the morphological features the following variables were used (Stojanović et al., 1975): *longitudinal dimensionality of the skeleton: 1.* body height (VIS), 2. leg length (DNO), 3. hand length (DSA), 4. foot length (DST), 5. arm length (DRU), 6. biacromial range (BIA), *Transversal dimensionality of the skeleton: 7*. Bicristal range (BIK), 8. hand width (SIŠ), 9. wrist diameter (DIR), 10. elbow diameter (DIL), 11. knee diameter (DIK), 12. foot width (SIS), *Circular dimensionality and body mass:* 13. body mass (MASA), 14. upper arm volume (ONA), 15. lower arm volume (OPO), 16. upper leg volume (ONT), 17. lower leg volume (OPT), 18. average thorax volume (OGK), *Subcutaneous fatty tissue:* 19. upper arm skinfold (NNA), 20. back skinfold (NLE), 21. armpit skinfold (NPA), 22. abdominal skinfold (NTR), 23. lower leg skinfold (NPO). In order to evaluate the technical and tactical skills the following variables were used: 1. Variables for the evaluation of handball technique with a ball - TEHNIKA: (handling a ball, receiving a ball, guiding a ball, stepping with a ball, basic throws, the other throws and aims); 2. Variables for the evaluation of game tactics – TAKTIKA: Individual game tactics during the attack phase : exposing, running in, passing the ball, receiving the ball, guiding and dribbling, scoring a goal, feigning); Individual tactics during defense: (rebounds, blocks, tracking, intercepting the ball, blocking, stopping an attack, covering; 3. RANG - the success achieved at the end of the championship.

Statistical data analyses

When calculating the relations between the two groups of variables, the canonical correaltional analysis was used (Popović, 1993; Malacko & Popović 2001).

THE RESULTS

When determining the statistically significant relations, that is, obtaining the maximal connection between the multivariate system of anthropological variables and the system of pseudo-motor variables, the canonical correlation analysis was used with the parameters of the canonical correlation (Rc), determinant coefficient (Rc^2), the Chi-square test (χ^2) and the degree of statistical significance (p). In the data processing, two statistically significant structures of the canonical factors were identified (p=.00, p=.00) among the handball players competing at higher competition ranks and one

statistically significant structure of the canonical factors (p=.00) among the lower-ranked handball players, in the system of anthropometric variables on the one hand and on the other hand, in the system of technical-tactical variables.

Among the handball players playing in the premiere league, using the Bartlett's Chi-square test (χ^2=682,13 and χ^2=84,13), the statistical significance of the canonical correlation coefficient was tested (Rc=1.00 and Rc=.99), which explains the linear combinations between the groups of variables, that is, the connection between two different systems of variables. By solving the characteristic equations of the cross-correlational matrix, we obtained, as the root of the equations, the square (the determinant coefficient) of the canonical correlation (Rc^2 =1.00 and Rc^2 =.99), which explains the common variance of the variables from the two groups in the overall variability of the analyzed system of variables.

In the following step of the data analysis, we identified a statistically significant structure of the canonical factors (p=.00), on the one hand, in the system of anthropometric variables, and on the other hand, in the system of pseudo-motor skills among handball players competing at the national level.

From the results contained in the matrix of the canonical structure of anthropometric and pseudo-motor variables of the handball players from the premiere league (Table 1), we can determine a significant correlation between the anthropometric variables and the first canonical factor. The first isolated canonical factor was defined by relatively high values of the statistically significant canonical correlation coefficients. Considering that the structure of the first isolated canonical factor consists of the variables such as arm length (DRU), elbow diameter (DIL), lower arm volume (OPO), lower leg volume (OPT), it represents a combination of the endomezomorph sports type. The second isolated canonical factor of the anthropometric variables is defined by relatively high values of the upper arm volume (ONA), upper leg volume (ONT) and upper arm skinfolds (NNA). The same table shows the matrix of the structure of the canonical factor of pseudo-motor variables where the first canonical factor is defined by the high values of the competition rank (RANG) and the second one by the individual technique of the handball players (TEHNIKA).

Based on the results contained in the matrix of the canonical structure of anthropometric and pseudo-motor variables of the handball players competing at the national level (Table 2), we can determine a statistically significant correlation between the anthropometric variables and the canonical factor. The isolated canonical factor was defined by the relatively high values of the bicristal range (BIK), the upper arm volume (ONA), back skinfold (NLE), abdominal skinfold (NTR) and lower leg skinfold (NPO) and it represents a combination of the endomezomorph sports type. The same table shows the matrix of the structure of the canonical factors of the pseudo-motor variables where the canonical factor was defined by a high value of the competitive rank (RANG).

TABLE 1 The canonical structure of the anthropometric and pseudo-motor variables of the premiere league handball players

	Rc	Rc^2	χ^2	df	p
1	1.00	1.00	682.13	44	.00
2	0.99	0.99	84.13	21	.00

Legend:

Rc - the canonical correlation

Rc^2 - the canonical correlation square

χ^2 – Bartlett's Chi-square test

p - statistical significance

The canonical factors of the left set

variables	CAN1	CAN2
Vis	-.20	-.04
Dno	-.20	.18
Dsa	.17	.00
Dst	.06	.10
Dru	**.41***	.07
Bia	.18	.17
Bik	.06	.07
Siš	-.01	.11
Dir	-.10	.03
Dil	**.36***	-.04
Dik	-.04	.29
Sis	-.13	.00
masa	-.16	.22
Ona	-.13	**.33***
Opo	**-.44***	-.13
Ont	-,19	**.32***
Opt	**-.57***	-.01
Ogk	.07	.07
Nna	-.20	**.32***
Nle	-.20	.05
Npa	-.22	.04
Ntr	-.03	.23
Npo	.11	.02

The canonical factors of the right set

variables	CAN1	CAN2
technique	-.69	**.70***
tactic	-.61	-.32
rank	**-.77***	.08

Legend:

1. Body height (VIS), 2. Leg length (DNO), 3. Hand length (DSA), 4. Foot length (DST), 5. Arm length (DRU), 6. Biacromial range (BIA), *7.* Bicristal range (BIK), 8. Hand with (SIŠ), 9. Wrist diameter (DIR), 10. Elbow diameter (DIL), 11. Knee diameter (DIK), 12. Foot width (SIS), 13. Body mass (MASA), 14. Upper arm volume (ONA), 15. Lower arm volume (OPO), 16. Upper leg volume (ONT), 17. Lower leg volume (OPT), 18. Average thorax volume (OGK), 19. Upper arm skinfold (NNA), 20. Back skinfold (NLE), 21. Armpit skinfold (NPA), 22. Abdominal skinfold (NTR), 23. Lower leg skinfold (NPO).

TABLE 2 The canonical structure of the anthropometric and pseudo-motor variables of handball players at the national level

	Rc	Rc^2	χ^2	df	P
1	.87	.77	106.02	69	.00

Legend:

Rc – canonical correlation

Rc^2 – canonical correlation square

χ^2 – Bartlett's Chi-square test

p – statistical significance

The canonical factors of the left set

variables	CAN1
Vis	-.11
Dno	-.20
Dsa	.25
Dst	-.01
Dru	.16
Bia	-.27
Bik	**-.39***
Siš	.01
Dir	.01
Dil	-.03
Dik	.06
Sis	-.00
masa	.23
Ona	**.32***
Opo	.13
Ona	.14
Opt	-.07
Ogk	.23
Nna	.26
Nle	**.34***
Npa	.06
Ntr	**.47***
Npo	**.81***

The canonical factors of the right set

variables	CAN1
technique	.26
tactic	.02
rank	**.98***

Legend:

Body height (VIS), 2. Leg length (DNO), 3. Hand length (DSA), 4. Foot length (DST), 5. Arm length (DRU), 6. Biacromial range (BIA), 7. Bicristal range (BIK), 8. Hand with (SIŠ), 9. Wrist diameter (DIR), 10. Elbow diameter (DIL), 11. Knee diameter (DIK), 12. Foot width (SIS), 13. Body mass (MASA), 14. Upper arm volume (ONA), 15. Lower arm volume (OPO), 16. Upper leg volume (ONT), 17. Lower leg volume (OPT), 18. Average thorax volume (OGK), 19. Upper arm skinfold (NNA), 20. Back skinfold (NLE), 21. Armpit skinfold (NPA), 22. Abdominal skinfold (NTR), 23. Lower leg skinfold (NPO).

DISCUSSION

A virtually infinite number of the manifest morphological features makes every attempt at determining the morphological functions exceptionally complex. Even when we overcome the classic typological orientation, which is clearly incompatible with the nature of both manifest and latent morphological variables, the procedures which, with the help of the canonical correlation analysis are aimed at the determination of the functions of the variables, often produce such complex structures that their identification, even though theoretically possible, is linked to the necessity of a simultaneous connection of a large amount of information which belongs to various logical systems. One of the ways to do so is to simplify the problem. That will facilitate the problem of the identification of the variables which define the function. This could prove to be very useful for the analysis of the laws which determine the formation of morphological functions, and thus offer a more reliable insight into their true essence (Malacko & Stanković 2009).

Handball is considered to be a game which requires the athlete to possess motor abilities which are interspersed with longer or shorter pauses, with frequent and sudden changes in the intensity, direction of movement and player position, with a continued performance of jumps during the game, as well as the alternate inclusion of intense anaerobic and aerobic work. Bearing in mind that a handball player on the court puts much effort into solving numerous problematic situations which require the

evaluation, prediction and reaction to constant situation changes, it is assumed that the analysis of the interaction between the anthropometric and pseudo-motor skills could be one of the important indicators of their anthropological status and interrelated functioning (Stanković & Malacko, 2008; Popović-Ilić et al., 2010; Stanković & Popović, 2011).

The relations between the first canonical factor from the system of anthropometric variables, interpreted as the canonical factor of the ectomezomorph sports type, and the first canonical factor from the system of pseudo-motor variables, interpreted as the achieved ranking at the end of the competitive season, show that the ectomezomorph structure of the handball players of the national league has a high correlation with the achieved rank, if there are higher values of arm length and elbow diameter and lower arm volume and lower leg volume with a very small input on the part of the subcutaneous fatty tissue and vice versa.

The relations between the second canonical factor from the system of anthropometric variables, interpreted as the voluminosity of the barachii region and the femoralis region, and the second canonical factor from the system of pseudo-motor variables, interpreted as the technical ability of handball players to handle a ball, indicate that handball players achieve high scores in the structuring of movement, if they have increased values in the aforementioned regions and vice versa. It is clear that the premiere league handball players have as their dominant characteristic the voluminosity of the brachii and femoralis region, which enables the performance of the technical elements such as handing the ball, receiving the ball, guiding the ball, stepping with a ball, basic throws, other throws and aiming at the goal with a greater effectiveness, allowing them to play in the higher competition ranks.

In the case of the national league handball players, the relations between the canonical factor from the system of anthropometric variables, interpreted as the canonical factor of the endomezomorph sports type, and the canonical factor from the system of pseudo-motor variables, interpreted as the achieved rank at the end of the competitive season, indicate that the endomezomorph structure of handball players at the national level has a high correlation with the achieved rank, if the players have a smaller pelvis, increased upper arm volume and the amounts of fatty tissue on the lower leg, abdomen and back. It is evident that success in the lower rank competitions depends much less on the technical and tactical abilities of the handball players and more on their overall mass and voluminosity. There are several reasons for drawing such a conclusion, including selection, chronological age of most athletes in this competitive rank, all the way to the training work done with the players competing at the lower competition levels.

CONCLUSION

All of the research done on the kinesiological transformational processes guides us in the direction of determining the basic laws of the development and maintaining of functions. In this sense it is clear that what we are dealing with is the determination of the laws of the dynamics of complex occurrences which are manifested in the realization of various types of motor movements. Certain morphological features of athletes have a greater connection with success in sport (Stanković, 2001; Behnke & Wilmore, 1974). In a series of studies it has been determined that in sports games, tall athletes, with long arms and legs, have a certain advantage over the shorter athletes, that is, those with shorter extremities. In addition, the athletes with a greater amount of fatty tissue are inferior to those with the same weight, but without this unnecessary burden (Popović, 2005). A great number of studies dealing with the transformation of morphological features indicate their great complexity considering that they are under the influence of both genetic factors (endogenic influence) and environmental factors (exogenic influence), where we should point out that the influence of the genetic factors is not the same for all latent morphological dimensions. The aim of

the current study was to use a sample of handball players to determine whether there were any statistically significant relations between the system of variables of morphological features and that of the technical-tactical abilities in order to take into consideration the influence and control of the transformational process of the relevant anthropological characteristics. On the basis of the obtained results, in the general conclusion we should point out that the results have indicated that during the training and competitive process of elite handball players, the training contents were to an optimal extent focused on the development of relevant abilities and features which correlate both with the technical skills and competitive rank, and on the other hand among the lower ranked handball players the morphological features do not correlate with their technical-tactical abilities but only the rank achieved during competitions. It is evident that skeletal musculature has a decisive influence on success in sport, and is considered the basis for the potential motor skills (Malacko & Doder, 2008).

REFERENCES

Bala, G. (1981). Struktura i razvoj morfoloških i motoričkih dimenzija dece SAP Vojvodine. Novi Sad: Fakultet fizičke kulture.

Behnke, A. & Wilmore, J. H. (1974). Evaluation and regulation of body and composition. Prentice-Hall, Englewood Cliffs.

Malacko, J. & D. Popović (2001). Metodologija kineziološko antropoloških istraživanja. Treće izdanje. Leposavić: Fakultet za fizičku kulturu.

Malacko, J. & Doder, D. (2008). Tehnologija sportskog treninga i oporavka. Novi Sad: Pokrajinski zavod za sport.

Malacko, J. & Stanković, V. (2009). The latent structure of morphological characteristics of top handball, basketball and football players. Sport Science, 2 (1), 111-116.

Popović-Ilić, T., Stanković, V., Vitošević, B. & Ilić, S. (2010). Struktura morfoloških dimenzija vrhunskih sportista. Praxis medica, 38 (3-4), 63-70.

Popović, D. (1993). Programi i potprogrami za analizu kvantitativnih promena. Priština: Fakultet za fizičku kulturu.

Popović, D. & Stanković, V. (2005). Kanonička povezanost motoričkih sposobnosti i efikasnosti izvođenja džudo tehnika. Plenarno izlaganje. 1st International scientific-simposium "The effect and influences of different models of training process to antropholigical status of sportsmen in fighting skills, (pp. 11-18), Pančevo, Srbija.

Stanković, V. (2001). Osnove primenjene kineziologije. Leposavić: Fakultet za fizičku kulturu.

Stanković, V. & Malacko, J. (2008). Relations between systems of motor, cognitive and conative variables of top-class handball players. Kinesiologia Slovenica, 3 (14), 33-43. (M51)

Станковић В. & Поповић М. (2011). Идентификација морфолошких карактеристика повезаних са хоризонталним осовинама рукометаша и фудбалера. Praxis medica, 39 (1-2), 55-58.

Stanković, V. & Malacko, J. (2011). Effect of morphological characteristics and motor abilities on the development of coordination abilities of boys aged 11-12. Acta Kinesiologica, 5 (1), 12-15.

Stojanović, M., Momirović, K., Vukosavljević, R. & Solarić S. (1975). Struktura antropometrijskih dimenzija. Kineziologija, 5 (1–2), 193-205.

Živanović, N., Stanković, V., Pavlović, P. & Stoiljković, N. (2010). Teorija fizičke kulture. Niš: Fakultet sporta i fizičkog vaspitanja.

KANONIČKA KORELACIONA ANALIZA MORFOLOŠKIH KAREKTERISTIKA I TEHNIČKO-TAKTIČKIH SPOSOBNOSTI RUKOMETAŠA RAZLIČITOG RANGA TAKMIČENjA

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SAŽETAK

Uvod: Imajući u vidu da rukometaš na terenu rešava brojne problemske situacije, koje zahtevaju procenjivanje, predviđanje i reagovanje na stalne promene situacije, pretpostavlja se da analiza relacija između pojedinih sposobnosti i karakteristika rukometaša, može da bude jedan od važnih indikatora njihovog antropološkog statusa i međusobnog funkcionisanja. Cilj istraživanja je da se na uzorku rukometaša različitih rangova utvrde statistički značajne relacije između sistema varijabli morfoloških karakteristika i tehničko-taktičkih sposobnosti radi sagledavanja uticaja i kontrolisanja transformacionog procesa relevantnih antropoloških karakteristika.

Metode: Na uzorku 120 rukometaša koji pripadaju I i II rukometnoj ligi Srbije bio je primenjen sistem od 27 varijabli (24 antropometrijske, 3 tehničko-taktičke varijable). Prilikom izračunavanja relacija bila je primenjena kanonička korelaciona analiza.

Rezultati: U obradi podataka identifikovane su dve statistički značajne strukture kanoničkih faktora (p=.00, p=.00), kod rukometaša višeg ranga takmičenja i jedna statistički značajna struktura kanoničkih faktora (p=.00), kod rukometaša nižeg ranga, s jedne strane u sistemu antropomoetrijskih varijabli, a sa druge strane, u sistemu tehničko-taktičkih varijabli.

Zaključak: U generalnom zaključku ovog rada vredno je istaći da su rezultati pokazali kako su u trenažnom i takmičarskom procesu vrhunskih rukometaša trenažni sadržaji u optimalnoj meri bili usmereni na razvoj relevantnih sposobnosti i karakteristika koji koreliraju kako sa tehničkim sposobnostima tako i rangom a sa druge strane kod rukometaša nižeg ranga morfološke karakteristike ne koreliraju sa tehničko-taktičkim sposobnostima već samo sa rangom postignutim u takmičenju.

Ključne reči: rukometaši, antropometrija, kvazimotoričke sposobnosti, relacije

THE TWO METHODS IN LEARNING THE BASIC ELEMENTS OF SKI TECHNIQUE

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SUMMARY

The best method of teaching beginners how to ski on modern skies is a subject of many debates (Hirano & Tada, 1996; Muller et al, 2005; Roder et al, 2005; Federolf, 2005; LeMaster, 2009). The aim of this research was to research which method is better in learning and the development of certain elements of ski technique. Forty male students werethe subjects of this research, divided into two groups. The participants of one group (GPT) were taught by the parallel technique, while the second group (GPSPT) were taught alpine skiing through the parallel and snow-plough techniques. Before the start of a *6-day* ski program, the examinees of the two groups didn't differ in motor abilities and morphological characteristics. Higher grades were obtained by the participants in the group taught by the parallel and snow-plough techniques (GPSPT) after the *6-day* ski program. These results are probably due to the fact that in the snow-plough techniques the beginners better learn basic ski movements. In the snow-plough techniques there are semicircular leg movements, which helped the demonstration of the short and parallel turns.

Key Words: method, parallel and snow-plough techniques, ski beginners

INTRODUCTION

The non-competitive leisure/recreational alpine skiing is often described as a social and pleasurable form of physical activity in an attractive outdoor scenery. More than 100.000 people in Serbia and 100 million around the world participate in alpine skiing. The best method of teaching beginners how to ski on modern skies is a subject of many debates (Hirano & Tada, 1996; Muller et al, 2005; Roder et al, 2005; Federolf, 2005; LeMaster, 2009). Some works have been focused upon comparing the carving and parallel turns (Muller et al, 2005).

Among the experienced practitioners, the skiing technique is referred to in a variety of ways. To a certain extent, different skiing communities use different terms and concepts. In the more systematic accounts, ranging from Joubert's classic Skiing: An Art, a Technique (1978), or LeMaster's A Skier's Edge (1999) to the introductory material such as that of Loland & Haugen (2000), hypotheses are proposed in terms of the basic principles or technical elements of alpine skiing. In Joubert's (1978) terminology, technical elements are the building blocks of a technique. A technical element is operationalized in terms of a series of sub-elements or movement patterns that, if put together in the right way, make up good skiing.

The first and primary element in Joubert's scheme is that of balance. The starting point of a good balance is the so-called neutral position: hip wide distance between the skis to secure a stable supporting base, a slight bending of the knees to be able to absorb the disturbances from an uneven surface, a slightly forward bent upper body and arms stretched outwards and forwards for fine tuning. In the neutral position, the skier is considered to be at the center of agency in skiing with short distances to all the extreme positions whether this implies

forward, backwards, sidewise, upwards or downwards movement.

Alpine skiing is about the efficient control of speed and direction. Such control is achieved in several ways. In the practice communities, references are made to "skidding" (which in most contexts is considered an expression of a problematic or bad technique), to "cutting" or "carving" turns, "getting a grip" on the snow (LeMaster, 1999), or as Joubert (1978) expresses it, to finding support on the surface.

In the learning situations with novice skiers, finding support can be explored with a series of practical exercises. A skier skids down an icy slope, hits a mogul and stops. The support from the surface is direct and concrete, the control over speed is immediate. Alternatively, the skiers skid down a slope with the skis turned across the fall line and are challenged to find support from the surface by using ski edges. Usually, the result is skidding (Loland, 2009).

To an unskilled skier, the moments of instability represent the threats of falling. By an expert, moving in and out of balance is done in controlled, playful manners.

The carving turn, in which the front and the back of the ski follow the same line on the surface with a minimum of skidding, is the technical ideal. The ski moves only forward, and not sideways and with a minimum of energy dissipation. A completely clean carving turn is an ideal. Stable carving requires a constant adaptation and variation of movement (Loland, 2009).

Thus, the aim of this research was to to research which method is better in learning and developing certain elements of ski technique.

METHODS

Forty male students of the Faculty of sport and physical education were the subjects (21.7±2.1 years) of this research, divided into two groups. There were no differences between groups in the morphological characteristics and motor abilities. The subjects were at the beginner's level. The participants of one group (GPT) were taught by the parallel technique, while the second group (GPSPT) were taught alpine skiing through parallel and snow-plough techniques. Ski knowledge was tested by a demonstration of three ski technique elements (uphill turn, short turn and parallel turn) by three indipendent judges, who did not know from which learning group the subject comes. The research was performed during a 6-day program during the practical skiing classes on mountain Kopaonik, Serbia. The ski time was about 3 hours total at the ski tracks „Krst", „Karamen-greben" and „Malo jezero". These tracks are classified as the beginner and intermediate tracks. The subjects skied on a groomed ski terrain. The skies were standardized according to the body size and consisted of 150 cm or 160 cm recreational slalom skis.

RESULTS AND DISCUSION

TABLE & FIGURE 1 Group taught by the parallel technique after a 6-day ski program - (GPT)

	N	Mean	Min	Max	SD
Short turn	20	3.50	2.00	5.00	0.83
Parallel turn	20	3.20	2.00	5.00	1.06
Uphill turn	20	3.30	2.00	5.00	1.03

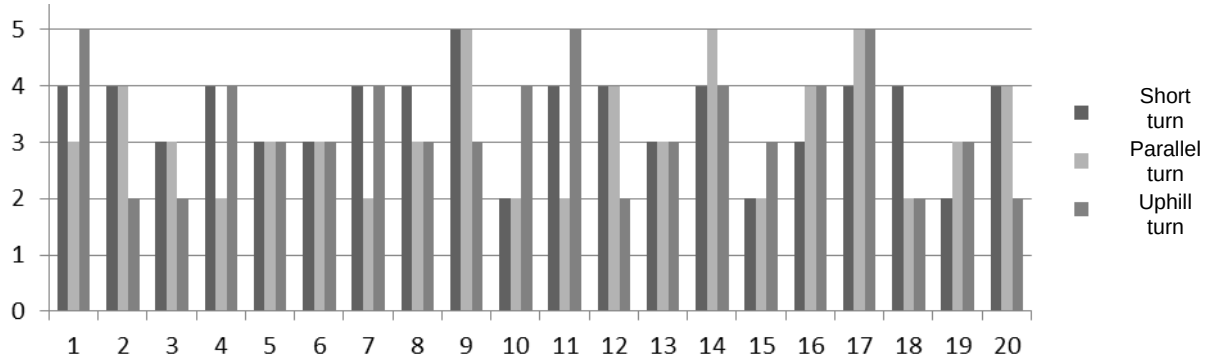

TABLE & FIGURE 2 Group taught by the parallel and snow-plough techniques after a 6-day ski program - (GPSPT)

	N	Mean	Min	Max	SD
Short turn	20	4.10	3.00	5.00	0.79
Parallel turn	20	3.95	3.00	5.00	0.69
Uphill turn	20	3.35	2.00	5.00	0.93

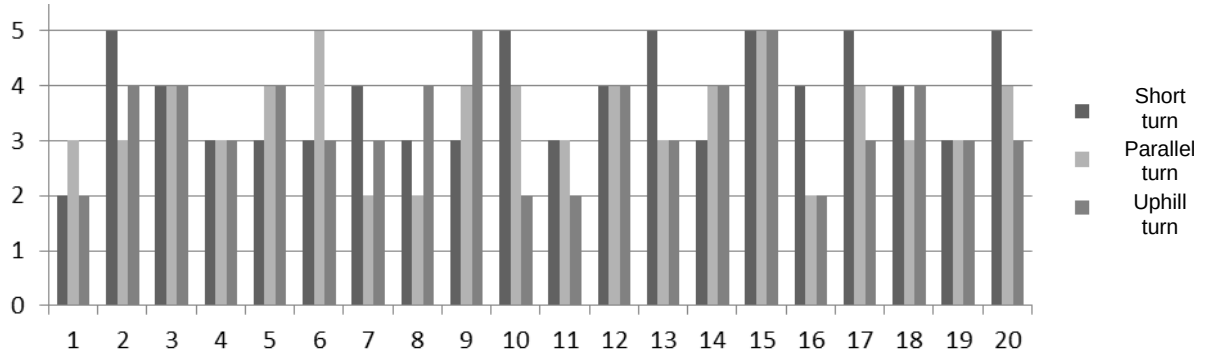

TABLE 3 Multivariate differences between the two groups in knowledge after a 6-day ski program

Wilks	F	Effect	Error	p
0.811949	2.7792	3	36	0.055030

TABLE 4 Univariate differences between the two groups in knowledge after a 6-day ski program

	GPT		GPSPT		F	P
	Mean	SD	Mean	SD		
Short turn	3.50	0.83	4.10	0.79	5.516129	**0.024145**
Parallel turn	3.20	1.06	3.95	0.69	7.089552	**0.011305**
Uphill turn	3.30	1.03	3.35	0.93	0.025850	0.873118

Before the start of the 6-day ski program, the examinees of the two groups didn't differ in motor abilities and morphological characteristics. Their achievement in learning alpine ski technique was affected only by one of the two methods of teaching certain elements of the ski technique.

The examinees of the two groups differed significantly in the grades (Table 4.) obtained for the

two out of three elements: Short turn 4.10 vs. 3.50 p=0.024145; Parallel turn 3.95 vs. 3.20 p=0.011305; Uphill turn 3.35 vs. 3.30 p=0.873118. Higher grades were achieved by the examinees whose method of learning has included the elements of the parallel and snow-plough techniques.

This basic turn can be done with or without poles at the start. By leaning over on to one ski while moving in the snow plough position, the weighted ski will turn. The weight is then transferred to the other ski to turn in the opposite direction. It should be emphasized that the weight remains on the outside ski until the next turn; the skier gets a feeling of continually weighting the downhill ski. Different instructors use different verbs to describe the snow plough steering action, but the instruction and the demonstration must be as simple as possible (http://www.ski-jungle.com/better-skiing/ch2.htm).

Higher grades were obtained by the participants in group taught by the parallel and snow-plough techniques (GPSPT) after the 6-day ski program. These results are probably because of the fact that in the snow-plough techniques the beginners learn basic ski movements better. In the snow-plough techniques there are semicircular leg movements, which helped in a better demonstration of short and parallel turns. The desire to more quickly convey the knowledge of alpine skiing by ommiting the snow plough technique in the end only deprives the beginer alpine skiers of the experience needed during the more advanced phases of learning (Cigrovski et al, 2010). This information can help the ski instructor and give direction that it is more efficient to initially use both the parallel and snow plough technique in the process of teaching alpine ski beginners how to ski.

REFERENCE

Cigrovski, V., Matković, B. & Kasović, M. (2010). How to make alpine ski learning process more efficient. *In proceedings of the 5th International Congress on Science and Skiing.*

Federolf, P.A. (2005). *Finite Element Simulation of a Carving Snow Ski*. PhD thesis,

Swiss Federal Institute of Technology Zurich, CH.

Hadžić R., Radosav, S. & Joksimović, A. (2009). Takmičarska forma alpskih skijaša u dečijem uzrastu. *Sportekspert*, 2 (2), 33-34.

Hirano, Y. & Tada, N. (1996). Numerical simulation of a turning alpine ski during recreational skiing. *Medicine & Science in Sports* & *Exercise*, 28, 1209-1213.

Joksimović, A. (2008). Bending tecnique in alpine skiing. *Fizička kultura,* 1, 129-131.

Joksimović, A. (2009). Instructions and recommendations in learning ski carving tehnique. *Sport & Science,* 1, 189-192.

Joksimović, A., Rakočević, T. & Joksimović, S. (2009). Mechanical influence that carving equipment has on skiing techniques. *Fizička kultura*, 1, 186-188.

Joksimović, D., Joksimović, A. & Stanković, D. (2010). Uloga psiholoških faktora u procesu obuke skijaških zavoja kod početnika. In: Stanković, R. (Ed.), *XIV International Scientific Conference FIS communications*. Niš. Faculty of Physical Education. 678-685.

Joubert, G. (1978). *Skiing - An Art, a Technique*. Boulder, CO: Poudre Press.

LeMaster, R. (1999). *The Skier's Edge*. Champaign, III. Human Kinetics.

LeMaster, R. (2009). Applications of physics education research to skiing pedagogy for coaches and instructors. In: Muller, E., Lindinger, S. & Stoggl, T. (eds.) *Science and skiing IV*. Oxford: Meyer & Meyer Sport (UK) Ltd. 347-356.

Loland, S. & Haugen, P. (2000). *Alpin skiteknikk***.** Oslo, Norges idrettshøgskole.

Loland, S. (2009). Alpine skiing technique - practical knowledge and scientific analysis. In: Muller, E., Lindinger, S. & Stoggl, T. (eds.) *Science and skiing IV*. Oxford: Meyer & Meyer Sport (UK) Ltd. 43-58

Muller, E., Schiefemuller, C., Kroll, J. & Schwameder, H. (2005). Skiing with carving skis – what is knew? In: Muller, E., Bacharach, D., Klika, R., Lindiger, S. & Schwameder, H. (eds.) *Science and*

skiing II. Oxford: Meyer & Meyer Sport (UK) Ltd, 15-23.

Roder, Y., Vater, H., Vater, K., Riehle, H. & Haag, H. (2005). Physiological aspects of alpine skiing with differently shaped skis. In: Muller, E., Bacharach, D., Klika, R., Lindiger, S. & Schwameder, H. (eds.) *Science and skiing III*. Oxford: Meyer & Meyer Sport (UK) Ltd, 166-171.

Stojanović, T., Joksimović, A. & Aceski, A. (2007). Komparacija različitih modela za učenje paralelnog zavoja u alpskom skijanju. *Glasnik Antropološkog društva Srbije*, Beograd, 42, 285-298.

http://www.ski-jungle.com/better-skiing/ch2.htm

DVE METODE U UČENJU OSNOVNIH ELEMENATA TEHNIKE SKIJANJA

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SAŽETAK

Bolja metoda učenja početnika kako da skijaju na modernim skijama je predmet mnogih debata (Hirano & Tada, 1996; Muller et al, 2005; Roder et al, 2005; Federolf, 2005; LeMaster, 2009). Cilj ovog istraživanja je da istražimo koji je metod bolji u učenju i razvoju odredjenih elemenata tehnika skijanja. Muški studenti su predmet ovog istraživanja, podeljeni u dve grupe. Učesnike jedne grupe (GPT) su učili paralelnom tehnikom, dok su drugu grupu (GPSPT) učili alpskom skijanju kroz paralelnu i snežno-plužnu tehniku. Pre početka šestodnevnog skijaškog programa, ispitanici ove dve grupe se nisu razlikovali po motoričkim sposobnostima i morfološkim karakteristikama. Veće ocene su dobili učesnici grupe koju su učili paralelnom i snežno-plužnom tehnikom, posle šestodnevnog programa. Verovatno je došlo do ovih rezultata zato što u snežno-plužnoj tehnici početnici bolje uče osnovne skijaške pokrete. U snežno-plužnoj tehnici postoje polukružni pokreti nogu, koji pomažu boljoj demonstraciji kratkih i paralelnih obrta.

Ključne reči: metod, paralelna i snežno-plužna tehnika, skijaški početnici

THE DIFFERENCES IN THE BASIC MOTOR AND THE SITUATIONAL MOTOR ABILITIES BETWEEN THE FEMALE HANDBALL PLAYERS OF THE BOSNIA AND HERZEGOVINA FIRST FEDERAL LEAGUE AND THE FIRST LEAGUE OF THE REPUBLIC SRPSKA

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UDC 796.322(439.55)

SUMMARY

The aim of this study was to confirm the difference in the basic motor and the situational motor abilities of the female handball players. The studies were conducted on 77 adult female handball players playing in the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska. For the basic-motor abilities, 18 variables were used which covered the factors for estimating the segmental speed, flexibility, coordination, power, repetitive power and balance. The situational motor capabilities were tested using five hypothetical latent factors which are responsible for the situational efficiency in handball: the speed of ball handling, precision, throwing strength, speed without the ball, and ball handling.

Independent T-test analysis of the quantitative differences showed that statistically significant differences exist between the capabilities of players from the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska. Our results can aid the better understanding, tracking, analyzing and perfecting the conditioning and the tactical preparation of the female handball players at various levels of the competition, all in the aim of achieving a better quality of competition for senior handball players in BIH.

Key words: handball, differences, basic motor and situational motor abilities.

INTRODUCTION

Modern handball is an exceptionally quick and explosive and is made up of varying physically intense movements which require high level motor skills, both basic and specific. (Đug, 2005; Czerwinski, 1995).

Basic motor abilities form the basis for further development of the specific motor abilities which are directly responsible for achieving quality results (Brčić et al. 1997; Demir, 2000).

The existence of five latent situational motor dimensions in handball has been confirmed by various authors and they are as follows: accuracy, ball handling, the speed of movement with the ball, the speed of movement without ball and throwing strength.

Kules and Simenc (1983) researched the impact of basic motor abilities on the success of players in handball, and they found that explosive strength (both horizontal and vertical leaping ability and the type of throw), accuracy, the speed of movement (with and without the ball) and co-ordination define the quality of the player.

Handball is increasingly dominated by the action and reaction speed, strength, and aggresiveness, as well as the versatility of the players as reflected by how many different positions he/she can play

(Rogulj, 2000; Srhoj et al. 2001; Vuleta et al. 2003; Delija et al. 1995).

The players are required to improve their ability to perform elements of technique with maximum intensity and develop their agility and explosive-reactive movement both in offense and defense .

Due to the number of powerful shots, attacks on goal, taxing duels between players and leaps in defence and offense, the players consume large amounts of energy during a game. As such, a handball game demands much energy (Vuleta et al. 1999; Mujezinović, 2008;).

The aim of this study is to determine the differences and the magnitude of those differences at different levels of competition based on the basic motor and situational motor indicators. The subjects studied were 77 adult female handball players from the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska.

METHOD

Subject

The studies were conducted on 77 physically fit, adult female handball players. All were the players from the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska, who were registered with the Bosnia and Herzegovina Handball Federation. The definition of the motor model in this study was done in accordance with Kurelic et al (1975).

Source of Variables

To measure the basic motor abilites, we used 18 variables. To measure the situational motor capabilites we used five variables.

Variables for determining basic motor capablities

Hand tapping – MSBTAP; leg tapping – MSBTAN; Bend, body twist, touch – MSBPZD; flex movement with a stick – MFLISK; full extensions on a benchs – MFDPK; splits – MFSPA: Standing on one leg crosswise on a bench with eyes closed – MRRAV; standing on a turned bench – MRSOK, balancing on a narrow beam– MRSUK; back extensions – MRSIST; 30 second sit ups – MRSD30; push-ups – MRSSK; coordination with pole – MKKOP; slalom with three medicine balls – MKS3M; 20 steps with pole – MK2IP; long jump from stationary position – MESDM; throwing a medicine ball from a lying position – MFEBML; vertical leap – MESVS.

Variables for determining situational motor capabilities

Ball handling in a slalom – SMVLS; shooting at a target – SMGLC; shooting at a distance from a walk – SMSLD; running in a triangle in a basic defensive position – SMTTOS; shooting against a wall for 20 seconds – SMSZ20.

Data processing methods

The differences between the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska players, for each applied variable, were confirmed by the T-test for independent causes.

RESULTS AND DISCUSSION

Analysis of the results of the basic motor ablity tests between the female handball players of the Bosna and Herzegovina First Federal League and the First League of the Republic Srpska.

In Table 1. looking at the arithmetic parameters we can see that the female handball players of the Bosnia and Herzegovina First Federal League achieved better results in the variables of standing on one leg with eyes closed, standing on a turned bench, balancing on a narrow beam and the variables which measure balance which is defined as the ability to control a balanced position by analyzing information which is collected by the

visual and kinesthetic receptors (Sekulić and Metikoš, 2007). The female handball players of the Bosnia and Herzegovina First Federal League showed better results in the following variables: flex movement with a stick, full extensions on a bench and the splits. These variables are a part of the group that measures the flexibility, which is defined as mobility, a freedom of movement or the possible movement in individual joints, a group of joints or the entire body. Better results in the mean for female handball players of the Bosnia and Herzegovina First Federal League showed up in the variables coordination with pole, 20 steps with pole, both of which are a part of the group of factors that measure coordination which represents a very complex motor dimension. One could say that this is one form of motor intelligence in athletes – a way of thinking in motion in space and time, a form of interpretation, speed of action and the speed of learning a new motor action.

Female handball players of the First League of the Republic Srpska showed better results in the following variables: hand tapping; leg tapping; bend, body twist, touch. These variables measure segmental speed – the mechanism for synergetic regulation and the regulation of the duration of tone. Female handball players in this league also showed better results in the variables, slalom with three medicine balls which measures coordination. These players had better results in the vertical jump - a variable that measures explosive strength. In this league, the players showed the best results in the variables of back extensions, 30 second situps, and push-ups, which measure repeated strength.

Results of the T-test (table 2) confirm meaningful difference in the following variables: full extensions on a bench, 20 steps with pole, back extensions

TABLE 1 The difference in the variables for basic motor movements between the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska:

	GRUPE	N	Mean	Std. Deviation	Std. Error Mean
MSBTAP	1	36	41,22	5,189	,865
	2	41	42,29	5,942	,928
MSBTAN	1	36	28,94	4,893	,815
	2	41	29,51	2,908	,454
MSBPZD	1	36	19,89	2,816	,469
	2	41	20,05	2,291	,358
MRRAV	1	36	44,44	38,782	6,464
	2	41	34,43	24,588	3,840
MRSUK	1	36	8,44	3,402	,567
	2	41	7,19	2,920	,456
MRSOK	1	36	8,08	4,500	,750
	2	41	6,63	2,922	,456
MFDPK	1	36	28,82	5,665	,944
	2	41	25,15	6,366	,994
MFSPA	1	36	181,72	13,127	2,188
	2	41	181,39	13,921	2,174
MFLISK	1	36	70,14	9,816	1,636
	2	41	64,07	15,579	2,433
MKS3M	1	36	60,42	8,849	1,475
	2	41	66,00	9,952	1,554
MKKOP	1	36	16,42	4,225	,704
	2	41	14,93	2,858	,446
MK2IP	1	36	18,14	4,593	,765

	2	41	15,44	2,721	,425
MESDM	1	36	174,00	14,217	2,369
	2	41	174,68	16,184	2,528
MFEBML	1	36	6,89	1,618	,270
	2	41	7,51	1,328	,207
MESSVS	1	36	32,31	6,480	1,080
	2	41	33,68	6,076	,949
MRSIST	1	36	24,61	10,061	1,677
	2	41	34,29	6,900	1,078
MRSD30	1	36	24,06	5,188	,865
	2	41	26,61	4,566	,713
MRSSK	1	36	11,78	6,556	1,093
	2	41	13,76	6,704	1,047

TABLE 2 The values of the T-test of the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska:

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
MSBTAP	,102	,750	-,836	75	,406	-1,070	1,280	-3,620	1,479
			-,844	74,999	,401	-1,070	1,268	-3,597	1,457
MSBTAN	,794	,376	-,628	75	,532	-,568	,904	-2,370	1,234
			-,608	55,413	,546	-,568	,933	-2,438	1,303
MSBPZD	2,695	,105	-,275	75	,784	-,160	,582	-1,320	1,000
			-,271	67,537	,787	-,160	,590	-1,338	1,018
MRRAV	14,810	,000	1,370	75	,175	10,013	7,310	-4,550	24,575
			1,332	57,769	,188	10,013	7,518	-5,038	25,063
MRSUK	,472	,494	1,730	75	,088	1,246	,720	-,189	2,681
			1,713	69,493	,091	1,246	,728	-,205	2,698
MRSOK	3,639	,060	1,696	75	,094	1,449	,855	-,253	3,152
			1,651	58,675	,104	1,449	,878	-,308	3,206
MFDPK	,122	,728	2,659	75	,010	3,673	1,382	,921	6,425
			2,679	74,983	,009	3,673	1,371	,942	6,404
MFSPA	,001	,970	,107	75	,915	,332	3,096	-5,836	6,500
			,108	74,601	,915	,332	3,084	-5,813	6,477
MFLISK	10,314	,002	2,011	75	,048	6,066	3,016	,057	12,075
			2,069	68,372	,042	6,066	2,932	,216	11,916
MKS3M	,192	,663	-2,584	75	,012	-5,579	2,159	-9,880	-1,277
			-2,604	74,985	,011	-5,579	2,143	-9,847	-1,310
MKKOP	1,246	,268	1,831	75	,071	1,490	,814	-,131	3,111
			1,787	60,267	,079	1,490	,834	-,178	3,157
MK2IP	10,377	,002	3,183	75	,002	2,700	,848	1,010	4,390
			3,084	55,298	,003	2,700	,876	,946	4,454
MESDM	,629	,430	-,195	75	,846	-,683	3,494	-7,643	6,277
			-,197	75,000	,844	-,683	3,464	-7,585	6,219
MFEBML	2,401	,125	-1,824	75	,072	-,613	,336	-1,282	,056
			-1,801	67,853	,076	-,613	,340	-1,292	,066

MESSVS	,252	,617	-,962	75	,339	-1,377	1,432	-4,229	1,475
			-,958	72,233	,341	-1,377	1,438	-4,243	1,488
MRSIST	7,101	,009	-4,974	75	,000	-9,682	1,946	-13,559	-5,804
			-4,857	60,807	,000	-9,682	1,993	-13,667	-5,696
MRSD30	,022	,883	-2,298	75	,024	-2,554	1,111	-4,768	-,340
			-2,279	70,331	,026	-2,554	1,121	-4,789	-,319
MRSSK	,011	,916	-1,305	75	,196	-1,978	1,515	-4,997	1,041
			-1,307	74,110	,195	-1,978	1,513	-4,993	1,037

The analysis of the results of the situational motor capabilities between the female handball players of the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska.

In table 3 looking at the mean we can see that female handball players in the BiH First Federal League achieved better results in the variables in shooting at a target. This variable measures precision, which is exceptionally important since it is responsible for the players' situational precision in shooting at a target within the handball goal, and responsible for the precision in the conditions of the game. Bosnia and Herzegovina First Federal League players also showed better results in running in a triangle in a basic defensive position, which measures the speed of a player's movement without a ball, and covers an area which is characteristic for the defense while less present in attack. In attack, this measurement represents gaining space, getting open, and running into position, while on defense this represents getting back on defense to prevent counter attacks and various other forms of defending and deterring of the opposing attackers.

The female handball players of the First League of the Republic Srpska showed better results in the variable of ball handling in a slalom which measures a player's speed of movement with a ball. This represents a player's movement in attack. Considering the fact that the space on the court is gained in attack faster and more securely by passing the ball, this type of ball handling is a task that is limited in the course of a game, except in the situations in which, for tactical reasons, ball handling is appropriate, such as an individual counter attack, in a counter attack with an additional player, in a move between two defenders and in some combinations of attack. The players in the First League of the Republic Srpska also achieved better results in shooting at a distance from a walk which measures ball throwing strength which is responsible for the situational explosive strength for throwing a ball. Throwing a ball when passing and shooting is one of the most common elements of handball technique. Considering the relatively small dimensions of the handball court, the throwing strength comes into consideration only in the organization of a counter attack with a long pass or in a quick cross court pass from one wing to the other side of the goal man's area. The ball throwing strength is considerably more important in shooting at the goal. Since shooting at the goal yields goals – on which the result of the game depends – it is clear that, along with precision, the ball throwing strength is very important for success in handball (Lakota, 2006).

The female handball players of the First League of the Republic Srpska showed better results in the variable of shooting against a wall for 20 seconds which measures ball handling, representing fine motor skills of a player with a ball in place or in motion. The skill of ball handling should be considered a basic precondition for achieving desired success in handball.

The results of the T-test (table 4) confirm meaningful differences for the following variables: Shooting at a target and running in a triangle in a defensive position.

TABLE 3 The difference in the variables of the situational motor parameters between the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska:

	GRUPE	N	Mean	Std. Deviation	Std. Error Mean
SMVLS	1	36	20,52	3,899	,650
	2	41	22,01	2,438	,381
SMGLC	1	36	38,31	4,335	,722
	2	41	33,76	5,531	,864
ŠMLŠD	1	36	20,95	3,260	,543
	2	41	22,58	4,322	,675
SMŠZ20	1	36	16,33	1,912	,319
	2	41	16,73	2,013	,314
SMTTOS	1	36	16,27	2,080	,347
	2	41	15,41	,864	,135

TABEL 4 The values of the T-test between the players of the Bosnia and Herzegovina First Federal League and the First League of the Republic Srpska:

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
SMVLS	13,249	,000	-2,030	75	,046	-1,485	,732	-2,943	-,028
			-1,972	57,248	,053	-1,485	,753	-2,993	,023
SMGLC	1,141	,289	3,977	75	,000	4,549	1,144	2,271	6,828
			4,040	74,098	,000	4,549	1,126	2,306	6,793
ŠMLŠD	2,977	,089	-1,849	75	,068	-1,631	,882	-3,389	,127
			-1,882	73,404	,064	-1,631	,866	-3,358	,096
SMŠZ20	,041	,840	-,887	75	,378	-,398	,449	-1,293	,496
			-,890	74,515	,376	-,398	,448	-1,290	,494
SMTTOS	7,271	,009	2,430	75	,017	,863	,355	,156	1,570
			2,320	45,488	,025	,863	,372	,114	1,612

CONCLUSION

The results of this study show that the female handball players in different levels of competition differ significantly statistically in their basic and situational motor abilities.

The existence of these differences between the female handball players of different levels of competition is primarily due to the differences in the level of competition. The Bosnia and Herzegovina First Federal League players have significantly more motivation because they have better help and support from RSBiH, and therefore have seriously defined careers. As is recognized, the psychological aspect is very important in sport. The second reason for the existence of these differences can be attributed to the training regime. The third reason for the difference is in the level of mental, physical and technical tactical training. The obtained results can contribute to better understanding, tracking, analyzing and perfecting the conditioning and the tactical training on various levels of competition, with the aim of improving the quality of competition in Bosnia and Herzegovina.

BIBLIOGRAPHY

Brčić, B., Viskić Štalec, N., & Jaklinović Fressl, Ž. (1997). Predictive value of variables for the evaluation of technical-tactical elements in handball. *Kinesiology, 1(29), 60–70.*

Czerwinski, J. (1995.). The influence of technical abilities of players on the tactical selection in the handball game. *European Handball,* 2:16-19.

Delija, K., Šimenc, Z. i Vuleta, D. (1995). Differences in some general and situation tests of motor abilities in handball player and those not play handball. *Kinesiology 27(1): 57 – 61*

Demir, M. (2000*). Canonic relation between morphological dimensions and situational-motion abilities with young handball players*. Master's thesis, Sarajevo: Faculty of Sport and Physical Education.

Đug, M. (2005). *Efficiency of different methods for improvement of handball players jumping ability.* Master thesis, Tuzla: Faculty of physical education and sport.

Kuleš, B. & Šimenc, Z. (1983). Relationship between different motor abilities and efficiency in handball.. *Kinesiology,* 15(2): 153-163

Kurelić N., Momirović K., Stojanović M., Šturm J., Radojević., Viskić-Štalec N. (1975). The Structure and Evolution of Morphological and Motor Dimensions of Youth. Institute for Scientific Research, Faculty of Physical Education of the University of Belgrade.

Lakota, R. (2006). *Effects of programmed work on transformation of basic-motor and situational motor abilities of handball players.* Master thesis, Sarajevo: Faculty of Sport and Physical Education

Lakota, R. (2009). *Effects of programmed work on transformation of basic-motor and situational-motor abilities of cadet handball players*. Doctoral thesis, Tuzla: Faculty of physical education and sport .

Mujezinović, M. (2008). *Effects of programmed training on special and basic motor abilities in handball.* Master thesis, Sarajevo: Faculty of sport and physical education.

Rogulj, N. (2000). Differences in situation-related indicators of the handball game in relation to the achieved competitive results of teams at 1999 World Championship in Egypt. *Kinesiology, 32* (2), 63-74.

Sekulić, D., Metikoš, D. (2007*). Basic Transformational Porcedures in Kinesiology*. University of Split: Faculty of Natural Sciences, Mathematics and Kineziology

Srhoj,V., Rogulj, N. Padovan, M., Katić R. (2001). Influence of the attack end conduction on match result in handball. *Collegium antropologicum*, 25(2):611-617

Vuleta, D., Milanović, D., Sertić, H. (1999). Latent structure of the spatial, phasic, positional and movement characteristics of the handball game. *Kinesiology, 31*(1), 37-53.

Vuleta, D., Milanović, D., Sertić, H. (2003). Relations among variables of shooting for a goal and outcomes of the 2000 Men's European Handball Championship matches. *Kinesiology,* 35(2), 168-183.

RAZLIKE U BAZIČNO MOTORIČKIM I SITUACIONIM SPOSOBNOSTIMA RUKOMETAŠICA PRVE FEDERALNE LIGE BIH I PRVE LIGE REPUBLIKE SRPSKE

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SAŽETAK

Osnovni cilj ovog istraživanja bio je utvrditi razlike u bazično motoričkim i situaciono motoričkim sposobnostima rukometašica. Istraživanje je urađeno na 77 rukometašice,seniorskog uzrasta iz Prve federalne lige BIH i Prve Lige Republike Srpske .U prostoru bazično-motoričke sposobnosti korišteno je 18 varijabli koje su obuhvatale faktore za procjenu segmentarne brzine, fleksibilnosti, koordinacije, eksplozivne snage, repetitivne snage, ravnoteža. Situaciono-motorički prostor je posmatran i obuhvata pet hipotetskih latentnih faktora koji su odgovorni za situacionu efikasnost u rukometu: Brzina baratanja sa loptom, preciznost, snaga izbačaja lopte, brzina kretanja bez lopte, baratanje loptom.

U analiza kvantitativnih razlika na univarijantnom nivou, T- testom za nezavisne uzorke, između Prve federalne lige BIH i Prve lige Republike Srpske u situaciono-motoričkim i bazično-motoričkim sposobnostima dobili smo da se nivoi takmičenja razlikuju odnosno da postoji statistička značajnost između tretiranih nivoa takmičenja. Dobiveni rezultati mogu doprinijeti boljem razumijevanju praćenja,analiziranja te boljem usavršavanju kondicijske i tehničko-taktičke pripreme rukometašica na različitim nivoima takmičenja, a sve u cilju postizanja većeg kvaliteta takmičenja rukometašica za seniorke u Bosni i Hercegovini.

Ključne riječi: rukomet, razlike,bazična motorika i situaciona motorika

THE CANONICAL CORRELATION OF COORDINATION AND OTHER ANTHROPOMOTORICAL ABILITIES OF THE DANCERS OF THE MODERN DANCE "DISCO DANCE"

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SUMMARY

The aim of this study is to determine the existence of the relationship between coordination and other anthropomotorical abilities in a sample of 60 women, from 13 to 14 years ± six months who are practicing modern sports dance in Nis and Vranje. For assessing the coordinating ability, as criterion variables, we have used 5 measuring instruments, and for assessing the ability of other anthropomotorical abilities, as predictor variables, we have used: 5 variable of power, 5 variable of speed, 2 variable of balance and 3 variable of flexibility. For the determination of the relationship between the two sets of variables a canonical correlation analysis was used. The results showed the existence of three significant canonical factors, which support the hypothesis about the connection between coordination and other antropomotorical skills.

Key Words: coordination, anthropomotoric abilities, relation, dancers

INTRODUCTION

Dance is a highly complex motor activity. By observing the movement of dancers we realize that dance is more than just physical changes in posture. It is an expressive visual art of short scenes which contribute to strength, balance and the grace of a dancer. Dancing is an excellent manifestation of physical skills which can simultaneously express raw power and elegant movements. Sculptural poses, innovative choreography and stunning images are the trademarks of dance as an art form. Dance reflects the impeccable balance, intensive control of your muscles, elegance, rhythm and speed of movement. (Haas, 2010).

There is a wide range of interests of scientists and experts of dance to explore dance as an art and as a sport activity. (Uzunović Mutavdžić, Kostic, 2010). In order to reach a high level of perfection and aesthetics at performing dance structures and movements, it is necessary for the dancers to have certain motor skills developed. The development of specific motor skills depends on the type of dance, since each type of dance engages appropriate muscle groups in a specific manner and develop, appropriate motor skills and physiological characteristics. (Pepper, 1984).

Coordination is a complex ability consisting of many specific skills. Coordination skills are considered one of the skills that form the foundation that is necessary to prepare athletes for the performance of motor skills in various fields of sports. Coordination skills are closely linked to the development of sport specific techniques. Specific

sports activities determine the type of skills that must be developed, as the athlete can't perfect the technique of specialized sports activities if he/she lacks coordination skills. It is the coordination capabilities that enable a sportsman to move with ease and reach the highest levels of motor coordination. (Mansour, 2010). For the dancers, coordination is manifested through speed abilities, temporal and spatial parameters of the dance technique and represents a fast connection of complex motor tasks in time and space." In order to achieve success in dance it is essential to determine a system, consisting of the coordinating ability, musical and intellectual skills first." (Kostic, 1996, p.44)

There are not many researches that connect coordination and other motor skills in dance. Kostic (1996) was investigating the hypothesis of the association of the anthropomotorical abilities as predictors with coordination as the criterion in a sample of 33 male and 33 female dancers from Nis, aged 12 to 13 years. The anthropomotorical abilities were determined with three tests of power, four tests of speed, four tests of flexibility and four tests of balance. Coordination was assessed with four tests also. The results were obtained by calculating the canonical correlation analysis, and showed that the same variable of speed, flexibility and balance and the same variable in coordination have significant projections of canonical factor. Different variables of power have significant projection in the canonical factor in the subsample of dancers. The research confirmed the hypothesis about the important connection between the two areas.

There are much more researches that are linking motor skills with success in dance, and dance performance prediction based on motor skills. Oreb (1984) in his study found that Slavonsko kolo, Moravac and general assessment can be assessed in terms of the primary motor dimensions, unlike Gorenjski valcek where this is not the case, and that the variability of the criterion variables that can be predicted, is mostly affected by coordination realization of the rhythmic structure, frequency and balance of the alternative movements, and explosive power. Kostic and Dimova (1997) have also found that it is possible to make a prediction of success in the sport dancing competitions based on the results of motor skills. Hierarchically the highest predictive value has variables of speed, flexibility, strength and balance. Although there are no significant variables of coordination in this case, this does not mean that the coordinative abilities are not essential for the dancers, but that the dancers already possessed a certain level of coordination capabilities which allow them to adequately succeed in competitions. Uzunović (2004) in his study got similar results, where variables that assess the speed, strength, balance and endurance of the male dancers had the largest contribution to the prediction of success based on motor abilities, and in the female dancers had variables of speed, flexibility, coordination, balance and coordination of the rhythm. Uzunović, Kostic, and Miletic (2009) in their study got the following results: the variables for the assessment of coordination, frequency of movement, balance, coordination, flexibility and rhythm explain 66% of the variance in the performance of the ballroom competitive dancing in female dancers, and variables that assess the speed of frequency of movement, explosive strength, static balance, flexibility and aerobic endurance explained 71% of variance in the performance of the ballroom competitive dancing for the male dancers. Uzunović Kostic Zagorc, Oreb, and Jocic (2005) found that success can be predicted in competitions in ballroom dancing based on the coordination skills - 30% in the sample of male and 40% in the sample of female dancers. A similar conclusion was made by Uzunović and Kostic (2005) who found that the largest contribution to the competitive success of Latin American dances has predictor variables that assess the frequency of movement, a variable for the assessment of spinal mobility, a variable that assess coordination and a variable for evaluation of coordination in rhythm that have the value of near statistical significance. Kostic, Uzunović Oreb, Zagorc, and Jocic (2006) in their study found a significant effect of

coordination skills on the prediction of competitive success in Latin American dances.

A large number of studies is related to the effects of dance and its impact on improving motor skills. Kostic (1997) found that the application of certain assets of dance training can affect the improvement of certain motor skills. The results of the discriminate analysis showed that the highest discriminatory value has a variable speed, flexibility, balance and two variables of coordination. Uzunović (2008) concluded that modern sports dance has significant effects on the changes in motor coordination, strength and speed while Mandaric (1999) found that the teaching of dance can influence the motor skills of co-ordination, speed and sense of rhythm. Research Crotts, Thompson, Nahom, Ryan, & Newton (1996) showed that the dancers have a better balance ability compared to the non-dancers, probably because of the use of specific strategies of dance techniques and balance that are an integral part of dance training.

Srhoj, Katic Kaliterna (2006) concluded that the overall performance of a dance depends mainly on coordination, followed by an explosive force and to a lesser extent, the frequency of movement.

The results indicate the specific features of the basic motor skills of dancers, with the most prominent being coordination, speed, strength, aerobic endurance, balance and flexibility. It is evident that the basic motor skills must be developed sufficiently in order for the dancers to be able to achieve the highest success and to be able to handle the loads that occur during a dance competition. But what remains a mystery is the relationship between certain motor skills and what is the nature of these relationships? This research is aiming to give an answer to that question.

The aim of this study was to determine the relationship of coordination and other anthropomotorical abilities of the dancers of modern dance aged 13 and 14 years.

METHODS

The sample

The sample consisted of 60 women, aged 13 to 14 years ± six months that were members of PK "La Luna" in Vranje and Nis and were selected randomly. The participants were included in the training process of the modern competitive dance "Disco Dance".

Sample of variables

Coordination consisted of a set of 5 criterion variables: Side - steps (CR), 20 steps forward with a baton (20ISK), horizontal jump rope (PRHV), turns into 6 six squares (O6KV) and foot and hand drumming (BNIR).

The predictor variables consisted of a set of 5 variables of power (standing long jump (SÜDMO), lifting the trunk in 30 seconds (DT30S) half squat on one leg (CU1N), pushups (skle) and throwing a medicine ball from lying position (BMLE)); 5 variable of speed (foot tapping against a wall (TANZ), forward bend, twist, touch (PZDO), hand tapping (TARU), foot tapping (TANG) and jumping over a gymnastic bar (PGKL)) 2 variable of balance (walking on low beam (HNGR) and standing on one leg (st1n)) and 3 variable flexibility (side bend (OTK**),** dislocate (Iskra) and forward bend (PRRA)).

Statistical procedures

The connection between the sets of variables coordination and other measures of anthropomotorical abilities was determined with the help of the canonical correlation analysis. The interpretation of the canonical factors was performed on the basis of complex vector coefficients to determine the canonical dimension: the canonical correlation coefficients (R), the roots of the characteristic equation (R-sqr.), the chi-square test of the significance of canonical roots (Chi-sqr.), the significant canonical roots (p). All

statistical analyses were performed using the "Statistics 7."

RESULTS

The connection between a set of variables of the atnthropomotorical capabilities and a set of variables of coordination for the female dancers (Table 1) is explained by three significant canonical factors in the common area of the two sets of variables.

TABLE 1 Canonical correlation of coordination and other anthropomotorical abilities

Root removed	Canonical R	Canonical R – sqr.	Chi-sqr.	p
0	0.84	0.71	170.72	**0.000**
1	0.77	0.59	110.99	**0.000**
2	0.72	0.52	68.00	**0.003**

Based on the correlation coefficient of the first pair of the canonical factors (R = 0.84), we conclude that there is a statistically significant correlation between the two sets of variables.

In the area of the anthropomotorical capabilities (Table 2) the highest projection on the first canonical factors have: foot tapping, hand tapping, throwing a medicine ball from lying position, jumping over a gymnastic bar, tapping foot tapping against the wall, straddle forward bend, standing on one leg, standing long jump.

TABLE 2 Canonical factor of other antrhropomotorical abilities

Variables	Root 1	Root 2	Root 3
Standing long jump	**0.50**	-0.22	-0.35
Lifting the trunk in 30 seconds	0.20	-0.09	-0.10
Half squat on one leg	0.28	-0.01	-0.32
Pushups	0.41	0.10	-0.33
Throwing medicine ball from lying position	**0.64**	-0.11	-0.25
Foot tapping against a wall	**0.61**	0.17	-0.20
Forward bend, twist, touch	0.39	-0.12	0.26
Hand tapping	**0.77**	0.04	-0.19
Foot tapping	**0.85**	0.17	0.16
Jumping over a gymnastic bar	**0.65**	-0.28	0.06
Walking on low beam	-0.05	**-0.53**	-0.04
Standing on one leg	**0.55**	-0.31	0.38
Side band	0.21	**-0.74**	0.31
Iskret	0.31	-0.07	0.34
Forward bend	**0.61**	-0.22	0.23

In the area of coordination, all five variables have a large projection on the first canonical factor, so we can define this factor as a general factor of coordination.

TABLE 3 The canonical factor of coordination abilities

Variables	Root 1	Root 2	Root 3
Side - steps	**-0.70**	0.48	**-0.51**
20 steps forward with a baton	**-0.63**	-0.18	0.32
Horizontal jump rope	**0.80**	-0.33	-0.31
Turns into 6 six squares	**0.71**	**0.60**	0.36
Foot and hand drumming	**0.64**	0.39	-0.11

The projection of the variables on the second and third canonical factor have less values, but still show a significant correlation of these two roots.

The largest projection on the second canonical factor in the space of the anthropomotorical abilities has the following: walking on low beam and side band, while turns into six squares have the largest projection on the second canonical factor in the area of coordination.

For the realization of the tasks in all prominent variables it is necessary to have a developed speed of frequency of limb movement, explosive strength of the legs, arms and shoulders, static and dynamic balance and coordination of arms and legs and the whole body. These elements connect the coordination and other motor skills, while also representing some of the elements of a successful dance.

DISCUSSION

Previous studies in the field of dance set aside certain motor skills that are important for the dance and its successful execution. Srhoj, Katic Kaliterna (2006) concluded that the overall performance of the dance depends mainly on coordination, followed by an explosive force and to a lesser extent on the frequency of movement. Uzunović (2008) concluded that the modern sports dance has significant effects on the changes in motor coordination, strength and speed, while Mandaric (1999) found that the use of teaching dance can influence the motor skills of co-ordination, speed and a sense of rhythm. Also based on the basic anthropomotorical abilities it is possible to make predictions of success in competitions (Kostic et al, 2006; Uzunović et al, 2005; Uzunović 2004; Uzunović et al, 2009; Uzunović and Kostic, 2005). In all of the researches coordination emerges as an important variable that has a great role in the prediction of success and the successful execution of the elements of dance, and that with the appropriate dance training coordination can be developed to a certain extent. All this indicates that the dancers must have a high level of coordination abilities developed, together with other abilities to achieve superior results. Given the fact that coordination is a complex motorical ability, which consists of many specific abilities, and that in the present researches it has been always found as a significant variable along with other motor abilities that are essential for the dancers, we can assume that there is a correlation between coordination and other motor skills. Data on the correlation of coordination with other motor skills we can find in the research of Kostic (1996) whose results were similar to the results of our research. Kostic found that for the realisation of the tasks in all the prominent variables is necessary to have an explosive leg strength and arm mobility of the spine in all planes, a balance in movement and alignment of limb movement. The results of this study show that in addition to the above variables, a major contribution also has the variables of frequency and the speed of limb movement and static equilibrium, and that these elements connect coordination and other motor skills.

The high correlation of coordination and other motoric abilities in the dancers of modern dance "Disco Dance" in this study may be explained by the specific technique Disco Dance and by the character of the dance. Disco dance is a modern dance sport characterized by a large number of jumps, leaps, turns, kicks, slides and other elements of the techniques and for its successful execution the

dancers must have certain motor skills developed. The figures in the "Disco dance" are performed with different parts of the body that need to be matched in space and time, and also, at the same time, the dance figures must accompany the music. The movements of "Disco dance" are complex in nature and are done in several planes and axes, in place and in motion, while during their performance the dancers need to take care of other athletes on the podium. That is why the hierarchical contribution of coordination in "Disco Dance" is great. (Uzunović, 2009). In addition to the coordinated execution of the movements, these elements must be done at a certain speed, and the movements need to be brisk and explosive because it expresses the nature and character of the dance. "Disco dance" contains certain elements from jazz ballet, as well as some acrobatic elements like splits, and other elements that require a high level of flexibility and a static and dynamic balance. In order to perform a dance element correctly and effectively it is essential for the dancer to execute the dance element with appropriate speed and the amplitude movements while exerting a certain level of strength, maintaining his body in a static or dynamic balance, and be coordinated in time and space. That is, in fact, the biggest importance of the correlation of coordination and other anthropomotoric abilities, because in order to perform the movement quickly and powerfully, it is essential that the movement is well coordinated, while good flexibility allows easy performance of the movements, and balance allows better conditions for the execution of a coordinated movement.

CONCLUSION

The study was conducted on a sample of 60 dancers of the modern dance "Disco dance" in Vranje and Nis aged 13 to 14 years. The aim of the research is to assess the relationship between the canonical relations between coordination and other anthropomotoric abilities in order to see what significance the anthropomotoric abilities have for coordination.

The anthropomotoric abilities were evaluated with five variables of strength, five variable of speed, two variables of balance and three variables flexibility. Coordination was assessed with five variables. The data obtained were analyzed by the canonical correlation analysis.

The obtained results confirmed the hypothesis about the connection of the anthroopmotoic abilities as predictors and coordination, as the criteria in the sample of female dancers of the modern dance "Disco dance".

REFERENCE

Crotts, D., Thomson, B., Nahom, M., Ryan, S., & Newton, R.A. (1996). Balance abilities of professional dancers on select balance tests. *J Orthop Sports Phys Ther,* 23(1), 12-17.

Hass, J.G., (2010). *Ples Anatomija.* Beograd: Data Status

Kostić , R. (1996). *Trening plesača:* Niš: SIA

Kostić, R. (1996). Kanoničke relacije koordinacije i drugih antropomotoričkih sposobnosti plesača. U N. Živanović (UR), „Fis – komunikacije 96, Zbornik radova Filozofskog fakulteta, Serija fizička kultura (145-148). Niš: Filozofski fakultet u Nišu.

Kostić, R. (1997). Uticaj dvonedeljnog treninga na motoričke sposobnosti plesačica. U R. Kostić (Ur), Šesti međunarodni simpozijum *„FIS komunikacije 1997" u fizičkom vaspitanju, sportu i rekreaciji* (107-114). Niš: Filozofski fakultet, Univerzitet u Nišu, Institut fizičke kulture.

Kostić, R., & Dimova, K. (1997) Motorical abilities like predictor of success in sport dance. *Second International Scientific Conference,* X (Abstrakts – 37). Skopje: Faculty of physical culture.

Kostić, R., Uzunović, S., Oreb, G., Zagorc, M., i Jocić, D. (2006). Relacije uspeha u latino-američkom plesu sa koordinacionim sposobnostima. U D. Petković (Ur), *Zbornik radova međunarodnoh skupa „Fis – komunikacije 2006" (86-89).* Niš: Fakultet fizičke kulture.

Mandarić, S. (1999). *Uticaj nastave plesova na razvoj osećaja za ritam, koordinaciju i frekvenciju*

pokreta donjih ekstremiteta. Neobjavljena magistarska teza. Beograd: Fakultet fizičke kulture.

Mansour, M.M.S.A. (2010). The Effect of Developing Some Coordination Capabilities by Using Novel Equipments on Improving Performance Level and Sport Confidence in Modern Dance. *World Journal of Sport Sciences,* 3(S), 109-115.

Oreb, G. (1984). *Relacije između primarnih motoričkih sposobnosti i efikasnosti izvođenja plesnih struktura kod selekcioniranog uzorka ispitanika.* Neobjavljena magistarstak teza. Zagreb: Fakultet za fizičku kulturu.

Pepper, M.S. (1984). Dance – a suitable form of exercise?. *South African Medical Journal,* 66, 883-888.

Srhoj, L., Katić, R., & Kaliterna, A. (2006). Motor abilities in dance structure performance in female students. *Coll Antropol,* 30(2), 335-341.

Uzunović, S. (2004). *Uticaj antropomotoričkih sposobnosti na uspešnost u sportskom plesu.* Neobjavljena magistarska teza. Niš: Fakultet fizičke kulture.

Uzunović, S. & Kostić, R. (2005). A study of succes in latin american sport dancing. Niš: *Facta Universitatis, Series Physical Education and Sport,* 2 (1), 35-45.

Uzunović, S., Kostić, R., Zagorc, M., Oreb, G., & Jocić, D. (2005). The effect of coordination skills on the succes in standard sports. In N. Dikić, S. Živanović, S. Ostojić, Z. Tornjanski (Eds), (Abstakts 32). *European college of sport science 10th annual congress,* Beograd: Sport Medicine Association of Serbia.

Uzunović, S. (2008). The transformation of strength, speed and coordination under the influence of sport dancing. Niš: *Facta Universitatis, Series Physical Education and Sport,* 6(2), 135-146.

Uzunović, S., Kostić, R., & Miletić, D. (2009). Motor status of competitive young sport dancers – gender differences. *Acta Kinesiologica,* 3(1), 83-87.

Uzunović, S., Mutavdžić, V., i Kostić, R. (2010). *Istraživanje efekata plesa.* Niš: Fakultet sporta i fizičkog vaspitanja.

KANONIČKE RELACIJE KOORDINACIJE I OSTALIH ANTRPOMOTORIČKIH SPOSOBNOSTI PLESAČA

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SAŽETAK

Cilj ove studije je da utvrdi postojanje relacija između koordinacije i ostalih antropomotoričkih sposobnosti na uzorku od 60 ispitanica od 13 do 14 godina ± šest meseci koje se bave modernim sportskim plesom u Nišu i Vranju. Za procenu koordinativnih sposobnosti kao kriterijumskih varijabli korišćeno je 5 mernih instrumenata, dok je za procenu ostalih antropomotoričkih sposobnosti kao prediktorskih varijabli korišćeno 5 varijabli snage, 5 varijabli brzine, 2 varijable ravnoteže i 3 varijable gipkosti. Za utvrđivanje relacija između dva seta varijabli primenjena je kanonička korelaciona analiza. Dobijeni rezultati su pokazali postojanje tri značajna kanonička faktora, koji potvrđuju hipotezu o povezanosti koordinacije i ostalih antropomotoričkih sposobnosti.

Ključne reči: koordinacija, antropomotoričke sposobnosti, relacije, plesačice

THE DIFFERENCES BETWEEN THE HANDBALL PLAYERS AND THE BASKETBALL PLAYERS IN TERMS OF EXPLOSIVE POWER

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UDC 796.323.322

SUMMARY

The objective of this transversal research is to determine the differences between the handball players and the basketball players in terms of explosive power based on the adequate motor skills tests. The sample of the respondents in this paper was comprised of the players of the handball club "Železničar" from Niš, the member of the Serbian Handball Super League (n=19) and the players of the basketball club "Konstantin" from Niš, the member of the Serbian First Basketball League (n=15). Force platform is used as an appropriate apparatus for the assessment of explosive power. The tests which have been applied were a semi-squat jump and a deep squat jump. We used the T-test for independent samples in order to determine the possible differences in terms of explosive power. Based on the results obtained with the T-test, it was determined that there were no major informational differences in terms of explosive power among the studied samples.

Key Words: Explosive power, team handball players, basketball players.

INTRODUCTION

Handball and basketball are dynamic sports characterized by complex movement structures, where their successful performance requires specific motor skills, such as accuracy, speed, agility and explosive power. The sole fact that the target in basketball is elevated in height, and that a successful execution of almost all shoots at the goal in handball requires surpassing of the defensive players, imposes the fact that the players with a more pronounced degree of explosive power have an advantage over the rest. Besides the technical and tactical skill, it has been proven that high degrees of strength, muscle power and throwing speed represent the most important factors, offering a clear advantage in terms of participation in elite levels of handball competitions (Gorostiaga, Granados, Ibanez, & Izquierdo, 2005). Nowadays, a handball game requires strong and stabile athletes, characterized by a high degree of motor and functional abilities, situational resourcefulness and a developed sense of team play. All the activities in a handball game are performed under specific conditions, including the presence of the opposite team players and the compliance of the game rules. The choice of a technique and its successful implementation depend on a specific situation during a game (Kozomara & Kozomara, 2009). Most of the shoots at the goal and other throwing activities depend on motor skills, especially on the explosive power of the muscle region which throws the ball. The positive effect of the strength on the motion speed of the ball has been confirmed by numerous studies (Kotzmanidis et al., 1995; Bayios et al., 1999). In a contemporary basketball game, body size and physical condition belong to the group of the most relevant factors, which determine the elite athletes. The player's specific physical constitution will determine his playing position in a team, while a high level of the intensity of the game requires a high level of physical condition

(Drinkwater, Pyne, & McKenna, 2008). One basketball match is comprised out of 46±12 jumps per player, with or without the eccentric-concentric phase (Mclennes, Carlson, & McKenna, 1995). The research including male and female basketball players shows that a squat jump and a counter movement jump performances correlate with the isometric power during the maximum extension of legs (Hakkinen, 1991). The part of the maximum power could also be significant for the explosive power development. The explosive power, during maximum extension of legs, could also be one of the very important indicators of neuromuscular performances of basketball players (Gillam, 1985; Maffiuletti et al., 2000). Explosive power represents one dimension of the anaerobic capacity, and its values are high in all sport activities that require explosiveness and quick production of maximum energy. In future, coaches and other experts in this field could monitor, in a useful way and through the training process, one of the most important variables for a specific sport (Popadic-Gacesa, Barak, & Grujic, 2009). 145 elite athletes participated in this research (14 boxers, 17 wrestlers, 27 hockey players, 23 volleyball players, 20 handball players, 25 basketball players and 19 soccer players). The results obtained by the means of the explosive power test indicate the highest values in basketball and volleyball players, compared to the values of other tested athletes. A similar problem has been analysed in a scientific study that compared the explosive power values of handball players to the values of other sports' participants. Comparing the handball players, basketball players, volleyball players, sprinters and body-builders, lead to the discovery that no significant differences in maximum explosiveness existed among them (Asci & Acikada, 2007). The dynamic muscular strength is one of the most important factors which influence the jumping ability in handball players (Gorostiaga, Granados, Ibarez, Gonzalez-Badillo, & Izquierdo, 2006). This kind of research results confirm that the explosiveness and power are essential for success on the highest level of sport performance in sports that include physical contact, such as handball. In the study of Bubanj and collaborators (Bubanj et al., 2010), the explosive power of lower extremities of the Faculty of sport and physical education students who practiced various sport activities, has been analysed. They performed the one-leg (either left or right) and two-leg Counter Movement Jump test. Using the Analysis of Variance (ANOVA) they concluded that there were no statistically significant differences found in the explosive power between the left and right leg, while some statistically significant differences were found between the jumps performed with both and with one leg only (either left or right). The authors confirm that these results could successfully be used in the athlete monitoring, that is in the monitoring of an athlete's achievements, talent identification, and the assessment of the athlete's readiness to rejoin the training process or the process of rehabilitation after injury. Explosive power is one of the success determinants of all activities which require performing of the maximum muscular force in the shortest period of time possible (Newton & Kraemer, 1994). The capacity to perform an explosive move is of great importance for sports performance and success in sports. The development of power, force and the rate of force development are being entitled with more importance then the training itself, at the moment of performing some specific task (Gašić i sar., 2011).

The object of this research is the explosive power of handball and basketball players.

The aim of this research is to determine the differences in explosive power between team handball and basketball players.

RESEARCH METHODS

The sample of respondents

This research's constituting population consists of elite athletes, the representatives of the highest

level of competition in our country. The total sample of male respondents, participating in this study, is 34 and consists of members of two sport clubs. These are the handball players of the handball club "Železničar" from Niš, the member of Serbian Handball Super League (n=19) and the basketball players of the Basketball Club "Konstantin" from Niš, the member of the Serbian First Basketball League (n=15). Team handball players subsample had the average of 27,6 years of age (SD±8,03), the average height of 187,6 cm (SD±6,05) and the average weight of 91,7 kg (SD±9,46). Basketball players subsample had the average of 22,5 years of age (SD±4,56), the average height 195,5 cm (SD±9,16) and the average weight 95,4 kg (SD±9,72). After being familiarized with the aim of the study, the respondents signed the consent agreeing to being included in the research.

Measuring instruments sample

The measuring instrument used for the assessment of the lower extremities' explosive power was the force platform, consisting of "NVM" sensors" and produced by the "TRCpro" organization from Novi Sad. The objects of the platform testing were various types of vertical jumps, which are analyzed using a computer, i.e. using the Catman® application software. The squat jump (SJ) represents the jump from a static posture. The test assesses the concentric component of jump explosiveness. The variables used in this study were: the maximum developed force during the jump (concentric phase peak), as well as the time needed to achieve that peak (concentric time). The counter movement jump (CMJ) represents the jump where all the phases are connected, i.e. there is no pause at the moment when the respondent changes the motion direction. The test assesses the eccentric-concentric component of jump explosiveness. The variables considered by this study are: the maximum developed force during the eccentric phase of the jump (eccentric phase peak), the maximum developed force during the concentric phase of the jump (concentric phase peak), as well as the time needed to achieve the eccentric phase peak (eccentric time) and also the time needed to achieve the concentric phase peak (concentric time).

Statistical analysis of the data

The "SPSS 21" statistical application package was used for the statistical analysis and results interpretation. The data have been processed using descriptive statistics. The Kolmogorov-Smirnov test was used for checking the normality of the distribution, while the T-test for independent samples was used for determining the possible differences in the explosive power of the lower extremities between the respondents of the two clubs.

RESULTS AND DISCUSSION

Before actually determining the differences in the measured parameters between the basketball and handball players, the descriptive statistics has been performed. The Kolmogorov-Smirnov test has also been performed to determine the normality of the distribution (table n°1). Based on the results shown in the table n°1, the assumption about the normality of the distribution is confirmed among 5 measured parameters (Sig.>0,05), except in the case of the counter movement jump concentric time (Sig=0,01), so this variable has been excluded from further analysis.

Table n°1. - *Kolmogorov-Smirnov test*			
	Statistic	df	Sig.
Eccentric time (Counter Movement Jump)	,097	33	,200*
Eccentric peak (Counter Movement Jump)	,095	33	,200*
Concentric time (Counter Movement Jump)	,206	33	**,001**
Concentric peak (Counter Movement Jump)	,135	33	,133
Concentric time (Squat Jump)	,098	33	,200*
Concentric peak (Squat Jump)	,165	33	,083

Table n°2. *The differences in terms of the explosive power between basketball and handball players*

	Players	N	Mean	t	p	Eta Squared
Eccentric time (Counter Movement Jump)	Basketball	14	0,199	-0,684	0,5	0,015
	Team handball	19	0,215			
Eccentric peak (Counter Movement Jump)	Basketball	14	-78,610	-3,715	**0,001**	**0,308**
	Team handball	19	-57,475			
Concentric peak (Counter Movement Jump)	Basketball	14	1712,546	-0,822	0,418	0,021
	Team handball	19	1827,190			
Concentric time (Squat Jump)	Basketball	14	0,30	0,097	0,923	0,000
	Team handball	19	0,297			
Concentric peak (Squat Jump)	Basketball	14	1166,332	-3,259	**0,003**	**0,255**
	Team handball	19	1566,296			

The differences in terms of the measured parameters between basketball and handball players have been performed using the T-test on independent samples. Based on the results shown in the table nº2, there is a statistically significant difference between the groups in question, in terms of the **force** effectuated during the concentric contraction of the **Squat Jump** (t=-3,259; p=0,003) (chart nº2). Based on the average (Mean) values, we can notice that the handball players (Mean=1566,296 N) obtain higher values of force while performing the **Squat Jump**, compared to the basketball players (Mean=1166,332N). Based on Eta Squared (Eta Squared=0**,**255), we can notice a **big** difference between the groups (according to Kohen: 0,01 is a small difference, 0,06 a medium difference, while 0,14 and more represent a big difference (Pallant,2011)). A basketball game is characterized by vertical jumps, unlike a handball one where, although the vertical jumps do exist, the predominant ones are the forward jumps. For that reason, it was expected from the basketball players to have better results, that is, to develop higher force values performing the **Squat Jump**, or at least no statistically significant difference for this type of jump was expected. However, this research shows that the handball players have higher resulting values, which made the authors of this study conclude that the main reason for this fact was fatigue, as the result of the competition schedule during the season. Namely, on the days around the testing period, the HC "Železničar 1949" team was approaching the end of the season, preparing for the last couple of games, while the basketball players

were participating in the final round of the Super League and they were playing two matches per week. Just before the testing, the basketball players had a very difficult match against BC "Radnički" from Kragujevac and they were preparing themselves for another strenuous match against BC "Partizan" from Belgrade. The difference could also be explained by a better physical preparedness of the handball players.

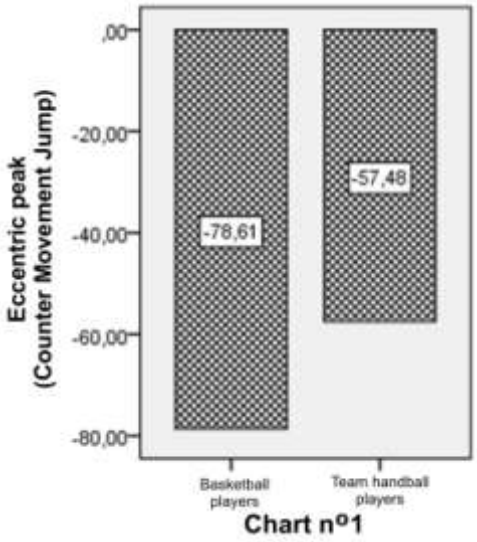

Chart nº1

By a further analysis and by also observing the Chart nº2, we can notice that there is a statistically significant difference between the basketball and handball players in terms of the **thrust** developed during the execution of the Counter **Movement Jump.** (t=-3,715; p=0,001) (chart nº1). Based on the average (Mean) values, we can notice that the handball players (Mean=-57,48kg) obtained higher values compared to the basketball players (Mean=-78,61kg). Based on Eta Squared (Eta Squared=0,308) we can notice a **big** difference between the groups (according to Kohen: 0,01 represents a small difference, 0,06 a medium difference, while 0,14 and more stands for a big difference (Pallant,2011)).

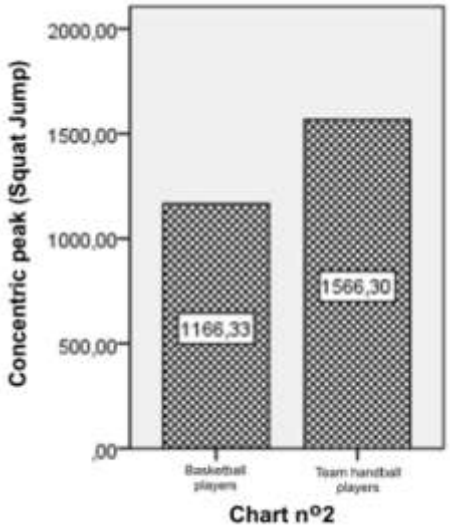

Chart nº2

CONCLUSION

On the basis of this research, it is not possible to determine with certainty the existence of the differences in terms of explosive power between basketball and handball players. They were detected in only two variables (force and thrust). The non-existence of the differences could be attributed to the respondents' samples, which were in both cases

positively selected in relation to the analysed ability. The generalization of this study's result is not justified, considering this is a relatively small sample, but it can be of great use to the basketball and handball experts as a guide line. It can also serve as a good guide mark for future studies.

REFERENCES

Asci, A.,& Acikada, C. (2007). Power production among different sports with similar maximum strength. *Journal of Strenght and Conditioning Research*, 21: 10-16.

Bayios, I. & Boudolos, K. (1999). The relationship between isokinetic strength of the internal and external shoulder rotators and ball velocity in team handball. U (Ur.) , Rome, (p.p. 206).

Bubanj, S., Stanković, R., Bubanj, R., Dimić, A., Bednarik, J., & Kolar, E. (2010). Razlike u vertikalnom skoku izvedenom odskokom sa jedne i sa dve noge. *Facta universitatis - series: Physical Education and Sport*, 8(1): 89-95.

Drinkwater, J., Pyne, D., & McKenna, M. (2008). Design and Interpretation of Anthropometric and Fitness Testing of Basketball Players. *Sports Medicine,* 38(7): 565-578.

Gašić, T., Bubanj, S., Živković, M., Stanković, R., Bubanj, R., Obradović, B. (2011). Razlike u eksplozivnoj snazi gornjih ekstremiteta između sportista u odnosu na njihovu sportsku aktivnost, vrstu angažmana u sportu i pol. *Sport science*, 4(1): 63-67.

Gillam, G. (1985). Identification of anthropometric and physiological characteristics relative to participation in college basketball. *Nation Strength Condit J*, 7: 34-36.

Gorostiaga, M., Granados, C., Ibanez, J., & Izquierdo, M. (2005). Differences in physical fitness and throwing velocity among elite and amateur male handball players. *International Journal of Sports Medicine*, 26(3):225-232.

Gorostiaga, M., Granados, C., Ibarez, J., Gonzalez-Badillo, J., & Izquierdo, M. (2006). Effects of an Entere Season on Physical Fitness Changdes in Elite Male Handball Players*. Med. Sci. Sports Exerc*., 38(2): 357-366.

Hakkinen, K. (1991). Force production characteristics of leg extensor, trunk flexor and extensor muscles in male and female basketball playuers. *J Sports Med Phys Fitness*, 31: 325-331.

Kotzamanidis, C., Karahekaglas, A., Kiparos, A., Giavroglov, A. & Tsaarouhas, E. (1995). The relationship between the physical and strength variables of the lower limbs and the velocity of ball release in various types of handball throws. *European Handb*all, 2: 25-30.

Kozomara, S. & Kozomara, G. (2009). The comparement of lower leg speed tt resultant at handball jump shots during rebound and landing, as possible anterior cruciate ligament injury prevention*, Acta Kinesiologica*, 3 (1): 44-49.

Maffiuletti, A., Cometti, G., Amiridis, G., Martin, A., Pousson, M., Chatard, J-C. (2000). The Effects of Electromyostimulation Training and Basketball Practice on Musle StrEngth and Jumping Ability. *Int J Sports Med*, 21:437-443.

McInnes, E., Carlson, S., & McKenna, J. (1995) The physiological load imposed on basketball plazers during competitions. *J Sports Sci*, 13: 387-397.

Newton, R.U. & Kraemer, W.J. (1994). Developing explosive muscular power: implications for a mixed methods training strategy. *Strength and Conditioning Journal*, 16(5), 20-31.

Popadic-Gacesa, J., Barak, O., & Grujic, N. (2009). Maximal anaerobic power test in athletes of different sport disciplines. *Journal of Strength and Conditionign Research,* 23(3): 751-755.

RAZLIKE U EKSPLOZIVNOJ SNAZI IZMEĐU RUKOMETAŠA I KOŠARKAŠA

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SAŽETAK

Cilj ovog transferzalnog istraživanja je da se na osnovu adekvatnih motoričkih testova utvrde razlike u eksplozivnoj snazi između rukometaša i košarkaša. Uzorak ispitanika u ovom radu činili su rukometaši RK "Železničar 1949" Niš, član Rukometne Super Lige Srbije (n=19) i košarkaši OKK" Konstantin" Niš član Prve Košarkaške Lige Srbije (n=15). Kao adekvatna aparatura za procenu eksplozivne snage u ovom istraživanju korišćena je tenziometrijska platforma. Testovi koji su bili primenjeni su skok iz počučnja i skok iz čučnja. Za utvrđivanje eventualnih razlika u eksplozivnoj snazi korišćen je T-test za nezavisne uzorke. Na osnovu rezultata dobijenih T-testom utvrđeno je da većim delom ne postoje statističke ni informacione razlike u eksplozivnoj snazi između istraživanih uzoraka.

Ključne reči: Eksplozivna snaga, rukometaši, košarkaši.

THE MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES IN SPORTS CLIMBERS

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UDC 796.012.422

SUMMARY

The aim of this paper was to review the researchs related to the morphological characteristics and motor abilities in sports climbers. Based on the available literature, it can be concluded that the climbers are of small to medium body height, mesomorph-ectomorf somatotype, have a small percentage of body fat, a higher *ape index* and relative strength compared to the normal population. It may also be noted that a huge strength of the arms and fingers sets apart the climbers from other athletes, , and that rock climbing training may result in some specific adaptations of the organism. Grip strength and hand grip endurance decreases during heavy continuous rock climbing, and there is a hierarchy in the way of adjusting the body position in relation to the movement performed. The motor components essential for success in sport climbing were specified - strength, endurance, flexibility and coordination. A specific climbing endurance of muscle strength, muscle endurance and a great upper-body strength, the relative strength and the concentric muscle flexion of the wrist, as well as a specific static strength and the climbing time before becoming exhausted are all highly important conditions for success.

Key Words: somatotype, specific strength

INTRODUCTION

Sports climbing today is a complex sport, complete with its own vocabulary and equipment that have come as a result of decades of experimentation. It has, for many years, been one of the fastest growing leisure activities, involving millions of people worldwide (Creasey et al., 1999, Stanković et al, 2011). According to the sports classification, sports climbing belongs to a group of combined (complex) sports. They are characterized by a high variety of movements in the conditions of compensated fatigue and a changing intensity of exercise (Verhosanski et al., 1992). The immanent characteristics of these sports are a changeable competition situation and a need to preserve a high level of working capacity in the compensated fatigue conditions. (Verhosanski et al., 1992).

Performing in the vertical plane requires physical capabilities such as strength, power, and endurance. It also demands the development of technical skills such as balance and economic movement while gripping and stepping in an infinite variety of ways, positions, and angles. Most importantly, the inherent stress of climbing away from the safety of the ground requires an acute control of your thoughts, focus, anxiety, and fears. All in all, the abovementioned factors form what may be one of the more complex sporting activities on this third rock from the sun (Horst, 2003).

Rock climbing movements require following a pattern that mostly exerts abundant pressure on the musculoskeletal system of the upper limbs. The total body weight is placed on a hand and one finger or more, many times during the performance. Active limbs, such as the hand and finger in particular, acting as a support and connection points between a climber's body and the wall, are susceptible to movement injuries (Shahram et al., 2007).

In the Balkans, this is a relatively new sport so very few researchers have conducted their studies in the area of this extremely complex sport. However, on the international level the body of researh on this sport and the experiments conducted on the climbing population is an enormous one. (Stanković et al., 2009)

The aim of this paper is to review the studies that are related to the morphological characteristics and motor abilities in sports climbers.

METHOD

By reviewing these studies it can be noted that much of the research related to sports climbing compares climbers and other athletes or non-athletes. (Cutts & Bollen, 1993; Watts et al.,1993; Stojnik et al, 1995; Grant et al., 1996; Quaine et al., 1997a; Grant et al., 2001; Grant et al., 2003; Watts et al., 2003a; Rodio et al., 2006). Most of these authors came to the conclusion that the climbers are of small to medium body height, have a small percentage of body fat and a high power-weight ratio (high relative strength) compared to the normal population. It may also be noted that the climbers, compared to other athletes, have a huge strength of the arms and fingers, and that rock climbing training may result in some specific adaptations of the organism.

Considering the study of the morphological characteristics of sport climbers, their somatotype is mesomorph-ectomorf (Viviani et al., 1991; Watts et al., 1993; Alvero-Cruz, 2011), and the climbers have a small percentage of body fat. (Viviani et al., 1991; Watts et al., 1993; Watts et al., 2003a; Chueng 2009; Tomaszewski et al., 2011; Wilson et al., 2011). *Ape* index (ratio between body height and arm span) in climbers in both sexes is greater (Chueng 2009; Mitchell et al., 2011; Tomaszewski et al., 2011; Wilson et al., 2011) and higher than the one in normal population (Tomaszewski et al., 2011). Although they are characterized by a smaller body compared to other athletes, the morphological characteristics did not prove to be the dominant factor affecting the outcome of a sport climbing performance. (Mermier et al., 2000; España-Romero et al., 2006; Mihailov et al., 2009; Tomaszewski et al., 2011)

Other researchers have studied the problems of the development of the grip and finger strength (Watts et al., 1996; Watts et al., 2003b, Davis, 2004) and the balance of sport climbers (Quaine & Martin, 1999). They came to the conclusion that the handgrip strength and endurance decrease with a continuous difficult rock climbing and remain depressed after 20 minutes of resting recovery. It also appears that the handgrip strength recovers at a faster rate than the handgrip endurance, and that there is no change in the handgrip strength, which is an essential climbing performance measure, during the training process. It was found that there is a hierarchy in the way of adjusting the body position in relation to the movement performed. Wats (2004) explained that the climb performance requires the use of both hands and the top climbers have a great symmetry of hand grip strength of both hands.

As for the difference in strength between men and women sport climbers (Binney & Cochrane, 2003 Stankovic et al., 2009b) and the development of a specific strength of sports climbers (Stanković & Aleksandrović, 2008), the results suggest that the differences in strength relative to the body weight between male and female competitor in sport climbing are comparable to the male-female differences in the competition, and that the 4-3-2-1 system of training is a good training system for increasing the specific strength of sport climbers.

Drapper and Hodgson (2008) have summarized the motor components for climbing and identified four key subspaces (strength, endurance, flexibility and coordination) and confirmed the earlier studies by Goddard and Neumann out in 1993. which showed exactly those four factors that are important for a successful climbing performance.

Regarding the strength, a specific climbing endurance in the forearm muscle strength is the basis for a great possibility of success (Binney & Cochrane, 2003c), while muscular endurance and a great upper-body strength are also very important (Wattts, 2004), as well as the relative strength and

the concentric wrist flexion muscles (Schweizer & Furrer, 2007), along with a specific static strength (Stanković et al., 2011) and the climbing time before noticing exhaustion (Espana-Romero et al., 2009).

As a sports form depends exclusively on the choice of the appropriate training models the, coaches and the athletes would have to know that the "winning" abilities should be developed. (Binney & Cochrane, 2003a) Some researchers are searching the predictors of success in sport climbing by using biomechanical analyzes (Quaine et al., 1997b; Binney & Cochrane, 2003b). However, most studies of success in sport climbing are related to the physiological responses of the body during sport climbing (Booth et al., 1999; Meimer et al., 2000; Davis, 2004; Sheel, 2004; Macleod et al., 2007).

CONCLUSION

In the end, it can be concluded that the climbers are of small to medium body height, mesomorph-ectomorf somatotype, have a small percentage of body fat, a higher *ape index* and relative strength compared to the normal population. It may also be noted that what set the climbers apart from other athletes is a huge strength of their arms and fingers, and that rock climbing training may result in some specific adaptations of the organism. Grip strength and hand grip endurance decrease during heavy continuous rock climbing, and there is a hierarchy in the way of adjusting the body position in relation to the movement performed. The motor components, essential for success in sport climbing, are grouped into - strength, endurance, flexibility and coordination. . A specific climbing endurance of muscle strength, muscle endurance and a great upper-body strength, the relative strength and the concentric muscle flexion of the wrist, as well as a specific static strength and the climbing time before becoming exhausted are all highly important conditions for success. However, most studies of success in sport climbing are related to the physiological responses of the body during sport climbing.

REFERENCES

Alvero-Cruz, J. R. (2011). Somatotipo, masa grasa y muscular del escalador Deportivo Español de elite. *International Journal of Morphology*, 29 (4), 1223-1230.

Binney, D.M., & Cochrane, T. (2003a). *Differences in Strength Between Male and Female Competative Rock Climbers*. *2nd International Conference on Science and Technology in Climbing and Mountaineering* Preuzeto 15.10.2007. sa http://www.trainingforclimbing.com/new/research/binney2003a.shtml

Binney, D.M., & Cochrane, T. (2003b). Rock Climbing Trajectory: A Global Variable of Rock Climbing Performance. *2nd International Conference on Science and Technology in Climbing and Mountaineering*. Preuzeto 15.10.2007. sa http://www.trainingforclimbing.com/new/research/binney2003d.shtml

Binney, D.M., & Cochrane, T. (2003c). Competative Rock Climbing: Phyliological and Anthropometric Attributes. *2nd International Conference on Science and Technology in Climbing and Mountaineering* Preuzeto 15.10.2007. sa http://www.trainingforclimbing.com/new/research/binney2003b.shtml

Booth, J., Marino, F., Hill, C., & Gwin, T. (1999). Energy cost of sport rock climbing in elite performers. *British Journal of Sports Medicine*, 33, 14-18.

Chueng, W. Y. (2009). *The anthropometric and physiological profile of Hong Kong elite male competition climbers*. Neobjavljeni magistarski rad, Hong Kong: Baptist University.

Creasey, M., Shepherd, N., Banks, N., Gresham, N., & Wood, R. (1999). *The Complete Rock Climber.* London: Lorenz Books.

Cutts, A., & Bollen, S.R. (1993). Grip strength and endurance in rock climbers. *Proceedings of the Institution of Mechanical Engineers H. Journal of Engineering in medicine*, 207 (2), 87-92.

Drapper, N., & Hodgson, C. (2008). *Adventure Sport Physiology"*. Chichester, UK: John Wiley and Sons, Ltd.

España-Romero, V., Ortega Porcel, F. B., García-Artero, E., Ruiz, J. R. & Gutiérrez Sainz, A. (2006). Características de rendimiento, antropométricas y de fuerza muscular en el escalador de elite español. *Journal Selección*, 15(4), 176-183.

España-Romero, V., Ortega Porcel, F.B., Artero, E.G., Jiménez-Pavón, D., Sainz, A.G., Castillo Garzón, M.J., & Ruiz, J.R. (2009). Climbing time to exhaustion is a determinant of climbing performance in high-level sport climbers. *European Journal of Applied Physiology*, 107(5), 517-525.

Grant, S., Hynes, V., Whittaker, A., & Aitchison, T. (1996). Anthropometric, strength, endurance and flexibility characteristics of elite and recreational climbers. *Journal of Sports Sciences,* 14 (4), 301-309.

Grant, S., Hasler, T., Davis, C., Aitchison, T.C., Wilson, J., & Whittaker, A. (2001). A comparison of the anthropometric, strength, endurance and flexibility characteristics of female elite and recreational climbers and non-climbers. *Journal of Sports Sciences*, 19 (7), 499-505.

Grant, S., Shields, C., Fitzpatrick, V., Ming, L., Whittaker, A., Watt, I, & Kay, J. (2003). Climbing-specific finger endurance: a comparative study of intermediate rock climbers, rowers and aerobically trained individuals. *Journal of Sports Sciences*, 21 (8), 621-630.

Goddard, D, & Neumann, U. (1993). *Performance Rock Climbing.* Mechanicsburg, PA: Stackpole Books.

Horst, E. J. (2003). *Training for Climbing: The Definitive Guide for Improving Your Climbing Performance*. Guilford: Falcon Press.

Macleod, D., Sutherland, D.L., Buntin, L., Whitaker, A., Aitchison, T., Watt, I., Bradley, J., & Grant, S. (2007). Physiological determinants of climbing-specific finger endurance and sport rock climbing performance. *Journal of Sports Sciences,* 25 (12), 1433-1443.

Mermier C.M., Janot, J.M., Parker, D.L., & Swan, J.G. (2000). Physiological and anthropometric determinants of sport climbing performance*. British Journal of Sports Medicine*. 34 (5), 359-366.

Mihailov, M. L., Mladenov, L. V. & Schoffl, V. R. (2009). Anthropometric and strength characteristics of World-class boulderers. *Medicina Sportiva*, 13 (4), 231-238.

Mitchell, A. C., Bowhay, A. & Pitts, J. (2011). Relationship between anthropometric characteristics of indoor rock climbers and top roped climbing performance. *Journal of Strength and Conditioning Research*, 25 (1), 94-95.

Quaine, F., Martin, L. (1999). Biomechanical study of Equilibrium in Rock Climbing. *1st International Conference on Science and Technology in Climbing and Mountaineering*. Preuzeto 17.11 2007. Sa http://www.leeds.ac.uk/sports_science/abstracts/climb99/fquaine.htm

Quaine, F., Martin, L., & Blanchi, J. (1997a). The effect of body position and number of supports on wall reaction forces in rock climbing. *Journal of Applied Biomechanics*, 13, 14-23.

Quaine, F., Martin, L., & Blanchi, J. (1997b). Effect of a leg movement on the organisation of the forces at the holds in a climbing position 3-D kinetic analysis. *Human Movement Science*, 16, 337-346.

Rodio A., Quattrini F. M., Fattorini L., Egidi F., & Marchetti M. (2006). Physiological significance of efficiency in rock climbing. *Medicina dello Sport*, 59 (3), 313.

Schweizer, A., & Furrer, M. (2007). Correlation of forearm strength and sport climbing performance. *Isokinetics and Exercise Science*, 15 (3), 211-216.

Shahram, A., Farzad, A., & Reza, R. (2007). A study on the prevalence of muscular-skeleton injuries of rock climbers. *Facta Universitatis*, *Series Physical Education and Sport*, 5 (1), 1-7.

Sheel, A.W. (2004). Physiology of sport rock climbing. *British Journal of Sports Medicine*. 38, 355-359.

Stanković, D., & Aleksandrović, M. (2008). Vpliv desettedenskega štiriciklusnega treninga na umetni steni na razvoj specijalne moči športnih plezalcev. *Revija za teoretična in praktična vprašanja športa Šport*, Ljubljana, LVI (1-2), 85-88.

Stanković, D., Joksimović, A., Raković, A., Michailov, M., & Piršl, D. (2009a). Metric characteristics of the specific strength sports climbers tests. *Facta Universitatis, Series: Physical Education and Sport,* 7 (2), 161 – 169.

Stanković, D., Raković, A., Aleksandrović, A., & Joksimović, A. (2009b). Differences in male and female competitors in basic parameters of the patterns and success in sports climbing. *Sport and science,* br.1, Sofija, 167-174.

Stanković, D., Joksimović, A., & Aleksandrović, M. (2011). Relation and influences of sports climbers' specific strength on the success in sports climbing. *South African Journal for Research in Sport, Physical Education and Recreation*, 33 (1), 121-131.

Strojnik, V., Apih, T., & Dempsar, F. (1995). Cross-section areas of calf muscles in athletes of different sports. *Journal of Sports Medicine and Physical Fitness*, 35, 25-30.

Tomaszevski, P., Gajewski, J. & Lewandowska, J. (2011). Somatic profile of competitive sport climbers. *Journal of Human Kinetics*, 29, 107-113.

Verhošanski, V.J., Šestakov, M.P., Novikov, P.S., & Nićin, Đ.A. (1992). *Specifična snaga u sportu*. Novi Sad: Prometej & Fakultet fizičke kulture.

Viviani, F. & Calderan, M. (1991). The somatotype in a group of „top" free-climbers. *The Journal of Sports Medicine and Physical Fitness*, 31 (4), 581-586.

Watts, P.B. (2004). Physiology of difficult rock climbing. *European Journal of applied Physiology*, 91, 361–372.

Watts, P.B., Martin, D., Sh., & Durtschi (1993). Anthropometric profiles of elite male and female competitive sport rock climbers. *Journal of Sports Sciences,* 11 (2), 113-117.

Watts, P.B., Newbury, V., & Sulentić (1996). Acute changes in handgrip strength, endurance, and blood lactate with sustained sport rock climbing. *Journal of Sports Medicine and Physical Fitness*, 36 (4), 255-260.

Watts, P.B., Joubert, L.M., Lish, A.K., Mast, J.D., & Wilkins (2003a). Anthropometry of young competetive sport rock climbers. *British Journal of Sports Medicine*, 37, 420-424.

Watts, P.B., Randall, & Jensen, R.L. (2003b). Reliability of Peak Forces During a Finger Curl Motion Common in Rock Climbing. *Measurement in Physical Education and Exercise Science*, 7 (4), 263-267.

Watts, P.B. (2004). Physiology of difficult rock climbing. *European Journal of Applied Physiology,* 91(4), 361-372.

MORFOLOŠKE KARAKTERISTIKE I MOTORIČKE SPOSOBNOSTI SPORTSKIH PENJAČA

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SAŽETAK

Cilj ovog rada bio je da se izvrši pregled istraživanja koja su vezana za morfološke karakteristike i motoričke sposobnosti sportskih penjača. Na osnovu dostupne literature može se zaključiti da su penjači malog do srednjeg rasta, mezomorfno-ektomorfnog somatotipa, poseduju veoma mali procenat telesnih masti, veći *ape index* i veliku relativnu snagu u odnosu na normalnu populaciju. Takođe, može se primetiti da penjače od ostalih sportista izdvaja velika snaga ruku i prstiju, kao i to da trening sportskog penjanja može rezultovati nekim specifičnim adaptacijama organizma. Snaga stiska šake i izdržljivost stiska šake smanjuje za vreme teškog kontinuiranog sportskog penjanja, a postoji i hijerarhija u načinu prilagođavanja položaja tela u odnosu na pokret koji se izvodi. Izdvojene su i motoričke komponente bitne za uspeh u sportskom penjanju - snaga, izdržljivost, fleksibilnost i koordinacija, a visoku predikciju na uspeh u sportskom penjanju imaju i specifična penjačka izdržljivost u snazi mišića, mišićna izdržljivost i velika snaga gornjeg dela tela, zatim relativna snaga i koncentrična fleksija mišića zgloba šake, kao i specifična statička snaga i vreme penjanja do iscrpljenosti.

Ključne reči: somatotip, specifična snaga

ANTHROPOMETRICAL MEASUREMENTS IN FEMALE JUDOKAS VS RECREATIONAL FOLK-DANCE SUBJECTS

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UDC 793.3035

SUMMARY

Aim: To determine the body composition and somatotype indices that may be able to distinguish elite female judo athletes and recreational level females.

Methods: A total of 26 healthy female participants took place in this cross-sectional study, 12 Serbian elite judokas and 14 recreational folk-dancers with less than 2 hours of practice per week. Body composition estimation was taken with same methodology to all participants, during the competitive period in judokas. The Student-T test was used to analyze differences between the two groups in the anthropometrical variables.

Results: Judoka athletes presented lower values in body fat percentage ($p=0.001$), triceps ($p<0.001$), subscapular ($p=0.002$), medial calf (0.001) and abdominal (0.007) skinfolds compared to untrained subjects. In addition, judokas shown significantly higher results in girths with following variables: arm flexed and tensed, and calf ($p<0.001$). The somatotype components presented significantly lower values in endomorphy ($p=0.002$) and ectomorphy ($p=0.017$), with a non-significant higher mesomorphy value ($p=0.059$).

Conclusions: Judo training in elite level athletes seems to produce changes in the body composition and somatotype profile. Generally, elite female judokas showed lower body fat mass and higher muscle mass compared to recreational dancers of similar age.

Key Words: Anthropometry, body build, judo.

BACKGROUND

The body composition and somatotype in elite judokas has been correlated with physical performance variables, as anaerobic power, muscle torque or power output (Kim et al., 2011; Lewandowska et al., 2011). In addition, these anaerobic and aerobic components are determinat for sucsess in judo competitions (Thomas et al., 1989; Krstulovic et al., 2005). Therefore, the somatotipe and anthropometric profile of elite judokas seems to be an interesting factor in the overall judoka physical evaluation.

Franchini *et al* (2011) suggested that are needed more studies to establish this relationship between the body composition and performance. Although we have to consider that judo is a dynamic and high-intensity intermittent sport, in which complex skills and tactical components are needed for success (Degoutte et al., 2003). Accordingly, anthropometric profile and physcial condition in judokas must be considered in conjuction with technical and tactical components (Sterkowicz et al., 2011).

Interesntingly, morphological variables have also been analysed in correlation with technical actions during combat (Franchini et al., 2005). In line with that, in order to improve some morphological characteristics in judokas this could be an important factor to take a relevant place in the training program.

Comparison of morphological body composition in elite judo athletes to the recreational level athletes could clarify the effect of judo training (Sterkowicz et al., 2011). These body build indices which permit to differenciate between female elite judokas and recreational level female athletes are not well-establish yet.

Thus, the aim of the present study was to determine body composition and somatotype profile and to find indicators that distinguishes female elite judokas and recreational folk-dance subjects. Obtained results could suggest the judo training effect in the female's body build, and could be used for the identification and selection of talented athletes.

METHODS

Participants

The sample consisted of 26 healthy female participants, 12 elite judokas from the Serbian national team (weight categories from 48-78 kg) and 14 recreational sport practitioners. Judokas subjects were members of the Serbian national team, and all of them were state champions or vice-champions for at least two years in a row. In addition, elite judokas won Balkan's championship at least once, or were placed in top 5 at junior or senior European championships in the past two years. Judokas have at least 18 hours of training weekly, 9 hours of specific judo training and the rest were other types of training. Untrained females only practiced physical activity 2 hours per week (2 sessions of 1 hour per week). Their physical activity consisted in Serbian folklore dance lessons as a recreational practice.

Judokas and untrained females volunteered to take part in the study and did not take any supplements or medications 48 hours prior to testing. Written informed consents were obtained from all participants before study entry or from both parents in case of subjects under 18 years old. The present study had the approval from the Novi Sad University's Ethical Advisory Commission.

Experimental design

In this cross-sectional study, body composition and somatotypes were presented and compared between the two experimental groups (Serbian elite judokas and recreational dancers). The study was carried out at the beginning of the training program for the 2007 Balkan Championships in Greece. Participants reported to the anthropometric assessment at 10 a.m. after a rest, they all consumed light breakfast (500 kcal) in the morning.

Anthropometric variables and body composition

Anthropometric variables were performed following the protocol developed by the International Society for Advanced of Kinanthropometry (ISAK) (Marfell-Jones et al., 2006). Anthropometric variables included body mass, height, 5 skinfolds (triceps, subscapular, supraspinal, abdominal and medial calf), 3 girths (arm flexed and tensed, and medial calf) and 2 breadths (humeral and femoral epicondyles). Height was measured to the nearest 0.5 cm using a stadiometer (Holtain Ltd., UK). Weight was measured to the nearest 0.1 kg using a balance beam scale (Avery Ltd., Model 3306 ABV). Skinfold thickness were obtained using a Harpenden caliper (British Indicators Ltd., St. Albans, UK). The girths were performed using a Gulick anthropometric tape (Creative Health Products, Plymouth, USA), and the breadths were measured with an anthropometer (Lafayette Co., USA). Skinfolds were taken three times on each point in a rotation system, as described by Heyward (1977), and the mean of 3 measurements was used in the analyses. All measurements were done by the same trained technician.

Body mass index (BMI) was calculated as weight/height^2 where weight was expressed in kilograms (kg) and height in meters (m). Somatotypes were determined according to the Carter and Health method (1990). Body fat (Carter,

1982) were calculated using the procedures described by the ISAK (Heyward, 1977).

Statistical analysis

Data are presented as mean ± standard error of the mean (SEM). The Shapiro-Wilk statistic was used to test the normality of distributions. Differences between two experimental groups were compared using a Student t-test. All analyses were carried out using the SPSS statistical package (version 17.0; SPSS, Inc, Chicago, Illinois, USA), and the level of significance was set at $p<0.05$.

RESULTS

General and anthropometric statistical differences between two experimental groups are shown in table 1.

Table 1. General and anthropometric characteristics of the female participants. *: significant statistical differences ($p<0.05$) between Serbian elite judokas and untrained. P: p value. SEM: standard error of the mean.

Variables		***Judokas***			***Untrained***				*P*
		Mean		SEM	Mean		SEM		
Age (years)		20.50	±	1.13	19.50	±	0.76		0.460
Height (cm)		166.17	±	2.49	172.50	±	1.37	*	0.300
Weight (kg)		60.37	±	2.31	61.55	±	1.74		0.681
Skinfolds (mm)	Triceps	10.13	±	1.00	20.06	±	1.79	*	<0.001
	Subscapular	8.55	±	0.64	13.13	±	1.12	*	0.002
	Supraspinal	10.73	±	1.23	13.59	±	2.32		0.311
	Medial calf	10.55	±	1.22	18.59	±	1.79	*	0.001
	Abdominal	13.85	±	1.71	23.91	±	2.91	*	0.007
Breadths (cm)	Humerus	6.27	±	0.09	6.21	±	0.09		0.635
	Femur	8.14	±	0.15	9.22	±	0.10	*	<0.001
Girths (cm)	Arm flexed	28.79	±	0.52	25.25	±	0.52	*	<0.001
	Arm tensed	30.78	±	0.43	26.79	±	0.52	*	<0.001
	Calf	34.55	±	0.60	37.79	±	0.44	*	<0.001
Somatotype	Endomorphy	3.04	±	0.29	4.57	±	0.33	*	0.002
	Mesomorphy	3.62	±	0.28	2.93	±	0.22		0.059
	Ectomorphy	2.51	±	0.31	3.45	±	0.19	*	0.017
Body Mass Index (kg/m2)		21.83	±	0.58	20.64	±	0.38		0.090
Body Fat (%)		12.40	±	0.59	16.60	±	0.95	*	0.001
n =		12			14				

Figure 1 shows the somatotype distributions of the Serbian elite female judokas and the recreational practitioners.

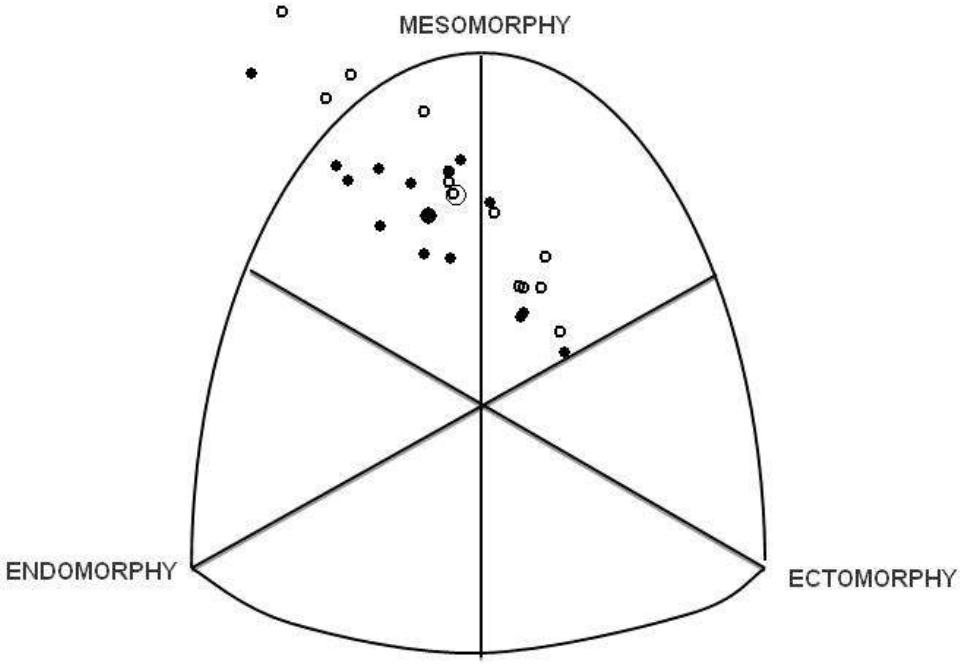

Figure 1. Somatotype distribution of Serbian elite female judokas (n=12) and untrained subjects (n=14). Symbol ◦: judokas. Symbol ○: judokas' mean. Symbol •: recreational. Symbol ●: recreational' mean.

DISCUSSION

The main finding of this study is the statistically significant difference in the somatotype profile between female judo athletes from the Serbian national team and the recreational sport practitioners.

Our results showed lower body fat content of judokas respect to untrained in several variables as the total body fat percentage and skinfolds. Accordingly, Sterkowicz-Pibicien and Almasba (2011) showed a significant higher body fat in untrained females compared to elite judo athletes. However, other study in males (Sterkowicz et al., 2011) found significant lower fat mass, fat-free mass index and body mass index (BMI) in the untrained group.

The higher girths' values in judokas are presented due to a higher muscle mass, given that the fat mass is lower than in untrained subjects and breaths seemed to show a similar bone mass or even lower. A recent study (Koga et al., 2011) determined that a judo long-term training strengthened muscular function, so the higher muscular mass could be explained by the mechanisms involve in the general sport practice, and specifically in judo training process which has a high anaerobic component and a high intensity level.

Somatotype components were significantly different in endomorphy and ectomorphy, and with a p value very close to the significant level (p=0.059) in mesomorphy. Thence, our two experimental groups had shown really different somatotype profile, which is in line with similar results obtained in other studies (Sterkowicz-Prybycień and Almansba, 2011).

In addition, judokas had a significantly lower body height, which can be due to the selection process in judo, since some studies reported that female judo athletes with lower body height and body fat mass demonstrate a higher level of specific physical condition (Smulski et al., 2011).

In this direction, we have to be careful with the interpretation of our data. We would like to highlight that findings in the present study were generated from a cross-sectional study and we cannot conclude if the effects are really due to a long judo training process.

Jagietto *et al* (2007) reported a female morphological diversification, with weight

categories as a determinant factor. For this reason, it would be interesting a long-term study with a higher subject sample: in order to determine the anthropometric profile of elite female judokas by categories, and comparing this data with untrained females of similar weight.

CONCLUSIONS

The present study shows significant differences in the anthropometrical profile of elite female judokas compared to recreational dancers. In this sense, elite female judokas shown lower body fat mass, and seemed to present a higher muscle mass compare to the recreational level subjects of similar age.

Therefore, a long judo training process in elite level could produce some body build changes in females; more studies are needed to elucidate the relevant anthropometric characteristics for success in female judo athletes which could be very useful for the training adjustment or for selection in talented female judokas.

REFERENCES

Carter, J. (1982). Body composition of Montreal Olympic athletes. In: Carter J. Physical structure of Olympic athletes Part 1. The Montreal Olympic Games Anthropological Project. Basel, Switzerland: Karger: 107-16.

Carter, J.E.L., Health, B.H. (1990). *Somatotyping: development and applications*. Cambridge, UK: Cambridge University Press.

Degoutte, F., Jouanel, P., Filaire, E. (2003). Energy demands during a judo match and recovery. *Br J Sports Med*, 37, 245-249.

Franchini, E., Del Veccio, F.B., Matsushigue, K.A., et al. (2011). Physiological profiles of elite judo athletes. *Sports Med*, 41, 147-166.

Franchini, E., Takito, M.Y., Bertuzz,i R.C.M. (2005). Morphological, physiological and technical variables in high-level college judoists. *Archives of Budo*, 1, 1-7.

Heyward, V.H. (1977). *Advanced fitness assessment and exercise prescription*. Champaign, IL: Human Kinetics.

Jagietto, W., Kalina, R.M., Korobielnikow, G. (2007). Morphological diversification of female judo athletes. *Archives of Budo*, 3, 27-34.

Kim, J., Cho, H.C., Jung, H.S., et al. (2011). Influence of performance level on anaerobic power and body composition in elite male judoists. *J Strength Cond Res*, 25, 1346-1354.

Koga, T., Umeda, T., Kojima, A., et al. (2011). Influence of a 3-month training program on muscular damage and neutrophil function in male university freshman judoists. *Luminescence*; doi: 10.1002/bio.2352

Krstulovic, S., Sekulic, D., Sertic, H. (2005). Anthropological determinats of succes in young judoists. *Coll Antropol*, 29, 697-703.

Lewandowska, J., Busko, K., Pastuszak, A., et al. (2011). Somatotype variables related to muscle torque and power in judoists. *J Hum Kinet*, 30, 21-28.

Marfell-Jones, M., Olds, T., Stewart, A. et al. (2006). *International Standards for Anthropometric Assessment*. Potchefstroom, SAF: North-West University.

Thomas, S.G., Cox, M.H., Legal, Y.M., et al. (1989). Physiological profiles of the Canadian National Judo Team. *Can J Sport Sci*, 14, 142-147.

Smulski, W., Wolska, B., Jagiello, W., et al. (2011). The correlation of general and sport-specific preparation indices of elite female judo competitors with their age-somatic characteristics. *Archives of Budo*, 7, 233-238.

Sterkowicz, S., Lech, G., Palka, T., et al. (2011). Body build and body composition vs. physical capacity in young judo contestants compared to untrained subjects. *Biology of Sport*, 28, 271-277.

Sterkowicz-Prybycień, K., Almansba, R. (2011). Sexual dimorphism of anthropometrical measurements in judoists vs untrained subject. *Science & Sports*, 26,316-323.

ANTROPOMETRIJSKE MERE DŽUDISTKINJA U ODNOSU NA ŽENE KOJE SE REKREATIVNO BAVE FOLKLOROM

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SAŽETAK

Cilj: Da se odrede telesna kompozicija i indikatori somatotipa koji bi mogli da izdvoje vrhunske džudistkinje od žena na nivou rekreativnog bavljenja folklorom.

Metode: Ukupno 26 zdravih ispitanica je učestvovalo u ovoj transverzalnoj studiji. U jednoj grupi je bilo 12 džudistkinja, članica reprezentacije Srbije, dok je drugu grupu sačinjavalo 14 žena rekreativnih folklornih plesača, koje su imale aktivnosti u trajanju od dva sata nedeljno. Procena kompozicije tela je urađena po istoj metodologiji za sve učesnice studije, tokom takmičarskog perioda džudistkinja. Za analizu razlika u antropometrijskim varijablama između ove dve grupe korišten je Studentov t-test.

Rezultati: Džudistkinje su pokazale procentualno niže vrednosti masnog tkiva (p=0,001), i kožnih nabora tricepsa (p<0,001), subscapularnog (p=0,002), spoljnog dela podkolenice (0,001) i abdominalnog kožnog nabora (0,007) u poređenju sa rekreativnom grupom. Pored toga, džudistkinje su pokazale značajno veće rezultate u sledećim varijablama za procenu obima: obim nadlakta savijene i opružene ruke i potkolenice (p<0,001). Komponente somatotipa su pokazale značajno niže rezultate u endomorfnim (p=0,002) i ektomorfnim vrednostima (p=0,017), sa neznačajno višim mezomorfnim vrednostima (p=0,059).

Zaključak: Dugogodišnji džudo trening na elitnom nivou sportistkinja izgleda da produkuje promene u kompoziciji tela i profilu somatotipova. Generalno, džudistkinje su pokazale nižu masnu telesnu masu, kao i veću mišićnu masu u poređenju sa ženama rekreativnog nivoa folklora istog godišta.

Ključne reči: Antropometrija, građa tela, džudo.

THE DIFFERENCES IN THE SCOPE OF MORPHOLOGICAL FEATURES WITH BASKETBALL AND HANDBALL PLAYERS

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UDC 796.323:676.014.8
796.325:676.014.8

SUMMARY

The understanding of the relevant morphological features in different sports branches, particularly the morphological features of some players' positions in a given sport, represents an important factor of the rational management of the process of sports preparation. Morphological features are of immense importance for determining the orientation and for making the selection in the majority of sports disciplines. This can be seen in the equation of success specification in some sports matches, as well as in every specific position in a team. Therefore, the importance of understanding themorphological dimensions is extremely high. This aim of this work is to determine the differences in the morphological features between basketball and handball players, in the national competition range. The sample of respondents were the handball players (19) of the handball club "Zeleznicar" from Nis, a member of the Serbian Super Handball League and the basketball players (15) of the basketball club "Konstantin" from Nis, a member of the Premier Basketball League of Serbia. On the sample mentioned above the differences between the groups of respondents were determined via the t-test. In order to evaluate the morphological features the anthropometric measures relevant for these sports were chosen. The results obtained might be of huge importance for further selection of children in handball and basketball.

Key Words: basketball, handball, anthropometrics, selection, morphological features

INTRODUCTION

Even though there are a large number of very precise and thorough definitions regarding morphological features, it can be most simply stated that morphology is a scientific discipline which studies the structure and development of living organisms and their constituent parts visible to the naked eye and through microscope. The morphological features, that are latent by nature, can be accessed through their manifestations – anthropometric measures. Therefore, anthropometry represents a group of methods and measurement results that can be performed on a living human being or a skeleton and that enables quantitative assessment of the morphological features. (Jakšić, 2010).

Talking about the level of development today it can be stated that selection is more and more present in every sphere of human action, and this can also be said for the sphere of sport. Scientific research, analyses and studies are invaluable for successful high-quality selection in sport so that those results can be directly applied in everyday sports practice. In order for one selection to be of high-quality, a multidisciplinary approach is needed since the development of a human individual is an integrative process (Karišik, Goranović & Valdevit, 2011). The research performed so far has shown that in order to accomplish top results in sport a certain influence of height, body mass as well as the proportions of particular segments of the body must be considered (Đurašković at al., 2011). The research

of the anthropometric features performed on sportsmen in various sports has pointed out that sportsmen have their own specific characteristics. A better insight into the anthropometric features, body structure and constitution of sportsmen has for its purpose the control over these features, the adjustment of trainings to the individual capacities and the prediction of the highest possible results. In order to accomplish top results in a certain sport, a sportsman must have special predispositions. Related to that there is a need to find and select the sportsmen with the predispositions that are visible during their growth and development (Popović, Smajić, Molnar & Mašanović, 2009).The morphological characteristics describe body composition and they affect the overall motor functionality and situational efficiency. Without the knowledge of the relevant morphological features for certain types and subtypes of sportsmen it is not possible to rationally direct the process of sports preparation. The diagnostic of the state of the morphological features enables not only the monitoring of the growth and development of a particular sportsman but also the placement onto a particular position or multiple positions during a match, as well as the tracking of the changes in the process of sports preparation (Trninić, Jeličić & Foretić, 2012). The morphological features are of a particular importance for the orientation and selection in the majority of sports disciplines. This is visible in the equation of the success specification in certain sports, and in every particular position within a team where the morphological dimensions occupy one of the most important places. The morphological structure that highly affects the efficiency in sport is mostly already known for a great number of sports disciplines. Even though, without a doubt, the coefficient of involvement of particular morphological dimensions can be changed in the equation of specification depending on the development of technique and tactics and modern global achievements in a particular sport (Živković, Goranović, Marković & Branković, 2010). The parameters that play an important role in the players' selection in handball are the anthropometric characteristics, the functional ability of organs and organic systems (aerobic and anaerobic capacity), motor skills, social personal characteristics, as well as cognitive and conative characteristics (Karišik, Goranović & Valdevit, 2011).

The problem of this work is related to the differences in the scope of morphological features between basketball and handball players.

The aim of this work is to determine the differences in the scope of morphological features between the basketball and handball players of professional range of competition.

MATERIALS AND METHODS

The sample of the examined

The sample of the examined in this research is based on top sportsmen, the representatives of the highest range of competition in Serbia – the basketball players from the basketball club „Konstantin" in Nis (14), who are the members of the First Basketball Serbian League and the participants of the Premier Serbian League, and the hanball players from the hanball club „Železničar" in Nis (19), who are the members of the Premier Serbian Handball League. The total number of the examined who participated in this research is 34 sportsmen of masculine sex. The youngest examined participant was 18, and the oldest was 46 years old. The average age of the examined was 26.6 years. The average age of the subsample of the basketball players was 25.2 years (SD= 4.56), the average height 195.5 cm (SD= 9.16), average weight 95.4 kg (SD= 9.72). The average age of the subsample of the handball players was 27.6 years (SD=8.03), average height 187.6cm (SD= 6.05), average weight 91.7kg (SD=9.46). The examined were acquainted with the aim of the research after which they signed their consent to be included into the research.

The sample of the variables

The evaluation of the morphological features was accomplished by the set of 21 measures which define three anthropometric dimensions:

I. Longitudinal dimensions of a skeleton:

1. Body height
2. Sitting height
3. Leg length
4. Arm length
5. Hand length
6. Foot length

II. Transversal dimensions of a skeleton:

1. Shoulder width
2. Hand width
3. Foot width
4. Elbow diameter
5. Knee diameter

III. Circular dimensions of a skeleton

1. Skin crease of the back
2. Skin crease of the triceps
3. Skin crease of the abdomen
4. Skin crease of the shin
5. Body mass
6. Percent of body fat
7. Circumference of the thorax
8. Circumference of the abdomen
9. Circumference of the upper arm
10. Circumference of the shin

The team that performed the measurements was composed of the person who measured and the person who wrote the results into the protocol of the measured person. As soon as the one who measured performed the measurement he would say the result loud and clear, and the one who wrote would repeat the result loudly and write it into the protocol. In order to obtain the results of the anthropometric parameters the instructions of the International Biological Programme (IBP) were used (Weiner, Laurie, 1969). The instruments were of standard production and they were calibrated before the measurements began. The measuring instructions were taken from the book ***Biology of the development of man in sports medicine*** of prof dr Ratomir Đurašković.

Methods of data processing

The data processing was performed with the statistics programme SPSS 20. For each dauma it was included:

1. The basic central and distributional parameters including:
   - Arithmetical mean
   - Skunis
   - Kurtosis
   - Minimal and maximal value
   - Standard deviation
2. In order to determine the normality of distribution the Kolmogorov-Smirnov test was used.
3. The difference in the scope of morphological features between basketball and handball players was determined by the students' T-test for independent specimen.

RESULTS

Before it was started with determining the possible differences in the morphological features of basketball and handball players, descriptive statistics was performed, and the chart with the results is shown below. The Kolmogorov-Smirnov test was done as well in order to determine the normality of distribution (chart no 1). Based on the results presented in the chart no 1, it can be seen that the supposition of the normality of distribution of 20 body measures is not disturbed (Sig.>0.05), except with the skin crease of the abdomen (Sig=0.04). That is why this measure is deleted from the further analysis.

Chart no. 1 – *Kolmogorov-Smirnov test*

Variable	Statistic	df	Sig.	Variable	Statistic	df	Sig.
Body mass	,075	33	,200*	Circumference of the thorax	,114	33	,200*
Percent of body fat	,102	33	,200*	Circumference of the abdomen	,077	33	,200*
Body height	,086	33	,200*	Circumference of the upper arm	,084	33	,200*
Sittingheight	,069	33	,200*	Circumference of the shin	,146	33	,070
Leg length	,134	33	,144	Skin crease of the back	,144	33	,082
Arm length	,134	33	,140	Skin crease of the triceps	,118	33	,200*
Hand length	,101	33	,200*	Skin crease of the abdomen	,188	33	**,004**
Foot length	,143	33	,083	Skin crease of the shin	,130	33	,172
Shoulder width	,095	33	,200*	Elbow diameter	,128	33	,184
Hand width	,107	33	,200*	Knee diameter	,117	33	,200*
Foot width	,115	33	,200*				

The t-test for independent specimen determined the differences in the anthropometric characteristics between basketball and handball players. Based on the results shown in the chart no 2, it can be seen that there is a statistically significant difference between the mentioned groupes in the percent of body fat (t=2.196; p=0.037) (graph no 1). According to the arithmetic mean value it can be seen that the basketball players (Mean=19.54) have higher values of body fat than the handball players (Mean=16.28). According to the Eta Square (Eta Squared=0.114) it can be seen that the difference between the two groups is **moderate**. According to Kohen, 0.01 is a small effect, 0.06 is a medium effect and 0.14 and more is a great effect (Pallant, 2011).

Chart no. 2 – *T-test results for the independent specimen*

		N	Mean	Std. Deviation	t	p	Eta Squared
Body mass	Basketball	14	95,37	9,715	1,094	,282	,037
	Handball	19	91,68	9,464			
Body fat(%)	Basketball	14	19,54	2,809	2,196	**,037**	**,114**
	Handball	19	16,28	5,579			
Body height	Basketball	14	195,47	9,162	2,973	**,006**	**,222**
	Handball	19	187,60	6,054			
Sitting heigh	Basketball	14	100,43	4,199	2,427	**,021**	**,160**
	Handball	19	97,43	2,916			
Leg length	Basketball	14	112,807	6,418	2,637	**,013**	**,183**
	Handball	19	107,48	5,179			
Arm length	Basketball	14	86,35	4,440	2,015	**,053**	**,116**
	Handball	19	83,64	3,307			
Hand length	Basketball	14	20,96	1,203	1,410	,169	,060
	Handball	19	20,43	0,961			
Foot length	Basketball	14	29,04	1,528	2,308	**,028**	**,147**
	Handball	19	27,94	1,195			
Shoulder width	Basketball	14	44,09	1,768	1,523	,138	,070
	Handball	19	43,13	1,826			
Hand width	Basketball	14	8,78	0,458	,489	,628	,008
	Handball	19	8,71	0,401			
Foot width	Basketball	14	10,13	1,034	-1,169	,251	,042
	Handball	19	10,47	0,633			

Circumference of the thorax	Basketball	14	106,05	4,774	,455	,652	,007
	Handball	19	105,08	6,786			
Circumference of the abdomen	Basketball	14	90,26	4,443	-,313	,756	,003
	Handball	19	90,96	8,346			
Circumference of the upper arm	Basketball	14	35,58	2,728	,509	,614	,008
	Handball	19	35,06	2,973			
Circumference of the shin	Basketball	14	39,13	3,601	-,588	,561	,011
	Handball	19	39,86	3,465			
Skin crease of the back	Basketball	14	11,11	2,900	-1,315	,198	,053
	Handball	19	12,89	4,403			
Skin crease of the triceps	Basketball	14	7,24	1,717	-,511	,613	,008
	Handball	19	7,62	2,338			
Skin crease of the shin	Basketball	14	5,99	1,512	-1,134	,266	,040
	Handball	19	6,96	2,925			
Elbow diameter	Basketball	14	7,81	0,884	,588	,561	,011
	Handball	19	7,66	0,573			
Knee diameter	Basketball	14	10,14	0,415	-2,78	**,009**	**,173**
	Hanball	19	10,74	0,794			

By further analysis, and also as it can be seen on the chart No 2, there is a statistically significant difference in the height between basketball and handball players (t=2,973.; p=0,006) graph No2. Based on the middle value (Mean) it can be seen that the basketball players (Mean=195,47) are higher than the handball players (Mean= 187,60). Based on the Eta Squared (Eta Squared=0,222) it can be seen that the difference in height is big. A statistically significant difference can be also seen in:

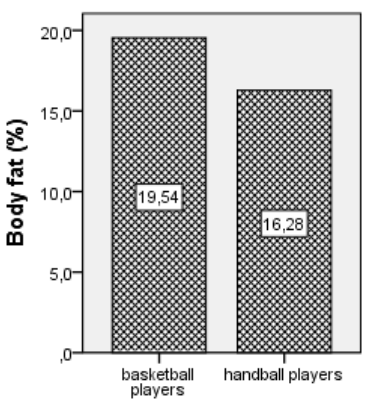
- **sitting height**: (t=2,427.; p=0,021;) (graph No.3), where basketball players have higher value (Mean=100,43) in comparison to handball players having (Mean=107,48). Based on Eta Squared (Eta Squared=0,160), it can be seen that the difference is **big**.

- **leg length**: (t=2,637; p= 0,13) (graph No 4), where again basketball players have higher value (Mean= 112,807) in comparison to handball players (Mean=107,48). Based on Eta Squared (Eta Squared=0,183) it can be seen that the difference in leg length is **big**.

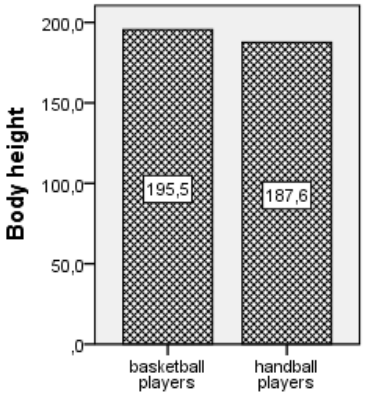
- **hand length**: (t=2,015; p=0,053) (graph No. 5), were again basketball players have higher value (Mean= 86,35) in comparison to handball players (Mean= 83,64). Based on Squared (Eta Squared=0,116) it can be seen that the difference in hand length is **medium**.

- **foot length**: (t=2,308; p=0,028) (graph No.6), where again basketball players have higher value (Mean= 29,04) in comparison to handball players (Mean=27,94) Based on Squared (Eta Squared=0,147) it can be seen that the difference in feet length is **big**.

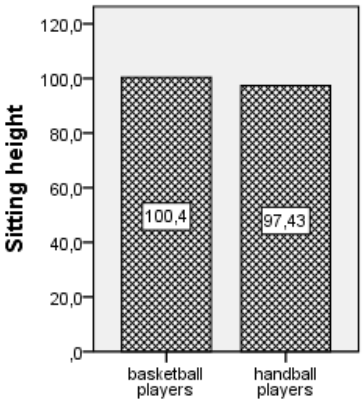
- **Knee diameter**: (t=-2,78; p= 0,009) (graph No. 7), where this time handball players have higher value (Mean= 10,74) in comparison to basketball players (Mean=10,14). Based on Squared (Eta Squared=0,173) it can be seen that the difference in knee diameter is **big**.



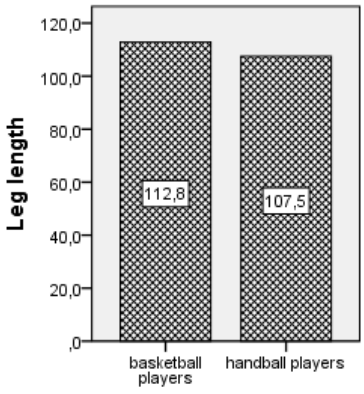
Graph No.1



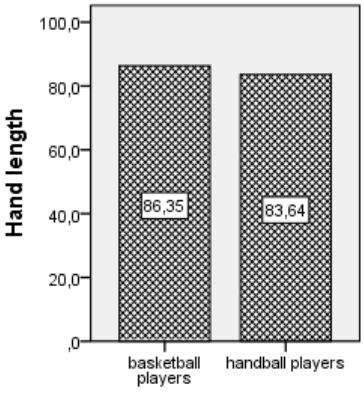
Graph No.2



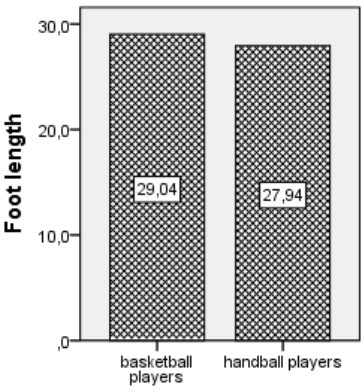
Graph No.3



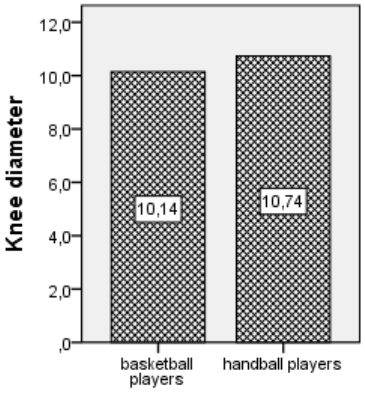
Graph No.4



Graph No. 5



Graph No.6



Graph No.7

ARGUMENT

An excellent knowledge of anthropological characteristics of sport players, who have achieved excellent results, may serve as orientation and guideline on how a training process and selection should be taken (Tomić,Smajić & Vasić, 2013). Practice has showed that basketball, as a team game, demands significant height, and others particularly external body dimensions (Sinobad, 1999; Erčulj & Bračič, 2010). Therefore, the basketball players' selection, from the anthropological view, should be taken according to longitudinal dimensions such as body weight, hand length, leg length, and feet length (Sinobad, 1999). The longitudinal dimensions affect mostly the efficiency of specific basketball moves

(Erčulj & Bračič, 2010). **Koprivica, (1996)** has compared anthropological characteristic between 136 basketball players with at least one year of practice and 138 non-players. He concluded that basketball players differ inherently from their peers, non-players. The most expressed differences are in height, leg, hand, and feet variable, so the author concludes that based on these differences the young selections can be made. **Sinobard, (1999)** has deducted that all pioneers, cadets, and juniors significantly differ in body weight from their peers, who are non-players. In our research, in five out of six longitudinal dimension measures (Body height, sitting height, Leg length, Hand length, Foot length) basketball players statistically showed more significant value than handball players. There is not any statistically significant difference between the groups, mentioned above, in palm length. **Popović, Smajić, Molnar & Mešanović, (2009)** have concluded the same when it comes to body height in their own research on the sample of excellent sport players. In their research, statistically, basketball players were significantly higher than handball players. The average handball player's height was 188,2cm, whereas the average basketball player's height was 199,5cm. **Bayios at al., (2006)** have concluded the same on the sample of professional Greek basketball players, who were members of the First National Greek League. They have showed in their research that female basketball players were statistically significantly ($p<0,01$) taller and thinner than female handball players **Musaiger, Ragheb & Marzooq (1994)** have also concluded based on their research that basketball players are higher than handball players. If we compare our research with the previous older, concerning the same subject, it can be seen that we have obtained the same results as previous authors. These results show that basketball players are the players with significantly more expressed longitudinal body dimensions in comparison to handball players, and that the difference is statistically significant. For that reason, estimating height is one of the main tasks performed by a coach. It has the following elements: parents' body height, relatives' body height, body weight measured on the day of birth, height acceleration between the age of 4-7, height at that moment, height acceleration in puberty, skeleton ossification quality. Parents' height is used as reliable element of definite height forecast (Dragaš, 2011).

The transversal dimension reflects in five measures, in this research: shoulder width, palm width, foot width, elbow diameter, knee diameter. A statistically significant value is shown in knee diameter. Handball players show more value at this measure than basketball players.

The circular dimensions reflect in ten measures: back skin fold, upper arm skin fold, abdomen skin fold, calf skin fold, body mass, body fat, chest circumference, waist circumference, the upper arm circumference, calf circumference. A statistically significant difference in this research of circular dimensions is in body fat. At this measure basketball players show more value (19,5%)) than handball players (16,3%). The results that we obtained in this research mismatch the results that Popović, Smajić, Molnar & Mešanović, (2009) have obtained. Namely they have showed in their research that handball players (12,4%) have statistically more significant value than basketball players (11,5%).It is interesting that both basketball and handball players in their research had lesser percent of body fat than basketball and handball players in our research. Both researches dwelt with professional players.

CONCLUSION

The anthropometric characteristics are the important factor in the selection of players. The players, who would like to compete in the highest leagues, have to satisfy a particular anthropometric characteristic, which is reflected in the longitudinal and circular skeleton dimension's measures. The result of this research has confirmed previous researches and showed that for professional basketball players, their height is the most important, in other words one of the longitudinal dimension's measure. The results of our research

may serve as orientation in further selection of basketball players.

REFERENCES

Bayios, I.A.,Bergeles N.K., Apostolidis, N.G, Noutsos,K., Koskolou, M.D. (2006). Anthropometric, body composition and somatotype differences of Greek elite female basketball, volleyball and handball players. *Journal of sports medicine and physical fitness*, 46, 271-280.

Dragaš, S. (2011). Fundamental Problems of Selection and Diagnostics in Basketball. *Zbornik radova Međimurskog veleučilišta u Čakovcu*, 2(1), 7-13.

Đurašković, R., Nikolić, M., Pantelić, S., Veličković, S., & Bojić, I. (2011). Weight-height relations of the elite athletes in different sports disciplines. *Glasnik Antropološkog društva Srbije*, (46), 25-32.

Erčulj, F., & Bračič, M. (2010). Comparison of the morphological profiles of young European female basketball players from different competitive levels. *Fizička kultura*, 64(2), 14-21.

Jakšić, D. (2010). *The application of different statistical methods to define the morphological types.* Published master thesis, Novi Sad: Faculty of Sport and Physical Education.

Koprivica, V. J. (1996). Physical development of basketball players aged 12-15. *Fizička kultura*, 50(4), 261-272.

Karišik, S., Goranović, S., & Valdevit, Z. (2011).Possible selection of elite handball depending anthropometric characteristics. *Sport and Health*, 6 (1), 60-66.

Musaiger, A.O., Ragheb, M.A., & Marzooq, G. (1994). Body composition of athletes in Bahrain. *British Journal of Sports Medicine*, 28(3), 157-159

Pallant,J.(2011). *SPSS survival manual.* Belgrade: Micro Book

Popović, S., Smajić, M., Molnar, S. & Mašanović, B. (2009). Determining body composition of top level athletes. *Journal of Social Sciences*, 4, 1535 - 1549.

Sinobad, M. (1999). Comparison of anthropometric variables and body composition among school children and basketball players of the same age. *Department of Anatomy, Faculty of Medicine,* Belgrade.

Trninić, M., Jeličić, M., & Foretić, N. (2012). The relations between the morphological status, situational efficiency and sport achievement of elite junior basketball teams. Fizička kultura, 66(2), 100-109.

Tomić, B., Smajić, M., Jakonić, D., & Vasić, G. (2012). Comparative analysis of morphological characteristics of two generations of football players. Glasnik Antropološkog društva Srbije, (47), 119-123.

Živković, M., Goranović, S., Marković, S. & Branković, N.(2010). Relations morphological characteristics and tests to evaluate explosive strength in young handball players. *Sportlogija*, *6(1), 36-40*.

CONTRIBUTION

Chart no. 3 - *Descriptive Statistics*

	N	Min.	Max.	Mean	Std. Deviation	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Age	33	18,00	46,00	26,6061	6,79586	1,064	,409	,533	,798
Body mass	33	75,0	112,0	93,248	9,5994	-,023	,409	-,488	,798
Percent of body fat	33	4,7	28,0	17,667	4,8363	-,488	,409	,509	,798
Body height	33	175,8	205,0	190,939	8,3863	,141	,409	-,975	,798
Sitting height	33	90,1	107,4	98,700	3,7708	-,097	,409	-,023	,798
Leg length	33	99,4	119,3	109,742	6,2416	-,024	,409	-1,229	,798

Arm length	33	76,0	94,0	84,788	4,0021	-,121	,409	-,255	,798
Hand length	33	18,5	22,9	20,652	1,0854	,210	,409	-,419	,798
Foot length	33	26,2	30,9	28,406	1,4333	,240	,409	-1,164	,798
Shoulder width	33	39,5	47,0	43,536	1,8388	-,421	,409	-,259	,798
Hand width	33	7,9	9,6	8,736	,4204	,126	,409	-,225	,798
Foot width	33	7,4	11,6	10,324	,8303	-1,374	,409	3,602	,798
Circumference of the thorax	33	94,5	118,0	105,494	5,9496	,276	,409	-,486	,798
Circumference of the abdomen	33	75,0	107,5	90,664	6,8796	,130	,409	,415	,798
Circumference of the upper arm	33	28,5	40,5	35,282	2,8393	-,017	,409	-,108	,798
Circumference of the shin	33	29,5	45,0	39,548	3,4862	-,958	,409	1,523	,798
Skin crease of the back	33	8,0	26,0	12,139	3,8883	1,707	,409	3,873	,798
Skin crease of the triceps	33	3,0	11,2	7,461	2,0757	-,312	,409	-,509	,798
Skin crease of the abdomen	33	6,2	33,0	15,421	7,8088	1,085	,409	-,036	,798
Skin crease of the shin	33	2,6	14,4	6,545	2,4455	1,245	,409	2,688	,798
Elbow diameter	33	6,3	10,4	7,721	,7132	1,457	,409	5,435	,798
Knee diameter	33	9,6	12,5	10,485	,7164	,960	,409	,686	,798
Valid N (listwise)	33								

RAZLIKE U PROSTORU MORFOLOŠKIH KARAKTERISTIKA KOD KOŠARKAŠA I RUKOMETAŠA

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SAŽETAK

Poznavanje relevantnih morfoloških karakteristika u različitim granama sporta, a naročito morfoloških karakteristika pojedinih igračkih pozicija u datom sportu, predstavlja važan faktor racionalnog upravljanja procesom sportske pripreme. Morfološke karakteristike su od posebnog značaja za orijentaciju i selekciju u većini sportskih disciplina. To je vidljivo u jednačini specifikacije uspeha u pojedinim sportskim igrama, pa i kod svake specifične pozicije u ekipi. Zbog toga je važnost poznavanja morfoloških dimenzija izuzetno velika. Cilj ovog rada bio je utvrditi razlike u morfološkim karakteristikama između košarkaša i rukometaša reprezentativnog ranga takmičenja. Uzorak ispitanika u ovom radu činili su rukometaši RK „Železničar“ Niš, člana Super Rukometne Lige Srbije (n=19) i košarkaši OKK „Konstantin“ Niš člana Prve Košarkaške Lige Srbije (n=15). Na navedenom uzorku ispitanika utvrđene su razlike između grupa ispitanika putem t-testa. Za procenu morfoloških karatkteristika izabrane su antropometrijske mere koje su relevantne za bavljenje ovim sportovima. Dobijeni rezultati istraživanja mogu biti od velikog značaja za dalju selekciju dece u rukometu i košarci.

Ključne reči: košarka, rukomet, antropometrija, selekcija, morfološke karakteristike.

Physical Education

THE ANALYSIS OF PARENTS' ATTITUDES CONCERNING THE LEVEL OF PHYSICAL ACTIVITY OF THEIR PRE-SCHOOL CHILDREN

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UDC 796.08 – 053.4

SUMMARY

Introduction: In the scope of the project called ''The anthropological status and physical activity of the population of Montenegro'' a research was done at the Faculty of Sports and Physical Education in Niksic, whose aim was to get direction for the improvement of teaching in the pre-school institutions and to improve the expert work of the teachers through monitoring and an insight into the attitudes of the parents on physical activity of the children attending the pre-school institutions in Montenegro. The problem of this research consists of the attempt to estimate how active the children from the pre-school institutions, all of it based on their parents' attitudes. Taking into account the decreasing trend of the physical activity of the children of all ages, a general hypothesis has been formulated: Hg-The physical activity of the pre-school children is on a non-satisfying level and it registers the decreasing trend.

Methods: The aim of the research consisted of the evaluation of the parents' attitudes on the volume and characteristics of the physical activity of their children and the attempts to use the given data in order to take certain measures on the base of which the characteristics of the physical activities of the pre-school children would be optimized. A special questionnaire made for this purpose only was used in which the questions were grouped to estimate the characteristics of the physical activity of the pre-school children. The examinees' sample consisted of 1356 parents of the pre-school children from all Montenegrian towns.

Results: The results of this research refer to the trend of a decreased physical activity of the pre-school children. The data were processed in percents and given in charts and graphics. The discussion and comments were integrally presented and discussed for all groups of answers to the polled questions.

Conclusion: Because of the obvious trend of a decreasing level of physical activity of the pre-school children, there is a need for intensifying in order to provide as optimal as possible influence on the complete mental and physical development of the children, especially in this, most sensitive period of their development. Trying to achieve this, the analysis of the position and role of a teacher as well as creating a stimulative ambient for enabling, motivating and stimulating their professional development and permanent improving, is especially important.

Key Words: mental and physical development, improvement, evaluation, characteristics.

INTRODUCTION

The physical activity of children attracts more and more attention of the world of the scientific community, due to a noticeable undiminished trend of the decline of its level in children of all ages. It is already clear that the modern lifestyle habits and lifestyles require appropriate changes in the objectives, structure, content and forms of realization of physical education at all levels.

The modern system of the preschool education has the task, among other things, to provide adequate social and material conditions for children, as well as the stimuli for the development of rich,

diverse and designed motion activities necessary for the proper growth and development.

It is well known that the main goals whose implementation should be pursued in the pre-school physical education are:

-a healthy, physically well and harmoniously developed child; the comprehensive development of the motor skills, ie, the formation and consolidation of the skills of mastering space through movement in it; coordinated, harmonious, graceful, balanced and rhythmic; the development of psychological and physical abilities: speed, agility, flexibility, strength, endurance, accuracy, etc.; the mastering of the basic locomotor and manipulating movements and improving fine motor skills – voluntary directing of the movement, its coordination, rhythm, strength, accuracy; the maintenance of the normal state of the apparatus for moving, especially joints, connections and muscle, which is reflected in their strength and mobility.

This general activation of the child and, in particular, his training for independent and joint acting, as well as for social life is the most important pedagogical function of preschool. Previous studies have shown that most of the children who participate in sports and are physically active as younger, keep these habits later as adults. According to Djordjevic, V. (2002), "Sport and physical activity have a positive effect on the development of all human characteristics, so we adults should make sure that the children and young people are more physically engaged."

Physical activity, which is mainly realized through a game at this age, is the main prerequisite for the maturation of the child and it represents the main means by which the child comes to realization of certain goals. Therefore, it can not be replaced or compensated with anything in the development and education of the child. It represents the basic specific form of children's activitiy, which is in full accordance with the mental and physical activities of their bodies. According to: Bjelica D. and Krivokapic D., (2010), "playing is not only fun to fill the time, but is an important part of the lives of babies and children in general. Play is their daily work and helps them learn and grow. Their complete motivation for playing comes from the satisfaction they feel in the process of playing. "

Due to the importance of the optimization of the physical activity of children in the preschool years, a survey was conducted at the Faculty of Sport and Physical Education in Niksic, with the aim to obtain the guidelines for improving teaching in preschools and advance the professional work of teachers through the monitoring of and insight into the views of the parents on the physical activity of the children attending preschool Montenegrin institutions.

The problem of this research is to attempt to assess the extent to which the children are physically active during the time spent out of pre-school institutions through the attitudes of their parents.

The aim of the research consisted of assessing the attitudes of parents on the extent and characteristics of the physical activity of their children and of trying to take the appropriate measures, according to the collected data, upon which the characteristics of the physical activity for preschool children would be optimized.

METODS

The sample of respondents

The survey was conducted by interviewing the Montenegrin preschool institutions through an anonymous questionnaire, which was completed by the parents of children enrolled in preschool. The sample consisted of 1356 parents of the preschool children who are attending pre-schools in every Montenegrin city.

A sample of measuring instruments

The survey questionnaire specially designed for this purpose was used, in which the questions were grouped in order to assess the characteristics of the physical activity of preschool children.

Statistical analysis of data

The descriptive statistical procedures were applied in the research, and the results are presented in both numerical and percentage table overview.

RESULTS

In the following tables the complete results are displayed numerically and in percentage for each question from the questionnaire to assess the physical activity of the children from preschools of Montenegro. Due to the limitations on the maximum length of works, only some of the results are discussed separately below.

TABLE 1 The physical activity of children and parents - part one

	Number of days of the week								Total number of respondents
	0	1	2	3	4	5	6	7	
During a typical week, how many days is your child physically active (exercises, runs, on average at least 20-30 minutes per day?									
The number of respondents	63	17	130	674	132	68	135	137	1356
Share %	4,65	1,26	9,59	49,70	9,73	5,01	9,96	10,10	
During a typical week, for how many days do you encourage your child to exercise or to be physically active?									
The number of respondents	62	13	203	746	61	15	135	134	1356
Share %	4,57	0,95	14,36	55,21	4,23	1,01	9,95	9,81	
During a typical week, how many days do you (or another person in the house) participate in physical activities with your child?									
The number of respondents	203	15	407	339	135	20	138	134	1356
Share %	12,74	1,01	30,01	24,95	9,96	1,41	10,11	9,81	
During a typical week, for how many days do you provide or another family member provides the transportation of your child to a place where he/she can be physically active or play sports?									
The number of respondents	339	135	132	558	63	68	61	7	1356
Share %	24,95	9,96	9,73	40,95	4,65	5,01	4,23	0,52	
How many days a week does your child have an organized lesson of physical education in the kindergarten?									
The number of respondents	61	618	341	131	137	68	10	4	1356

Share %	4,23	44,59	25,38	9,66	10,10	5,01	0,74	0,29	
During a typical week, for how many days do you participate in the physical activity or exercise (leisure, not work time), of moderate intensity, for at least 30 minutes per day, either continuously or in "portions" of 10 minutes or more?									
The number of respondents	594	242	140	301	134	14	63	3	1356
Share %	37,52	15,25	10,32	21,19	9,81	1,04	4,65	0,22	

TABLE 2 The physical activity of children and parents – part two

How much do you agree or disagree with the following statements (circle the number)						
	I do not agree at all	I do not agree to some extent	Neutral	I do agree to some extent	I agree at all	Total number of respondents
My child enjoys participating in physical activities / sports.						
The number of respondents	2	68	203	271	813	1356
Share %	0,15	5,01	14,97	19,98	59,89	
It is important that my child is engaged, for at least 30 minutes, in a moderate physical activity almost every day						
The number of respondents	3	66	135	540	610	1356
Share %	0,22	4,87	9,96	39,97	44,98	
It is important that my child has a quality physical education in kindergarten almost every day						
The number of respondents	2	64	137	679	474	1356
Share %	0,15	4,72	10,10	50,07	34,96	
It is important to regularly encourage my child to be physically active						
The number of respondents	5	68	67	678	539	1356
Share %	0,37	5,01	4,94	50,00	39,68	
I personally enjoy physical activity and sport						
The number of respondents	72	65	339	610	270	1356
Share %	5,31	4,79	25,00	44,98	19,92	
My child is playing rather outdoors than in the apartment						
The number of respondents	72	74	6	333	881	1356
Share %	5,31	5,46	0,44	24,56	64,53	

TABLE 3 The involvement of children in sport and recreation clubs

		YES	*NO*	*Total*
Over the past year, was your child involved in a sports club, sports hopscotch, recreational clubs, etc..?	The number of respondents	339	1017	1356
	Share %	25,0	75,0	

On the basis of *Table 3* we can see that only 25% of children are involved in a sports club, sports hopscotch or recreational club.

TABLE 4 The engagement of children in certain sports

Type of activity	The number of respondents who answered with YES	Share %
Tennis	15	4,02
Athletics	6	1,61
Football	72	19,30
Dance	84	22,52
Bascetball	106	28,41
Martial arts	65	17,42
Volleyball	11	2,94
Swimming	9	2,41
Gymnastics	2	0,54
Aerobics	8	2,14
Others	4	1,07
TOTAL	373	

Out of 373 children who are involved in the work of a sport team *(Table 4),* most of them are involved in the work of: 28.41% basketball clubs, 22.52% dance, 19.30% football and martial arts clubs 65%.

TABLE 5 The activities of the children during the previous day (The day that preceded survey of parents)

Activities during the previous day	*The number of respondents*	*Total time (h,mm)*	*Average time (h,mm)*	*Share in time %*
Cycling	214	82,03	0,23	7,24
Swimming	5			0,37
Gymnastics (loom, back, circles, beam, trampoline, etc.)	3			0,22
Exercises: pushups, sit-ups, skipping of the rope	5	1,35	0,27	3,70

Basketball	13	4,33	0,20	0,34
Football	26	8,67	0,20	0,69
Volleyball	14	4,66	0,20	0,34
Ice skating, inline skates	52	13,87	0,16	1,81
Racket Sports (tennis, badminton)	13	2,17	0,10	0,17
Ball games: Between 2 and 4 fires, handball	95	50,67	0,32	4,13
Active games: jumping rope, hopscotch	88	24,93	0,17	2,15
Outdoors games: climbing the trees, hide and seek, etc...	78	54,6	0,42	7,15
Water games (pool)	12	2,00	0,10	0,17
Martial arts: judo, karate, wrestling	14	12,37	0,53	2,58
Dance (folk, social, ballet)	13	2,17	0,10	0,17
Indoor houseworks: vacuuming, cleaning, transfering, etc.	15	1,23	0,05	0,09
Skate board, trotinet	14	11,67	0,50	0,86
Walking	292	13,43	0,46	21,02
Running	177	91,45	0,31	7,58
TOTAL	1356	58,05	0,43	

Table 5 shows that during the previous day (by which the survey was preceded) with the children of the surveyed parents, almost all of these activities and mainly walking, running and ball games were represented.

TABLE 6 The use of computers

The use of computers	The number of respondents	Share %
At home	1084	79,94
In kindergarten	3	0,22
Somewhere else	205	15,12
Do not use	64	4,72
TOTAL	1356	

Table 6 shows that 79.94% of the children of the parents surveyed use a computer only at home and 15.12% of children use it somewhere else also. Only 4.72% of the children of the parents surveyed do not use computer.

TABLE 7 Watching TV, playing the PC games

Time during the previous day spent watching TV or playing PC games:	The number of respondents	Total time (h,mm)	Average time (h,mm)	Share in time %
TV / Video / DVD	732	23,30	1,14	65,6338
Video games i computer games	623	12,20	0,46	34,3662

According to *Table 7* we can see that almost all of the children during the previous day (by which the survey was preceded) were watching TV / Video / DVD and playing video and computer games for the average time of 1 hour and 14 minutes for watching TV / video / DVD, and for the average time of 46 minutes playing computer and / or video games.

TABLE 8 The total time of watching TV and playing games

	The number of respondents	Share %
Not at all	3	0,22
Less that 1 hour	402	29,65
1-2 hours	880	65,00
3-4 hours	67	4,94
5 or more hours	4	0,29
TOTAL	1356	

On the question how much time their child spends during a typical weekend watching TV and videos or playing games on the computer or on the video (at home, in kindergarten, at the neighbor), 880 parents or 65% stated that their children spend 1-2 hours on the weekends, 402 parents or 29.65% - less than one hour and 67 parents have answered that their children spend 3-4 hours. Only 4 parents stated that their children spend 5 or more hours during a typical weekend watching TV and videos or playing games on the computer or video *(Tabela8).*

TABLE 9 The child's safety while playing outside with other children without adult supervision

	The number of respondents	Share %
It is unsafe	271	19,98
It is unsafe to some extent	203	14,97
I am not sure	136	10,04
It is safe to some extent	678	50,00
It is safe	68	5,01
TOTAL	1356	

When asked how safe it is for their child to play outside with other children from the neighborhood, without adult supervision, 203 respondents thought that it was safe to some extent and only 68 of the

respondents that it was safe. 271 of the respondents considered that it was unsafe, 203 of them thought that it was unsafe to some extent and 136 of the respondents were not sure *(Table 9).*

TABLE 10 The payment of the membership fee to attend some organized physical activity

		YES	*NO*	*Total*
Over the past year, was there an adult in your family who paid a fee to ensure that your child can attend dance classes, tennis, karate, judo, swimming, gymnastics, horseback riding or some other physical activity?	The number of respondents	407	949	1356
	Share %	30,02	69,98	

As it can be seen in *Table 10,* during the previous year, a fee was paid by 407 respondents, or 30.02%, so the child could attend dance classes, tennis, karate, judo, swimming, gymnastics, horseback riding or other physical activities.

TABLE 11 The physical activity of the respondents over the course of 7 days

	The number of respondents	Number of exercises during 7 days	Average	Share in%
Light exercises (minimal effort). For example slow walking, fishing, bowling, table tennis, golf, horseback riding, volleyball, badminton, etc...	716	19,00	2,71	52,81
Moderate exercises (effort is not exhausting) brisk walking, folk dancing, hiking, tennis, basketball, etc...	603	16,00	2,67	44,46
Intense exercises (heart beats rapidly) eg. Jogging, running, football, karate, skating, cycling, swimming, aerobic dancing, etc...	37	1,00	1,00	2,73
	1356	36,00	2,571429	

When it comes to the exercises that were practiced by the respondents, keeping in mind the period of 7 days and the exercises that took over 20 minutes, from the total number of 1356 respondents, the exercises were practiced by 716 of them (Table 11). This is mainly related to light exercises (716 respondents - an average of 2.71 times per week, ie 52.81%), and moderate (603 respondents on average 2.67 times per week, or 44.46%) and, at the end, intense exercise (37 respondents, one time during the week)

Table 12 The data about the average time children go to bed and their getting-up time.

	The number of respondents	Total time	Average time
How many hours a week do spend away from home because of work?	1356	421,00	31,05
When does your child usually wake up in the morning and gets out of bed?	1356	145,30	7,16
When does your child usually go to sleep at night?	1356	184,00	9,20

On the basis of *Table 12* we can see that the parents surveyed spend an average of 31.05 hours out of their house because of work. We can also see that the children of the surveyed on average go to bed at 21:20h, and get up in the morning on average at 7.16 h.

In this study, the results were not directly compared to the corresponding results from the analogue research because, even when it comes to similar research, formulation, the meaning and the number of the questions are mainly different. Therefore, the results obtained in this study can provide approximate guidelines which can direct further action in terms of improving physical education in preschools as an essential condition in increasing the volume and intensity of physical activity of the children attending preschools in Montenegro. Also, the results can be used for comparison with future studies in this area, which will, without doubt, be more frequent, due to the evident declining of the levels of physical activity at all ages.

DISCUSSION

Although physical education in our pre-school system has a long tradition, the modern lifestyles require appropriate changes in the objectives, structure, content and forms of the implementation of teaching, so Bjelica, D., Krivokapic, D. (2012) state: "the actual number of classes and lessons in form and content can not fully respond to the goals and tasks that are put in front of the subject in the modern life. First of all, it is thought of inadequate intensity, but above all, the volume of work. "

According Bjelica, D., and Krivokapic, D. (2011), "the need for physical activity in children of the preschool age is very strong. Movement activities stimulate the development of the respiratory system, improves the blood picture, stimulates the activity of bone marrow, induces a proper body posture. " These are the reasons why it is necessary to pay due attention to the intensification of the physical activity of children of the preschool age, especially now, when the passive forms of leisure, in its duration, and frequency, significantly exceed the time that is filled with physical activity.Family conditions are important for providing support for physical activity and in general for the integral development of the child. Previous studies have found that family support was positively correlated with the higher levels of physical activity of preschool children. It should be noted that family support is not limited only to verbal support, but includes the provision of material assumptions, and the creation of a positive and pleasant environment for physical activity.

CONCLUSION

Because of the apparent trend of the decreasing level of physical activity of preschool children, there is the need for its intensifying in order to ensure a more optimal impact on the entire mental and physical development of children, especially in this, most sensitive period of their development. The positive aspects of a regular physical activity can be observed in the physical and mental health, and in psychosocial development.

From this research and its results, it could be concluded that the physical activity of children and their parents is on an unsatisfactory level.

The preschools with a well educated staff definitely represent a place that has the greatest potential impact on the level of the physical activity of preschool children. Precisely because of its apparent downward trend at all ages of children a special attention should be given to physical acitvity in order to ensure the optimal impact on the body of children, especially in preschool institutions. This study represents a segment of the project "The anthropological status and physical activity of the population of Montenegro". At the Faculty of Sport and Physical Education in Niksic a survey was conducted with the aim to obtain the guidelines for improving teaching in preschools and advance the professional work of teachers through the monitoring of and insight into the views of the parents on the physical activity of children attending preschool Montenegrin institutions.

In this effort, the analysis of the status and the role of teachers and the creation of a stimulative environment through which we encourage and stimulate their professional development and permanent improvement, is crucial for increasing the effects of physical activity in preschool children.

REFERENCE

1.Bjelica, D., Krivokapić, D.(2010): *Teorijske osnove fizičke kulture*, Univerzitet Crne Gore, Podgorica, str:36

2.Bjelica, D., Krivokapić, D.(2011): *Teorija igre,* Fakultet za sport i fizičko vaspitanje i CSA-Podgorica, str:90

3.Bjelica, D., Krivokapić, D.(2012):Stavovi profesora fizičke kulture u oblasti ličnog usavršavanja, zadovoljstva poslom i razvoja sporta u Crnoj Gori, Rad je prezentovan na IX međunarodnoj naučnoj konferenciji i VIII kongresu CSA.

4.Božić – Krstić, V. , Pavlica, T. , i Rakić, R. (2000). *Telesni status dece predškolskog uzrasta u Novom Sadu*:Zbornik radova, str:65

5.Đorđević, V. (2002).*Predškolsko fizičko vaspitanje u Vojvodini*. Vršac: Viša škola za obrazovanje vaspitača, str.79

ANALIZA STAVOVA RODITELJA O NIVOU FIZIČKE AKTIVNOSTI NJIHOVE DJECE PREDŠKOLSKOG UZRASTA

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SAŽETAK

Uvod: O okviru projekta "Antropološki status i fizička aktivnost stanovništva Crne Gore" na Fakultetu za sport i fizičko vaspitanje u Nikšiću sprovedeno je istraživanje s ciljem da se kroz praćenje i uvid u stavove roditelja o fizičkoj aktivnosti djece koja pohađaju crnogorske predškolske ustanove dobiju smjernice za poboljšanje nastave u predškolskim ustanovama i unaprijedi stručni rad vaspitača/ica. Problem ovog istraživanja sastoji se u pokušaju da se na osnovu stavova roditelja procijeni u kojoj mjeri su njihova djeca fizički aktivna u periodu izvan boravka u predškolskim ustanovama. S obzirom na opadajući trend fizičke aktivnosti djece svih uzrasta, formulisana je generalna hipoteza: Hg- Fizička aktivnost djece predškolskog uzrasta je na nezadovoljavajućem nivou i bilježi opadajući trend.

Metode: Cilj istraživanja se sastojao u procjenjivanju stavova roditelja o obimu i karakteristikama fizičke aktivnosti njihove djece i pokušaju da se na osnovu dobijenih podataka preduzmu odgovarajuće mjere na osnovu kojih bi se optimizovale karakteristike fizičke aktivnosti djece predškolskog uzrasta. Za anketiranje je korišten upitnik posebno konstruisan za ovu namjenu, u kojem su pitanja bila grupisana s ciljem procjene karakteristika fizičke aktivnosti djece predškolskolskog uzrasta. Uzorak ispitanika činio je 1356 roditelja djece predškolskog uzrasta koja pohađaju predškolske ustanove u svim crnogorskim opštinama.

Rezultati: Rezultati ovog istraživanja ukazuju na trend opadanja fizičke aktivnosti djece predškolskog uzrasta. Obrađeni su procentualno i prikazani su tabelarno. Diskusija i komentari su integralno predstavljeni i diskutovani za sve grupe odgovora na anketna pitanja.

Zaključak: Zbog očiglednog trenda opadanja nivoa fizičke aktivnosti djece predškolskog uzrasta, nameće se potreba za njenim intenziviranjem kako bi se obezbijedio što optimalniji uticaj na kompletan psihofizički razvoj djece, posebno u ovom, najsenzitivnijem periodu njihovog razvoja. U tom nastojanju, analiza položaja i uloge vaspitača/ica kao i stvaranje stimulativnog ambijenta kroz koji se omogućava, podspješuje i stimuliše njihov profesionalni razvoj i permanentno usavršavanje, od posebnog je značaja.

Ključne riječi: psihofizički razvoj, unapređenje, procjena,karakteristike.

THE IMPACT OF THE BASIC MOTOR ABILITIES ON THE SITUATIONAL MOTOR EFFICIENCY IN FOOTBALL AMONG THE PUPILS OF THE 6TH AND THE 7TH GRADE OF ELEMENTARY SCHOOL

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SUMMARY

Introduction: The aim of this research is to determine the relations between the anthropological status of an individual defined by some basic motor abilities and the situational motor efficiency during a football game among the pupils of the 6th and the 7th grade of elementary school, who are not involved in any kind of extra-curricular sports activities. A statistically significant correlation is expected between the basic motor abilities and the efficiency in the motor situational tests for the football game.

Methods: The sample of participants The research was conducted on a sample of 100 participants, boys 10 to 12 years of age, who in addition to the regular physical education classes were not involved in any kind of extra-curricular sports activities. The sample of variables The study included 20 variables (Mikić, 1999). Of these 20, 17 were the predictor ones (the variables for assessing the basic motor abilities) and 3 were criterion variables (the variables for assessing situational motor abilities). All of the obtained data was processed using a programme package SPSS 17, and STATISTIKA 8.

Results: The study aimed to determine the interconnection between the motor and situational - motor space, which was first presented in terms of cross-correlation matrix. Continuing the study, the regression analysis of the first principal component of football game in the whole area of the basic motor abilities was performed as well as the analysis of the partial coefficients, where it was clear that the coefficient of multiple correlation was extremely high (.906). What the results showed, was that using the set of the predictor variables of motor space at the level of significance (Sig. = .000), a prediction can be made of the criterion variable (the main component) of performing of the situational-motor tests in the game of football. Also, the coefficient of determination shows that the 82% of the criteria can be predicted, that is, explained via the input system of the motor variables.

Conclusion: Based on the results of the research, it can be concluded that the tests for assessing the frequency of feet movement, speed and balance are in a significant correlation with the total situational motor efficiency. This is particularly true for success the control of a ball, while the tests for the repetitive and explosive strength showed a high correlation with the situational motor tests in assessing the strength of shooting the ball.

Key Words: Pupils, football, motor abilities.

INTRODUCTION

It is a known fact that the formation of personality is influenced by a number of factors starting with the genetic heritage, family, environment and society, etc. All of these factors also influence, to a greater or lesser degree, the pupil's success in school, the overall success, as well as the results in certain areas. From this, we can make a conclusion that the observation of the results and success among pupils in certain areas and on the whole based on only one aspect that we consider the dominant one, necessarily leads to the neglect of other factors that in some individuals, in a specific

moment, can have a major and perhaps even a dominant influence on success (Kebat, 2012).

The problem of this research derives from the need of the everyday practise for a more efficient and purposeful planning, lecture programming, selecting and directing pupils to specific kinesiology activities, as well as the requirements for the objective evaluation.

The game of football is a complex and semi structural movement activity, and thus a greater number of factors that have an impact on and that are relevant for the success of this game. The factors responsible for the success in football can be briefly defined as the applied technical tactical knowledge (the competition efficiency), specific skills, basic motor abilities, functional abilities, morphological structure and the cognitive-conative sphere (Petrić, 1981; Jerković, 1986).

Many studies show that the success in football game depends on a great number of different abilities and individual characteristics (Barišić, 1996). The researches conducted in the previous studies have shown a close correlation between the motor abilities and the situational-motor specific movement IN FOOTBALL **(**Gabrijelić, 1972; Elsner, 1982; Mekić, 1988). It is worth mentioning that the distinction should be made between the relations of the basic motor and situational motor abilities defined by the situational motor tests and the relations between the motor abilities and the efficiency in the conditions of an actual sports match. The motor efficiency in the situational conditions, that is, the conditions of a continuous cooperation within the team and countering the opposing team's actions, is determined by complex interactions of the anthropological dimensions (Mandić and associates, 2012). In any casem it largely depends on the level of the basic motor and situational-motor abilities (Reilly and associates, 2000).

The aim of this research is to determine the relations between the anthropological status of an individual defined by certain basic motor abilities and the situational motor efficiency during a football game among the pupils of the 6th and 7th grade of elementary school, who are not involved in any kind of extra-curricular sports activities.

This study assumes that the basic motor abilities are the most responsible for an individual movement and that are a priority in terms of the situational-motor efficiency in sport games and that the correlation between the variables from the basic and situational-motor space should have a significant statistical interconnection.

METHODS

The sample of participants

The research was conducted on a sample of 100 participants, boys 10 to 12 years of age, who in addition to regular physical education classes were not involved in any kind of extra-curricular sports activities.

The sample of measuring instruments

The study included 20 variables (Mikić, 1999). Of these, 17 were the predictor ones (the variables for assessing the basic motor abilities) and 3 were the criterion variables (the variables for assessing the situational motor abilities).

TABLE 1 The variables for assessing the basic motor abilities

	VARIABLE	DESCRIPTION	VALIDITY	UNIT OF MEASURE
1	**MFESDM**	Standing long jump	explosive power assessment	length (cm)
2	**MFETRO**	Standing triple jump	explosive power assessment	length (cm)
3	**MFESVM**	Standing high jump	explosive power assessment	length (cm)
4	**MFE20V**	Running at 20 m from a standing start	speed estimation	time (sec)
5	**MBFTAZ**	Foot taping against the wall	speed estimation	number of repetitions

6	**MBFTAN**	Foot taping	speed estimation	number of repetitions
7	**MKLSNL**	Leg slalom with two balls	assessment coordination	time (sec)
8	**MAGKUS**	Sidesteps	assessment coordination	time (sec)
9	**MKTOZ**	Agility in the air	assessment coordination	time (sec)
10	**MRESKL**	Push ups	repetitive power assessment	number of repetitions
11	**MRCDTŠ**	Sit up	repetitive power assessment	number of repetitions
12	**MFLPRK**	Bend on the bench	flexibility assessment	length (cm)
13	**MFLPRR**	Bend astride	flexibility assessment	length (cm)
14	**MFLBOS**	Side split	flexibility assessment	length (cm)
15	**MBAU20**	Standing on one leg bench	balance assessment	time (sec)
16	**MBAP2Z**	Standing transversally on the bench	balance assessment	time (sec)
17	**MBAU10**	Standing on one leg longitudinally	balance assessment	time (sec)

TABLE 2 The variables for assessing the situational-motor abilities

VARIABLE		DESCRIPTION	VALIDITY	UNIT OF MEASURE
1	**ONŽL**	Ball juggling	Feel for the ball coordination	number of repetitions
2	**ONVLS**	Leading the ball at slalom	Leading the ball coordination	time (sec)
3	**ONSU**	Kicking the ball	Kick strength assessment	length (meters)

Statistical data processing

Data analysis in this study with the use of the statistical-mathematical procedures is determined using a programme package SPSS 17, and STATISTIKA 8, on a univariate, bivariate and multivariate level.

The results of the statistical analysis are discussed and interpreted in the following segments:

- In the first segment the cross correlation results of the applied variables are listed.
- In the second segment, the results of the regression analysis that determine the significance and magnitude of the prediction system's influence on the criterion system (the integral and partial regression coefficients) can be found.

RESULTS AND DISCUSSION

The study sought to determine the interconnection between the motor and situational-motor space, which is shown in terms of the cross correlation matrix (Table 3). It must be emphasized that the obtained correlation coefficients indicate only a connection between the variables but not the specific impact of one to the other. Based on these results it can be concluded that a mean transient connection between the investigated areas was achieved in terms of the common covariance results of the motor and situational-motor space.

TABLE 3 The cross correlation matrix of the motor and situational-motor abilities

	ONZL	ONVLS	ONMSU
MFESDM	.189	-.076	.471
MFETRO	.267	-.252	.385
MFESVM	.183	-.172	.423
MFE20V	-.330	.471	-.629
MBFTAZ	.341	-.492	.458
MBFTAN	.247	-.253	.537
MKLSNL	-.297	.333	-.506
MAGKUS	-.165	.258	-.295
MKTOZ	-.343	.331	-.566

MRESKL	.474	-.350	.685
MRCDTS	.379	-.391	.712
MFLPRK	.020	-.137	.359
MFLPRR	-.072	-.118	.202
MFLBOS	.152	-.136	.359
MBAU20	.564	-.399	.602
MBAP2Z	.517	-.515	.684
MBAU10	.486	-.388	.566

During the research a regression analysis was performed (Table 4) from where it is clear that the coefficient of multiple correlation is very high (.906). Based on these results it is evident that through the predictor variables of the motor space at the level of significance (Sig. = .000), one can make a prediction of the criterion variable (the main component) of performing the situational-motor tests in football. Also, the coefficient of determination shows that 82% of the criteria can be predicted, that is, explained through the input system of motor variables (Table 5).

Accordingly, the results obtained clearly show a high connection, and the remaining unexplained part of the common variability can be explained by some other characteristics and skills of the respondents (the anthropometric characteristics, functional and cognitive abilities, motivation factor, measurement error, etc.).

TABLE 4 The regression analysis of the situational-motor abilities in the area of motor abilities

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.906	.820	.773	.476

TABLE 5 The ANOVA analysis results of the situational-motor abilities in the area of motor abilities

Model		Sum of Squares	df	Mean Square	F	Sig.
1	**Regression**	82.836	21	3.945	17.373	.000
	Residual	18.164	80	.227		
	Total	101.000	101			

The values of the partial regression coefficients (Table 6), indicating the size of the individual impact of the input variables on the result set of success in performing the situational-motor elements of football are: both legs stand transversally on the bench with eyes closed (MBAP2Z . 460), foot taping against the wall (MBFTAZ .245), foot taping (MBFTAN .205), side splits (MFLBOS -.305), sit up (MRCDTS .231), standing long jump (MFESDM -.183).

A modest number of other valid partial regression coefficients obtained in terms of the presented regression analysis leads to a conclusion that a prediction (forecast) of the predictor's influence on the criterion variable can only be made with the help of the entire system of the predictor variables.

TABLE 6 The regression analysis of the partial coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	MFESDM	-.009	.004	-.183	-2.414	.018
	MFETRO	.002	.001	.123	1.700	.093
	MFESVM	-.008	.011	-.052	-.713	.478
	MFE20V	-.050	.196	-.020	-.253	.801
	MBFTAZ	.070	.018	.245	3.894	.000
	MBFTAN	.039	.012	.205	3.346	.001
	MKLSNL	-.002	.008	-.015	-.202	.840
	MAGKUS	-.042	.021	-.269	-2.051	.044
	MKTOZ	-.164	.073	-.179	-2.253	.027
	MRESKL	.009	.011	.088	.876	.384
	MRCDTS	.009	.003	.231	2.491	.015
	MFLPRK	.024	.015	.127	1.613	.111
	MFLPRR	-.009	.010	-.072	-.878	.382
	MFLBOS	-.016	.006	-.305	-2.657	.010
	MBAU20	.002	.005	.043	.313	.755
	MBAP2Z	.291	.055	.460	5.256	.000
	MBAU10	-.005	.004	-.160	-1.205	.232

The results of the research have shown that the test for assessing feet movement frequency, speed and balance has the highest correlation with the overall situational-motor efficiency, especially with the efficiency of controlling the ball, while the tests for assessing the repetitive and explosive strength are in high correlation with the situational-motor tests for the kick strength assessment. This is confirmed by the results of similar studies (Mekić, 1988). As in previous similar studies (Elsner, 1982), it was confirmed that the efficiency in performing complex situational-motor tasks depends on the functioning of the highest regulatory mechanisms while performing simple situational-motor tasks on the functioning of the lower regulatory mechanisms. These data show the relationship of the basic motor abilities and success in football, that is, the dimensions that are responsible for the success of the football game as well as the role of the isometric strength, explosive power and especially its manifest variable, running at 20 meters (Gabrijelić, 1972). According to the above mentioned it can be concluded that the efficiency of performing complex situational-motor tasks of a football game in the first place depends on coordination, movement frequency, precision and balance while simple movement structures on the explosive and repetitive strength. This confirms the results of an earlier research (Elsner i sar., 1983; Talović 2001).

CONCLUSION

From the above stated facts it follows that within the framework of the participating segments of the anthropological status, the basic motor abilities are responsible for the movement manifestations of an individual and that they have a statistically significant influence on the situational-motor efficiency in the analysed sport games and that for results/score achievements in all of the analyzed situational tests the ideal combination of motor characteristics is the one dominated by the speed or the explosive and repetitive strength. Based on the obtained results a general conclusion is derived that the efficiency in performing complex situational-motor tasks such as success in the precision of ball handling depends on the functioning of the higher

and complex regulatory structure movements while the performing of the simple situational-motor tasks on the functioning of the lower regulatory mechanisms. The motor tests under the influence of the complex regulatory structures of movement had the dominant predictive value. The results of this research clearly indicate that the basic motor tests and related basic motor abilities to some extent can determine success on the specific motor tests of the treated sample. The results presented in this study provide new information relating to the treated anthropological status (motor abilities, situational-motor abilities) among pupils of 10 to 12 years of age. This gives the teachers enough information which can be used for future planning and the physical and health education programming. A contribution is thus made to a clearer assessment of the dynamics and the evaluation of the motor and other abilities' development and on the basis of the stated a better selection and guidance of pupils towards those kinesiology activities for which they are talented.

REFERENCES

1.*Barišić, V. (1996). Strukturalna analiza nogometne igre na temelju nekih antropoloških karakteristika – Master Thesis. Zagreb: Faculty for Physical Culture.*

2.Elsner, B. (1982). Kanoničke relacije nekaterih morfoloških in motoričnih dimenzija psihosomatskog statusa mladih nogometašev., PhD Dissertation, Edvard Kardelj University in Ljubljana, Academy for Physical Culture, Ljubljana,

3.Gabrijelić, M. (1972). Neke situacione psihomotorne sposobnosti potencijalno aktualno značajne za uspjeh djece u nogometnoj igri., Kineziologija N^0 1,

4.Jerković, S. (1986.): Relacije morfoloških i motoričkih sposobnosti sa efikasnošću u nogometu kod nogometaša uzrasta 12 do 14 godina., PhD Dissertation, FFK, Zagreb,

5.Kebat, R. (2012). Povezanost bazično motoričkih sposobnosti I konativnih regulativnih mehanizama sa uspješnosti u sportskim igrama kod učenika VI I VII razreda osnovne škole. *Master Thesis*. *Faculty of Sport and Physical Education in Sarajevo*.

6.Mandić Jelaska, P.,Miletić, Đ.,Jelaska, I., (2012). Mjerenje preciznosti kod mladih nogometaša. 4th International Scientific Conference "Contemporary Kinesiology", Faculty of Kinesiology, Split.

7.Mekić,M. (1988). Kanoničke relacije motoričkih varijabli i rezultata u situacionim nogometnim testovima. Kineziologija, N^0 1. Zagreb,

8.Mikić, B. (1999). Testiranje i mjerenje u sportu. Faculty of Philosophy, University in Tuzla.

9.Petrić, D. (1981). Relacije nekih motoričkih dimenzija i uspjeha u nogometnoj igri kod omladinaca. Kineziologija, Vol. 12 (1 – 2): 29 – 34.

10.Reilly, T., Bangsbo, J., Franks, A.,(2000). Anthropometric and physiological predisposition for elite soccer. Journal of Sport Sciences 18(9), 669-683

11.Talović, M.(2001) Efekti programa na poboljšanje motoričkih i funkcionalnih sposobnosti kao i nekih elemenata tehnike nogometaša. Faculty of Sport and Physical Education. PhD Dissertation.

UTJECAJ BAZIČNO MOTORIČKIH SPOSOBNOSTI NA SITUACIONO MOTORIČKU EFIKASNOST U NOGOMETU KOD UČENIKA VI I VII RAZREDA OSNOVNE ŠKOLE.

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SAŽETAK

Uvod : Cilj ovog istraživanja je utvrditi relacije između antropološkog statusa individue definisanog nekim bazičnim motoričkim sposobnostima i situaciono motoričke efikasnosti u nogometnoj igri kod učenika VI i VII razreda osnovne škole, koji nisu uključeni u vannastavne i vanškolske sportske aktivnosti. Očekuje se statistički značajna povezanost između bazičnih motoričkih sposobnosti I efikasnosti u situaciono motoričkim testovima za nogometnu igru.

Metode : Uzorak ispitanika Istraživanje je rađeno na uzorku od 100 ispitanika, dječaka dobi 10 do 12 godina, koji pored redovne nastave tjelesnog odgoja nisu uključeni u dodatne nastavne,vannastavne i vanškolske sportske aktivnosti. Uzorak varijabli U istraživanju je obuhvačeno 20 varijabli (Mikić, 1999). Od toga 17 prediktorskih (varijable za procjenu bazičnih motoričkih sposobnosti) i 3 kriterijske varijable (varijable za procjenu situaciono motoričkih sposobnosti). obrada podataka u ovom istraživanju uz primjenu statističko-matematičkih postupaka utvrđena je programskim paketom SPSS 17, I STATISTIKA 8,

Rezultati : Istraživanjem se nastojalo utvrditi međusobna povezanost između motoričkog i situacijsko – motoričkog prostora, što je prvo prikazano u okvirima kroskorelacijske matrice. U nastavku istraživanja, urađena je regresiona analiza kako prve glavne komponente nogometne igre u cijelom prostoru bazične motorike tako I analiza parcijalnih koeficijenata. gdje se jasno vidi da je koeficijent multiple korelacije je izrazito visok (.906). Na osnovu dobijenih rezultata vidljivo je da se prediktorskim skupom varijabli motoričkog prostora na nivou značajnosti (Sig. = .000), može izvršiti predikcija kriterijske varijable (glavna komponenta), izvođenja situaciono-motoričkih testova iz nogometa. Takođe, koeficijent determinacije pokazuje de se 82% kriterija može predvidjeti, odnosno objasniti ulaznim sistemom motoričkih varijabli

Zaključak : Na osnovu rezultata istraživanja, došlo se do zaključaka da su testovi za procjenu frekvecije pokreta nogama, brzine i ravnoteže u značajnoj korelaciju sa ukupnom situaciono motoričkom efikasnošću. Ovo je naročito izraženo kod uspješnosti prilikom kontrole lopte, dok su testovi za procjenu repetitivne i eksplozivne snage pokazali visoku korelaciju sa situaciono motoričkim testovima za procjenu snage šutiranja.

Ključne reči : Učenici, nogomet, motoričke sposobnosti.

RESEARCH OF THE EFFECTIVENESS OF THE SPECIALIZED TRAINING OF PUPILS IN TIMES OF DISASTERS

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UDC 796.015.59:502.58

SUMMARY

Introducion: The scientific report shows the efficiency of the applied specialized survival training in times of different disasters. Gaining knowledge about the nature and specifics of disasters, about the behaviour and actions against agression and violence, building applied motor skills and habits, as well as improving students' physical preparation is realized during the physical education classes. Specialized training was additionally included in the curriculum.

To reveal its efficiency we used psychological tests, motor tests, and expert evaluation about students' readiness for actions in times of disasters.

The applied specialized training of the pupils during the physical education classes is assumed to be effective.

Methods: 1) State/Trait Anxiety Inventory – Ch. Spielberger; 2) Speed test – 20 m running from high starting position (sec); 3) test for explosive power of the lower limbs – long jump from static position (cm); 4) Test for power endurance of the abdominal muscles – sit-ups (number of repetitions in 30 sec); 5) Test for the grip strength – hand dynamometer grip test (kilos); 6) Expert assessment of the pupils' readiness – 6 graded scale.

Results: The most significant increase in the achievements of all the tests is revealed in the speed indexes for both genders from the EG compared with the pupils from the CG with P=99%. The purposeful influence through specific exercises (running from different starting positions – lying with eyes closed, sitting on a chair, bench; running short distances while going round hurdles, etc.) are effective for development of the motor skill having the key significance for fulfilling adequate actions in times of disasters.

Conclusion: The specialized training for actions in times of disasters applied in the physical education classes is effective. It has had a positive impact on forming skills for actions in times of disasters and on improving the physical readiness of the pupils.

Key Words: psychic readiness, physical readiness, survival

Human's life predisposes his constant going through various situations which affect him in different ways.

Disasters are situations which occur suddenly and threaten human's life and health or are subjectively assumed as life, health, self being, and well being threats (8). They are a special type of extreme situations (6) and are often viewed as "dramatic and tragic episodes in human life" (4).

The constant increase in their number, as well as the insignificant action-oriented preparation (1,3,9) have led to the necessity of applying a specialized survival training in the physical education classes which aims at forming readiness for action in times of disasters.

The readiness for action in times of disasters is built around five interconnected and relatively independent structures – psychic, physical, technical,

tactical, and special. The overcoming of different extreme situations requires forming adequate psycho-physical readiness which includes two of the five structures – the psychic and the physical ones. (5)

The psychic readiness includes cognitive, emotional, and will sub-structures (the cognitive one having main significance for the adequacy of human's actions). The level of psychic readiness for actions in different situations is determined to a great extent by the anxiety level of the individual.

The physical readiness includes the following aspects of the motor abilities of the person, viewed as motor (physical) skills – muscle strength, speed, endurance, agility, and dexterity.

The richness of means and methods characteristic of physical education and the parallel manifestation of cognitive and motor activities during the classes provide the pupils with a favorable atmosphere for forming readiness for surviving different disastrous situations. The major tasks of the lesson are connected with providing knowledge, forming motor skills and habits, and improving the level of physical preparation based on the complex development of the physical skills.

The specialized survival training aims at obtaining knowledge, connected with the preliminary preparation for actions in times of disasters, forming applied skills and habits, improving the physical preparation for the effective application of the already built skills, learning basic principles and rules for action in case of violence, aggression, and attack. (2)

Based on the theoretical analysis the following work **hypothesis** is formulated:

The applied specialized training of the pupils during the physical education classes is assumed to be effective.

The purpose of the present research is studying the effectiveness of applying the specialized training of the pupils for actions in times of disaster during the physical education classes.

To fulfill the purpose the following **tasks** are set:

1. To develop a theoretical base of the problem.
2. To study the psychic and physical readiness of the pupils for actions in time of disasters.
3. To reveal the effectiveness of the applied training for actions in times of disasters with pupils.

The subject of the research is the effectiveness of the methods of the specialized training for actions in times of disasters with pupils.

The object of the research is the specialized training of pupils for actions in times of disaster.

The contingent of the research is 94 sixth-grade pupils (52 boys and 41 girls), studying in a Sofia school, divided into a control group (CG) – 50 pupils (26 boys and 24 girls) and experimental group (EG) – 44 pupils (27 boys and 17 girls).

RESEARCH METHODS

Complex methods for fulfilling the purpose and tasks of the research have been applied, including: studying the literary sources, pedagogical observation, and undertaking pedagogical transforming experiment during the physical education classes. Indexes for the psychic and physical readiness have been measured before and after the experiment through the following tests:

1) the State/Trait Anxiety Inventory – Ch. Spielberger (7); 2)a speed test – 20 m running from high starting position (sec); 3) a test for explosive power of the lower limbs – long jump from static position (cm); 4)a test for power endurance of the abdominal muscles – sit-ups (number of repetitions in 30 sec); 5) a test for the grip strength – a hand dynamometer grip test (kilos); 6) expert assessment of the pupils' readiness – 6 graded scale.

The results have been processed with the help of the variation analysis.

The research was done from 15.09.2012 to 15.03.2013 in accordance with the tasks set. In this period, within 40 classes, together with the fulfillment of the educational contents of the subject

"Physical Education" for the 6th grade an additional training for forming readiness in times of disasters was applied. During the time of the experiment the pupils obtained knowledge connected with the adequacy of their actions in times of different natural and social disasters and worked purposefully for improving their speed, muscle strength and endurance through applying various exercises. At the same time the pupils from the control group learned the educational contents of the subject "Physical Education".

After the initial testing of the CG and EG it was found that there were no statistically significant differences in the indexes between the two groups.

The expert assessment of the pupils' readiness at the beginning of the research showed a poor preparation for action in times of different disasters.

Tables 1 and 2 show the final results of the students from CG and EG.

The statistically significant differences of the students from the EG are clearly visible in comparison to those of the pupils from the CG.

TABLE 1 Final results of the 6th grade girls – Control and Experimental groups

№	Assessment / INDEXES	CG		EG		d	d%	P %
		$\overline{X}_1$	S_1	$\overline{X}_2$	S_2			
1	State anxiety	39	8.1	37	6.1	2	5.1	75
2	Trait anxiety	46	9.1	39	5.0	7	15.2	99
3	Speed 20m.	4.5	0.3	4,3	0.2	0.2	4.4	99
4	Long jump	146	18.1	154	14.0	8	5.5	89
5	Sit-ups	20,5	2.8	21.1	2.0	0.6	2.9	30
6	Hand dynamometer grip test (right hand)	16	3.5	17	4.2	1	6.3	79
7	Hand dynamometer grip test(left hand)	15	3.3	16	3.6	1	6.6	90

TABLE 2 Final results of the 6th grade boys – Control and Experimental groups

№	Assessment / INDEXES	CG		EG		d	d%	P %
		$\overline{X}_1$	S_1	$\overline{X}_2$	S_2			
1	State anxiety	39	8.5	34	5.5	5	12.8	95
2	Trait anxiety	45	9.1	38	6.0	7	15.6	98
3	Speed 20m.	4.3	0.3	3.9	0.1	0.4	9.3	99
4	Long jump	146	17.1	172	19.1	26	17.8	99
5	Sit-ups	22	2.8	24	2.1	2	9.1	95
6	Hand dynamometer grip test (right hand)	18.8	5.5	19.1	6.7	0.3	1.6	11
7	Hand dynamometer grip test(left hand)	18.2	4.7	18.1	6.1	0.1	0.5	6

The knowledge about human behavior in times of natural disasters, aggression or assaults obtained by the students has contributed to forming readiness for overcoming extreme situations. The applied methods, aiming at broadening the knowledge, as part of the cognitive sub-structure of the psychic readiness of the researched individuals, have had higher influence on the boys from the EG. Their state anxiety has decreased by 5 points or 12,8% (P=95%), and their trait anxiety –by 7 points or

15,6% (P=98%) in comparison to the same indexes with the boys from the CG. There is a statistically significant lower level of trait anxiety with the girls from the EG – 7 points (P=99%) in comparison to the girls from the CG, and there are decreasing trends in the level of the state anxiety (P=75%).

The most significant increase in the achievements of all the tests is revealed in the speed indexes for both genders from the EG compared with the pupils from the CG with P=99%. The purposeful influence through specific exercises (running from different starting positions – lying with eyes closed, sitting on a chair, bench; running short distances while going round hurdles, etc.) are effective for the development of the motor skill having the key significance for fulfilling adequate actions in times of disasters.

There is a high increase in the explosive power of the lower limbs indexes with the boys from the EG, with a difference of 26 cm (17,8%). The development of this skill, crucial for the fast start of the movements and running in times of disasters has been influenced by the application of the specific training means (exercises with long and high jumps).

The execution of the applied exercises for fast start of the movements and locomotion and for overcoming obstacles have affected the improvement of the strength endurance of the abdominal muscles with the boys P=95%. There is an improvement of the explosive power of the lower limbs and the strength endurance of the abdominal muscles with the girls from the EG but with P<95%.

To prove the effectiveness of the specialized training the results of the pupils from the EG, at the beginning and the end of the experiment, have been analyzed (Tables 3 and 4).

TABLE 3 Results from the tests with 6th-grade girls – EG

№	ASSESSMENT / INDEXES	INITIAL		FINAL		d	d%	P %
		$\overline{X}_1$	S_1	$\overline{X}_2$	S_2			
1	State anxiety	39	9.1	37	6.1	2	5.1	92
2	Trait anxiety	43	10.0	39	5.0	4	9.3	95
3	Speed 20m.	4.6	0.2	4.3	0.2	0.3	6.5	99
4	Long jump	146	19.8	154	14.0	8	5.5	99
5	Sit-ups	19	1.9	21	2.0	2	10.5	99
6	Hand dynamometer grip test (right hand)	16	3.5	17	4,2	1	6.3	58
7	Hand dynamometer grip test(left hand)	14	4.3	16	3.6	2	14.3	96

TABLE4 Results from the tests with 6th-grade boys – EG

№	ASSESSMENT / INDEXES	INITIAL		FINAL		d	d%	P %
		$\overline{X}_1$	S_1	$\overline{X}_2$	S_2			
1	State anxiety	37	8.2	34	5.5	3	8.1	93
2	Trait anxiety	41	9.6	38	6	3	7.3	90
3	Speed 20m.	4.2	0.4	3.9	0.1	0.3	7.1	95
4	Long jump	163	21.3	172	19.1	9	5.5	99
5	Sit-ups	20	2.7	24	2.1	4	20	99

6	Hand dynamometer grip test (right hand)	18	6.1	19	6.7	1	5.6	69
7	Hand dynamometer grip test(left hand)	17	5.3	18	6.1	1	5.9	58

There is a decrease in the state and trait anxiety with 2-3 points at the end of the research period with the pupils from the EG (fig. 1). A higher positive change with 4 points (9,3%) can be observed with the girls (P=95%) due to the specialized training. Therefore, there are stable positive changes in the psyche and personality of the 6th-grade girls from the EG.

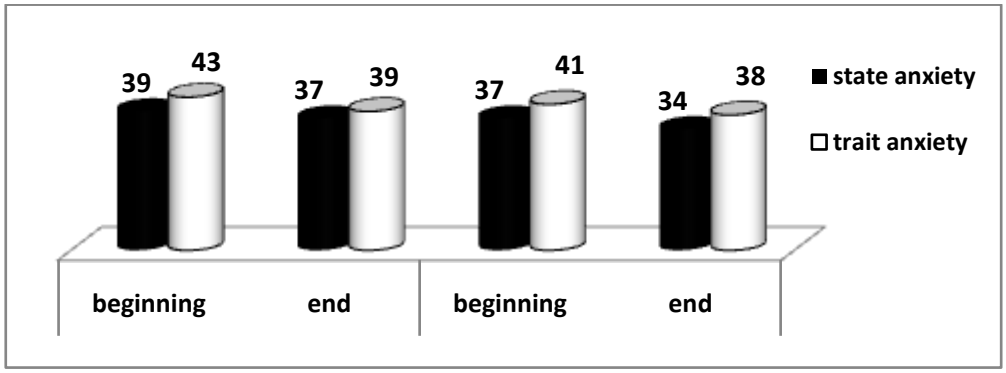

Fig. 1Anxiety Dynamics with the Pupils from the EG

Regarding the trait anxiety of the boys and the state anxiety of both genders there is a trend of improvement as a result of the applied specialized training.

The specialized training turns out to have a great impact on improving the speed. The statistically significant difference in the achievements from the speed test among the pupils from the EG and CG is supported by the increase in the development of this skill with the EG (fig. 2). The speed of the girls from the EG has improved by 0.3 sec or 6.5%, and the speed of the boys – by 0.3 sec or 7.1%. Due to the slowly occurring changes in the development of this motor skill, this low percentage of variation is significant, which is supported by the statistical reliability coefficient P=99% for the girls and P=95% for the boys.

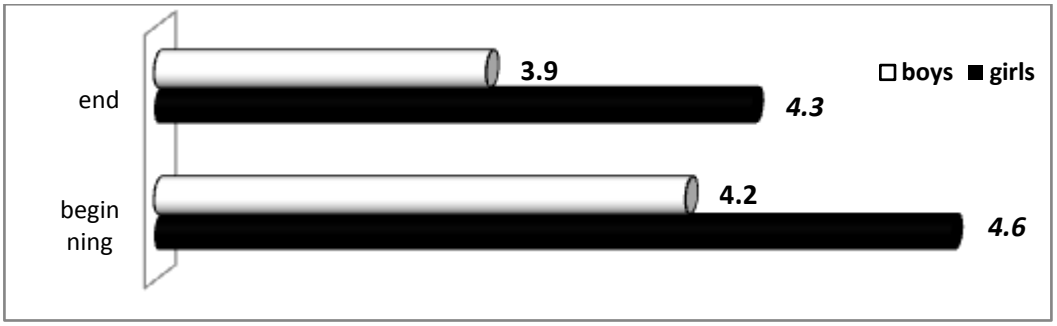

Fig.2 Speed Dynamics with the Pupils from the EG(sec)

The results for the speed are indicative with the high homogeneity of the indexes (V<10%), which reflects the good organization of the specialized training.

The most significant changes are observed in the indexes for the explosive power of the lower limbs and for strength endurance of the abdominal muscles.

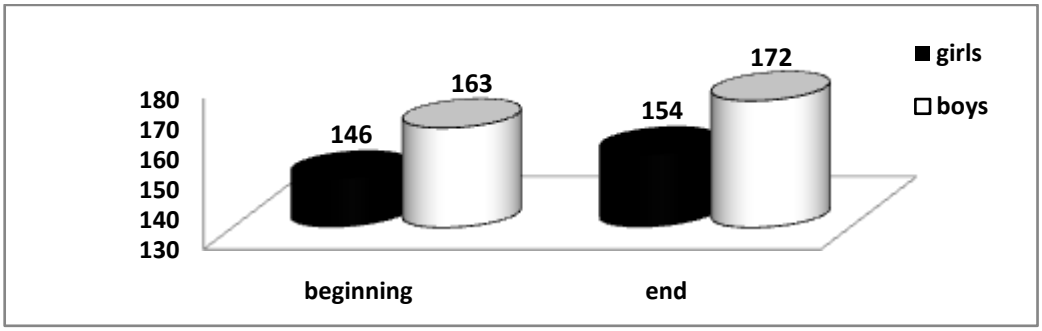

Fig.3 Explosive Power of the Lower Limbs Dynamics with the pupils from the EG

Fig. 3 shows the results from the test "long jump from static position". The differences in the pupils' achievements at the beginning and the end of the experimental period are clearly outlined. The average value of the girls' achievements has increased by 8 cm or 5.5% (P=99%), and the average value of the boys' achievements has increased by 9 cm or 5.5% (P=99%). This statistically significant increase in the explosive power of the lower limbs of the pupils probably affects the improved results of their speed in the test "20 m running".

Fig. 4 shows that there is an increase of two sit-ups among the girls and 4 sit-ups among the boys in comparison with their initial trials (P>99%). The highest increase (20%) in the achievements from all the tests can be observed in the test for the strength of the abdominal muscles with the girls from the EG (P=99%).

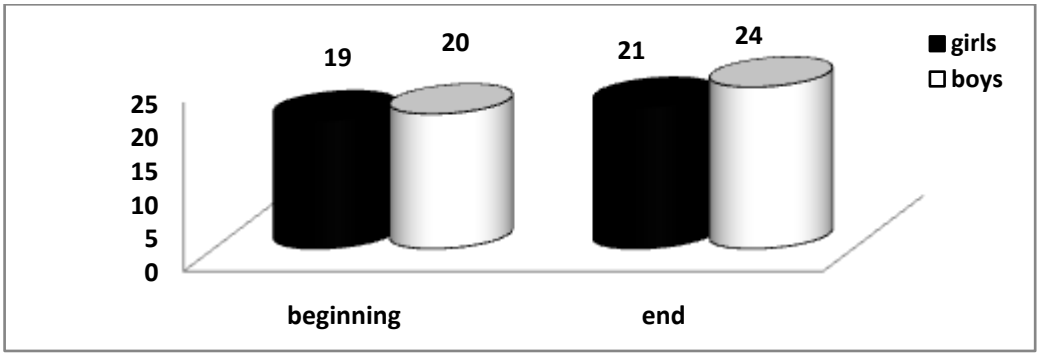

Fig.4 Strength Endurance of the Abdominal Muscles Dynamics (EG)

The strength of the abdominal muscles is of great significance not only for the maintenance of the functions of the organism, but also for the fulfillment of adequate actions in times of natural and social disasters.

The applied specialized survival training has had a slight impact on the hand grip. Similar and almost insignificant are the changes in the hand grip of both left and right hands with the pupils from the control group. The girls from the experimental group have improved their left hand grip by 2 kilos (14,3 %) with the P=96%. This change in the girls' grip can be partially explained by the applied specialized training as well as their earlier entering the age of puberty.

The talks given and the expert assessment at the end of the experiment found that the pupils' readiness for actions in times of different disasters is on a good level.

After the analysis and summary made, the following **conclusion** can be provided:

The specialized training for action in times of disasters applied in the physical education classes is **effective**. It has had a positive impact on forming skills for action in times of disasters and on improving the physical readiness of the pupils.

ИЗПОЛЗВАНА ЛИТЕРАТУРА:

Алексиев. Р. Проучване на готовността на учителите за действия при бедствени ситуации.(Проблеми на училищното физическо възпитание и спорт). “Сердолик”. С. 2002

Гешев, П. Т. Маринов. Подготовка на учениците за оцеляване в бедствени ситуации в урока по физическо възпитание. СиН, бр.6. С. 2012.

Годишни отчети от Постоянните общински комисии за защита на населението при бедствия, аварии и катастрофи. www.nsi.bg

Градев, Д. Социална психология на масовото поведение. С. 1987

Кайков, Д. Готовност за оцеляване в екстремални ситуации. „Сердолик”. С. 2004

Кайков, Д. Теория и методика на изследване на екстремалните ситуации. Военно издателство. С. 1988

Уеб-страница: Медицински тестове. Самооценъчна скала за тревожност (Спилбъргър).

http://www.polls.hapche.bg/index.php?sid=65472

Шойгу, Ю. Психология экстремальных ситуаций для спасателей и пожарных. (под общей ред.). „Смысл**”. М. 2007**

Credcrunch. Centre for Research on the Epidemiology of Disasters – CRED. Newsletter, Issue № 27. 2012 http://www.emdat.be/publications

THE SHAPE OF THE HOMOGENIZATION OF MOTOR INDICATORS DEPENDING ON GENDER

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UDC 796.012.1

SUMMARY

Introduction: The grouping of motor abilities on the basis of physiological preconditions, as the characteristics of motoricity structure where they are manifested, frequently defines the entire process of total periodisation of sport training. This anthropomotorics phenomenon especially attains its significance when it is necessary to realize exercise programs with the athletes of different gender, for which the same exercise structures do not give identical results. Therefore, it is very important to be familiar with the principles of homogenization within motoricity potentials.

Methods: The total sample of the examinees for this research was made up of 300 boys and girls and was structured from two sub-samples of 150 boys and 150 girls from fourth grade of secondary school. The system of motoricity tests applied in this research consisted of motion tasks for the estimation of speed, explosive-strength and the abilities of flexibility. The shape of the indicators of motoricity factors was determined by the factor analysis, and their characteristics were determined on the basis of their results.

Results: The results of this research, namely the parameters of the factor analysis, indicate to a high level the differences in the grouping of the manifestly motoricity indicators for male and female sex.

Conclusion: According to the results obtained in this research, there can be observed important differences in the shape of the homogenisation of manifestly motoricity indicators for boys and girls. Such results enable us to come to a conclusion that motoricity indicators for male and female sex do not function in an entirely identical manner.

Key words: motor development, factorizing, periodisation.

INTRODUCTION

The grouping of the motor abilities on the basis of physiological prerequisites, and the characteristics of motorcity structures in which they are shown, very often define an entire process of sport training periodisation. This anthropo-motoricity phenomenon especially gets its significance when it is necessary to implement training programs with athletes of different sexes, for which the same training structures do not give identical results.

The motoricity abilities can be defined as the latent motoricity structures that are responsible for an endless number of the manifested motoricity reactions and which can be measured and described (Mraković, 1992). Regardless of a big number of definitions of motor abilities, there is a range of situations when an insufficient accuracy can be applied in their design and interpretation. The attempt to comprise a complete phenomenon of motor ability by one definition is almost impossible. Lately it has been possible to come across the stances that motor abilities are actually physiological characteristics of the neural-muscular system and that they should be treated in such a way.

On the basis of that, it can be concluded that motor abilities are precisely determined processes of energy and exploration of the neural-muscular potential which is reached because of the space-timely motoricity manifestation.

The differences among motor abilities, different character, emerging among the two sexes are relatively often researched, but they were mostly related to the potential in some motoricity factors. The assumption that the motoricity could also have different structures was rarely interesting for the researches (Planinšec, 2001; Bala, 2002).

In the researches that aimed to prove possible structural differences in the structure of motoricity abilities among sexes, the examinees mostly come from pre-school and lower school age and, as a conclusion, the authors argue that boys and girls should not be mutually separated in the kinesiologic activities through to the period of differentiation.

The goal of this research was to prove the possible differences in the structure of motor abilities between male and female sex in the period when motor abilities become different and attain other shape.

METHODS

Participants

The total sample of the examinees for this research of 300 examinees was made of two sub-samples of 150 girls, students of fourth grade of secondary school (age: 18 year ± 6 months; height: 169,81cm ± 6,49; mass: 61,34kg ± 6,66) i 150 boys, students of grade class of secondary school (age: 18 year ± 6 months; height: 183,97cm ± 5,69; mass: 76,81kg ± 10,14).

Measurements

The motoricity tests for the estimation of speed, explosive-strength and suppleness abilities are applied in the research.

For the estimation of the speed abilities, the following tests are applied: taping by hand (MBTAPR), running 20 m, flying start (TRČ20), running 30m high start (TRČ30).

For the estimation of the explosive-strength abilities of hands and shoulder band and lower limbs, the following tests are applied: medicine ball throwing from sitting position (MFEBMS), medicine ball throwing from lying position (MFEBML), medicine ball throwing back over the head (MFEBMN), standing jump (MFEDM), standing triple jump (MFETM), jump up-sergeant (MFEVM).

For the estimation of the suppleness of some body parts, the following tests are applied: side bend with a stick (MISK), deep forward bend on a bench (MDKP), spagat (MSPA).

Each of the manifested motor ability variables was measured three times and to get the most accurate result, the final value of the test was calculated as an average value of all three measurements.

In order to avoid a negative impact of a various application of the motoricity tests on the total result in the individual tests, during the week preceding the measurement, the exercise of the tests was performed. During that week, the examinees attended three times an organized exercising of the tests planned for the accomplishment of this research. The duration of each exercise was 40 minutes.

At the end of the exercises, each examinee had to adopt a motoricity craft at such a level which enables the best execution of an estimated variable of motor ability.

The request implied a compulsory attendance of the training and each examinee had to fulfill this request in order to be included in the measurements. Only after all the examinees passed the exercise period, the practical accomplishment of the researches and the estimation of the manifestation of the treated motor abilities was done.

Statistical analysis

A model of the multivariate factor analysis (component) aiming that the group of mutually connected vectors of manifested variables from inter-correlation matrix, by a method for sloping transformation of factors (direct oblimin), mathematically transform into a smaller number of

fundamental non-measurable factors, as the determinants of covariance, responsible for the emerged common variance in the results of measurement. On the basis of such obtained data, the shape of the homogenization of the motoricity indicators separately for masculine and feminine, and the characteristics and the level of given homogenization, namely their difference will be defined.

The process of factorization, namely the calculation of the number of main components in the multidimensional system of motoricity variables and the extraction of their common factors was performed on the basis of the Gutmann-Keiser's criterion for the calculation of the number of main components. By the transformation of the initial coordinate system and by the solution of the characteristic equation of the inter-correlation matrix, reduced statistically significant characteristic roots which have their own values, bigger or equal to 1.00 ($\lambda \geq 1.00$), were retained. After the separating of the factors and in order to avoid a negative correlation among the extracted factors so as to identify the structure of a latent dimension and the determination of their mutual relations, slope angle transformation of latent dimensions by the direct oblimin solution.

RESULTS

Table 1 presents the values of characteristic roots of the motoricity variables and explains the parts of common variance for the sample of masculine. In this table, the column designated with «λ» gives the characteristic roots, column with «%» the estimation of the total variance and column with (CUM %) the cumulative percent of the total variance of the analyzed variables belonging to these characteristic roots.

TABLE 1 Characteristics roots and the explained common variance of the motricity variables (men)

Factors	Lambda	Variance (%)	Cumulative (%)
1.	4.95	41.30	41.30
2.	1.54	12.89	54.20
3.	1.18	9.90	64.10

By the factorization of the matrix of the inter-correlation of the motoricity variables from the total analyzed manifested space, the numerical algorithm is in factor matrix had extracted three relevant characteristic roots λ. This means that three obtained interpretable hyper-ellipsoids of the resulting vectors cumulatively explain 64.10% of a standardized common variance of the total variability of the group of all 12 vectors of the measured variables.

TABLE 2 The structure of the motoricity latent dimensions (A-matrix of system and communalities)

Variable	OBL1	OBL2	OBL3	h^2
TRČ20	-.11	(.87)	.13	.83
TRČ30	-.21	(.86)	.06	.87
MFEBMS	(.69)	-.03	-.17	.58
MFEBML	(.73)	-.12	-.08	.63
MFEBMN	(.74)	.07	.01	.53
MFEDM	(.89)	-.09	.13	.80
MFETM	(.76)	-.22	.06	.68
MFEVM	(.81)	-.15	.26	.71
MBTAPR	(.53)	.03	-.25	.41
MISK	.09	.15	(.78)	.58
MDPK	.09	.04	(-.76)	.63
MSPA	(.50)	.36	.18	.39

Table 2 presents the parallel projections of the vector coordinates of the manifested motoricity variables onto the factors (A-matrix of system) and the values of communalities (h^2). By an insight into table 2, it is possible to see the obtained values of communalities, namely the proportions of variance of each manifested variable which was explained by a common separated factor.

The results presented in tables 1 and 2 indicate that the numerical algorithm of the multivariate model of factor analyze had the real space of the correlation matrix of the group of 12 applied motoricity indicators in a hypothetically three-dimensional model of the differenced latent dimensions transformed, which together explains approximately 65% of the common variance of all measured variables.

TABLE 3 The characteristic roots and the explained common variance of the motoricity variables (girls)

Factors	Lambda	Variance (%)	Cumulative (%)
1.	5.02	46.85	46.85
2.	1.58	13.20	60.05
3.	1.08	9.05	69.11

Table 3 gives the values of the characteristic roots of the motoricity variables and the explained parts of a common variance for the sample of feminine.

TABLE 4 The structure of motoricity latent dimensions (A-matrix of system and communalities)

Variable	OBL1	OBL2	OBL3	h^2
TRČ20	(-.95)	.11	-.00	.85
TRČ30	(-.96)	.13	-.00	.87
MFEBMS	-.11	-.01	(.91)	.75
MFEBML	.05	-.07	(.88)	.77
MFEBMN	.31	.20	(.52)	.67
MFEDM	(.48)	.40	.29	.80
MFETM	.32	(.52)	.23	.68
MFEVM	(.55)	.50	.03	.75
MBTAPR	.42	(.43)	.12	.57
MISK	.09	(-.56)	-.12	.35
MDPK	-.02	(.88)	-.19	.69
MSPA	-.07	(.70)	.03	.49

The results presented in tables 3 and 4 indicate that the numerical algorithm of the multivariate model of factor analysis had transformed the real space of the correlation matrix of the group of 12 applied motoricity indicators in a hypothetically three-dimensional model of differenced latent dimensions, which together explain approximately 70% of the common variance of all the measured variables for the sample of girls of fourth class of secondary school.

Because of the accord of the results A-matrix of the system, namely the calculated values of the parallel projections of the variables onto the vectors with the results F-matrix system which contains orthogonal projections of the variables onto the factors meaning that F-matrix does not give the

information about separate latent dimensions, these are not presented in this work.

DISCUSSION

The first extracted latent dimension from the applied motoricity space, for the sample of students from fourth grade of secondary school with its contribution of 41.30% variability, is dominantly defined by the vectors of all 6 motoricity tests applied for the estimation of the explosive strength both of the lower limbs and hands and shoulder band. Regardless of the participation in the defining of this factor and the test for the estimation of suppleness MSPA, this factor is identified as THE FACTOR OF EXPLOSIVE STRENGHT.

The second extracted dimension with a variance of 12.89% is defined by the tests for the estimation of running speed TRČ20 and TRČ30, so this factor must be defined as THE FACTOR OF RUNNING SPEED.

As the third and the last factor, namely the latent dimension, with its own contribution to the common variance of 9.90%, THE FACTOR OF SUPPLENES has been identified and it is defined by the motoricity indicators MISK and MDKP.

On the other side, the first extracted dimension of the applied motoricity space, for the sample of male students of fourth grade of secondary school with its contribution of 46.85% of variability, is dominantly defined by the tests for the estimation of running speed TRC20 and TRC30 and two other tests for the estimation of the explosive strength of the lower limbs MFEDM and MFEVM. On the basis of these findings, this factor must be identified as THE FACTOR OF THE LOWER LIMBS EXPLOSIVE STRENGHT.

The second latent dimension with a variance of 13.20% is defined by three applied tests for the estimation of suppleness together with taping by hand tests and standing triple jump. Having in mind many times the identified specificity of the taping by hand test, and with complex technical realization of a standing triple jump, this factor is defined as THE FACTOR OF SUPPLENESS.

The third and the last defined factor for the sample of the female sex with an individual contribution to the common variance of 9.05% is defined by three applied motoricity tests for the estimation of the explosive strength of hands and shoulder band, and as such, this factor is identified as THE FACTOR OF EXPLOSIVE STRENGTH OF HANDS AND SHOULDER BAND.

The common feature of both structures of the motoricity space, which is in an identical way applied to the samples both masculine and feminine, is the independence of the factor of suppleness, which is not significantly disrupted by smaller oscillations neither for male nor for female sex. This part of a latent structure would be conditionally considered as identical for both sexes. The part which significantly separates the way of the homogenization of motoricity indicators is related to the indicators of the explosive strength and the indicators of running speed.

Unlike the sample of male students, where the explosive strength emerged as the ability of a general character with a high level of an independence, namely specificity, for the sample of female students the explosive muscle potential of the lower limbs, hands and shoulder band is manifested as mutually independent. Beside this, the factor of the explosive strength of the lower limbs is, for the female sample, also defined by the tests for the estimation of running speed, while, for the male sample, the test field for the estimation of running speed has shown a high level of independence which reached the level of the extracted factor.

The extracted factor of the running speed for boys is a significant indicator that in this period, movement structure such as sprint running possesses a high level of a specific motoricity and muscle engagement, and that, in synergy with a quality technique, represents a base for the results. In this period, for girls, the level of the movement structure of sprint running is already at a descending level and, as such, it is first of all defined by the

explosive potential of the lower limbs, because of which motoricity indicators of running speed were grouped together with the tests for the estimation of the explosive strength of lower limbs. The closeness of the results of these tests for the female sample led to the extraction, namely separation of the indicators for the estimation of the explosive strength of hands and shoulder band into an independent factor, which after all, significantly draws its independence from the characteristics of the anatomical structure of hands and shoulder band of female body.

If the results of this research are compared with the previously executed works on a similar topic, although there has been a little of them so far, and with the sample which is not compatible with the sample of this research, it can be concluded that these authors come to the same conclusions proving that the structure of the motoricity space for men and women actually functions in different ways (Planinšec, 2001, Zurc et al., 2005).

Beside this, in many scientific works a very various ways of biological development of some motoricity potential among boys and girls are proven, what is the additional factor which enables safer giving the conclusions about the differentiation of the process within the motoricity field for male and female sex (Bala, 2002; Bala, 2003; Bala et al., 2009).

All these conclusions question the attitudes that the boys and girls in early school age can be trained with the same movement structures. It is a fact that the closeness of contents which can be performed with boys and girls is big, but it is questionable if it can be identical.

In any case, this and a great number of previous researches has shown that the latent dimensions of motoricity space for masculine and feminine are significantly different, both in the quantitative and the qualitative features, and the additional explanations for this phenomenon should be found in the future.

CONCLUSSION

Having in mind all previously said, the fact that there are significant differences in the shape of homogenization of manifested motoricity indicators for boys and girls emerges as an unavoidable conclusion. Such results enable the conclusion that the motoricity potential of masculine and feminine do not function in a totally identical manner.

Although such presented information in the majority of cases would bring nothing new, if we consider training programs that are every day executed with the members of both sexes, it is quite obvious that there is a huge space for the direct application of such findings telling that the functional-motoricity potentials of men and women do not function in an identical way.

On the other side, the findings of this and other researches can mark a very important advancement in the approach to total sport training of both sexes, especially in its conditioning part.

If the conclusions of such researches are to be seriously taken into account, what must be a priority, it would relatively quickly trigger a very significant advancement in the correction of daily errors in training, reaching of the functional-motoricity limits for both sexes, and the raising of a humanistic aspect of sport training in general.

REFERENCES

Bala, G. (2002). Strukturalne razlike motoričkih sposobnosti dečaka i devojčica u predškolskom uzrastu. *Pedagoška stvarnost 48*(9-10), 744-752.

Bala, G. (2003). Quantitative diferences in motor abilities of pre-school boys and girls. *Kinesiologia Slovenica 9*(2), 5 – 16.

Bala, G., Popović, B. & Jakšić, D. (2009): Trend of changes of general motor ability strukture in pre-school children. *1th International Scientific Conference*, Novi Sad, Srbija, 26 – 28 march 2009: 113 – 118.

Idrizović, K. (2004). *Motoričke sposobnosti i morfološke karakteristike školske omladine i njihove relacije sa atletskim disciplinama*. Nikšić: Unigraf.

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, J. & Štalec, N.V. (1975). Struktura i razvoj morfoloških i motoričkih dimenzija omladine. Beograd: Institut za naučna istraživanja Fakulteta za fizičko vaspitanje.

Momirović, K., Štalec, J. & Wolf, B. (1975). Pouzdanost nekih kompozitnih testova primarnih motoričkih sposobnosti. *Kineziologija, 5*(1-2), 169-192.

Planinšec, J. (2001): A comparative analysis of the relations between the motor dimensions and cognitive ability of pre-school girls and boys. Kinesiology 33 (1): 56-68.

Zurc, J., Pišot, R. & Stojnik, V. (2005). Gender differences in motor performance in 6,5–year–old children. *Kinesiologia Slovenica, 11* (1), 90–104.

OBLIK HOMOGENIZACIJE MOTORIČKIH POKAZATELJA U ZAVISNOSTI OD POLNE PRIPADNOSTI

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SAŽETAK

Uvod: Grupisanje motoričkih sposobnosti na osnovu fizioloških preduslova, kao i karakteristika motoričke strukture u kojoj se manifestuju, definišu veoma često ukupan proces cjelokupne periodizacije sportskog treninga. Ovaj antropomotorički fenomen posebno dobija na važnosti kada je potrebno realizovati trenažne programe sa sportistima različitog pola, kod kojih iste trenažne strukture neće identično rezultirati. Prema tome veoma je važno poznavati principe homogenizacije unutar motoričkih potencijala

Metode: Ukupan uzorak ispitanika za ovo istraživanje od 300 momaka i djevojaka bio je strukturiran od dva subuzorka od po 150 momaka i 150 djevojaka četvrtog razreda srednje škole. Baterija motoričkih testova primijenjena u ovom istraživanju sastojala se od kretnih zadataka za procjenu brzinskih, eksplozivno-snažnih i sposobnosti gipkosti. Faktorskom analizom je utvrđen oblik homogenizacije motoričkih pokazatelja, na osnovu čijih rezultata su utvrđene i njihove karakterističnosti.

Rezultati: Rezultati ovog istraživanja, odnosno parametri faktorske analize ukazuju na visok nivo različitosti u grupisanju manifestnih motoričkih pokazatelja muškog i ženskog pola.

Zaključak: U skladu sa dobijenim rezultatima ovog istraživanja mogu se konstatovati značajne razlike u obliku homogenizacije manifestnih motoričkih pokazatelja kod momaka i djevojaka. Takvi rezultati omogućavaju zaključak da motorički potencijali muškog i ženskog pola ne funkcionišu na potpuno identičan način.

Ključne reči: motorički razvoj, faktorizacija, periodizacija.

THE INDEPENDENCE OF MOTOR FACTORS IN THE PERIOD OF DIFFERENTIATION AND AMALGAMATION

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UDC 796.012.8

SUMMARY

Introduction: The level of independence of motor abilities is one of the most important factors of the man's entire motor development, and also of an adequate and quality realisation of conditioning training through the process of a long sport development of each sportsman.

Methods: The total sample of the examinees for this research consisted of 300 pupils and was structured from two sub-samples, each having 150 pupils from fifth grade of primary school and fourth grade of secondary school. In this research, the motoricity tests for the estimation of speed, explosive-strength and the abilities of flexibility were applied. The level of the independence of motoricity factors during the two most important definable time spans of motor abilities, single and together as a part of unitary space, was determined by the correlation analysis.

Results: The results of this research show that the numerical values of the calculated correlation coefficients range in spans where it is possible to ascertain important differences at the level of the independence of motoricity factors of male sex during the period of differentiation and amalgamation.

Conclusion: Based on the obtained results from this research, a significantly higher level of the independence of motoricity factors can be seen, which were treated by this work in the amalgamation period in relation to the period of amalgamation.

Key words: motor abilities, structure, physical conditioning training.

INTRODUCTION

The studying of motor abilities of children has begun relatively early. Hicks (1930) researched the development of the motor abilities of ball throwing at a movable and unmovable target on the sample of sixty younger children. Several years later, Cowan and Pratt (1934) checked the possibility of the applying of jumping over the obstacle as a developmental and diagnostic test for the estimation of coordination development. The sample consisted of eighty children aged between three and twelve years. They proved that jumping over an obstacle can be a good indicator of the development of general coordination for children (according to Horvat, 2010).

Just general coordination is often taken as a global qualitative indicator of motoricity space. The motoricity space is structured of a significant number of its relatively independent sub-spaces (motoricity factors) that are significantly mutually interdependent. The interdependence, namely the independence of the motoricity factors, is a very important problem of kinesiological science, and, therefore, it is the basis for a great number of researches. Such is the case in this study.

Beside this, the level of the motoricity ability independence (factors) is one of the most important indicators of the total human motoricity development, as is also an adequate and a quality implementation of conditioning training through the

process of a long-term sport development of each athlete.

The motoricity space, as an indivisible part of the total multi-dimensional space that a man is, functions for a very long time as a very complex but individual, namely integral potential, during a biological development of a young human body, regardless of his complexity.

During the biological development up to the amalgamation process, motoricity abilities at first significantly and latter less and less, function as part of one global motor ability.

This global motor ability is most usually called the general motoricity factor (Bala & Franceško, 1997; Jozić & Đurak, 2003; Žgur & Čuk, 2011).

Unfortunately for the practitioners and probably luckily for the kinesiologists, the model of motoricity abilities of a man has not (it is a question if it would ever be) been clearly and relatively firmly defined yet. Therefore, the area of the research of the motor abilities structure stays a very interesting area for scientific research.

The latent structure of human motor abilities has been one of the central questions of kinesiologic science for some decades. An especially interesting area is the proving of the structure of child's motor abilities, having in mind the important methodological problems emerging during testing on one side, and a very pronounced causal link of the motor, conative, cognitive and other anthropological spaces on the other side (Bala et al., 2007).

The latent motoricity space is not entirely and finally defined, because the researches of this space are relatively meager, non-unified and are based on still insufficiently precise and defined measurement devices (tests), done on different populations and in different environments. Namely, the latent space is a dynamic system with the possibility of discovering new latent dimensions of motoricity, and the application of cybernetics, mathematics, information technology, metrology, system analyze, statistics and other processes and approaches, introduces new horizons in the researches of the latent motoricity space (Nićin, 2000).

According to all mentioned, the proving of the independence level of motoricity factors in two very important time intervals (differentiation and amalgamation) of an entire biological and, separately, motoric human development is set as the basic goal of this research.

METHODS

Participants

The total sample of the examinees for this research of 300 boys was created from two sub-samples of 150 pupils of fifth grade of elementary school (age: 11 years old ± 6 months; height: 150,18cm ± 6,87; mass: 41,75kg ± 7,62) and 150 pupils of fourth grade of secondary school (age: 18 years old ± 6 months; height: 183,97cm ± 5,69; mass: 76,81kg ± 10,14). The age of the examinees, namely the characteristics of the age of these two sub-samples is defined on the basis of the age of an examinee, that matches the assumed time interval, during which the processes of amalgamation and differentiation are performed.

Measurements

The motoricity tests for the estimation of speed, explosive-strength and suppleness abilities are applied in the research.

For the estimation of the speed abilities, the following tests are applied: taping by hand (MBTAPR), running 20 m, flying start (TRČ20), running 30m high start (TRČ30).

For the estimation of the explosive-strength abilities of the hands and shoulder band and the lower limbs, the following tests are applied: medicine ball throwing from sitting position (MFEBMS), medicine ball throwing from lying position (MFEBML), medicine ball throwing back over the head (MFEBMN), standing jump (MFEDM), standing triple jump (MFETM), jump up-sargent (MFEVM).

For the estimation of the suppleness of some body parts, the following tests are applied: side bend with a stick (MISK), deep forward bend on a bench (MDKP), spagat (MSPA).

Each of the manifested motoricity ability variables was measured three times and to get the most accurate result, the final value of the test was calculated as the average value of all three measurements.

In order to avoid a negative impact of the various applications of motoricity tests on the total result in the individual tests, during the week preceding the measurement, the exercise of the tests was performed. During that week, the examinees attended three times an organized exercising of the tests planned for this research. The duration of each exercise was 40 minutes.

At the end of the exercises, each examinee had to adopt the motoricity craft at such a level which enables the best execution of the estimated variable of motor ability.

The request implied a compulsory attendance of the meetings and each examinee had to fulfill this request in order to be included in the measurements. Only after all the examinees passed the exercise period, the practical accomplishment of the researches and the estimation of the manifestation of the treated motoricity abilities were done.

Statistical analysis

The independence level of motoricity factors during two most important periods of the defining of motor abilities was determined by the correlation analysis. The correlation matrix of the manifested variables, namely its big diagonal and numerical values of the correlation coefficients on it, represented the basis for drawing the conclusion of this research.

RESULTS

Table 1 gives the values of the correlation coefficients for the sample of fifth grade pupils of elementary school. The numerical designations from number 1 to number 12, given in the first row of the table 1 and table 2 where there are the values of the correlation coefficients for the sample of forth grade pupils of secondary school, represent the applied motoricity tests and are ordered according to the adequate motoricity tests in the first column. The statistically significant values of the correlation coefficients are for p=.05 of numerical value r=.16, and for statistical significance level of p=.01 the values are r=.21.

TABLE 1 The correlation matrix of motoricity variable for the pupils from fifth grade of elementary school

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TRČ20	1.0											
TRČ30	.68	1.0										
MFEBMS	-.03	-.03	1.0									
MFEBML	-.07	.01	.62	1.0								
MFEBMN	-.12	-.09	.47	.51	1.0							
MFEDM	-.33	-.32	.28	.33	.35	1.0						
MFETM	-.38	-.33	.36	.33	.29	.58	1.0					
MFEVM	-.31	-.38	.17	.13	.20	.55	.49	1.0				
MBTAPR	-.28	-.14	.08	.16	.16	.25	.15	.11	1.0			
MISK	.00	-.07	.10	-.05	-.08	-.11	-.01	-.08	-.07.	1.0		
MDPK	.01	-.01	.15	.13	.05	.24	.14	.11	.03	-.20	1.0	
MSPA	.05	.02	.30	.32	.14	.26	.27	.08	.19	-.10	.37	1.0

TABLE 2 The correlation matrix of motoricity variables for the pupils of the fourth grade of secondary school

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TRČ20	1.0											
TRČ30	.81	1.0										
MFEBMS	-.27	-.36	1.0									
MFEBML	-.35	-.40	.73	1.0								
MFEBMN	-.19	-.27	.52	.53	1.0							
MFEDM	-.36	-.40	.50	.62	.52	1.0						
MFETM	-.37	-.48	.42	.54	.47	.77	1.0					
MFEVM	-.36	-.41	.45	.48	.44	.82	.69	1.0				
MBTAPR	-.17	-.20	.36	.38	.43	.41	.45	.32	1.0			
MISK	.05	.08	-.24	-.20	-.09	-.09	-.16	-.03	-.15	1.0		
MDPK	-.13	-.04	.18	.15	.17	.21	.16	.09	.32	-.31	1.0	
MSPA	-.04	-.01	.37	.27	.20	.31	.23	.22	.15	-.02	.32	1.0

DISCUSSION

The numerical values of the correlation coefficients in table 1 and 2, like their mutual connection, indicate to the smaller level of motor ability independence for the sub-sample of fifth grade of elementary school in relation to the pupils of fourth grade of secondary school.

For the sample of younger boys, a significantly higher level of determination in relation to other motor abilities is shown by the strength, both of the shoulder band and the lower limbs.

The numerical value of the correlation coefficients within the motoricity indicators of the explosive strength of hands and shoulder band for fifth grade pupils ranges from r=.47 to r=.62. These values, taken together, with all other correlation coefficients in table 1 (which are of a significantly smaller level) directly indicate a stable independence of this ability for the age of pupils from the first sub-sample.

The approximately same level of the correlation coefficients is calculated for the motoricity indicators of the explosive strength of the lower limbs, that range from r=.40 to r=.58. In the same way as for the indicators for the explosive strength of the hands and shoulder band, these coefficients, in synergy with the values of all remaining coefficients in the correlation matrix, tell about a significant independence of the explosive strength factors of the lower limbs for fifth grade pupils.

The explosive strength as man's motoricity potential is highly genetically determined. The basic reason for such a physical state lies in the fact that the primary factor of the quality of explosive strength is the representation of fast muscle fibers in a human body. Therefore, if their representation in muscles is higher, the quality of explosive strength is also higher.

On the other hand, on the basis of the performed researches, it is considered that the explosive strength is of a general type (Momirović, 1980), namely that a high level of explosive strength of one body part is a strong indicator of a high level of explosive strength for other body parts.

On the basis of these facts, the correlation coefficients among the indicators of the explosive strength of the hands and shoulder band and the lower limbs for fifth grade pupils should be on a high level of statistical significance. However, we have not obtained such a result in our research, even though there is one of these coefficients which is not statistically significant.

Beside other factors which are of smaller significance, the main reason for such results is found in the following.

The motion-related structures of throwing that make a base for the estimation of the explosive

strength of the hands and shoulder band, belong to the group of the biotic motoricity programs whose primary goal is the manipulation with different things (Sekulić & Metikoš 2007).

The motion-related aspects of throwing that are used as motoricity tests for the estimation of the explosive strength of the hands and shoulder band are very simple motoricity movements and, as such, are relatively early learned and the results are in accord with them.

The throwing initializes very sensible factors of motor abilities such as accuracy and coordination and their quality development is practically only possible to attain in the early life phases (Sekulić & Metikoš, 2007).

On the other hand, the movement-related structures of jumping are, in this research, used as the tests for the estimation of the explosive strength of the lower limbs. Jumping belongs to the group of motoricity programs for the mastering of spaces and obstacles (Idrizović, 2010).

Jumping is the movement whose execution depends on the quality participation of leg and torso muscles, hand and leg coordination and also the whole body. The maintenance of balance of a body which, overcoming obstacle or space, is in the air without a solid foundation, demands a high level of inter and intra-muscle cooperation. The landing on the surface without injuries and stress, which would disturb further activity, demands a high level of wrists participating in the entire movement. A very big number of muscle groups participate in the execution of jumping which, on one side, makes this activity very difficult and complex and, on the other side, it highly impacts locomotor, cardiovascular and respiratory system (Idrizović, 2010).

It can be said that the leaps of the movement-related structure are of more important character than throwing and, as such, very few people master them during their life. Because of this, it can be concluded that the examinees from fifth grade pupils are at the age when there is still a significant difference among the movable structures like throwing and jumping.

According to the previously said, the fact that among the tests of the explosive strength of the hands and shoulder band and the test of running speed there is no statistically significant coefficient that can be considered as very interesting.

The reason for this could be found in the fact that the running technique in this age in general population, from which the sample was taken, is not one of the significant factors of the results, hence the explosive potential of the hands and shoulder band was left unused, yet it did not influence the results.

The tests for the estimation of running speed and maximum running speed accomplished an important statistically significant correlation with all the tests for the estimation of the explosive strength of the lower limbs. As an explanation of the statistically significant correlations among these two groups of tests is the fact that sprint running is the presentation of the explosive qualities.

Beside this, it is important to mention a relative dissonance among various authors about their subject of measurement. The tests of running at 20m and 30m from different starting positions can be seen in literature as the tests of explosive strength, the tests of leg strength, the tests for the estimation of the explosive or speed-related strength of a relative type, or as the tests for the estimation of running speed (Momirović et al., 1975; Kurelić et al., 1975; Milanović et al., 1986; Nićin ,2000, according to Idrizović, 2004).

The lowest congruence of the variables, namely the degree of correlation, is calculated within the sub-system of the tests for the suppleness.

The particular individual aspect in relation to all other tests was shown by the test for the estimation of speed of frequent movements MBTAPR. Although it is a test for the estimation of speed qualities, it is not possible to say that this test is in statistically significant correlation with any system of the applied tests for the sub-sample of younger boys.

Opposite to the results obtained on the sample of younger boys, the values of the calculated correlation coefficients of the sample of older boys, namely fourth grade boys from secondary school are

of a significantly higher level of statistical significance, while in a number of cases, they rose from the field without a statistical significance to the field of significant values.

Individually, by the hypothetical blocks of motoricity indicators, the correlation coefficients for the sample of older boys are fairly stronger for the tests for the estimation of the explosive strength of the lower limbs and range from r=.69 to r=.82. The stabilization of the movable structures such are leaps, led to a significantly equalized exploitation of the speed-explosive potentials of musculature engaged in these tasks, thence, to the higher level of overlapping of the obtained results.

The spacing of the correlation coefficients within the group of tests for the estimation of the explosive strength of hands and shoulder band ranges from r=.52 to r=.73 and is also significantly higher than the same coefficients for the sample of younger boys.

Very significant differences in certainty and independence, like in synergetic acting of some motoricity factors of the older compared to the younger boys, are obtained in the space of the significant correlations among the indicators of the explosive strength of the hands and shoulder band and the explosive strength of the lower limbs, and also among the indicators of the explosive strength of the hands and shoulder band for the running speed estimation. By a higher level of mastering of the movable structures such are leaps during the years of growing up, the dominant factor in their realization directly become the inherent explosive potentials of each of the examinees individually. This led to the situation where the correlation coefficients among these two hypothetic blocks, indicate to the generality of the explosive strength as a motor ability. The identical reasons influenced the statistically significant connection of the tests of running speed and the explosive strength of the the hands and shoulder band, where, now, a quality technique representing energetic and coordinated hand movements was one of the significant elements of the obtained results.

The individual aspect of the MBTAPR test is changed in other direction so the results of these tests for the sample of older boys were in a significant correlation with the results of all other tests, except with the two tests of suppleness. The physiological bases of the men's speed potential highlighted in the representation of some shapes of muscle fibers in the period of amalgamation have entirely been uncovered.

The hypothetic group of tests has remained on approximately the same level of connection, which is in accordance with the fact that, among all other motoricity factors, this ability was the first to accomplish its limits and that in the period of differentiation it already had its defined values. It is possible to state, although conditionally, that on the basis of the correlation coefficient obtained in these tests, the suppleness indicators are more coherent for the samples of younger boys than older boys.

CONCLUSION

On the basis of all data obtained in this work, and on the basis of the presented attitudes and conclusions of the earlier researches, it can be concluded that, in the period of differentiation, the motoricity factors within a motoricity space still behave insufficiently determined in relation to other human functionally-motor potentials. They do not show a high level of independence and, therefore, they are very difficult to be defined. This suggests that motoricity factors are still under a very strong influence of the general motoricity factor.

Unlike pre-school and lower school age, where the significance of the general motorcity factor stronger, in the period of differentiation, it is possible to give significant assumptions in a future constellation within the motoricity space of psychosomatic status.

In the period of amalgamation, it is this research which also proved that motor abilities, as the most significant factors of human motion, obtain their almost defined characteristics through the fulfillment of movable structures and directly show their character which depend on their physiologic

assumptions. Also, a broad spectrum of movable structures that are mastered and stabilized during the bringing up and development emerges as an additional element of the influence on efficient exploitation of motor abilities. The efficient exploitation of motor abilities finally lead to a very strong synergy of the motoricity factors, which, unlike the period of differentiation when they still function within one global ability and where they are very difficult for individual recognition, they now do it as independent potentials.

REFERENCES

Bala, G. & Franceško, M. (1997). Motor and cognitive functioning of students of Faculty of phisical education. *Facta universitatis - series: Physical Education*, *1*(4), 1-6.

Bala, G., Stojanović, M. & Stojanović, M. (2007). *Merenje i definisanje motoričkih sposobnosti dece*. Novi Sad: Univerzitet u Novom Sadu, Fakultet sporta i fizičkog vaspitanja.

Horvat, V. (2010). *Razlike između morfoloških i motoričkih dimenzija te spremnosti za školu djece predškolske dobi.* Neobjavljena doktorska disertacija. Zagreb: Sveučilište u Zagrebu, Kineziološki fakultet.

Idrizović, K. (2004). *Motoričke sposobnosti i morfološke karakteristike školske omladine i njihove relacije sa atletskim disciplinama*. Nikšić: Unigraf.

Idrizović, K. (2010). *Atletika I i II*. Podgorica: Univerzitet Crne Gore.

Jozić, M. & Đurak, H. (2003). Faktorska analiza nekih testova za procjenu motoričkih i morfoloških dimenzija učenika šestog razreda osnovne škole. U V. Findak & K. Delija (Ur.), *12. Ljetnja škola kineziologa Republike Hrvatske* (str. 62-65). Rovinj: Hrvatski kineziološki savez.

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, J. & Štalec, N.V. (1975). Struktura i razvoj morfoloških i motoričkih dimenzija omladine. Beograd: Institut za naučna istraživanja Fakulteta za fizičko vaspitanje.

Milanović, D., Hofman, E., Puhanić, V. & Šnajder, V. (1986). *Atletika-znanstvene osnove*. Zagreb: Fakultet za fizičku kulturu Seučilišta u Zagrebu.

Momirović, K., Štalec, J. & Wolf, B. (1975). Pouzdanost nekih kompozitnih testova primarnih motoričkih sposobnosti. *Kineziologija, 5*(1-2), 169-192.

Momirović, K. (1980). *Psihologija sporta (skripta za poslijediplomske studije)*. Zagreb: Fakultet fizičke kulture.

Nićin, Đ. (2000). *Antropomotorika-teorija*. Novi Sad: Fakultet fizičke kulture.

Sekulić, M. & Metikoš, D. (2007). *Osnove transformacijskih postupaka u kineziologiji*. Split: Sveučilište u Splitu.

Žgur, E. & Čuk, M. (2011). Uloga generalnog motoričkog faktora kod djece sa cerebralnom paralizom. *Specijalna edukacija i rehabilitacija, 10*(4), 689-702.

SAMOSTALNOST MOTORIČKIH FAKTORA U PERIODU DIFERENCIJACIJE I AMALGAMACIJE

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SAŽETAK

Uvod: Nivo samostalnosti motoričkih sposobnosti je jedan od najbitnijih faktora ukupnog motoričkog razvoja čovjeka, kao i adekvatne i kvalitetne realizacije kondicionog treninga kroz proces dugoročnog sportskog razvitka svakog sportiste.

Metode: Ukupan uzorak ispitanika za ovo istraživanje od 300 dječaka bio je strukturiran od dva subuzorka od po 150 dječaka petog razreda osnovne i četvrtog razreda srednje škole. U istraživanju su primijenjeni motorički

testovi za procjenu brzinskih, eksplozivno-snažnih i sposobnosti gipkosti. Korelacionom analizom je utvrđen nivo samostalnosti motoričkih faktora tokom dva najvažnija perioda definisanja motoričkih sposobnosti, pojedinačno i zajedno kao jedinstvenog prostora.

Rezultati: Rezultati ovog istraživanja pokazuju da se numeričke vrijednosti izračunatih koeficijenata korelacije kreću u takvim rasponima da je moguće konstatovati bitne razlike u nivou samostalnosti motoričkih faktora muškog pola u periodu diferencijacije i amalgamacije.

Zaključak: Na osnovu dobijenih rezultata ovog istraživanja može se konstatovati značajno veći nivo samostalnosti motoričkih faktora koji su tretirani ovim radom, u periodu amalgamacije u odnosu na period diferencijacije.

Ključne reči: motoričke sposobnosti, struktura, kondicioni trening

THE BURDEN OF SCHOOLBAG WEIGHT ON PRIMARY SCHOOL PUPILS

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UDC 37.062

SUMMARY

Introduction: The aim of the reserach was to explore the weight of schoolbags which pupils carry on a daily basis, i. e. the percentage ratio between the schoolbag weight and the body weight which may not exceed 10 % of the body weight according to the recommendation of the World Health Organisation. **Methods:** The research was empirical, transversal, conducted in four primary schools on the territory of the city of Jagodina**.** The research included 1 469 examinees divided into eight characteristic subsamples, based on the age. In addition to the descriptive statistics, the univariate analysis of variance was applied to determine the significant difference between the schoolbag weight and the body weight according to the pupils' age. **Results:** The obtained results indicate that there is a statistically significant difference between the average values of the schoolbag weight in relation to the body weight between seventh graders and eighth graders and the pupils of other grades, as well as between the pupils of first and second grade. **Conclusion:** A research work of the same kind should be continued with the aim to find the place of this issue within official institutions, so that the schoolbag weight could not affect normal growth and development of the school population.

Key words: load, schoolbag, primary school age

INTRODUCTION

One of the priorities of the process of education is the health protection of pupils. Carrying heavy schoolbags represents an issue that has been addressed even more, lately. Incorrect body posture, back and neck pains as well as spinal column deformities are related to the overburdening by heavy schoolbags (Виграм, 2002). In some countries the maximum weight of schoolbags that pupils could carry is regulated by the law as recommended by the World Health Organisation. It is considered that pupils may not carry more than 10 % of their body weight. The Ministry of Education in Austria acted in accordance with the recommendation where in 1996 a decision was brought to limit the weight of schoolbags to a maximum of 10 % of the body weight of pupils.

In most examined cases (Casey & Dockrell, 1996; Pascoe et al., 1997; Withfield ; Grimmer et al., 1999; Kath, et al., 2002) the weight of the pupils' schoolbags ranged from 4.0 to 7.7 kg. Expressed in percentages of the body weight of pupils these values range between 10 to 20 %.

In the research (Kath, et al., 2002) conducted in Great Britain the ratio between the schoolbag weight and the pupil weight in lower grades (thirteen-year-olds) was 10.4 % while in higher grades it was 10.2 %. Similar results for the ratio between the schoolbag weight and the body weight of 12.5 % to 14.3 % were recorded by German examiners, with a slightly rising trend in higher grades (Voll & Klimt, 1977). Somewhat higher average results of 15.2 % were recorded in Ireland at younger ages (in ten-year-olds)(Casey, 2003).

In research work conducted in the USA (Pascoe et al., 1997; Meckenzie, 2003) the average values of the ratio between the schoolbag weight and the body weight ranged from 15 to 20 %, while in some cases the values were as high as 22 %. The Hong Kong Society for Child Health and Development recorded high average values of 20.2 %. They also recorded that 45 out of 812 pupils participating in the project had a certain form of the spinal column deformity. The average weight recorded in pupils with the spinal column deformity was 4.74 kg which is a somewhat higher value compared to the average weight in all pupils, measured at 4.61 kg.

Research results (Grimmer et al., 1999) recorded the average weight of schoolbags in Australian pupils of 5.3 kg which is the value of about 10 % of the body weight of pupils. Although the average value was near the recommended standard value of 10 %, a concern arouse with regard to the fact that a half of the pupils exceeded the given average value.

A recent research in Croatia, including pupils of all the lower primary school grades, has shown that the ratio between the average weight of a schoolbag and the body weight ranges from 12.5 % to 13.8 % (Paušić i Kujundžić, 2008). In Slovenia the corresponding ratio in twelve-year-olds was 13.17 % (Fošnarič & Smrečnik, 2007).

The aim of this research is to determine the current status in our country having in mind that the recommendations of the Ministry of Education have not worked in practice. Also, in our country there is an evident lack of research papers on this topic. The weight of a schoolbag will be examined as well as the percentage of the overall weight in the pupils of all primary school grades from four schools on the territory of the city of Jagodina. In addition, the differences between the grades and the interdependence of the percentage of the schoolbag weight and body weight will be determined. A method of carrying a schoolbag from home to school will be examined as well as the distance that pupils walk to school and back under the burden of a schoolbag.

METHODS

Examinee sample

The research was empirical, transversal, conducted in four primary schools on the territory of the city of Jagodina**.** The research included 1 469 examinees divided into eight characteristic subsamples, based on their age. The research was conducted under standardized conditions in May 2010.

Sample of measurement instruments

Without a prior announcement and in agreement with the school principal, research assistants measured the body weight of the pupils and their schoolbags during one day. Each pupil filled in a questionnaire, with the help of the previously trained assistants, which contained questions concerning the method of carrying a bag, the duration of carrying a bag from school to home and the method of going to school.

Statistical data processing

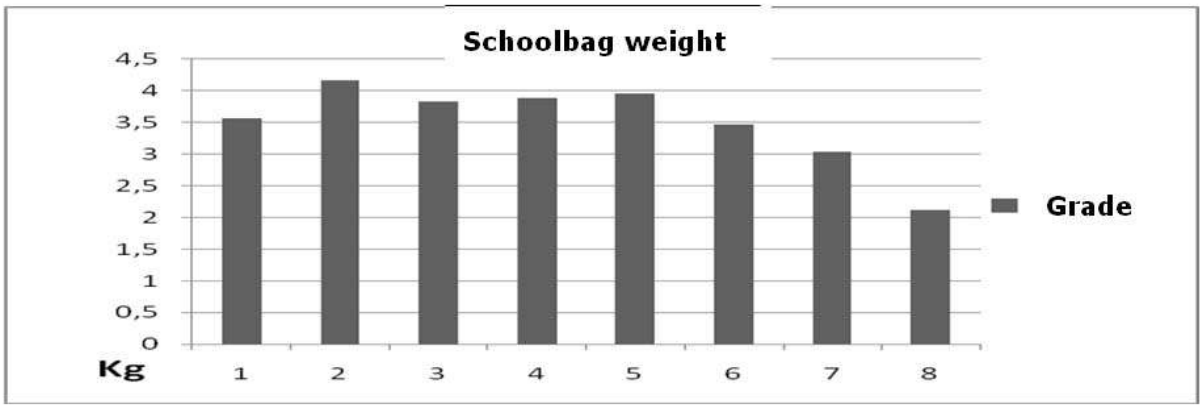
The statistical software SPSS 16.00 and MS Office Excel were used for data processing. In addition to the descriptive statistics, the univariate analysis of variance (ANOVA) was also applied.

RESULTS WITH ANALYSIS

The body weight of the pupils was measured as well as the weight of their schoolbags and all 1 496 questionnaires were filled in. The average measured weight of schoolbags ranged from 4.16 kg in second grade up to 2.12 kg in eighth grade. A tendency of the decline of the average values of the weight of schoolbags in higher grades was noted (Chart 1). By the application of the univariate analysis of variance (ANOVA), statistically significant differences were determined on the level of $p< 0.05$ between the

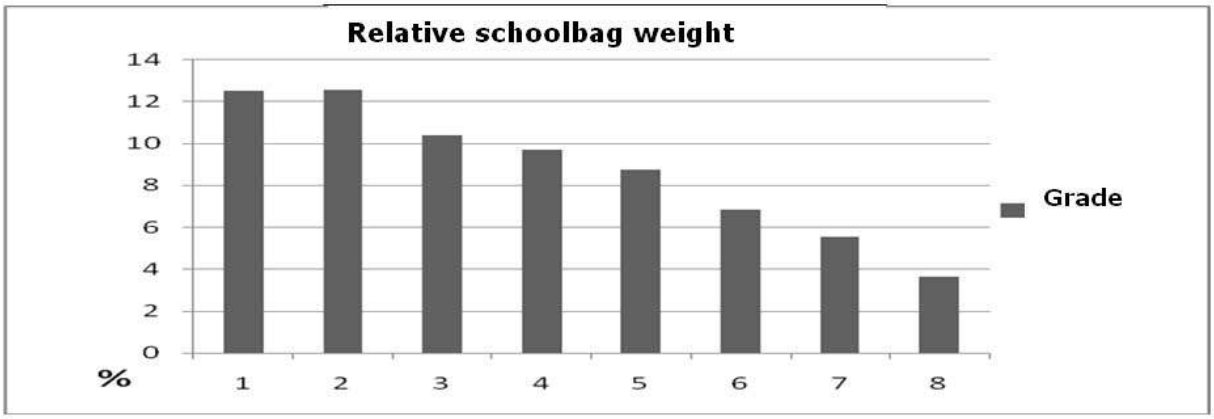
average values of the schoolbag weight in eighth graders and the weight of schoolbags of the pupils of all other grades. This was the case with seventh graders as well. Statistically significant differences were also found between first graders and second graders.

Chart 1 **The average weight of schoolbags in relation to the grade**



The value of the average relative weight (the schoolbag weight in relation to the weight of a pupil) was noted to be highest in second grade, 12.57 %, while in eighth grade it was the lowest value of 3.63 % (Chart 2). By the application of the univariate analysis of variance statistically significant differences ($p<0.05$) were determined between the majority of grades. The only differences that were statistically significant ($p>0.05$) were those between first and second grade as well as between third and fourth grade, while among all other grades statistically significant differences *were* determined.

Chart 2 **The relative schoolbag weight in relation to the grade**



The variations between pupils and classes were high ranging from 0.5 kg to 7.0 kg (Table 1). The variations were high even within the same class (in a sixth grade class values ranged from 0.6 kg to 6.4

kg). Such a big value range is not solely typical of the older grades, it was noted as well in relation to the younger school ages. For example, the weight of the schoolbags in second grade ranged from 1.00 kg to 6.30 kg, in third grade from 1.00 kg to 6.40 kg.

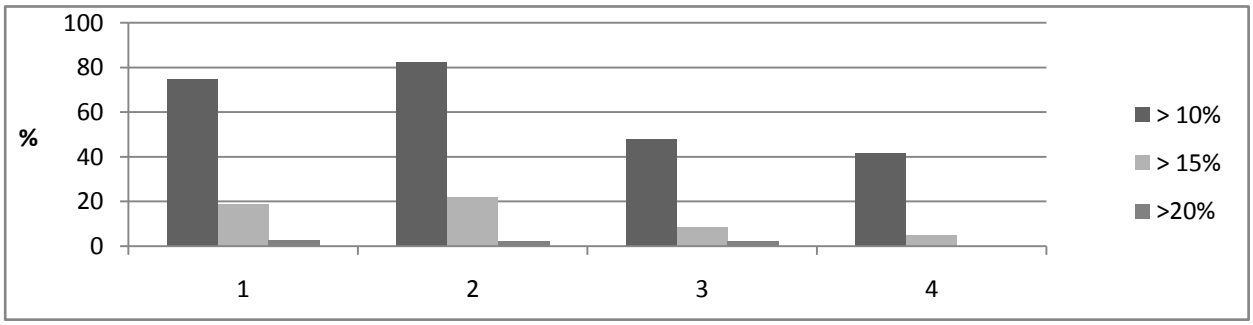
The average relative weight (in relation to the weight of pupils) is highest in first and second grade (over 12.50 %) then constantly decreasing in higher grades. The biggest value range was recorded in second grade where the highest, 24.10 %, and the lowest value, 2.64 %, were also recorded for the younger school age. The relative values showed a decrease in the older school ages up to eighth grade when values exceeding 10 % were not recorded.

TABLE 1 The schoolbag weight and the relative values in relation to the grade

		Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII
Schoolbag weight (kg)	M	3.56	4.16	3.83	3.89	3.95	3.47	3.04	2.12
	min	2.00	1.00	1.00	2.50	1.50	0.50	1.00	0.50
	max	5.20	6.30	6.40	6.20	7.00	7.00	6.50	5.00
Relative values (%)	M	12.54	12.57	10.41	9.70	8.77	6.84	5.54	3.63
	min	6.46	2.64	3.45	4.98	2..86	0.80	1.35	0.20
	max	23.81	24.11	21.99	19.32	16.67	17.24	12.50	9.30

Also, a great number of second graders (82.10 %) carry schoolbags exceeding 10 % of the body weight of pupils. A somewhat lesser number of pupils in first (74.80 %), third and the fourth grade (<50%) carry schoolbags exceeding the threshold of 10 %. Identically, a great number of second graders (22.10 %) carry schoolbags exceeding 15 % of their overall weight. In first grade the percentage is lower than 20%, while in third and fourth grade that percentage is lower than 10 %. More than 2 % of pupils carry the weight of more than one fifth of the overall body weight in first, second and third primary school grades (Chart 3).

Chart 3 **The ratio between the schoolbag weight and the weight of the lower grade pupils, expressed in percentage**



As regards the method of carrying schoolbags, the majority of pupils (82.40 %) carry their bags engaging both shoulders. In the younger school age 95 % of pupils carry their bags on both shoulders while in the older primary school age 74.10 % of pupils carry their bag on both shoulders, with 23.1 %

engaging only one shoulder. These results are identical with the results of a similar research with values ranging from 68 – 94 % (Casey & Dockrell, 1996; Pascoe et al., 1997).

As regards the method of going to school, 76 % of pupils go on foot, 85.40 % of whom in the younger school age. A car is used with 7.7 % of pupils (8.7 % in lower and 7.1 % in higher grades), 15.60 % of pupils travel by bus (5.9 % in lower and 21.6 % in higher grades).

It takes between 5 and 15 minutes for the majority of pupils (45.61 %) to reach their schools. The case in the younger school age (46.40 %) is almost identical with the case in the older school age (45.20 %). A higher percentage of the lower grade pupils, 33.53 %, walk to school less than five minutes in comparison with the higher grade students, 25.95 %. The case is reciprocal with regard to travelling longer than fifteen minutes with 22.66 % of the higher grade pupils and 18.26 % of the lower grade pupils.

TABLE 2 Period of carrying a schoolbag

Period of carrying a schoolbag	Grades I-IV	Grades V-VIII	Grades I-VIII
Less than 5 min.	33.53	25.95	28.72
5 – 15 min.	46.40	45.15	45.61
15 – 30 min.	18.26	22.66	21.05
More than 30 min.	1.79	6.22	4.60

In the research by Fosancic (Fosancic, 2007) the average period of carrying a schoolbag from home to school and back is 47.93 minutes in fifth grade, in seventh grade 51.16 minutes. Interestingly, 11.30 % of pupils in fifth grade and 9.20 % of pupils in seventh grade carry schoolbags longer than 1h.

CONCLUSION

The average value of the schoolbag weight in pupils of the younger school age is 3.75 kg, while in pupils of the older primary school grades this value is 3.30 kg. These average values are lower in comparison to the values obtained in similar researches (Casey & Dockrell, 1996; Pascoe et al., 1997; Withfield; Grimmer et al., 1999), ranging from 4.00 to 7.70 kg.

The weight of a schoolbag expressed in the percentage of the body weight of pupils was 11.43 % in the pupils of the younger school age. The values stay in the range of the values obtained through similar researches. Although significantly higher values (over 15 %) were recorded through a certain research work (Pascoe et al., 1997; Meckenzie, 2003), in the majority of the research the average values range from 10-14 % (Withfield, 2007; Fosančić, 2007; Paušić & Kujundžić, 2008; Kath, et al., 2002; Voll & Klimt, 1977).

In Grimmer's research (Grimmer et al., 1999) it is indicated that in over 50 % of pupils the schoolbag weight exceeds 10 % of the overall body weight. In this research the fact arising concern is that in first grade (74.80 %) and second grade (82.10 %) the correspondingly given percentage of pupils carry the content of over 10 % of their body weight in schoolbags. A trend of decreasing is noticeable after second grade, still with more than 40 % of pupils in third and fourth grade carrying over 10 % of their body weight. In higher grades, the relative schoolbag weight shows a decrease, amounting to 6.65 % which is a far lower value than those in the cited research papers. The reason of the lower average values in higher grades can be explained by the increase of the body weight and also by a greater number of lighter schoolbags, i.e. by a reduced

number of textbooks and notebooks. One of the explanations is related to the time of research (the first week of May) conducted at the time of approaching the end of the school year.

PRACTICAL RECOMMENDATIONS

This topic has good media coverage. The following recommendations are provided for parents, teachers, pedagogues, psychologists, school practitioners, school principals, school `the administrative authorities and the Ministry of Education: every-day check of the schoolbag content, accustomed short check of the schoolbag content by the parents and the teachers on a regular basis; the size of the schoolbag contributes to its weight as well as the size of the pencil cases that contain more than sufficient school utensils weighing in some cases more than a kilogram. Competent professionals recommend that notebooks of A5 format should be chosen over those of A4 format, having in mind that most of the teachers require notebooks of a bigger format. To illustrate, six notebooks of a bigger format duplicate the weight of the corresponding number of the small format notebooks.

The schoolbags should be light and anatomically shaped, made of high-quality waterproof materials, following the line of the child's shoulders, the bottom should be made of hard materials with a back support, shoulder pads should be wide and soft so as not to make skin incisions on shoulders, both shoulders should be burdened, never one shoulder or a hand; they should have more compartments to distribute the weight and reflex reflectors so that a child could be more prominent in traffic, they should be without metal applications, sharp edges or added parts made of hard plastics. Schools should provide space for school closets that pupils could use to leave a part of the textbooks intended for their schoolwork only.

The Ministry Of Education can reduce school curriculums by up to 30 % without affecting the corpus of the knowledge intended for pupils to acquire through primary school education.

REFERENCES

Casey, G. (2003): A pilot study of the weight of schoolbags carried by 10-year old Children, Physiotherapy Ireland, 17 (2).

Fošnarič, S., Delčnjak, I. S. (2007): Physical overburdening of pupils with the weight of school bags during the period of passing from eight year primary school to nine year primary school, *Informatologia*, 40, 3, 207-210.

Grimmer, KA., Williams, MT., Gill, T. (1999): *The associations between adolescent head-on-neck posture, backpack weight, and anthropometric features,* Spine; 24(21): 2262 Á/7.

Hong Kong Society for Child Health and Development. The weight of school bags and its relation to spinal deformity. Hong Kong: The Department of Orthopedic Surgery, University of Hong Kong, The Duchess of Kent Children's Hospital, 1988.

Kath, D.W.B., Ann, C.P., Gareth, T.J.B., Stewart, T., Deborah, P.M.S., Alan, J. S., Gary, J.M.B. (2002): Low back pain in schoolchildren: occurrence and characteristics, Pain, 97, 87–92.

Mackenzie, W.G., Sampath, J.S., Krtise, R.W., Sheir-Neiss, G.J. (2003): "Backpacks in children", *Clinical Orthopaedics*, 409, pp. 78–84.

Pascoe, D.D., Pascoe, D.E., Wang, Y.T, (1997): Influence of carrying book bags on gait cycle and posture of youths, *Ergonomics*, 40, 631-41.

Paušić, J., Kujundžić, H. (2008): Težina školske torbe u djece razredne nastave. U B. Maleš (ur.), Proceedings of the 3nd International Conference "Contemporary Kinesiology", Mostar, 2008. (str. 183-187). Split: Kineziološki fakultet.

Voll, H J, Klimt, F. (1977): Die beanspruchung des kindes durch die schultasche, Offentliche Gesundheitswesen, 39: 369-378.

Whittfield, K. J., Legg, S. J., Hedderley, D. I. (2001): The weight and use of schoolbags in New Zeland secondary schools, *Ergonomics*, 44 (9), p.p. 819-824.

OPTEREĆENJE UČENIKA OSNOVNO-ŠKOLSKOG UZRASTA MASOM ĐAČKIH TORBI

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SAŽETAK

Uvod: Cilj istraživanja je bio da se istraži masa torbe koju učenici svakodnevno nose, tj. procentualni odnos mase đačke torbe u odnosu na masu tela koji po preporuci Svetske zdravstvene organizacije ne sme da prelazi 10% mase tela. **Metode:** Ovo je bilo empirijsko istraživanje transverzalnog karaktera, realizovano u četiri osnovne škole na teritorija grada Jagodine. Istraživanjem je obuhvaćeno 1469 ispitanika podeljenih u osam karakterističnih subuzoraka, u odnosu na uzrast. Pored deskriptivne statistike, za utvrđivanje značajnosti razlike između mase đačke torbe i mase tela po razredima primenjena je univarujantna analiza varijanse. **Rezultati:** Dobijeni rezultati ukazuju na statistički značajne razlike između prosečnih vrednosti mase torbe u odnosu na telesnu masu između učenika sedmog i osmog i svih ostalih razreda, kao i između učenika prvog i drugog razreda. **Zaključak:** Istraživanja ove prirode treba nastaviti u cilju pronalaska mesta ovom problemu u zvaničnim institucijama, tako da masa đačke torbe ne utiče na pravilan rast i razvoj školske populacije.

Ključne reči: opterećenje, đačka torba, osnovno-školski uzrast

ABOUT THE CHILDREN OF THE MINORITY GROUPS OF INHABITANTS AND THEIR PHYSICAL EDUCATION AT SCHOOLS

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UDC 796.01

SUMMARY

Introduction: Population of a country is not homogeneous. There live different minority of groups that possess the same rights in the social life. According to the census of the population from 2011 in Bulgaria 84, 8 % are Bulgarians, 8, 8 % are Turkish, 4, 7 % are Gipsy (Romani people), 0, 9 % are Armenians. In the country live also 40 000 Chinese, 1 500 Vietnamese, Koreans, Arabs. Since 2007 and the join of Bulgaria to the European Union residents of the country became people of the former USSR and the former Yugoslavia. It is hardly to define the number of the people that immigrated to Bulgaria since 2007 but it is supposed that they are above 200 000. The children of all these people are embraced in the educational system and as if their integration to school becomes without any striking problems. Our hypothesis was that pupils of the minority groups (in our case the Gipsy minority) have lower physical fitness results than the Bulgarian pupils and need special attention.

Methods: Our research is done for 4 years - from school year 2008/2009 (children then were 11-years-old) to school year 2011/2012. The physical fitness in 6 tests of 54 pupils (27 Gipsy and 27 Bulgarians) and each group with 10 males and 17 females was measured at the beginning and at the end of the school years. After the statistical procedures and questionnaire we found, as follows:

Results: Physical fitness of both groups in the period 11 – 15-years old is with constant tendency of improvement but this improvement is with irregular character. Bulgarian boys have higher results and higher increase in all tests in comparison with the Gipsy boys. At the same time we register higher results in the Gipsy girls in the age periods connected with the earlier puberty of this ethnic group (standing long jump, throwing of 2 kg ball in all measurements, and 300 m dash only at the beginning of the school years).

Conclusion: Usually the worse results of the Gipsy pupils is due to lack of enough organization and low self-discipline in some of the pupils.

Key Words: ethnic group, puberty, physical fitness

INTRODUCTION

The population of a country is not homogeneous. Different minority groups, that possess the same rights in the social life, live there. According to the census of the population from 2011 in Bulgaria 84, 8 % are Bulgarians, 8, 8 % are Turkish, 4, 7 % are Gipsy (Romani people), 0, 9 % are Armenians. 40 000 Chinese, 1 500 Vietnamese, Koreans, Arabs also live in the country. Since 2007 and the join of Bulgaria to the European Union residents of the country became people of former USSR (Russia, the Ukraine, Moldova, Armenia) and former Yugoslavia (Republic of Macedonia, Serbia, Bosnia and Herzegovina). It is hard to define the number of the people that immigrated to Bulgaria since 2007 but it is supposed that it is above 200 000. The children of all these people are embraced in the educational system and their integration in schools is without any striking problems. The children of immigrants

show good adaptation to the social life in the country, the constant uncertainty makes work harder in mastering the Bulgarian language and on this base all other demands of the educational system. Participation in PE lessons is well accepted by all of them maybe because the values of different cultures and base religions are humanity orientated.

The beginning of the 21st century is marked by world economic crises. Bulgaria is no exception. Whole families leave the country, go abroad to seek mostly often seasonal work. In 5 – 6 months they return back and all this confuses the educational system especially in the smaller towns. The PE teachers have to show a very good flexibility to adapt their lessons and demands to the capabilities of the individual pupil and at the same time to the whole class.

Special minority group is that of the people of Roma origin. They have different temperaments, even views of the world and all these particularities require special approach and attention for gaining them for lasting school presence. In this minority group there are many subgroups but in Bulgaria the most numerous is the group of the yerlies and they are the object of our study. Though the traditional devotion to crafts and trade some of the Roma people are incorporated into field farming as well. The gene dependence to the nomadic way of life makes them difficult for organized and settled life (Басанович, 1957). This refers the participation of the elderly Roma people in the economic life and the participation of their children in education including physical education. If sometimes is registered a lower intellectual level in the Roma-pupils it is a consequence of the illiteracy of their parents. Another problem is the lower presence in school of the Roma pupils which also reflects their results.

The hypothesis of our study was that the pupils of the Roma minority group have lower physical fitness results than the Bulgarian pupils and because of this a special attention is needed.

METHODS

Our research was done for 4 years or since the school year 2008/2009 to the end of the school year 2011/2012. At the beginning of the study the children were 11-years-old and at its end 15-years - old. The physical fitness in 6 tests of 54 pupils (27 Gipsy and 27 Bulgarians) and each group with 10 males and 17 females was measured at the beginning and at the end of the school years. The tests we used are the tests adopted by the Ministry of Education in Bulgaria. These tests are 50 m dash, standing long jump, throwing of a 2 kg ball with two hands above head, push-ups, sit-ups, 300-meter run for the girls and 600-meter run for the boys. During these 4 years the pupils participated only in the regular PE lessons 2 times per week and every lesson was 40 minutes long.

To see what the problems of the pupils in PE lessons are and to solve these problems in time, as a method of interactive argument we and the PE teacher that carried out the education of the two classes that we observed also used debate and persuasion. The knowledge we got from this base made our approach to the pupils' capabilities and desires more flexible. It is here the place to share that sometimes we had problems with the presence of the Roma pupils in PE lessons. The statistical procedures with the variational analysis and the conclusions that we draw were the last stage of our study.

RESULTS

Physical fitness of all groups in the age of 11 – 15-years old (tables 1 – 4) is with a constant tendency of improvement but this improvement is of irregular character.

TABLE 1 Physical Fitness – Bulgarian Boys

Measurements	*Class*	*V*		*VI*		*VII*		*VIII*			
	Month	*X*	*V*	*X*	*V*	*X*	*V*	*X*	*V*	*d*	*Pt %*
50 m Dash	s	9,9	9,8	8,9	8,9	8,2	8	7,7	7,7	-2,2	99,9
Standing Long Jump	cm	161	165	167	166	161	165	193	203	42	99,9
Throwing Ball (2 kg)	cm	378	392	440	528	378	392	652	698	320	99,9
Push-Ups	Number	24	16	21	28	24	16	35	37	13	99,54
Sit-Ups	Number	43	76	79	83	43	76	76	98	55	99,9
600-Meter Run	s	154,8	150,9	147,2	144,4	154,8	150,9	140	129	-25,8	99,9

TABLE 2 Physical Fitness – Romani-Boys

Measurements	Class	*V*		*VI*		*VII*		*VIII*			
	Month	*X*	*V*	*X*	*V*	*X*	*V*	*X*	*V*	*d*	*Pt %*
50 m Dash	s	10,7	9,8	9,1	8,8	8,3	8,9	7,9	7,6	-3,1	99,9
Standing Long Jump	cm	148	154	162	173	181	188	191	195	47	99,9
Throwing Ball (2 kg)	cm	351	362	449	516	605	668	649	732	381	99,9
Push-Ups	Number	22	18	20	23	25	27	24	28	6	99,10
Sit-Ups	Number	40	34	42	46	50	55	54	61	21	99,9
600-Meter Run	s	163,4	162,9	156,7	154,6	148,5	143,8	153,1	151,5	-11,9	99,9

What happened in the groups of boys? The Bulgarian boys have higher results and higher increase in all the tests in comparison with the Roma boys. Still at the beginning of the study there were differences in the mean values in all used tests and this advantage was for the group of the Bulgarian boys. All of them were classmates of the Roma boys. So, in 50 m dash Bulgarian boys were 0, 8 s quicker. Their mean result in standing long jump was 13 cm better and in throwing of a ball of 2 kg with 27 cm better than the mean result of the Roma boys. As if at the beginning of the study there was not a sensitive difference in the tests push-ups and sit-ups in the two boys' groups. With the number of 24 against 22 in the push-ups the Bulgarian boys are better. With the number 43 against 40 in the sit-ups once again the Bulgarian boys are better. The difference in the test 600-meter run at the beginning is serious. The mean value of 154, 8 s for the Bulgarian boys against 163, 4 s for the Roma boys means a difference of 8, 6 s (Pt > 95%).

During these 4 years we register instability in the improvement of the mean results in the Bulgarian boys (table 1). In 7th grade when they were 13 -14-years-old their results in the tests 50 m dash, standing long jump, throwing of a 2 kg ball and 600-meter dash deteriorated and this we explain with the starting of puberty for the majority of the boys in this group. Puberty is connected with a disturbance in the balance between the anthropological measurements of human body and the results shown in the physical fitness tests. Height increases by more than 12 cm a year, sometimes even by 20 cm (J. M. Tanner, 1955). At the same time muscles stay weak and with difficulty support and coordinate the increasing body mass and its muscles. Only a year later when boys are in 8th grade the results in physical fitness improve visibly. At the same time in

the group of the Roma boys the increase in the tests seems to be more even obvious(table 2).

What happened in the groups of girls during these 4 years (table 3 and table 4)?

TABLE 3 Physical Fitness – Bulgarian Girls

Measurements	КЛАС	V		VI		VII		VIII			
	МЕСЕЦ	X	V	X	V	X	V	X	V	d	Pt %
50 m Dash	s	10,9	10,7	9,8	9,6	8,5	8,9	8,9	8,8	-2,1	99,9
Standing Long Jump	cm	130	128	140	143	148	154	158	157	27	99,9
Throwing Ball (2 kg)	cm	279	275	310	355	390	407	389	464	185	99,9
Push-Ups	Number	6	8	9	10	11	13	13	14	8	91,36
Sit-Ups	Number	23	32	35	40	44	46	41	48	25	99,9
300-Meter Run	s	93,2	93,2	94,2	89,9	84,6	76,5	81,1	78,2	-15,0	99,9

TABLE 4 Physical Fitness – Romani-Girls

Measurements	Class	V		VI		VII		VIII			
	Month	X	V	X	V	X	V	X	V	d	Pt %
50 m Dash	s	11,3	10,5	9,7	9,3	8,9	8,8	9	8,9	-2,4	99,9
Standing Long Jump	cm	131	128	137	143	156	157	159	165	34	99,9
Throwing Ball (2 kg)	cm	264	277	326	372	438	438	385	445	181	99,9
Push-Ups	Number	10	9	9	10	10	11	12	13	3	95,40
Sit-Ups	Number	23	31	33	35	40	41	31	41	18	98,89
300-Meter Run	s	84,5	81,4	76	93,2	76,5	78,8	81	79,1	-5,4	99,9

It is as if the two girl groups do not differ one from the other very much. There are evident differences at the beginning in two tests. In the first measurement in September 2008 the Bulgarian girls are quicker with the average result in 50 m dash of 10, 9 s. This result in the Roma girls is 11, 3 s (Pt = 99, 9 %). On the contrary: at the beginning, the Roma girls have greater power of endurance in comparison to the Bulgarian girls. Their average result in 300-meter run is 84, 5 s against 93, 2 s for the Bulgarian girls (Pt = 99, 9 %). As a whole a smooth increase is seen in both girl groups in all tests for these 4 years. We dare to say that the registered higher results in the Roma girls in this age period in some of the measurements we connect much more with the earlier puberty of this ethnic group (standing long jump, throwing of 2 kg ball in all measurements, and 300 m dash only at the beginning of the study). The differences are not always reliable as Pt<95%. In the Roma girls we do not register improvement always but even a fall in the results in 8th grade when they are 14 – 15-years-old. The improvements in Bulgarian girls are more stable.

Discussion: We do not want to look for the reasons but in both girl groups the results in all measurements in the tests push-ups and sit-ups are at least twice lower than the results of the boys. A provoking question comes. Do girls need very strong arms and abdominal muscles? Will the purposeful development of the strength of these muscles cause the loss of their grace typical for the females?

Conclusion: (1) Physical fitness of the Bulgarian and Roma pupils (boys and girls) during the age period od 11 – 15-years-old is with a constant tendency to improve and this is due to a great extent to the starting of puberty. (2) During these 4 years the changes and improvements are of an irregular and unsteady character. (3) The boys with Bulgarian origin are better in all 6 tests carried out by us. Usually worse results of the Roma are due to the lack of enough organization and the low self-discipline in some of the pupils. (4) The girls of Bulgarian origin

are better in 50 m dash, in the push-ups, and the sit-ups but the differences are not always reliable. (5) On the other hand, Roma girls are better in standing long jump and throwing of a 2 kg ball. In 300-meter run though in the first measurement, the Roma girls had a lower average result, in the next measurements they equalized their achievements with the Bulgarian girls. All better results in the Roma girls we explain with the earlier puberty in this ethnic group. (6) At the age of 11 – 15-years-old the physical fitness of boys and girls, no matter what nationality they are, is a function of several arguments but unconditionally most important is the process of physical education at school. Pupils who were regular in their attendance of the PE lessons had higher results. Here comes our recommendation: teachers and parents need to show their intolerance to the absence of the PE lessons and need to encourage the regular physical activities of the pupils of all ages.

REFERENCES

Басанович, Й. Върху произхода на циганите и техния език, С., 1957.

Tanner, J. M. Growth and Adolescence. London, Oxford, 1955.

http://bg.wikipedia.org/wiki/Имиграция-в-България

THE SPECIFIC NATURE OF TEACHER INVOLVEMENT IN SCHOOL SPORTS ACTIVITIES AND THE RELEVANT PREVENTIVE MEASURES AND PROCEDURES

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UDC 796.034.4

SUMMARY

The immediate implementation of the goals and objectives of the physical education activities of the teachers in school sports is very complex and demanding, because of the direct participation of the teachers in these processes. Even the best designed programs and activities in all aspects of physical education (indoor and outdoor), cannot be realized without an active and professional attitude of the teachers towards them. The important aspects of the organization of competitions are the preventive measures and the procedures of all the entities in the competitions. They are in the domain of school and teacher implementers. The complexity of these phenomena requires a proper understanding. The paper deals with the specific involvement of the teachers in terms of: character, competence and the engagement and prevention (security) measures during the event: security area - gyms, outdoor sports courts and a swimming pool, safety equipment and props, audience, spectators and space for them - panel and safety of the sportsmen.

Key Words: school sports, preventive measures, teacher, security, competition

INTRODUCTION

School sports represent an important sub-domain of professional sports in which the participant manifests his creative and technical-tactical abilities in a specific manner (through planned training), and at the same time satisfies his need for improving and evaluation his personal physical and psychological abilities. Physical activity as a part of school sport represents a practical means of achieving good health, the promotion of a healthy lifestyle, a decrease in violence among the young and the avoidance of deviant behavior *(Bjelica, Petković, 2009).*

The basic aims of school sport could be considered to be the following: the promotion of the importance of leading a healthy lifestyle, the reduction in the level of violence and aggressive behavior among the young, the correction of deformities and the avoidance of risky behavior. Schools, as educational institutions, should have optimal programs which would include an increasingly large number of children in an organized physical education exercise (regular physical education classes and extracurricular activities – school teams and extracurricular activities – outdoor activities: field trips, recreational activities, outdoor camps etc.), and as a part of a single educational process in the schools. Naturally, the well-organized school sports societies should create the conditions for the schoolchildren to continue their sports activities.

Thus, realization of the sports activities in schools requires a staff with an appropriate training, the necessary conditions for the realization of these sports activities (the proper facilities and

equipment), collaboration with the sports associations, but also with the local authorities. The national education program for children needs to be a priority in the Republic of Serbia. It is of public interest to establish a permanent influence on the creation of the conditions for sports education, as well as the organization of school competitions.

The direct realization of the goals and tasks of physical education and the activities of the teachers themselves in school sports is a very complex and demanding task, due to the direct participation of the teachers in these processes. Even the best thought-out processes and activities in all forms of physical education (curricular and extracurricular) cannot be realized if the physical education teacher does not have an active and professional relationship with them. In terms of their immediate realization, all activities depend on the teacher as a subject in the process, as he is the basic element in it *(Momčilović, 2008).*

THE SPECIFIC NATURE OF TEACHER INVOLVEMENT

The specific nature of the involvement of a teacher in a school sport will be analyzed from several aspects. In practice this generally refers to: **the image of the teacher, the professional experience of the teacher (his pedagogical skills) and the teacher's involvement.** In the case of school sports we are primarily referring to a direct collaboration between the teacher in the school teams and their involvement in different competitions.

The image of the teacher is explained in the context of the teaching process and the teacher's involvement in school teams which meet in the institution which educates children and the young. It is necessary for a teacher to love his job, to love children and have a creative relationship toward them. Professional practice reminds us of the fact that in that educational process, it is often the case that children identify with the image of their teacher. It is more than an obligation for the teacher himself to be objective, forthcoming, intelligible and easy to understand, honest and consistent in his work. In a direct contact with the schoolchildren, the teacher must have a motivational effect and treat them as subjects in the teaching process. In his professional educational requirements he must be consistent. In addition, when working with children in an exercise program, the teacher also needs to be: patient, determined, principled, calm and organized. In communication with the students, the teacher must instill them with a sense of confidence and safety. By taking into account their psycho-physical characteristics, he must develop work and creative habits regarding their physical education.

The situations which are not a routine require that the teacher exhibit more tact in working with the children, that he be instructive and experienced, so as to avoid any unwanted consequences. Naturally, the teacher involved in the school sport activities must be composed, open and forthcoming in communication and in his relationships towards other colleagues and the participants in competitions. That is, he must always be at his best, respecting the code of the physical education teachers. In making certain decisions he should be timely and objective, and in certain situations also self-critical with, ultimately, positive effects (competitive results). During school competitions he must leave the impression of an individual who is to be trusted and who knows what he is doing at any given moment. He must never fall under the influence of extreme emotionality as a result of a competitive success or cheering from the crowd.

The teacher's professional abilities primarily include his expertise in the field. They are reflected in a certain body of knowledge from both natural and social sciences. Most of all he must possess professional knowledge regarding the exercise process. In addition, the teacher must possess some general knowledge which is of importance for a more extensive pedagogical work. What we are primarily referring to is the knowledge of the system of education, educational and sports institutions, the system of competitions in school sport and the

knowledge of a wider social community. The basic pedagogical abilities of the teachers in school sport are reflected in the direct transfer of knowledge onto the students during the work with school teams and at competitions. Pedagogical abilities in a direct work with children are reflected in the organization of one's work. It is reflected in the efficiency of using knowledge, experience, time, space, facilities, equipment and didactic devices. The teacher must harmonize his abilities, habits, attitudes and views with those of his colleagues, students, parents and other participants in school sports with the aim of realizing common goals in school sports. Good communication with the students during group work and at competitions can in a particular moment be decisive for the final outcome of the competition.

Continued education of the teachers in the field of school sports via seminars, open discussions, panel discussions and round tables is necessary for the purpose of keeping up with the latest findings. Today, these activities are noted by the relevant authorities in the schools. We would like to point out that internal motivation and the teacher's faith in the work being done with the children is also very important for school sports *(Savić, 2013).*

Teacher involvement in school sport is of great importance for the ultimate outcome of the school competitions. The outcomes at such competitions should not be viewed only as the results of the competition. We are primarily referring to the teacher's involvement in the school, school sports, sport associations and the wider community. Through his personal engagement he must be a role model and a factor of motivation for the children he is working with. The teacher must initiate work within school teams as well as initiate the organization of school competitions themselves.

In these cases he should come across as a responsible, hard-working person. Participation in school competitions should always be in the context of the teacher as a pedagogue. Victory and defeat at competitions should not dissuade the teacher from working with children. He should manifest his involvement in a great number of hours spent outside the classroom preparing and organizing the competitions themselves. In a word, he must be completely involved in the school sport activities in order to create sublimated outcomes of the educational process. Thus, we should remind ourselves that by 'teaching others we ourselves learn' *(Višnjić, Jovanović, Miletić, 2004).*

SAFETY MEASURES AND PROCEDURES AT SCHOOL COMPETITIONS

In terms of the period in which the sports activities take place, we could, in a sense, divide them into safety measures and procedures:

1. prior to the activities themselves – competitions,
2. during the competition and
3. following the end of the sport competition.

The safety measures and procedures **prior to the competition** refer to the formation of a **safety committee** which would consist of: the physical education teacher, the school handyman (supporting staff), the school doctor, the school policeman and the president of the Physical Education Teacher Association. Their task would be to determine, review and make available: the facilities for the competition, the equipment and props, and the space where the spectators would be seated (the bleachers). In addition, this committee should assign control duty to the staff who will be specially marked for this task.

Based on the previously determined competition plan designed by the Physical Education Teacher Association, the safety measures and procedures **during** the sports activities could be viewed as:

1. facility safety (gyms, open sports fields – stadiums and pools),
2. equipment and prop safety,
3. audience safety, spectator safety and the places where they are located (the bleachers),
4. and the safety of the competitors themselves.

Safety of the facility requires an overview of the gyms, open sports fields and pools in the sense of removing certain potential dangerous objects and

the equipment which could injure the competitors (tools, scaffolding, benches, chairs, watering hoses etc.), as well as ensuring their safety for others (for example radiators, hoses, ventilation devices etc.). In addition, this procedure includes an overview of the surfaces (parquet floors, tartans, asphalt, gravel, tiles, etc.) and removing any imperfections and cracks in them. Hot water heaters, light bulbs and electric installations, especially those fixed to the wall and those which hang from ceilings in the changing rooms and gyms require special check-ups and preventive measures. This includes an overview of all the glass surfaces (on the windows and doors in gyms), which also need to be protected.

The safety of the equipment and props requires a detailed and professional evaluation of the necessary equipment and props which will be used during the competition itself. In the case of the props, special attention should be paid to the athletic props, mobile basketball hoops, goals and volleyball nets. The goals and hoops need to be in accordance with the propositions, colored and marked and adequately fixed and protected by layers of sponges or mats, as prescribed. The gymnastics equipment, considering their date of manufacture, should also be professionally examined and secured *(Marijanović, 2012).*

The safety of the public, spectators and their location (bleachers) is reflected in the examination of the state and functionality of the bleachers, especially those that are collapsible, that is, mobile. They cannot contain any objects which could be thrown onto the court during a competition. A school police officer and the safety monitors are in charge of this.

The safety of the competitors themselves is provided by adhering to the rules of the competitions by providing the security staff, the school doctor and the school police officer in all the competitions. The school doctor needs to provide a medical bag with the necessary first aid kit. All of the participants need to give their best *(Savić, 2013).*

CONCLUSION

School sport represents an educational process in the permanent 'sports triangle' consisting of: the student (the athlete), the coach and the parents. This system needs to be developed and improved permanently. School sport today has clear goals and tasks which inevitably stem from the goals and tasks of the physical education exercise. School sport viewed up close should be developed on the basis of its tradition, in close connection to the schools, in the locations where children are taught discipline, tolerance and responsibility. We must always bear in mind that there is a 'positive correlation' between participating in sports competitions and the academic achievements and/or success in school.

The specific nature of the involvement and activities of the teacher in school sport was analyzed from two aspects: the image of the teacher, the teacher's professional abilities (his pedagogical abilities) and the involvement of the teacher. We point out that all the aspects in the immediate work with children (working with sport teams and during competitions) are of great importance and should be viewed as a unique whole.

Finally we would like to point out that the important segments in organizing competitions are the 'safety measures and procedures' of the competitions themselves. They fall within the domain of the school and the teachers who realize the competitions, who also shoulder the greatest responsibility. The safety factor is complex and as such it should be studied, since safety at competitions has a sociological character.

REFERENCES:

Bjelica, D. & Petković, J. (2009) *Teorija fizičkog vaspitanja i osnove školskog sporta.* Crnogorska sportska akademija – Podgorica i Fakultet za sport i fizičko vaspitanje – Nikšić.

Višnjić, D., Jovanović, A., & Miletić, K. (2004) *Teorija i metodika fizičkog vaspitanja.* Beograd: SIA.

Dragić, B., & Pešić, B. (2012) *Fizičko vaspitanje od V do VIII razreda osnovne škole.* Niš: FSFV.

Živanović, Ranđelović, Stanković & Pavlović. (2010) *Teorija fizičke kulture.* Niš: Fakultet sporta i fizičkog vaspitanja i Panotikum Niš.

Zrnić, M. (2009) *Mendžment događaja.* Banja Luka: Javna ustanova Sportski centar „Borik", Upravni odbor ustanove.

Marijanović, R. (2012) *Menadžment školskog sporta* – skripta. Beograd: Fakultet za menadžment u sportu ALFA Univerziteta.

Momčilović, Z. (2008) *Metodika fizičkog vaspitanja.* Vranje: Učiteljski fakultet u Vranju, Centar za naučnoistraživački rad.

Savić, Z. (2013) *Osnove školskog sporta (rukopis neobjavljenog udžbenika)*. Niš: Fakultet sporta i fizičkog vaspitanja.

SPECIFIČNOSTI ANGAŽOVANJA NASTAVNIKA I PREVENTIVNE MERE I POSTUPCI U ŠKOLSKOM SPORTU

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SAŽETAK

Neposredna realizacija ciljeva i zadataka fizičkog vaspitanja i samih aktivnosti nastavnika u školskom sportu veoma su složeni i zahtevni, iz razloga neposrednog učestvovanja nastavnika u tim procesima. I najbolje osmišljeni programi i aktivnosti u svim vidovima nastave fizičkog vaspitanja (školske i vanškolske), nemoguće je realizovati bez aktivnog i profesionalnog odnosa nastavnika prema njima. Važan segment u organizovanju takmičenja jesu i preventivne mere i postupci svih subjekata na takmičenjima. One spadaju u domen škole i nastavnika realizatora. Složenost ovih pojava zahteva i adekvatno sagledavanje. Rad tretira specifičnost angažovanja nastavnika sa aspekta: lika, stručnosti i samog angažovanja, kao i preventivne (bezbedonosne) mere za vreme takmičenja: bezbednost prostora – fiskulturnih sala, otvorenih sportskih terena i bazena, bezbednost opreme i rekvizita, publike, posmatrača i prostora za njih – tribina i bezbednost samih takmičara.

Ključne reči: školski sport, preventivne mere, nastavnik, bezbednost, takmičenja.

MOTOR LEARNING OF CHILDREN IN RELATION TO ENVIRONMENT

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UDC 796.012

SUMMARY

Introduction: Motor learning is fundamental in a child's development through controlled physical activity that positively affects the motor development of the child and encourages the acquisition of healthy habits. In addition to a variety of physical activities that are indispensable, the environment in which they are implemented may further stimulate development. The subject of this paper refers to the area of implementation of motor learning. Selection of the implementation area of motor learning will influence the physical activity, and thus influence and their importance to children's body.

Methods: This topic will include children aged three to eleven years due to their specific characteristics that affect motor learning. Motor learning of natural forms of movement, games, and other forms of physical exercise in the natural environment or gym for physical exercise are the basis of every physical education teachers. Regardless the destination (outdoors or indoors), it will encourage a child to engage in physical activity.

Conclusion: The natural environment is the biggest challenge for child during his development and as such should be the first place for the implementation of physical activity. Especially risks and challenges of the natural environment are rich of opportunities for learning, problem solving, and social development components. Closed spaces for the realization of physical activity should complement an active time of children, because they are made to replace the open spaces, natural playgrounds.

Key Words: physical activity, motor development, open and closed space

INTRODUCTION

Physical education is a complex subject taking into consideration all its aspects. Physical education teacher is facing challenges at every class, from the characteristics of the individual, its activity in the group - making group dynamics, to the primary goal, motor learning. Teacher must know the structure subject of physical education and also is important to know the age characteristics of children. Knowing their development, growth and sensitive periods it is possible to have more complex approach to their bodies through physical exercise.

Physical education teacher realizes set of goals on class through motor learning. Motor learning is conducted in the child's environment because it is the best stimulus for learning motor tasks. The term environment is too undetermined and could be precisely determined as indoor and outdoor space for the realization of physical exercise. Indoor and outdoor space allows children to research, discover, and in that way they stimulate their development. Outdoor space includes all of natural environment, while indoor spaces are modification of the open space and they usually involve gym for physical education.

The fact is that physical education is necessary, and this is confirmed by numerous studies that show the current state of children and their physical engagement, which is not satisfactory (Deforche et al., 2003 Ara et al., 2007).

A large number of previous studies documenting that play has a vital role in learning, growth and development of the child's organism, including all domains - physical, cognitive, social, emotional (Fisher, 1992; Isenberg, Quisenberry, 2002 Stine, 1997). The play by Little & Wyver (2008) is the traditional basis of good practice in early childhood.

In the modern world, and the conditions they carry, a number of factors can be extracted that influence children's play and physical activity in the natural environment (Wyver & Little, 2008). Autors White & Stoecklin in 1998 point that childhood and playing outside are not anymore the synonymous. With increasing road traffic we limited places for safe play, the children are forced to move their game in parks, backyards. Increasing of population in urban areas leads to the reduction of private property, and therefore the playing area. The combination of these factors with parents who have less free time, we get a very bad outcome that do not benefits the children and their play and physical activity. The children have less space for playing outdoors and when they have it, they spend hours in front of the TV or computer (White & Stoecklin, 1998).

The problem inactivity of a younger population, the presence of the new technology, the reduction of free time for physical activity, carries out a number of troubling consequences that affects the health, growth and development of the child's organism. According to research from the Vojvodina, which included children aged 7 to 9 years, it was found that the implementation of very intense physical activity (which leads to sweating and rapid breathing children) occurs in only 30.07 % of the children, while about two thirds of the surveyed children never have to breathe and sweat. As a way to increase physical activity parents see their child in organized school activities, involvement in sports clubs and in joint activities parents and children. In the first places for the implementation of physical activities are indoor places (gyms, swimming pools), and at the last one are opendoors spaces (Lolić, 2011). In a study of children's free time from 2010, also in Vojvodina, it was found that 89% of children would rather play outside with friends than watch television programs (Draskovic, 2010). The children have needs for physical activities, but that needs are unfortunately strangled with new technologies.

The subject of this paper refers to the area of implementation of motor learning. This topic covers children aged three to eleven years because their specific characteristics, which can affect motor learning. On the one hand children at this age follow the development of body characteristics and the formation of fundamental motor skills, and on the other hand a great potential for gaining new movement. The specificity is reflected in the constant development of height and weight, in the underdeveloped power, speed, coordination, and yet on the other hand easy and quick mastering movement, curiosity and curiosity in motor learning. The aim of this paper is to describe the characteristics of the area in which the most commonly implemented physical activity, and to reinforce their importance and impact on the overall development of the child.

MOTOR LEARNING IN CHILDREN

The learning is a complex psychological process of changing behavior based on acquired knowledge and experience. Learning includes the adoption of habits, information, knowledge, skills and abilities. It is a process of data warehousing in storage memory. Motor learning is just one form of learning. Motor learning or practicing is the process of the formation of motor skills, which can be defined as the ability of harmonious performance of a motor task. Exercise develops motor program, written in the motor memory that contains information about the structure, sequence and duration of the movement and allows information process during the execution of the task (Haibach & Holden, 2011).

Motor activities can be divided into phylogenetic and ontogenetic (Brković, 2000). The first is specific to type and have the established order of occurrence to all people and depend on the maturity of the body

(walking upright, motoric of arm). Ontogenetic motor activities occur only in those who are specially trained for it (skiing, writing, playing).

Based on changes in children's structure movement it can be find out about the motor development of the child. Motor development proceeds in a completely spontaneous way and by natural laws that directly depend on central nervous system. The course of development is genetically determined patterns of development, but at the same time stimulated by stimulation from the outside. The ability to perform movements child finds in his surroundings, while climbing the stairs to the house, at swing behind the building, toys and so initially contribute to motor development. Environment represents child an inexhaustible source of activity and its importance is even greater if it applies controlled by physical education teachers.

Motor learning involves relatively permanent change in the performance of movement and appearance of the movement that occurs as a result of physical exercise or experience. Milojevic and Komlenic (2002) define motor learning as a process of formation of motor skills, also defined as the ability to smooth and graceful performance of a motor task. Motor learning in children is considered to be fundamental learning in relation to all other kinds of learning (Liukkonen & Auweele, 2007). The maturing allows the child to master some movement and teach it, while researching environment and a variety of physical activities contribute to the expansion of the initial base movement.

Knowledge of motor development and learning is very important if we want to improve the child's motor skills. Previous studies have led to the conclusion that besides these segments (motor development and learning) we need to be familiar with motor skills, cognitive characteristics of children, as they together affect and see the overall picture of the child's motor development (Haibach & Holden, 2011). Children react to physical exercise with all its intellectual and conative capacities, and therefore in this period physical exercise can affect the whole person.

When a child starts walking his verbal skills begin to grow rapidly. With walking children learn about the environment and expand their knowledge about the world in which they live. Between the second and the fourth year it begins with the game of role, an imitation and takeovers of their parents' role. The child learns motor activities first in manipulative games, which also contributes to motor development. In this age the main characteristics of the child's personality is self-centeredness, where it sees the world from its perspective, it is not interested in making friends, because of that we need to carry out activities which do not involve large groups or group tasks.

The characteristic of children from 4 to 7 years is that they cannot concentrate only on one activity. For example the child who plays soccer at this age is so much focus on the performance to hit the ball, and do not consider the possibility that his partner in game is single, at the free part of the field. Children of this age the best master movements that are simple. In motor learning in this group age should be avoided analytical method (motor partial learning of the technical element), because the child will learn move in parts and will perform it slow. When child watches adults act he more notes resulting from the action, and does not recognize methods of taking and connecting movements. The child has to create the entire image what should and should not do (synthetic method of training). For effectively motor development it is practiced that teachings and rules of sports games are modify. The efficiency is improved at the expense of time because the kids are more involved in a given sport activity. From 7 to 11 years old children are already able to solve several tasks at the same time and the process of motor learning becomes more complex. Complex motor skills require specially organized training (Haibach & Holden, 2011).

When it comes to physical activities that children must master first, we cannot avoid the basic activities. They represent the foundations for future development, and depending on how much time is devoted to their development later motor

development and learning will be facilitated. These are the following activities: crawling, running, walking, turning, throwing, jumping, pushing, climbing and so on.

Physical exercise expressed through the game, is very important part of every childhood. Through the play children, beside motor development, make friendships and develop social component. The game consists of movement, which is the base of motor development and motor learning. Physical education allows children to compare their capabilities and skills with their peers, and in that way they develop social and motor components. The teacher must adjust the weight of physical exercise, to prevent dissatisfaction and negative emotions because of the impossibility of participation by children who cannot fulfill the task (Kovar & Combes, 2009).

PLACE AND PRINCIPLES OF MOTOR LEARNING IN CHILDREN

The most suitable place for the implementation of motor learning for the child is environment. Wherever child is in outdoors or in indoor spaces it has a need to move and explore. The children are getting to know environment through the physical activity. The final sum about environment and physical activity will lead to the proper motor development of the child (Image 1). On the way to achieving this goal principles have an important role that facilitate and accelerate the ultimate outcome of environment and physical activity.

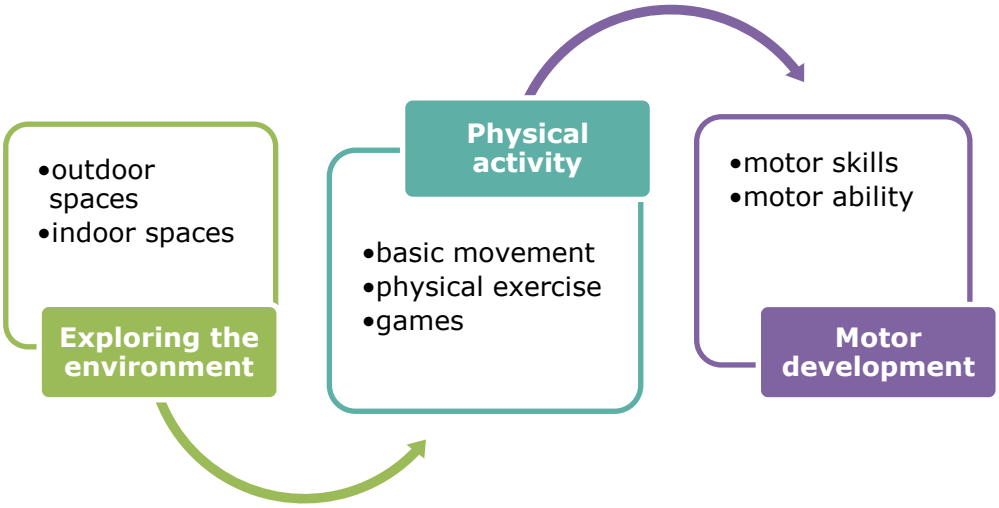

Image 1. Graphical representation of the didactic approach.

The principles that should not be ignored:

1) the principle of diversity,
2) the principle from simple to complex,
3) the principle of creativity,
4) the basic principle of movement.

All of these principles correlated and their harmony will lead to an improvement of motor learning and motor development of the child.

The principle of variability is reflected in the fact that the place for the realization of physical activity should be diverse and changed over the time. Diversity affects the entire spectrum of children's needs and in this way influences positive motor development. Attention should be paid to the child's age and then adjust place to his abilities.

Principle from simple to the complex is inevitable and generally known as its application in other subject. Satisfying this principle prevents the occurrence of monotony in class, it will provide a new task, more difficult and that contributes to the engagement of children. An interesting lesson will be a positive imprint and will affect to the development of positive physical habits.

The third principle, the principle of creativity is primarily for the teachers. It is reflected in the fact that the teacher must always brings a dose of creativity through physical exercises, games, in choosing subjects and places for their realization. His creativity through a job he loves will affect and contribute to the children's creativity and imagination, and also playing the game of research character.

Last, but not least is principle reflected in the fact that some basic activities children must master first. Running, walking, climbing and other activity in various modifications (changing speed, rhythm, direction, course) should be the basis for upgrading of the child's motor development, they are unavoidable and the first with which the child should meet.

CHARACTERISTICS OF OUTDOOR SPACE

Environment presents one of the biggest challenges for children and if it is more diverse and different it will represent a greater challenge. Childhood must include an outdoor play, children must be given the opportunity to explore, experiment, manipulate, change, discovery, pushing their own limits, singing and shouting (Johnson et al., 2005).

Outdoor space includes: natural playgrounds, parks, quay along the rivers, gardens, forest areas, meadows, and it depends on the residence. The outdoors spaces should be seen as an "open room". Design of the space is going to regulate the intensity, duration and quality of child engagement. Authors Liukkonen и Auweele (2007) said that outdoor spaces consist of topography, vegetation and natural.

Topography can be flat, hair, hilly, rocky, etc. The vegetation consist of plants, they cover area, while natural resources are various items that can be found in nature and serve as an instrument to play (branches, stones, leaves).

The team of experts from Norway in 1999 dealt with the impact of natural environment on physical activity of the child. In their work they investigated the impact of the natural environment - the forest landscape to the children aged 5, 6 and 7, who daily visited and played in it. It was concluded that the natural environment has a positive impact and satisfy the child's needs. The topography and diverse vegetation correspond to the children's needs for play and develop their motor skills (coordination and balance). Children need green areas, fields for football, trees for climbing and bushes for hid in. It is believed that the courts are too simple compared to the natural environment (Fjortoft & Sageie, 2000).

Stay outdoors provides a large number of various activities. Parsons (2011) points out that is very important because it establishes a connection between the child and nature and based on the time (child's age) when the connection is established will affect its strength. Some researchers talk about the so-called "moment" that occurs between 6 and 12 years, calling it an "imprint" that creates a lasting impression of how a child sees nature throughout life (Kellert, 2002). Children with physical exercise can gain healthy habits and learn about the world around them and their environment. Outdoors allows them to test their limits of physical and emotional capacities (Johnson et al., 2005).

The basic choice for outdoor activities is the basic movements that will lead to establishing motor skills through motor learning. Over time, the number of motor skills will increase and will be more complicated in proportion to the age and activities that children do in the environment. Different types of games provide children to develop motor skills naturally, using basic movements. There are various games, and they are by different authors systematized differently. The division of games according to the authors Liukkonen & Auweele (2007) can be classified into three groups: functional play, role play and imagination, constructional play.

Functional games are the hide and seek, frogs (throwing stones into the river), climbing a tree or rock and all that affect the motor development of the child through the mastering of certain motor skills. Children often make up games, changing their role,

in it pretending to be animals, monsters, take up the roles of their parents and in this way develop their imagination. Constructional games also require physical activity that is expressed in the moving and carrying branches and other materials to build their shelters.

All of these activities and many more are preferable and enforced in outdoors. Meadows allow running, jumping, rolling, and they are good for the games in snow in the winter. Forest areas with a different combination of vegetation and a variety of play materials allow children to climb trees, using twigs and stones to build houses and plays games of imagination. Areas that are rocky encourage climbing and it is recommended for this age group that the slope does not exceed 30 degrees (Fjortoft & Sageie, 2000). Boys generally like to play more outdoors than girls, because in this way they can express their capabilities through extreme challenges. Children should be able to explore the environment, objects and structure of a given environment, and physical activity is ideal for the fulfillment of the task.

Studies have confirmed that physical activity outdoors leads to the development of socialization, concentration and motor skills (Tranter & Karen, 2003). The research from this area has shown that a variety of extracurricular activities contribute to the development of students' creativity (Jankovic, 2002).

The combination of the natural environment and motor learning leads to the following positive effects on the child's body:

- It stimulates all aspects and stages of motor development,
- Allows multiple experiences,
- Stimulates learning through play,
- Develops imagination, creativity, self-confidence,
- Provides inner peace,
- It allows them to understand and get to know reality and nature,
- Develops friendship, communication (White & Stoecklin, 1998).

Staying in the open spaces stimulates the overall development of the child and the environment is healthier for its implementation.

Recognizing the importance of the natural environment and the space within the school where children spend most of the time, there are more works about the organization, planning, and most rational utilization of a given space. In the school it is recommended to choose some open space and order it by certain standards. That place will require the presence of diverse vegetation. The playing surface must be grass, sand, with some rocky paths. Equipment should be paint with natural colors, and they should allow children sitting, crawling, shelter, play and other basic forms of movement, but in the first place should be safe. It should have set structure, materials and equipment which can be moved according to their imagination (Tranter & Karen, 2003).

CHARACTERISTICS OF INDOOR SPACE

Indoor space is a modification of the open space, the attempt of man to bring nature into the room, so that children in any weather conditions can be engage in physical activity. Swedish ladders are a replacement for wood, mat is replacements for meadow, ball exchanges a stones etc.

Such as outdoor space has a positive effect on children's development and closed stimulate children to explore their moving capabilities. Once they enter into a room immediately children are exploring it, researching, walking, running, climbing the stairs, jumping from various objects. They learn to solve problems by adjusting their body to the environment.

A main goal of physical education is to enable children a proper development and accommodate their needs for mobility. Primary place for the realization of that objective is gym for physical exercise, and as a supplement can be a swimming pool. Beside school that provides the space for playing under the closed space are considered and

playrooms that are nowadays very popular. Their popularity is reflected in the fact that parents become aware of the insufficiently of physical exercise in school.

The equipment can expand the range of activities in school and it can be classified as follows: fixed equipment, standard and additional (Liukkonen & Auweele, 2007). Preview of that classification of equipment in indoor spaces is shown in Image 2. This equipment is also applied in the playrooms, it is even richer and more diverse.

Image 2. Classification of equipment.

Equipment should fulfill a certain standard. The equipment must be adjusted to the child's age and they have to stimulate children development, and not prevented it, if they are too large or complex for a given age. Fixed equipment which are listed in the classification, have features of that static. Indoor spaces should have a lot of mobile objects, that can be moved and transform according to the desired situation. Besides the adjustment of equipment to the certan age and mobility, there is one more indispensable item, their safety.

Range of activities that can be used in the room, playroom, or any other indoor space is also large. Some of the popular activities are elementary games, sports games and free activities. Polygon as methodical organizational form is applicable for children of all ages. Like in the outdoors, children should be allowed to solve the problems in the shortest possible time, which is achieved by polygons. After fully trained and mastery of the basic activities, teacher makes a task, where children need to overcome in the shortest possible time. Sports games besides basic sports (gymnastics, athletics and swimming) are completing children's motor skills. Children aged three to eleven features that they cannot keep concentration on one activity for a long time, the ideal solution is to often applies a free, optional activities in accordance with their wishes.

Like in outdoor spaces and in indoors we are following the same principles. With the principle of diversity the dominant role have equipment, where a combination of fixed and mobile devices can contribute to a more complete impact on the development of the child's body.

POSITIVE AND NEGATIVE SIDES FOR PLACES OF REALIZATION PHYSICAL ACTIVITY

Children acquire motor skills naturally through play in a natural environment. The environment may be different, and it depends on the place where they live and go to school. Stay outdoors and indoors provide a variety of physical activities and represents an additional stimulation to children's motor development. Both areas have positive and negative characteristics with which physical education teacher should be familiar.

Open space, natural environment as a place for children's play is an unavoidable for the younger children. Through outdoor games they satisfy the

need for mobility, which contributes to their motor development and acquisition of the basic knowledge about the world around them. Discovering their own capabilities is also one of the features that is satisfied with physical activities in the natural environment. The child will realize its potential only by experimenting with their surroundings, and if it grows and evolves together with the natural environment he will discover connections with nature.

The natural environment is a better place for realization of physical activity because of the implementation to the health of a child. Open spaces reduce the possibility of spreading of viral infections and through physical exercise strengthen children's body. The establishment of healthy habits for exercise and keeping the environment clean is an important factor. Children who enjoy the outdoors and acquire healthy habits, as adults are more prone to hiking, cycling, climbing and other outdoor activities (Johnson et al., 2005).

The main feature of outdoor space is that it depends on time of year. Different climate offers diverse spectrum of activities, from winter games to swimming in the nearby river, all the way to collecting leaves. Varied topography and vegetation are challenges to children, with specific, slope and rough surface itself is already a challenge. Fresh air, sun rays and all of these features give great advantage to the teacher to determine exactly for the physical activities in outdoors.

However, the outdoor living space can be unpredictable, primarily because of changes in weather, and too much freedom and lack control.

Indoor spaces also have a positive impact through physical exercise on motor development. They can be a challenge for children, but the teacher has something more important role in the children development. First of all, class organization and creativity must be at a high level. The most often problem arises from a lack of equipment, and not so rare from lack of gym for physical exercise. The monitoring of conditions in indoors spaces in which the classes are realized is higher, so that is positive side, but static equipment on the other hand can be a problem.

The natural environment compared to the indoor spaces more encourages the development, imagination and creativity. It was determined that the school is a place that has a potential impact on the level of physical activity, but it is necessary to make some radical changes. First of all, it is necessary that with children at early age work qualified specialists for teaching physical education. Also, all extra-curricular activities in the school should be subordinated to actions on increasing the level of physical activity, for what would be again in charge of physical education teachers. It is necessary that the school curriculum includes a minimum of 3 hours of physical education with minimum of 120-180 minutes per week.

It can be concluded that the outdoor space more correlated with physical activity. The natural space authors Fjortoft & Sageie (2000) defined as a challenging place for motor learning. The natural environment encourages children to engage in a large number of activities and in a given study the impact of physical activity most looked at coordination and balance.

CONCLUSION

The change that carries a modern way of life, especially recent years has affected the children's play, space and the implementation of physical activity. Reducing natural playgrounds there has been a change in the quality of children's games, and consequently their experiences. Researchers from different fields recognize the negative impact that carry these changes in a child's growth and development, where, despite a lack of physical activity is increasingly emphasize the importance of their realization.

Physical activity is an irreplaceable component that combined with proper nutrition and the natural environment has a positive effect on the complete body of the child. Play and other physical activities in the natural environment provides an open, dynamic, diverse opportunities and unpredictability, but

sometimes also a risk. Exactly that risks and challenges of the natural environment are rich of opportunities for learning, problem solving, and social development. The use of open space for children's play correspond to their needs for jumping, running, climbing, racing, yelling, hiding, and making mess, and as such, the natural environment is the most challenging and the best playground for children.

Indoors spaces for the implementation of physical activity should complement the free time of children, because they are made to replace the natural playgrounds. In recent decades they have begun to occupy an important place for increasing physical activity and unfortunately dominate over the natural environments. A large number of factors lead to this situation, but more important is the current situation and the measures to be taken in order to solve. As a first step in solving this problem is to raise awareness and educate the population. The significance of this work lies in describing the essential, but common knowledge of places where physical activities are realized and their characteristics in order to determine their significance and impact on the child's body. It can be noted that the natural environment should be the first place for the realization of children's games and physical education classes, if weather conditions allow. Indoors spaces are a good substitute, but never cannot reproduce fully the natural environment and its importance.

REFERENCES

Ara, I., Moreno, A.L., Leiva, T.M., Gutin, B., Casajús, A.J. (2007). Adiposity, physical activity, and physical fitness among children from Aragón, *Obesity*, 15 (1), 1918-1924.

Brković, A. (2000). *Developmental Psychology*, Lapčević: Teachers College in Uzice.

Deforche, B., Lefevre, J., Bourdeaudhuij, I., Hills, A.P., Duquet, W., Bouckaert, J. (2003). Physical fitness and physical activity in obese and nonobese Flemish youth. *Obese Res*, 11(1), 434-441.

Draskovic, M. (2010). Children, Media and spending the budget of free time, *Media Dialogues*, 4, 339-354.

Isenberg, J. P., Quisenberry, N. (2002). Play: Essential for all children, *Childhood Education*, *79*, 33-39.

Jankovic, P. (2002). Extra-curricular activities and students' creativity, *Norma*, 8 (3), 59-78.

Johanson, J., Christie, J., Wardle F. (2005). *Play, development and early education.* Boston: MA Allyn and Bacon.

Kovar, S. Combes, C. (2009). *Elementary Classroom Teachers as Movement Educator,* United States: McGraw-Hill Higher Education.

Kellert, S. R. (2002). Experiencing Nature: Affective, Cognitive, and Evaluative Development in Children, *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations.* Cambridge: MA.

Liukkonen, J., Auweele, V., Vereijken, B., Alfermann, D. & Theodorakis Y. (2007). *Psyhology for physical educators, students in focus,* United States: Human Kinetic.

Lolić, V. (2011). The Social and family environment, nutrition, and physical development, Sports, *Science and Health*, 1, 12-17.

Little, H., Wyver, S. (2008). Outdoor play: Does avoiding the risks reduce the benefits?, *Australian Journal of Early Childhood*, 33, 33-40.

Milojevic, A., Komlenić, M. (2002). Motor learning, *Themes*, 3, 359 – 369.

Parsons, A. (2011). Young Children and Nature: Outdoor Play and Development, Experiences Fostering Environmental Consciousness, master dissertation, Virginia: Faculty of the Virginia Politechnic Institue.

Stine, S. (1997). *Landscapes for learning*. New York: John Wiley & Sons.

Tranter, P., Karen, M. (2003). School Grounds as Sites for Learning: making the most of environmental opportunities, *Environmental Education Research,* 9 (2), 283-302.

Fisher, E. P. (1992). The impact of play on development: A meta-analysis, *Play and Culture*, 5, 159-181.

Fjortoft, I., Sageie, J. (2000). The natural environment as a playground for children Landscape description and analyses of a natural playscape, *Landscape and Urban Planning,* 48, 83-97.

Haibach, P., Holden, D. (2011). *Motor Learning and Development.* United States: Human Kinetic.

White, R., Stoecklin, V. (1998). Children's Outdoor Play & Learning Environments: Returning to Nature, *Early Childhood News, 3, 54-62.*

MOTORNO UČENJE DECE U ZAVISNOSTI OD OKRUŽENJA

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SAŽETAK

Uvod: Motorno učenje je fundamentalno u dečijem razvoju, kroz doziranu fizičku aktivnost pozitivno se utiče na motorni razvoj deteta i podstiče se sticanje zdravih navika. Pored raznovrsnih fizičkih aktivnosti koje su nezamenljive, okolina u kojoj se one sprovode može dodatno stimulisati razvoj deteta. Predmet ovog rada odnosi se na prostor sprovođenja motornog učenja. Odabirom mesta realizacije motornog učenja usloviće se fizičke aktivnosti, a samim tim i uticaj i njihov značaj na dečiji organizam.

Metode: Ovom temom biće obuhvaćena deca uzrasta od tri do jedanaest godina zbog njihovih specifičnih karakteristika koje utiču na motorno učenje. Motorno učenje prirodnih oblika kretanja, sprovođenje igara, i drugih oblika fizičkih vežbi u prirodnom okruženju ili sali za fizičko vežbanje su osnova rada svakog nastavnika fizičkog vaspitanja. Bez obzira o kojoj okolini je reč (otvorenom ili zatvorenom prostoru), ona će podsticati dete na bavljenje fizičkom aktivnošću.

Zaključak: Prirodno okruženje predstavlja najveći izazov detetu prilikom njegovog razvoja i kao takvo treba da bude na prvom mestu za realizaciju fizičkih aktivnosti. Upravo rizik i izazovi prirodnog okruženja stvaraju bogate mogućnosti za učenje, rešavanje problema, i razvoj socijalnih komponenti. Zatvoreni prostori za realizaciju fizičkih aktivnosti treba da upotpunjuju aktivno vreme dece, jer su i nastali kao zamena otvorenim prostorima, prirodnim igralištima.

Ključne reči: fizička aktivnost, motorni razvoj, otvoren i zatvoren prostor

THE RELATION BETWEEN THE MORPHOLOGICAL CHARACTERISTICS AND COORDINATION IN SEVENTH GRADE STUDENTS OF ELEMENTARY SCHOOL

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UDC 676.014.8:796

SUMMARY

The aim of this research was to determine if there is any relation between the morphological characteristics and coordination on a sample of 52 seventh grade students of elementary school, aged 13 years ± 6 months, by applying the battery of thirteen anthropometric measures (three measures for the evaluation of longitudinal dimensionality, three measures for the evaluation of transversal dimensionality, four measures for the evaluation of circular dimensionality and body mass and three measures for the evaluation of subcutaneous fatty tissue) and three measuring instruments for the evaluation of coordination skills. The results of the applied canonical correlation analysis using the parameter Bartlett's Lambda test and its testing with a chi-square test showed that between the anthropometric measures and motor coordination for seventh graders there were statistically significant relations (p=.02), which means that the morphological characteristics are significantly related to the coordination dimension.

Key Words: relations, morphological characteristics, coordination, seventh grade students.

INTRODUCTION

In the area of the studies of an anthropological status, except some anthropological research of space's structure, the research of the relations among different dimensions of two or more studied areas, considering their variability depending on sex and age of the participants as well as many other factors, is current. The results of numerous studies that have dealt with this problem, show that there is a significant influence of the morphological characteristics on the efficiency of motor tasks, and that the anthropometric and motor dimensions are so closely linked that the relationship requires comparative study of both areas.

Coordination is one of the main components of physical fitness that allows the harmonious functioning of body parts involved in the movement, including gross motor movement, fine motor movement and motor planning. Motor Coordination is based on the combination of movements created within the parameters that result in intended actions. It is an ability to quickly and purposefully perform difficult spatio-temporal movement structures. Such movements usually work together smoothly and efficiently. Motor coordination involves the integration of the processes ranging from how muscles interact with the skeleton system to the neural processes of motor planning which involves the neurological pathways required to notice and perform a desired task the the controlling muscles movement in the spine and brain. Within this context, coordination abilities are understood as an externally visible manifestation of the control and regulation processes of the motor activity of the central nervous system.

Basic coordination abilities are the adaptive ability, balance ability, combinatory ability,

kinesthetic differentiation ability, orientation and rhythm ability. Adaptive abilities enable modifications of the motor activity on the basis of comparison or anticipation of new or changing conditions during the performance of a motor activity. The balance ability enables keeping body or its parts in a relatively stable position. The combinatory ability is an ability to simultaneously put partial movements together into more complex movement structures. Most movements are composed of a number of different muscle groups acting together in a temporally coordinated fashion. Ability of kinesthetic differentiation which enables the realization of kinematic and dynamic features of the movement. The orientation ability is an ability to realize the position of the body or its parts in space and time. The rhytm ability enables grasping and motorically expressing rhythm which is externally determined or contained in the motor acidity itself.

A well-coordinated movement is a movement of a body part that actually consists of many movements of joints, occurring in a proper sequence and of appropriate extent, such that the resulting motion is smooth, straight, and directed to the object of interest. This is the essence of coordination, which applies equally well to muscles, joints, and whole body parts.

The ability of motor coordination is best developed between the ages of 7 and 14, with the most crucial period occurring between 10 and 13 years.

Understanding the relations' principles between some individual latent variables of the morphological characteristics and motor coordination variables is emphasized because the motor coordination can be manifested only through morphological parameters. The importance of knowing a hierarchical structure of factors that affect on coordination efficiency is in possibility of not only more rational choice i.e. optimal selection of potential athletes but also in possibility of more rational process of planning, programming and controlling training process as well as in the process of valid and aimed projections of further wanted development of those anthropometric measures, which are significant for coordination abilities and may be transformed in training process.

The aim of this study was to determine the canonical relationships between the predictor system of the anthropometrics measures with the criterion of coordination variables of the 7th grade students, supposing the possibility of certain results' prediction of the coordination tests, based on the results of those anthropometric measures which could be transformed in the training process.

RESEARCH METHODS

The sample of participants

The research was conducted on a sample of 52 seventh grade students aged 13 years, who regularly attended the classes of physical education, in order to determine the relations between the anthropometrical characteristics and the variables for the assessment of motor coordination.

The sample of measuring instruments

For the assessment of the morphological characteristics a set of 13 anthropometric measures that define the longitudinal dimensionality of the skeleton was applied: body height (AVIS), arm length (ADRK), leg length (ADUN); transversal dimensionality of the skeleton: shoulder width (AŠRA), pelvic width (AŠKA), hips width (AŠKU); circular dimensionality and body mass: thorax circumference (AOGR), thigh circumference (AONK), calf circumference (AOPK) and body weight (AMAS) and subcutaneous fatty tissue: abdominal skin fold (AKNT), thigh skin fold (AKNK), medial calf skin fold (AKPK). The proposed model sample of the anthropometric measures was taken on the recommendations of the International Biological Program (Lohman, Roche and Martorell, 1988).

For the evaluation of motor coordination three tests were applied: agility in the air (MOVA),

coordination with a bat (MOPA) and agility on the ground (MONT). The applied set of variables in motor coordination is taken from a research by Kurelić et al., 1975.

Data processing

In order to determine the relationship between the anthropometrical characteristics and the variables for the assessment of motor coordination, a canonical correlative analysis has been applied, using the statistical package Statstic 7.0.

RESULTS

TABLE 1 The results of the canonical corellation analysis of the morphological characteristic and motor coordination

Canonical R	Canonical R^2	Chi-sqr.	df	p- Level
.70	.50	123.18	45	.002

Legend: coefficient of canonical corellation (R), coefficient of determination (R^2), the chi-square test, degree of freedom (df), significance level (p-level)

The results of the canonical correlation analysis showed that in the relations between the predictor system consisting of the anthropometric variables and the criteria consisting of the variables for the assessment of motor coordination, there is one statistically significant canonical pair obtained (Table 1).

The obtained canonical factor (R = .70) as well as their common variance (Can R2 = .50), significantly explains the degree of correlation between the sets of predictor variables with the criteria system. The influence of the morphological characteristics on the efficiency of motor coordination is explained by the coefficient of determination with 50%.

TABLE 2 Canonical factors of the predictive measures of morphological characteristics

ANTHROPOMETRIC MEASURES	Root 1
AVIS	0.35
ADRK	0.25
ADUN	0.29
AŠRA	0.22
AŠKA	0.23
AŠKU	0.24
AOGK	0.45
AONK	0.44
AOPK	0.53
AMAS	0.45
AKNT	-0.64
AKNK	-0.43
AKPK	-0.56

By an insight into the structure of the canonical factors (Table 2) it can be concluded that many factors of the morphological characteristics participate in forming the structure of the canonical factors, in other words, the efficiency of the motor coordination variables, but their influence is different. The most effect have the factors of circular dimensions and body mass: thorax circumference (AOGR: 0.45), thigh circumference (AONK: 0.44), calf circumference (AOPK: 0.53), body weight (AMAS: 0.45) and subcutaneous fatty tissue: abdominal skin

fold (AKNT: - 0.64), thigh skinfold (AKNK: - 0.43), medial calf skin fold (AKPK: 0.56).

TABLE 3 Canonical factors of the criterion variables of motor coordination

Variables	Root 1
MOVA	-0.49
MOPA	-0.59
MONT	-0.41

The obtained results indicate (Table 3) that the effectiveness in tests of motor coordination is most defined by the test coordination with the bat (MKOP - 0.59), then slightly less by the test agility in the air (MOKV - 0.49), and least of all by the test agility on the ground (MONT- 0.41).

TABELA 4 Cross-corellational matrix of anthropometric and motor variables

VARIABLES	MOVA	MOPA	MONT
AVIS	0.22	-0.20	0.23
ADRK	0.21	-0.33	-0.22
ADUN	0.25	-0.23	0.12
AŠRA	0.23	-0.12	-0.18
AŠKA	0.14	-0.17	-0.15
AŠKU	0.28	-0.23	-0.24
AOGK	0.47	-0.54	-0.55
AONK	0.54	-0.53	-0.54
AOPK	0.53	-0.42	-0.56
AMAS	0.42	-0.42	-0.46
AKNT	-0.51	-0.54	-0.57
AKNK	-0.57	-0.45	-0.59
AKPK	-0.48	-0.46	-0.58

Based on the results of cross-correlations matrix (Table 4), it can be noticed that there are varying degrees of correlations between the applied system of anthropometric measures and motor coordination variables. The variables of circular dimensionality and body mass: thorax circumference (AOGR), thigh circumference (AONK), calf circumference (AOPK) and body weight (AMAS), positively affected on coordination efficiency. Variables of subcutaneous fatty tissue: abdominal skinfold (AKNT), thigh skinfold (AKNK), medial calf skinfold (AKPK) negatively affected the coordination ability.

DISCUSSION

This research was conducted in order to determine the relationship between the anthropometric measures of the morphological characteristics and motor coordination in 7th grade pupils of primary school.

The results of the canonical correlation analysis showed that in the study sample, considering the achieved high projection of the dimensions of both researched spaces on the canonical factor, exists a statistically significant correlation between the morphological characteristics and motor coordination (P level = .002).

On the basis of the results of the canonical relations, can be concluded (Table 2-4) that the greatest impact to efficiency in the motor coordination had the anthropometric measures for the evaluation of circular dimensionality and body mass: chest circumference (AOGK), thigh circumference (AONK), lower leg circumference (AOPK) and body weight (AMAS). In this research it

has also been found about the relations between the anthropometric measures subcutaneous fatty tissue and the variables of motor coordination, but they were negatively affected the coordination ability.

A number of authors (Arunović, 1992; Bompa, 2006; Durakovic 2008) highlights the importance of evaluation of morphological characteristics and motor coordination, as an indicators of overall sporting form, because dimensions of both these areas are in essence of the efficiency of motor skills.

It is well known (Malacko, 2010) that the maximum development of motor skills is possible only when all growth and development processes are completed and all the morphological characteristics, motor and functional abilities are optimally developed. But just in sensitive phases it is the largest opportunity to development of the capacity for maximum specified development of abilities. The largest opportunity for the coordination skills development was noted among children aged 11 to 13 (Bompa, 2006),

Some researchers (Kurelić et al., 1975; Hadžikadunić, 1998), suggest that the development of speed and explosive properties, characterized by motor coordination, are time-conditioned, so that their development should be started as early as possible. These properties also depend on the development' stage.

CONCLUSION

Based on the obtained results it can be concluded that the anthropometrical variables of circular dimensionality and body mass, are significantly associated with the coordination skills and positively affect the coordination efficiency. In the aplied sample of 7th grade students, the greatest imact to motor coordination efficiency, had variables of subcutaneous fatty tissue: thigh skinfold, medial calf skinfold and abdominal skinfold, but all of them negatively affected concerning motor coordination, especially on the efficiency of the coordination test agility on the ground.

LITERATURE

Arunović, D., Berković, L., Bokan, B., Madić, B., Matić, M., Radovanović, Đ. i Višnjić, D. (1992). Fizičko vaspitanje, Teorijsko-metodičke osnove stručnog rada. Niš: »Sirius«.

Bala, G. (1981). Struktura i razvoj morfoloških i motoričkih dimenzija dece SAP Vojvodine. Novi Sad: Fakultet fizičke kulture.

Beunen, G.P., Malina, R.M., Lefevre, J., Claessens, A.L., Renson, R., Kanden Eyunde, B., Vanreusel, B. & Simons, J. (1997). Skeletal maturation, somatic growth and physical fitness in girls 6-16 years of age. (Zrelost skeleta, somatski razvoj i fizička sposobnost dečaka 6-16 godina starosti). International Journal of Sports Medicine, 18 (6), 413-419.

Bompa, T.O. (2006). Periodization: Theory and methodology of training (Periodizacija: Teorija i metodologija treninga). Champaign, IL: Human Kinetics.

Bompa, T.O. (2008). Periodization: Theory and methodology of training (Periodizacija: Teorija i metodologija treninga). Champaign, IL: Human Kinetics.

Duraković, M. (2008). Kinatropologija, Biološki aspekti tjelesnog vježbanja. Zagreb: Kineziološki fakultet Sveučilišta.

Neljak, B. (1999). Struktura morfološkog prostora adolescenata muškog pola, Kineziologija za 21. stoleće. Zbornik radova, Zagreb : Fakultet za fizičku kulturu Sveučilišta u Zagrebu.

Gajić M. (1986). Struktura i razvoj koordinacije kod učenika osnovne škole. Novi Sad: Fakultet fizičke kulture.

Godina, E., Khomyakova, I., Purundzhan, A., Tretyak, A. & Zadorozhnaya, L. (2007). Effect of physical training on body composition in Moscow Adolescents. Journal of Physiological Anthropology, 26 (2), 229-234.

Hadžikadunić, M. (1998). Uticaj programiranog vježbanja na neke antropometrijske karakteristike motoričke i funkcionalne sposobnosti. Sarajevo: Fakultet za fizičku kulturu.

Hirtz, P. & Starosta, W. (2002). Sensitive and critical periods of motor coordination development and its relation to motor learning. Journal of Human Kinetics, 7, 19-28.

Jerković, S. (1986). *Relacije između antropometrijskih, dinamometrijskih i situaciono-motoričkih dimenzija i uspeha u nogometnoj igri*, Doktorska disertacija. Zagreb: Fakultet fizičke kulture.

Kurelić N., Momirović, K., Stojanović, M., Radojević, Ž. i Viskić-Štalec, N. (1975). Struktura i razvoj morfoloških i motoričkih dimenzija omladine, Beograd: Institut za naučna istraživanja. Fakultet za fizičku kulturu.

Lohman, T. G., Roche, A. F., & Martorell, R. (1988). Anthropometric standardization reference manual. Chicago: Human Kinetics Books.

Malacko, J. (2010). Utjecaj genotipa i fenotipa u treningu brzine, agilnosti i eksplozivnosti. 8. godišnja međunarodna konferencija "Kondicijska priprema sportaša 2010" (str 585-588). Zagreb. Kineziološki fakultet Sveučilišta u Zagrebu.

Malacko, J. i Popović, D. (2006). Relacije između sistema morfoloških i motoričko-funkcionalnih varijabli i njihov uticaj na aerobni kapacitet kod dece 5. razreda osnovne škole, Naučno-stručni časopis iz oblasti sporta i tjelesnog odgoja »Homo Sportikus«. Sarajevo: Fakultet sporta i tjelesnog odgoja.

Milanović, D. (2007): Teorija treninga, Priručnik za studente sveučilišnog studija. Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu.

Najšteter, Đ. (1997). Kineziološka didaktika. Sarajevo: Federalno ministarstvo obrazovanja, nauke, kulture i sporta.

RELACIJE IZMEĐU MORFOLOŠKIH KARAKTERISTIKA I KOORDINACIJE UČENIKA SEDMOG RAZREDA OSNOVNE ŠKOLE

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SAŽETAK

Cilj istraživanja je bio utvrđivanje relacija između morfoloških karakteristika i motoričke koordinacije na uzorku od 52 učenika sedmog razreda osnovnih škola, uzrasta 13 godina ± 6 meseci, primenom baterije od 13 antropometrijskih mera (tri mere za procenu longitudinalne dimenzionalnosti, tri mere za procenu transferzalne dimenzionalnosti, četri mere za procenu cirkularne dimenzionalnosti i mase tela i tri mere za procenu potkožnog masnog tkiva). Za procenu dimenzije koordinacije primenjena su tri testa. Rezultati kanoničke korelacione analize su pokazali da između antropometrijskih mera i koordinacije postoje statistički značajne relacije (P=.002), te se zaključuje da su morfološke karakteristike značajno povezane sa dimenzijom motoričke koordinacije.

Ključne reči: relacije, morfološke karakteristike, koordinacija, učenici sedmog razreda

THE INFLUENCE OF PHYSICAL EDUCATION CURRICULUM ON THE CORRECTION OF BAD BODY POSTURE AND THE CHANGES OF MOTOR STATUS IN THE PREPUBERTAL SCHOOLCHILDREN

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UDC 796.01:613.71/.72

SUMMARY

The study of the influence of the regular physical education curricula on improving the postural and motor status of children is a brief description of the topic of this research. The research sample consists of schoolchildren, aged 11 years (plus or minus six months) at the initial measurement. The two groups of variables comprise: the variables for the determination of the spine deformities in the sagittal plane (kyphotic and lordotic bad body posture) and the variables for the determination of the motor status of the researched subjects (nine motor tests for the assessment of the flexibility, the explosive and repetitive strength of the body were applied). The initial, control and final tests gave results that were expressed through the canonical discriminative analysis and have shown that the physical education curricula did not contribute to the total rehabilitation of the kyphotic and lordotic bad body posture, but quite contrary, its implementation brought about a deteriorated postural status. In the same line there was no improvement of the motor status.

Keywords: kyphotic bad body posture, lordotic bad body posture, motor skills, physical education curricula, discriminative analysis.

INTRODUCTION

This research paper is a study of the effects of the regular physical education curricula on the deformities of the spinal column in the sagittal plane and the motor status of schoolchildren during the pre-puberty period.

Lj. Radojičić-Finkelštaj in the paper "On the negative effects of certain physical exercises on the body posture," cites tonostatic muscles which are important in maintaining the human upright posture.

The author believes that the main cause of a poor body posture is the negative effect of gravity on the man's upright position. The regime of a typical teaching process in the schools favors this fact, so a major correction task would be to establish a proper relationship of the tonostatic and kinetic musculature and to reach an adequate quality in both muscle groups. To this purpose, she provides an overview of the values of some corrective movements, exercises and initial positions. Furthermore, it is proposed that a physical education teacher must establish, on the bases of the examination of schoolchildren, a relationship of certain indications and -contra indications of the application of some exercise in relation to their age, body composition and the type of bad body posture.

D. Ulic in the paper entitled "The physical education class as a significant factor in the prevention of bad body posture in schoolchildren aged 10 to 11 ", explains how by the implementation of certain curriculum contents

within the physical education class one can obtain positive effects in the effort to prevent bad body posture. During the work with two experimental groups the author has obtained some positive results in the group that underwent the corrective treatment, but also in the group, which in the physical education (PE) class was administering a preventive exercise design, which also brought about positive results. Thus, it is assumed that physical education teachers should pay attention to the use of the same treatment in their PE class organization.

D. Jeričević, in the work " The role and influence of two methods that are currently in use in the correction of the postural disorders of the spine ", among other things, talks about the role and impact of physical exercises. It is claimed that a large number of children with postural disorders indicates the need to implement a physical education as an educational process and not as a school subject represented in the teaching process just by two or three hours per week .

In the paper "The role of a physical education teacher in the timely detection, prevention and correction of the disorders of body posture ," D. Jeričević and Lj . Koturović indicate that it is of vital importance to establish a cooperation of physical education and a school physician in the detection, prevention, and rehabilitation of the postural disorders. It is significant also to note that over the recent years physical education teachers have been attending conferences and congresses where they discussed poor body posture, deformities and the methods of their treatment. This is all the more important because PE teachers are the qualified personnel, trained and educated during their studies to be able to monitor and observe the changes in a young body, and through different forms of physical activity to contribute to the reducing of the epidemic of poor body oposture. As they are approaching older age and senior grades schoolchildren are classified on the basis of their aptitude for foreign language learning. At the end of the paper the authors suggest that the division would be far more successful, if it were based on the identified state of their health, physical deformities and the preferences of the students. This is all the more important because all the teaching subjects and their contents, missed for some reasons, can be compensated for during the students' lifetime, but a disturbed health condition is much more difficult to improve.

Lj . Koturović in the paper "The need of a greater use of corrective exercises within the regular teaching process" explains the use of certain terms such as rehabilitation, kinetic therapy and corrective gymnastics. The author further argues for the ways to determine some deviations from the normal, and indicates the need for the harmonization of the criteria on the evaluation of physical status, to avoid blunders and mistakes, so that a poor posture transforms into a fixed deformity. This adjustment and education would be implemented through seminars, where the key lecturers would be competent experts in this field.

METHODS

The subject sample was drawn on the basis of the stated deformities of the spine in the sagittal plane of 25 schoolchildren of fifth grade of primary school, aged 11 years plus or minus 6 months.

The two groups of variables represent the variables for the assessment of postural and motor status. For the assessment of the postural status the following variables were selected: kyphotic bad body posture (KKIF) and lordotic bad body posture (KLOR). The motor status of the research subjects was rated by the following battery of tests: to assess flexibility (trunk flexion with a bat (MISK) leg pick up from lying position on the stomach (MZLE) and deep forward bend on the bench (MDPR), to assess the explosive strength (throwing a medicine ball from lying down (MBME), standing long jump (MDSK) standing high jump (IASC) and for the assessment of the repetitive strength - push-ups on the floor (MSKLE), forward bend from lying down (MTRB) and backword bend from lying down (MLED).

The measurements of the deviation of the spine in the sagittal plane were performed in the morning hours with the use of clinical methods, of the somatometric type (plumb, ruler and dermograph). A more lenient criterion was used for its mean values. All results which are in the thoracic region had values greater than 3.5 cm, and in the lumbar region the values greater than 4.5 cm were subjected to further observation in the course of three school semesters.

To measure motor skills the generally accepted tests whose validity was demonstrated through previous research, were used.

The group of subjects formed on the basis of the identified disorders did not perform any special regime of work but the subjects just pertained to the usual regular physical education curricula contents. For the purposes of this research this group served as the control group and was observed and monitored through the initial, control and final measurements.

RESULTS AND DISSCUSION

The results of the measurements were statistically processed by the canonic discriminative analysis and the obtained relations were explained in the discussion section.

TABLE 1 Canonic discriminative functions

Fcn	Eigen V	Pct of var	Cum pct	Can cor	Wilks λ	$\chi 2$	DF	Sig
1	.22	93.03	93.03	.42	.80	18.58	10	.04
2	.01	06.97	100.00	.12	.98	.98	4	.84

TABLE 2 Correlation functions

Test	FUNC 1	FUNC 2
KKIF	.42*	-.32
KLOR	.28*	-.22
MDSK	.17	.15
MDPR	.08	.01
MSKL	.10	.57*
MBME	.26*	.54*
MLED	.34*	.53*
MTRB	.00	.29*
MVSK	.13	.22*
MZLE	.19	.22*
MISK	.09	-.10

TABLE 3 Centroids of groups

Groups	FUNC 1	FUNC 2
1	-.65	-.01
2	.27	.16
3	.37	-.14

By applying the discriminative analysis on the control group of boys, ie. their motor status and the status of the deformities of the spine, we have obtained the results indicating a positive trend in the development of spinal deformities in the sagittal plane and a slight imrovement of the motor status.

By condensation of the variables of the motor tests and the variables of the postural disorders in the spinal cord, there were isolated two statistically

significant discriminative variables, out of which only the first discrimination is statistically significant, so that both variables are going to be interpreted and only the statistically significant discriminative variable is going to be discussed. This discrimination explains two motor tests which are responsible for the estimation of the repetitive strength of the back and the explosive strength of the shoulder girdle, and it also explains the variables of the postural status.

The significance of this statistically significant, isolated discriminative variable (Eigen V=.22) was tested by the Wilks lambda test (λ=.80) and the Bartlett chi-square test (χ2=18.58) with 10 (DF=10) degrees of freedom. This discrimination separates the motor variables MBME and MLED as well as the lordotic and the kyphotic bad body posture (KLOR and KKIF) on the basis of the discriminative coefficients (cum pct=93.03) and its canonical correlation is .42 (can cor=.42) and explains the differences with 93.03% of the intergroup variability (pct of var=93.03).

Based on the size and the sign of the projection of centroids on the statistically significant discriminative function, it can be concluded that the postural disturbances of the spine in the sagittal plane (KKIF = .33) and (KLOR=.26) have progressed from the initial towards the final measurement.

On the first (initial) measurement, the projection of centroids on these two variables of discriminative functions, is with a negative sign and the size of -.65. Already in the second (control) measurement, the size of the projection of centroids is growing, all the more with the change of the sign .27, which proves the deterioration in the bad body posture. In the third (final) measurement there is a slight increase in comparison with the second measurement .37, which, generally, points to the continuous advancement of the disorders of the spine in the sagittal plane. Therefore, the control group of boys, who were not included in the special program of physical education curriculum, has a tendency of an increase of the bad body posture - kyphotic and lordotic, with the possibility for the development of spinal deformities, that is, the transformation of the functional disorders into the disorders of the structural type, which in turn is much more harder to rehabilitate.

Despite this, the tests (their projections) for the assessment of the explosive strength of the shoulder girdle (MBME) and legs (MVSK and MDSK), as well as the tests for the assessment of the repetitive power of the shoulder girdle (MSKL), abdominal muscles (MTRB) and the extensors of the spine, that is, of the trunk (MLED), showed a slight improvement, as related to the first (initial) and the third (final) measurement.

As for the projection of centroids on the variables of the motor status in the statistically significant discriminative function, we can say that, except for the variables MBME and MLED, which represent the motor tests estimating the explosive strength of the shoulder girdle and the repetitive power of the extensors of the spine, that is of the trunk, other variables were not statistically significant.

CONCLUSION

A slight increase in the strength of the shoulder girdle and back muscles and the statistical insignificance of the variables of other motor tests show us that in boys, belonging to this group, which apart from attending regular physical education classes was not included in any other special program of physical education, one can notice a slight improvement of their motor status and the deterioration of the postural status.

It becomes much more obvious to reach a conclusion that the sole attendance of the regular physical education curricula is not enough to significantly improve the motor status and that it has no effect whatsoever on the prevention and correction of the postural disorders; therefore it is essential to insist on an additional engagement of schoolchildren, in the sense of the imrovement of their motor ability and the prevention, correction

and rehabilitation of bad body postures, postural disorders and body deformities.

REFERENCES

1. Jeričević, D., Koturović, Lj.: The Role of Physical Education in the timely detection, prevention and correction of disorders of posture. Sports-medical publication, Ljubljana, 1975, 1-3.

2. Jeričević, D.: The role and influence of the two methods that are now used in the adjustment process. Physical Culture, 1982, 3

3. Koturović, Lj.: Need for greater use of corrective gymnastics in the teaching process. Physical Culture, 1962, 3-4.

4. Radosavljevic, M.: Corrective gymnastics with the basics of physical training. Faculty of Physical Education, Belgrade, 2001

5. Radoicic-Finkelstein, Lj.: About the negative effects of certain physical exercises on posture. Physical Culture, Belgrade, 1954.

6. Street, D.: Physical education as an important factor in the prevention of bad body posture of the schoolchildren aged 10-11 . Physical culture, Podgorica, 1995.

7. Zivkovic, D.: Fundamentals of Kinesiology with elements of clinical kinesiology. Faculty of Sport and Physical Education, Nis, 2009

UTICAJ NASTAVE FIZIČKOG VASPITANJA NA KOREKCIJU LOŠEG DRŽANJA TELA I PROMENE MOTORIČKOG STATUSA KOD UČENIKA PRETPUBERTETSKOG UZRASTA

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SAŽETAK

Uticaj redovne nastave fizičkog vaspitanja na poboljšanje posturalnog i motoričkog statusa dece, je kratak opis ovog istraživačkog rada. Uzorak ispitanika sačinjavaju učenici starosti 11 godina (plus-minus šest meseci) na inicijalnom merenju. Dve grupe varijabli sačinjavaju: varijable za utvrdjivanje poremećaja na kičmenom stubu u sagitalnoj ravni (kifotično loše držanje i lordotično loše držanje) i varijable za utvrdjivanje motoričkog statusa ispitanika (devet motoričkih testova za ocenu fleskibilnosti, eksplozivne i repetitivne snage organizma). Inicijalno, kontrolno i finalno merenje dali su rezultate koji su kroz obradu kanoničkom diskriminativnom analizom, pokazali da nastava fizičkog vaspitanja nije doprinela saniranju kifotičnog i lordotičnog lošeg držanja, već naprotiv, došlo je do pogoršanja posturalnog statusa. Takođe, nije došlo ni do značajnijeg poboljšanja motoričkog statusa.

Ključne reči: kifotično loše držanje, lordotično loše držanje, motorika, nastava fizičkog vaspitanja, diskriminativna analiza.

LATENT STRUCTURE OF SOME INDICATORS OF IMPAIRED POSTURAL STATUS OF PRIMARY SCHOOL AGE PUPILS

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UDC 613.71/72:796

SUMMARY

On the specimen of 204 examinees, primary school older pupils of both genders the somatic examination has been conducted according to instructions and criteria of Auxter and Wooctt (1997) in order to evaluate postural status. All the male and female pupils representing specimen of testants regularly attended physical education classes, without conspicuous motor or psychological aberrations.

For the aberration of the impaired postural status the following variables have been applied: asymmetry of epigastric corner (ASIEGU), asymmetry of blades, (ASILOP), asymmetry of shoulders (ASIRAM), flat foot (RAVSTO), X legs (X-NOGE), O-legs (O-NOGE), kiphosis (KIFOZA) and lordosis (LORDOZ).

The basic aim of the research was that through the application of component model of factor analysis to determine latent structure of the impaired postural status of primary school age pupils.

The obtained factor analyses results regarding the postural status show that extracted (isolated) are three main components(factors) that may be defined as: *factor of asymmetry, factor of thoracic sacral deformity of spine and faktor of lower extremities deformity including feet.*

Key Words: pupils, impaired posture, deformity, factor analisys.

THE INTRODUCTION

The proper postural status is the foundation for a good health and proper growth of children, because only proper posture secures the normal functioning of organs and organic systems, as well as maintaining of psychomotor abilities. Concerning the significance of proper posture in development of children and youths, the postural status is the object of numerous researches (Đonović, Ilić i Damjanov, 2008; Kovačević, 2000; Kosinac, 2005, 2006, 2007). However, we witness that nowadays the proper postural status in every day activities takes no considerable role. The cause of (improper) bad posture of children should be looked for within family first, then within preschool institutions, since the adequate approach and understanding of significance of physical activity generaly by parents and educators, implies the prevention for school children and youths.

Long and improper sitting at home and at school, long standing, carrying of „heavy" school bag, inadequate bed and sleeping pillow, insufficient movement activity, as well as certain external factor act systematically in negative ways on proper posture of children causing in that way damages and permanent deformities of locomotor system. Bad posture implies functional deviation from proper posture where there are no structure changes on locomotor apparatus. Bad posture characterises the weakness of the whole organism, especially locomotor apparatus, for with such conditions is mostly conspicuous the static insufficiency of spine, which causes weakness of other locomotor apparatus parts (Bogdanović and Milenković, 2008). Due to this reason, a proper programming of body

exercises through the process of physical education classes and health education should contribute improving and strengthening of health status of students along with creating proper posture habit. By correct choice of body exercises it is possible to make the weakened musculature stronger and bring parts of locomotor apparatus back to normal functioning. However, preventive acting to occurance of deformity of locomotor apparatus is possible only if the impairments are being registered timely, while still functioning. (Stankić, 2009). Unless the impairment is registered on time, then it leads to continuous progression in deformity when the intervention, that is process of recovery is harder and lasts longer.

THE METHOD OF WORK

The specimen of examinees

The population out of which the specimen of respondents has been defined for this research are the older primary school pupils in Banja Luka. To be able to define the specimen as representative, in this research the somatic examinaton of 204 examinees was conducted of both genders regularly attending the lessons of physical and health education during the school year.

The specimen of variables for evaluation of impaired postural status

1. Asymmetry of epigastric corner…… (ASIEGU),
2. Asymmetry of blades …….. (ASILOP),
3. Asymmetry of shoulders…….. (ASIRAM),
4. Flat foot…….. (RAVSTO),
5. X legs…….. (X-NOGE),
6. Kiphosis…….. (KIFOZA)
7. Lordosis…….. (LORDOZ).

Method of data processing

For determining of latent structure of impaired postural status of primary school pupils the component model of **factor analysis** has been applied.

RESULTS AND DISCUSSION

Within table 1. the results of characteristic roots and explained parts of commont variable for evaluation of impaired postural status are presented, explaining total variability with 77,281% of common variable of the entire system of applied variables.

Through factoring of intercoloration matrix of applied manifested variables for the evaluation of postural status of primary school pupil's status, the characteristic roots are calculated, explaining the common variable of each isolated (extracted) chief component. By applying Gutman-Kaiser's criteria, based upon enthropy of analysed matrix, that is the total amount of information being given by observed system, the characteristic roots whose values are bigger or equal to 1.00 are kept, which defines the upper limit of significant number of the main components.

As it is seen in table 1 the three main components have been isolated, whose values are visible in column Total. Those three isolated components clarifies 77% of variability of common variance. The individual contribution of each particular components differs. By inspecting the column Total it is noticable that the first isolated component carries the highest share in clarifiying of the total variable and amount 2,48. The second isolated component has the value 1.83, and the third isolated component values 1.09.

Through the insight into table, the single contribution (% of Var) values from 35,44% of the first isolated component , 26,23% of the second isolated component and 15,61% of the third isolated component.

TABLE 1 Characteristic roots and explained parts of common variables for the evaluation of impaired postural status

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Componen	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**2,481**	**35,446**	**35,446**	**2,481**	**35,446**	**35,446**
2	**1,836**	**26,228**	**61,674**	**1,836**	**26,228**	**61,674**
3	**1,093**	**15,607**	**77,281**	**1,093**	**15,607**	**77,281**
4	,757	10,820	88,101			
5	,523	7,466	95,567			
6	,270	3,861	99,428			
7	,040	,572	100,000			

Extraction Method: Principal Component Analysis.

Legenda: Total Variance Explained – Objašnjeno ukupno varijanse; Initial Eigenvalues – Inicijalne sopstvene vrijednosti; Exstracion Sums of Squared Loadings – Ekstrakcija sume zasićenih kvadrata; Component (C) – komponenta; Total – Ukupno; % of Variance - % varijanse; Cumulative % - Kumulativno %.

By inspecting table 2, representing matrix of isolated components, the values of coefficients are represented, actually correlations of vectors of manifested variables and isolated components. As it was said before, and in table presented, three components have been isolated, out of which the highest part of variability is carried by the first isolated component.

TABLE 2 Matrix of isolated components or component matrix

Varijable	Component		
	1	2	3
ASYMECORNER	,853	,238	,005
ASYM.BLADES	,846	-,477	,086
ASYM.SHOULDER	,852	-,480	,063
FLATFOOT	,089	,413	,697
X-LEG	,142	,470	,575
KIPHOSIS	,352	,741	-,334
LORDOSIS	,399	,616	-,391

By ignoring the conditions of orthogonality, being done through transformation of the main components and performance of oblique rotation by applying direct oblimin solution, three matrix came as a result: structure matrix, frame matrix and matrix of intercorrelation of isolated factors. Within frame matrix (table 3) paralel projections of vectors of manifested variables to single, isolated factors are presented. Within structure matrix(table 4) the orthogonal vector projections of manifested variables and factors. Within matrix of corelated factors (table 5) values of correlation coefficiency between those three factors are presented.

The share of single factors in explaining common variance shall be presented in a specific way. In review of isolated factors it could be noticed the single contribution of manifested variables in clarifying of total variance and single projection to factors. Already interpreted and now showed in illustration is that each variable has smaller or bigger projection to single factors. The dominant values of single variables defined individual factors.

It is obvious that variables of asymmetries of epygastric corner, asymmetry of blades and asymmetry of shoulders made high connection with the first factor. Visible are determined projection values in next two factors. High paralel projections with first factor can be relatively easily clarified.

The most important paralel vector projections of manifested variables to other isolated factor have achieved variables for estimate of spine deformation in sagittal level, kiphosis and lordosis. The realized projections are of high and very high statistically important level (0.62 i 0.74). Defining of other isolated factor is relatively easy, for high projections of manifested variables are homogenized into latent block, therefore this factor can be defined as factor of spine deformity in sagittal level (kiphosis and lordosis).

The most significant paralel projections with the third factor are being realized by variables for estimate of lower extremities deformation in the area of knees and feet. Those variables achieved high projections defining so the third isolated factor as factor of lower extremities deformation in the area of knees and feet.

TABLE 3 Frame matrix

Varijable	Factor 1	Factor 2	Factor 3
ASIEGCORN.	,853	,238	,005
ASYMBLADES	,846	-,477	,086
ASYMSHOULD.	,852	-,480	,063
FLATFOOT	,089	,413	,697
X-LEGS	,142	,470	,575
KIPHOSIS	,352	,741	-,334
LORDOSIS	,399	,616	-,391

In structure matrix (table 4) the orthogonal vector projections of manifested variables for estimate of posture status to isolated factors are presented.

In first factor, high and statistically essential projection are done by the variables for upper parts of hull, the asymmetry of epigastric corner, asymmetry of blades and asymmetry of shoulders, so that it is very difficult to define this factor in any other way but the factor of upper parts asymmetry. This definition is known in researches so far. This definition has been reached basing upon coefficiency values. On the base of aforementioned the first main component may be defined as **factor of asymmetry,** and this component with its part explaines the largest part of common variance (35,446%).

Within the same table, after the defininig of the first factor, the second isolated component in clarification of common variance comprises 26,228%. The most important corelation coeficients with this component realises variables for estimate of spine deformity in sagittal level. Basing upon coefficient values, that is projection of variables for estimate of spine deformity in sagittal level (kiphosis and lordosis), the second factor can be defined as **factor of thoracic sacral spine deformity.** The most significant corelations with the third main components are realized by variables for estimate of lower extreimities and feet deformation.The third factor has been defined as the ability of maintaining of desirable (balanced) movement. Basing upon coefficient values, that is projection of variables for estimate of lower extremities and feet deformation the third isolated component can be named as **factor of lower extremities and feet deformation.** This factor explains 15,607% of total common variance.

Farther interpretatin of structure matrix is not necessary, for such presented values are sufficient to confirm defining of results within frame matrix.

TABLE 4 Structure matrix

Variable	Factor 1	Factor 2	Factor 3
ASIEGCOR.	,853	,238	,005
ASYMBLADES	,846	-,477	,086
ASYMSHOULD.	,852	-,480	,063
FLATFOOT	,089	,413	,697
X-LEGS	,142	,470	,575
KIPHOSIS	,352	,741	-,334
LORDOSIS	,399	,616	-,391

By analysing of matrix of isolated factor variable for estimate of postural status (table 5) it can be observed that the real values of coefficients differ in height of statistical significance. The highest correlation coefficient value is between the first and second isolated factor and it is 0.361. Somewhat lower, but statistically important correlation has been achieved also between the first and the third factor which is 0,238. Complexity of the first isolated factor has probably the decisive role in achieving such connections.

TABLE 5 Matrix of intercorrelations of isolated factors

	Factor 1	Factor 2	Factor 3
Factor 1	1,00	0.361	0.238
Factor 2	0.361	1,00	0,121
Factor 3	0,238	0,121	1.00

CONCLUSION

The research has been conducted on the specimen of 204 examinees, the pupils of older grades of both genders in Primary school „Vuk Stefanovic Karadzic." In the research the set of seven variables for estimate of pupils posture statuse has been used.

The basic aim of research was to determine through application of component models of factor analysis the latent structure of examinee posture status-pupils of older grades of both genders in Primary school „Vuk Stefanovic Karadzic" in Banja Luka.

The obtained results of factor analysis of posture status show that extracted (isolated) three main components (factors), that can be defined as: factor of asymmetry, factor of thoracic sacral deformity of spine and factor of lower extremities and feet deformation.

The obtained results within this research may give significant information on the most frequent location of deformities caused by improper posture with older grades primary school pupils, along with basic directions in selection and application of body exercises in upbringing of proper body posture creating of preventive programs for preventing deformations of locomotor apparatus.

REFERENCE

Auxter, D., Pyfer, J., & Huettig, C. (1997). *Principles and methods of adapted physical education and recreation*. St Louis, MO: Mosby.

Bogdanović, Z., & Milenković, S. (2008). Uticaj programiranog vežbanja korektivne gimnastike na morfološki i posturalni prostor devojčica osnovnoškolskog uzrasta. U Zborniku radova *IV Međunarodne konferencije „Menadžment u sportu"(str. 123 131).* Beograd: Fakultet sportskog menadžmenta.

Dušek-Lončar, M., Pećina, M., & Prebeg, Ž. (1991). A Longitudinal Study of Growth Velocity and Development of Secondary Gender Characteristichs Versus Onset of Idiopathic Scoliosis. Clinical

Orthopedics and Related Research. *JB Lippincott Co*, *270*, 278-82.

Đonović, L., Ilić, M., Damjanov, V. (2008). *Skolioza kod školske dece na teritoriji grada Kragujevca,* IZJZ Kragujevac, Medicinski fakultet Kragujevac,

Kosinac, Z. (2006) *Kineziterapija: tretmani poremećaja i bolesti organa i organskih sustava.* Sveučilište u Splitu, Udruga za šport i rekreaciju djece i mladeži grada Splita, 291-330.

Kosinac, Z. (2006). Utjecaj nekih antropometrijskih i somatskih pokazatelja na dismorfične promjene prsnog koša (pectus carinatum i pectus excavatum). *Fizička kultura, Beograd*, *60*(1), 39-49.

Kosinac, Z. (2007): *Relacije između nekih pokazatelja otklona posture i skolioze u djece različitog spola.* In: 16.ljetna škola kineziologa Republike Hrvatske.

Kosinac, Z., & Brešan, I. (2005). *Kineziterapija sustava za kretanje*. Udruga za šport i rekreaciju djece i mladeži grada Splita.

Kosinac, Z., & Srzić, M. (2006). Kineziološki problemi posture u djece mlađe životne dobi. *Contemporary Kinesiology, Kupres*, 116-120.

Kovačević, V. (2000). Problematika kralješnice razvojne dobi. *Paediatr Croat*, 44 (supl 1): 199-204.

Mijailović, N. (2003). *Značaj i mogućnost sistematskih pregleda u ranoj detekciji skolioze kod školske dece u Kragujevcu.* Neobjavljeni magistarski rad, Medicinski fakultet, Kragujevac.

Stankić, Lj. (2009). *Gledaj kako rastem.* Subotica, Srbija.

Wooactt, M. H. (1994). Normal and abnormal development of posture control in children. *Yabe, Kusano, K., Nakata, H. editors: Adapted physical activity: Health and fitness, New York, Spring-Verlag*.

LATENTNA STRUKTURA NEKIH POKAZATELJA NARUŠENOG POSTURALNOG STATUSA UČENIKA OSNOVNOŠKOLSKOG UZRASTA

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SAŽETAK

Na uzorku od 204 ispitanika, učenika starijih razreda osnovne škole, oba pola izveden je somatski pregled u skladu sa uputama i kriterijima Auxtera i Wooctta (1997) za ocjenu posturalnog statusa. Svi učenici i učenice koje su predstavljali uzorak ispitanika redovno su pohađali nastavu tjelesnog odgoja, bez izraženih motoričkih i psihičkih aberacija.

Za procjenu narušenog posturalnog statusa primijenjene su sljedeće varijable: asimetrija epigastričnog ugla (ASIEGU), asimetrija lopatica (ASILOP), asimetrija ramena (ASIRAM), ravno stopalo (RAVSTO), X noge (X-NOGE), O-noge (O-NOGE), kifoza (KIFOZA) i lordoza (LORDOZ).

Osnovni cilj istraživanja bio je da se primjenom komponentnog modela faktorske analize utvrdi latentna struktura narušenog posturalnog statusa učenika osnovnoškolskog uzrasta.

Dobijeni rezultati faktorske analize u prostoru narušenog posturalnog statusa pokazuju da su ekstrahovane (izolovane) tri glavne komponente (faktora), koji se mogu definisati kao: *faktor asimetričnosti, faktor torakalno-sakralnog deformiteta kičmenog stuba i faktor deformiteta donjih ekstremiteta i stopala.*

Ključne riječi: učenici, narušena postura, deformacije, faktorska analiza.

RELATIONSHIP BETWEEN MORPHOLOGICAL CHARACTERISTICS AND IMPACT OF COORDINATION AND EXPLOSIVE STRENGTH OF STUDENTS 12 YEARS OLD

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UDC 796.015.52-055.15

SUMMARY

Introduction: Basic motor skills that were examined in this study are coordination and explosive power for students 12 years old. Morphology range was analyzed with longitudinal, transversal dimensionality and with rage of the volume and body weight. The research problem is corelatio and influence of morphological characteristics on coordination and explosive power of the age of 12 years.

Methods: The research was conducted on a sample of 42 children old 12, 27 male and 15 female subjects. The criteria variables: longitudinal dimensionality, mass and volume, transversal dimensionality and predictor variables: dribbling the ball with hand, bending down to eight, polygon backwards, long jump from position, triple jump from position and throwing a medicine ball. („Metikoš i saradnici“, 1989). Results were analyzed using descriptive and comparative statistics.

Results: Correlation analysis showed that measures of longitudinal dimensionality of the skeleton on examinees of both sexes has significant correlation with test results of coordination assessment. It is observed negative corelation between test scores of coordination evaluation with volume measures and body mass on both geder examinees. Negative corelation was observed in correlation of transversal morphological features with coordiation test results. Regression analysis durig analysis of longitudinal dimensionality of the skeleton found that based on body height it is significantly possible to predict test results of dribblling by hand on examinees of both geders, and tests of the eight with bending and polygon backwards for female gender examinees. Body mass from the group of morphological mass characteristics and body voluminosity statistically significantly can predict test results of dribbling by hand, eight with bending and backward polygon on male examinees. By analysis of transversal dimensionality of the skeleton was concluded that based on the foot width measure statistically significantly is possible to predict test results of dribbling by hand, eight with bending and backward polygon for female examinees. However, on male examinees the diameter of hock ankle predicts test results of eight with bending.

Conclusion: The most important application derived data of this research is that these data can be used during selection for sports where coordination is dominant as motor skill. Results of this study showed that longitudinal dimensionality has significant correlation with coordination test results. As further alleged, during selection should be given attention to this morphological feature. During the selection should also take into account the morphological characteristics of mass and volume of the body, where it is also shown a significant impact on coordination. The significance of this research is that it is shown that longitudinal and transversal dimensionality plays an important role in lower extremities explosive strength manifestation.

Key Words: morphological characteristics, coordination, explosive power

INTRODUCTION, PROBLEM AND SUBJECT

Basic motor skills that were investigated in this study coordination and explosive power of the age 12 years. Space morphology was analyzed longitudinal , transversal dimension of the space and volume and body weight. Several authors dealt with the definition of morphological characteristics. "Under the morphological characteristics of the anthropological status of man usually involves a certain system of basic anthropometric latent variables" (Malacko, 1991, p. 23). "Under the morphological characteristics of the anthropological Satus man usually imply processes of human growth and ontogenetic development" (Malacko and Rađo, 2004, p. 160). Malacko (1991). Further stated that based on a number of previous studies of morphological space factor identified a number of factors, which provide important initial information about a specific morphological structure dimensions. Based on research, most often identified four main factors that determine the morphological structure of a human, which is applied in practice. In these four factors included "longitudinal dimensionality of the skeleton, transversal dimensionality of the skeleton, the mass and volume of the body and subcutaneous adipose tissue" (Malacko, 1991, p. 23). For bone growth in length is a factor responsible longitudinal dimensionality of the skeleton. From the large number of parameters that determine the structure of this factor, this paper analyzed: body height, leg length, upper leg, lower leg length and foot length. For bone growth in width factor responsible transversal dimensionality of the skeleton. From the large number of parameters that determine the structure of this factor, this paper analyzed: diameter of the knee joint, ankle joint diameter and width of the foot. A factor that is often referred to as a factor circular dimensions of the body, which is responsible for the total weight and volume of the body, is a factor of mass and volume of the body.It showed that has the highest correlation with motor skills and is considered to be one of the most important factors in the morphological space. From the large number of parameters that determine the structure of this factor, this study analyzed: body weight, thigh girth and calf girth. "The information about the structure of the morphological characteristics are very important in terms of their transformations (use and development). Morphological characteristics are mainly influenced by genetic factors (endogenous effects) and environmental factors (exogenous effects). The influence of genetic factors is the same for all latent morphological dimension. The coefficient of inborn dimensions of the skeleton is about 0.98, 0.90 volume of the body, and tissue fet 0.50. Therefore, the greatest transformation under the influence of exogenous factors (the process of sports training) is possible in fat, then volume of the body, and it is almost negligible in the dimensionality of the skeleton" (Malacko, 1991, p. 24). "The factor structure of the anthropometric variables everywhere in the world is different with respect to aspects of age and sex, as well as considering genetic factors and ecosocials" (Bijelić and Simović, 2005, p. 22.). Its also showed that the period of growth and development ungrateful for anthropometric measurements, because in this period the anthropometric measures are very unstable. Coordination as a basic motor skills, yet greatly attracted the attention of specialists. The reason is that the results of this research compabilities do not provide sufficient information on which could be considered a well-studied. For the study of these abilities are not enough, responsible enough knowledge of the functioning of processes in the brain, where even experts in the field of neurology have no definitive answers. In defining the mechanisms that govern the coordination of the CNS is responsible "for structuring mechanism of movement is defined as a control and integration system allowing the rapid formation of efficient motor programs and their controlled in response to the information coming in through the large number of channels" (Nićin, 2000, p. 167.). Based on the above coordinates can be defined as "Intended and

controlled energy, the temporal and spatial organization of the movement into a whole" (Gajić 1985, cited in Nićin, 2000, p. 167). Research coordination which were used in this study were related to the research Huhlaeve (1976.) oin which showed that under agility means the ability of a man to quickly master new movements and to changes in accordance with the needs of the situation suddenly changed. Matveev and Novikov (1976.) emphasize that the agility mainly depends on the activity of analyzers, especially the engine. Stambulova (1978.) upon years of research into psychological cognitive process, concluded that the visual perception and motor skills with each other are strongly correlated. Explosive power is a form of power that is responsible for the execution of movements at high speed. In this paper, power, as well as motor skills explored the explosive power of the lower and upper extremities. Explosive power is defined "as the ability to mobilize short-term maximum muscle force to accelerate the movement of the body." (Nićin, 2000, p. 131.). To evaluate the morphological status of the subjects were used anthropometric measures recommended by the International Biological Program. Coordination is analyzed as a coordination body parts and the body as a whole. Explosive strength was analyzed with the upper and lower extremities, valid tests. The research problem is the connection and influence of morphological characteristics of coordination and explosive power of the age of 12 years. It is focused on coordination and explosive power as motor skills.

With regard to the issue of the treated, the aim was to investigate the relationship and influence of morphological characteristics of the achieved results of the assessment of coordination and explosive strength in children of the age 12 years.

METHODS

This research uses the method of theoretical analysis which provides the theoretical framework and the interpretation of results of coordination and explosive power of students of 12 years old. It was used also descriptive and causal methods are aimed to describe and explain the relationship between the obtained results and their inter- relationships.

The sample

The survey was conducted on a sample of 42 children aged 12 +/- 6 months and 27 male and 15 female subjects. The respondents were not involved in any form of physical activity, other than attending regular physical education classes in schools.

The sample of variables

The variables in this study were divided into predictor and criterion:

The criteria :

a) longitudinal dimension:

-body height **(TV),**

-leg length **(DUZINOG),**

-thigh length **(DUZINATK),**

-calf length **(DUZIPOTKO),**

-foot length **(DUZISTOP),**

b) The mass and volume:

- body weight **(BW),**

- thigh girth **(OBIMNATK),**

- the volume of the lower leg **(OBIMPOTKO),**

c) transversal dimension:

- diameter of the knee joint **(DIJAMZGKOLJ),**

-ankle diameter **(DIJAMSKZG),**

- width foot **(SIRINASTOP),**

Predictor variables :

a) tests for the assessment of coordination:

- keeping hand balls **(MKAVLR),**

- eight with bending **(MAGOSS),**

-ground backward **(MREPOL),**

b) tests to assess explosive power:

- jump from the center **(SKOKDALJ),**

- triple jump **(TROSKOK),**

- throwing a medicine ball **(BACANJEMED).** (Metikoš et al, 1989.).

Methods of data processing

In order to formulate valid conclusions, it is calculated as follows:

• Basic statistical parameters:

- mean,
- variation width,
- standard deviation,
- variance,
- measures of skewness and kurtosis of asymmetry,
- Kolmogorov - Smirnov test.

• Parametric statistics:

- Correlation - numerical correlation between the results achieved,
- Correlation - regression prediction of the results.

Statistical analysis was performed on a PC Pentium IV, and used the statistical program SPSS (version 11.0).

INTERPRETATION OF RESULTS

Table 1. presents the results of descriptive statistics morphological characteristics for both sexes. Before the analysis of the results was tested normality of distribution of all the results from Komogorov-Smirnov test (KS test). By the results of the morphological characteristics for both sexes value of KS test, showed that for all tests a normality distribution . When analyzing of difference between the maximum and minimum results in subjects for both sexes, and the rank values, the results of anthropological measures of body height **(TV)** showed the highest dispersion, while the results of anthropological measures of ankle diameter **(DIJAMSKZG)** showed the lowest observed scattering results. The highest value rank of anthropological measure body height **(TV)** can be justified on the basis of puberty where there are respondents. During this period, the major differences noticeable in longitudinal bone growth, resulting in slow or rapid increase in body height. The minimum value of the rank of anthropological measures of ankle diameter **(DIJAMSKZG)** can be analyzed on the basis that the respondents are involved in some form of physical activity that would lead to an increase in transversal dimension of the ankle due to ossification, which is a result of physical activity. Skewness measures asymmetry (incidence curves) shows a positive and a negative value. A positive value shows the distribution of results mostly positive direction, the curve tends towards greater results.

TABLE 1 Descriptive statistics of morphological characteristics of both sexes

men	N	Rang	Min	Max	M	S. D.	Varian	Skewnes	Kurtos	KS test
TV	27	41.00	137.00	178.00	150.63	11.29	127.47	0.89	0.05	0.36
DUZINOG	27	18.00	83.00	101.00	94.57	4.51	20.30	-0.84	0.26	0.61
DUZINATK	27	15.25	39.00	54.25	49.45	4.68	21.86	-0.79	-0.39	0.30
DUZIPOTKO	27	11.20	40.80	52.00	45.01	2.50	6.26	0.93	1.23	0.56
DUZISTOP	27	5.50	23.00	28.50	25.41	1.16	1.35	.018	1.18	0.26
TM	27	30.80	35.00	65.80	45.42	9.24	85.40	0.95	-0.19	0.35
OBIMNATK	27	35.90	38.10	74.00	47.43	7.52	56.56	1.97	5.12	0.10
OBIMPOTKO	27	20.50	28.50	49.00	33.28	4.18	17.50	2.23	6.86	0.15
DIJAMZGKOLJ	27	4.75	7.75	12.50	8.98	0.95	0.90	2.16	6.40	0.05
DIJAMSKZG	27	1.94	5.86	7.80	6.93	0.43	0.19	-0.06	0.57	0.90
SIRINASTOP	27	3.04	7.76	10.80	8.95	0.59	0.34	1.04	3.15	0.45
women	**N**	**Rang**	**Min**	**Max**	**M**	**S. D.**	**Varian**	**Skewnes**	**Kurtosis**	**KS test**
TV	15	44.00	137.00	181.00	155.00	13.42	180.00	0.36	-1.04	0.63
DUZINOG	15	11.75	88.00	99.75	95.67	3.34	11.17	-1.02	0.79	0.70
DUZINATK	15	10.00	45.00	55.00	51.40	3.07	9.43	-1.00	-0.02	0.33
DUZIPOTKO	15	5.00	43.00	48.00	44.28	1.40	1.97	1.50	2.34	0.90
DUZISTOP	15	2.50	23.50	26.00	25.00	0.76	0.57	-0.29	-0.57	0.26
TM	15	22.80	39.00	61.80	48.49	8.95	80.04	0.48	-1.81	0.47
OBIMNATK	15	15.50	41.50	57.00	47.33	5.18	26.86	0.52	-1.17	0.58
OBIMPOTKO	15	9.20	30.30	39.50	33.42	2.93	8.61	0.92	-0.16	0.85
DIJAMZGKOLJ	15	1.80	7.80	9.60	8.56	0.39	0.15	0.76	4.16	0.17
DIJAMSKZG	15	0.90	6.50	7.40	6.77	0.25	0.35	1.43	1.82	0.68
SIRINASTOP	15	1.78	8.42	10.20	9.10	0.52	0.27	0.96	0.15	0.32

TABLE 2 Descriptive statistics of the results of tests of coordination and explosive power in subjects of both sexes

men	N	Rang	Min	Max	M	S. D.	Varian	Skewne	Kurtosi	KS test
MKAVLR	27	10.35	5.90	16.25	10.34	3.43	11.75	0.13	-1.53	0.28
MAGOSS	27	21.37	15.90	37.27	27.33	9.05	81.89	-0.24	-2.03	0.05
MREPOL	27	16.00	7.50	23.50	12.81	3.41	11.64	1.04	2.42	0.90
SKOKDALJ	27	89.00	138.00	227.00	176.41	22.78	518.79	0.49	-0.67	0.51
TROSKOK	27	241.00	399.00	640.00	520.07	67.84	4602.30	0.11	-0.83	0.76
BACANJEMED	27	458.00	315.00	773.00	472.07	132.46	17544.46	0.82	-0.03	0.64
women	**N**	**Rang**	**Min**	**Max**	**M**	**S. D.**	**Varian**	**Skewne**	**Kurtosi**	**KS test**
MKAVLR	15	7.84	6.50	14.34	10.33	2.85	8.11	0.13	-1.93	0..41
MAGOSS	15	23.50	15.60	39.10	26.42	9.75	94.98	0.16	-2.19	0.13
MREPOL	15	6.79	10.11	16.90	13.38	2.01	4.04	0.18	-0.73	0.99
SKOKDALJ	15	70.00	149.00	219.00	186.13	19.68	387.41	-0.61	0.03	0.60
TROSKOK	15	156.00	446.00	602.00	535.73	46.57	2168.35	-0.93	-0.16	0.23
BACANJEMED	15	272.00	240.00	512.00	414.80	80.29	6445.89	-0.58	-0.15	0.85

While negative values indicate the distribution of results predominantly negative direction, the curve tends to result in lower average results. Kurtosis measures the asymmetry (curve curve) shows the positive and negative values. A positive value represents a deviation in the results toward **convex** curve, where the curve is convex and expressed greater clustering of results about the mean. Negative values represent a deviation in the results toward **rounded** curve, where the curve is more rounded and expressed greater deviation from the mean results.

Table 2. presents the results of descriptive statistics, the results of tests of coordination and explosive power in subjects of both sexes. Before the analysis of the results was tested normality of distribution of all the results from Komogorov-Smirnov test (KS test). By the results of tests of explosive strength and coordination of both sexes value of KS test showed that for all tests a normality distribution. When analyzing the difference between the maximum and minimum actual results to a single test or rank values in all subjects with respect to gender, higher values were observed in male subjects, except in the test with eight bending **(MAGOSS)**, where higher values observed in subjects females. It talks about the lesser homogeneity compared to the results achieved in overcoming test rate for men compared to women. Male respondents in tests to assess coordination, showed lower average value only in the result of the test polygon backwards **(MREPOL)**, which means that this test better performance than female respondents. Analysis of the results of tests for the assessment of explosive strength, male respondents showed a better performance in the test throwing a medicine ball **(BACANJEMED)**, while the female respondents in the other two tests with better results. Skewness measures asymmetry (incidence curves) shows a positive and a negative value. A positive value shows the distribution of results mostly positive direction, the curve tends towards greater results. While negative values indicate the distribution of results predominantly negative direction, the curve tends to result in lower average results. Kurtosis measures the asymmetry also shows positive and negative values. A positive value represents a deviation in the results toward **convex** curve, where the curve is convex and expressed greater clustering of results about the mean. Negative values represent a deviation in the results toward **rounded** curve, where the curve is more rounded and expressed greater deviation from the mean results.

Table 3. shown the connection between measures of morphological characteristics with the results of tests of explosive strength and coordination of the respondents. The connection is defined by the correlation analysis and numerical connection between the results obtained. When analyzed the correlation of longitudinal dimensionality of the skeleton with the results of tests of coordination, in subjects of both sexes threatened a statistically significant correlation. Measure longitudinal dimension of the results of tests of coordination are mostly negatively correlated. Tests of coordination with which these morphological measures showed association in both sexes are dribbling hand **(MKAVLR)** and eight with bending **(MAGOSS)**. From the results it can be concluded that participants with higher body height and greater lengths of the lower limbs can achieve better results in the execution of these tests. Also interesting is the correlation of the results of tests to assess explosive strength, standing long jump seats **(SKOKDALJ)** and triple jump **(TROSKOK)**, with male participants with the length of the foot **(DUZISTOP)**. According to the obtained results, it can be concluded that participants with higher length of the feet can provide better explosive power of the lower extremities. Length of the foot can be connected with the power of the foot, which is also important in showing explosive power of the lower extremities. Correlation of test results to assess the coordination of measures volume and body weight in subjects of both sexes, is negatively correlated . This negative relationship indicates that respondents with greater body mass, higher volumes of lower extremities, can perform better

coordinating the movements and elements of coordination of upper and lower extremities, as well as the coordination of the whole body. A negative relationship was observed with the transverse correlation of morphological features with the results of tests of coordination. This can be justified on the grounds that the respondents with larger diameters of the knee joint, ankle and foot, faster execution of complex acts of coordination of the lower limbs or whole body.

TABLE 3 Correlation analysis

	Varijables	Coefficient corellation	MKAVLR	MAGOSS	MREPOL	SKOKDALJ	TROSKOK	BACANJEMED
men	TV	Pears.Core	-0.80	-0.79	0.12	0.09	0.19	-0.18
		Sig.	0.00	0.00	0.54	0.67	0.35	0.37
	DUZINOG	Pears.Core	-0.47	-0.42	0.07	0.23	0.27	0.18
		Sig.	0.01	0.03	0.74	0.24	0.18	0.37
	DUZINATK	Pears.Core	-0.80	-0.82	0.04	0.04	0.00	0.05
		Sig.	0.00	0.00	0.84	0.83	0.98	0.87
	DUZIPOTKO	Pears.Core	-0.60	-0.71	0.12	0.30	0.44	-0.03
		Sig.	0.00	0.00	0.57	0.13	0.02	0.90
	DUZISTOP	Pears.Core	0.07	0.02	-0.07	0.43	0.40	0.28
		Sig.	0.73	0.93	0.73	0.03	0.04	0.18
	TM	Pears.Core	-0.58	-0.64	0.47	-0.15	0.01	-0.13
		Sig.	0.00	0.00	0.01	0.45	0.96	0.51
	OBIMNATK	Pears.Core	-0.44	-0.52	0.74	-0.27	-0.05	-0.10
		Sig.	0.02	0.01	0.00	0.18	0.81	0.64
	OBIMPOTKO	Pears.Core	-0.41	-0.47	0.70	-0.21	-0.01	-0.02
		Sig.	0.04	0.01	0.00	0.29	0.95	0.93
	DIJAMZGKOLJ	Pears.Core	-0.51	-0.57	0.62	-0.19	0.05	-0.04
		Sig.	0.01	0.00	0.00	0.35	0.80	0.83
	DIJAMSKZG	Pears.Core	-0.56	-0.72	0.34	0.09	0.28	-0.04
		Sig.	0.01	0.00	0.08	0.66	0.16	0.85
	SIRINASTOP	Pears.Core	-0.49	-0.59	0.14	0.26	0.40	0.13
		Sig.	0.01	0.00	0.48	0.19	0.04	0.51
women	TV	Pears.Core	-0.86	-0.87	0.67	0.19	0.19	-0.31
		Sig.	0.00	0.00	0.01	0.51	0.50	0.26
	DUZINOG	Pears.Core	-0.46	-0.46	0.05	-0.14	0.03	0.23
		Sig.	0.08	0.04	0.87	0.61	0.91	0.36
	DUZINATK	Pears.Core	-0.57	-0.65	-0.17	-0.11	-0.08	0.42
		Sig.	0.03	0.01	0.55	0.69	0.77	0.12
	DUZIPOTKO	Pears.Core	-0.14	-0.18	0.48	-0.10	0.26	0.34
		Sig.	0.62	0.52	0.07	0.73	0.34	0.21
	DUZISTOP	Pears.Core	0.64	0.64	-0.05	-0.32	-0.09	0.17
		Sig.	0.01	0.01	0.87	0.25	0.75	0.55
	TM	Pears.Core	-0.77	-0.75	0.43	0.14	0.14	0.00
		Sig.	0.00	0.00	0.11	0.63	0.62	1.00
	OBIMNATK	Pears.Core	-0.66	-0.66	0.48	0.25	0.28	0.17
		Sig.	0.01	0.01	0.07	0.37	0.31	0.55
	OBIMPOTKO	Pears.Core	-0.63	-0.64	0.51	0.30	0.34	0.25
		Sig.	0.01	0.01	0.05	0.28	0.21	0.37
	DIJAMZGKOLJ	Pears.Core	-0.04	0.02	0.26	-0.02	0.02	0.29
		Sig.	0.89	0.96	0.34	0.94	0.95	0.32
	DIJAMSKZG	Pears.Core	-0.27	-0.28	0.53	0.12	0.29	0.16
		Sig.	0.33	0.32	0.05	0.66	0.29	0.58
	SIRINASTOP	Pears.Core	-0.60	-0.66	0.73	0.29	0.28	-0.04
		Sig.	0.02	0.01	0.00	0.30	0.31	0.89

TABLE 4 The influence of longitudinal dimension of the test results of coordination and explosive power in subjects of both sexes

respondents	Indepentendt variable	Unstandardized coefficents		Standardized coefficents	T	Sig.	Depentent variable
		B	Std. eror	Beta			
men	konstanta	15.70	7.19		2.18	0.04	MKAVLR
	TV	-0.14	0.05	-0.45	-2.95	0.01	
	DUZINOG	0.26	0.55	0.34	0.46	0.65	
	DUZINATK	0.14	0.50	0.19	0.28	0.78	
	DUZIPOTKO	-0.46	0.58	-0.34	-0.80	0.43	
	konstanta	53.67	12.17		4.41	0.00	MAGOSS
	TV	12.54	0.08	-0.12	-1.21	0.24	
	DUZINOG	0.10	0.91	-0.02	-0.03	0.97	
	DUZINATK	1.29	0.85	0.67	1.52	0.14	
	DUZIPOTKO	-1.63	0.97	-0.45	-1.67	0.11	
	konstanta	-800.49	529.17		-1.51	0.14	BACANJEMED
	DUZINATK	-8.60	14.86	-0.29	-0.58	0.57	
	DUZIPOTKO	18.95	10.39	0.67	1.82	0.08	
	DUZISTOP	45.21	34.10	0.40	1.33	0.20	
	konstanta	-177.25	279.39		-0.63	0.53	TROSKOK
	DUZISTOP	12.54	12.97	0.22	0.97	0.34	
	DUZIPOTKO	8.41	6.02	0.31	1.40	0.18	
	konstanta	-38.00	90.13		-0.42	0.68	SKOKDALJ
	DUZISTOP	8.44	3.54	0.43	2.38	0.03	
women	konstanta	2.87	14.94		0.19	0.85	MKAVLR
	TV	-0.15	0.03	-0.69	-5.18	0.00	
	DUZINATK	0.20	0.12	0.22	1.58	0.14	
	DUZISTOP	0.79	0.54	0.21	1.47	0.17	
	konstanta	-4.16	38.10		-0.11	0.92	MAGOSS
	TV	-0.41	0.09	-0.57	-4.40	0.00	
	DUZINOG	-1.30	0.98	-0.45	-1.32	0.22	
	DUZINATK	2.18	0.92	0.69	2.38	0.04	
	DUZISTOP	4.28	2.17	0.33	1.98	0.08	
	konstanta	-2.23	4.78		-0.47	0.65	MREPOL
	TV	0.10	0.03	0.67	3.28	0.00	
	konstanta	-1492.81	562.89		-2.65	0.02	BACANJEMED
	DUZINOG	2.36	6.68	0.10	0.35	0.73	
	DUZISTOP	67.26	29.53	0.63	0.28	0.84	

When performing regression analyzes were used only predictor variables that showed statistically significant correlations with the criterion variables. After the regression analysis, which examined the prediction of test data for evaluation of coordination, dribbling hand **(MKAVLR)** in subjects of both sexes, observed a statistically significant prediction on the basis of morphological characteristics of body height **(TV)**. The value of the significance of male respondents is 0.01 and for women 0.00 and on that basis it can be concluded that there is a statistically significant prediction on the basis of morphological characteristics. Because of the negative sign and the obtained results it can be concluded that participants with higher body height can achieve better results in the execution of this test. Based on the values of the coefficient B, it can be concluded that the results in subjects of both sexes are negatively correlated, suggesting that if the body height "increase" of 1 cm, the result of this test coordination will decrease by

0.14 seconds of the male half and 0.15 seconds in female subjects. Other morphological characteristics of the longitudinal dimension, although statistically significant correlation, no statistical significance in predicting the results of this test coordination. When examining the predictions of the test results with eight bending **(MAGGOS)** of the male sex, is not observed statistically significant prediction based on all morphological characteristics. Whereas in the case of female respondents noted a statistically significant prediction based on morphological characteristics of body height **(TV)** and the length of the upper leg **(DUZINATK)**. The value of the significance of the morphological characteristics of body height **(TV)** is 0.00, and for the length of the upper leg **(DUZINATK)** is 0.04 and on that basis it can be concluded that there is a statistically significant prediction on the basis of these morphological characteristics. Based on the values of the coefficient B, it can be concluded that the results of morphological features **(TV)** are negatively correlated, suggesting that if the body height "increase" of 1 cm, the result of this test coordination will decrease by 0.41 seconds, However, if the length of the upper leg "cut" of 1 cm will be reduced and the result of this test in 2.18 seconds. When questioned predict the results of the test polygon backwards **(MREPOL)** of male respondents did not observed statistically significant prediction based on all morphological characteristics. Whereas in the case of female respondents noted a statistically significant prediction based on morphological characteristics of body height **(TV)**. The value of the significance of the morphological characteristics of body height **(TV)** is 0.00 and based on this we can conclude that there is a statistically significant prediction on the basis of these morphological characteristics. Based on the values of the coefficient B, it can be concluded that the results of morphological features **(TV)** are positively related, which means that if the body height "reduce" to 1 cm, the result of this test coordination will be reduced to 0.10 seconds. Morphological characteristics of both sexes were not statistically significant in predicting the results of tests of explosive force, except for the morphological characteristics of foot length **(DUZISTOP)** with male to test long jump seats **(SKOKDALJ)**. Value sigficant is 0.03. Based on the B coefficient has a positive sign, it is concluded that with the increase of length of the foot **(DUZISTOP)** for 1 cm rezultana this test will increase by 8.44 centimeter. From the previous analysis it can be concluded that participants with higher body height can achieve better results in the applied coordination tests. It can also be concluded that the larger foot length allows better demonstration of the explosive power of the lower extremities.

TABLE 5 Influence of volume and body mass of the test scores of coordination and explosive power in subjects of both sexes

respondents	Indepentendt variable	Unstandardized coefficents		Standardized coefficents	T	Sig.	Depentent variable
		B	Std. eror	Beta			
men	konstanta	12.78	5.93		2.16	0.04	MKAVLR
	TM	-0.32	0.12	-0.87	-2.67	0.01	
	OBIMNATK	-0.26	0.33	-0.57	-0.80	0.43	
	OBIMPOTKO	0.74	0.60	0.90	1.22	0.23	
	konstanta	34.33	14.56		2.36	0.03	MAGOSS
	TM	-0.83	0.30	-0.85	-2.81	0.01	
	OBIMNATK	-1.10	0.80	-0.92	-1.38	0.18	
	OBIMPOTKO	2.49	1.48	1.15	1.69	0.11	
	konstanta	-3.50	4.45		-0.79	0.44	MREPOL
	TM	-0.22	0.09	-0.60	-2.47	0.02	
	OBIMNATK	0.61	0.24	1.35	2.51	0.02	
	OBIMPOTKO		0.45	-0.10	-0.17	0.86	
women	konstanta	16.60	8.72		1.90	0.08	MKAVLR
	TM	-0.33	0.16	-1.07	-2.11	0.06	
	OBIMNATK		0.30	0.17	0.31	0.76	
	OBIMPOTKO	0.16	0.47	0.16	0.34	0.74	
	konstanta	53.18	30.80		1.73	0.11	MAGOSS
	TM	-1.03	0.55	-0.97	-1.86	0.09	
	OBIMNATK	0.31	1.08	0.16	0.29	0.78	
	OBIMPOTKO	0.26	1.66	0.08	0.16	0.88	
	konstanta	1.62	5.47		0.30	0.77	MREPOL
	OBIMPOTKO	0.35	0.16	0.51	2.16	0.05	

The study forecasts the results of tests for the assessment of coordination, based on morphological characteristics of the mass and volume of the body in both sexes, it was observed with male morphological characteristics of body weight **(BW)**, significantly affect the results of all three tests and measures the volume of the upper leg **(OBIMNATK)** only the results of the test polygon backwards **(MREPOL)**. For female respondents only measure the volume of the lower leg **(OBIMPOTKO)** significantly affect the results of the test polygon backwards **(MREPOL)**. Because of the negative sign and the obtained results it can be concluded that participants with higher body mass can achieve better results in the execution of all the tests of coordination, too, if you have a smaller volume of thigh can achieve better results on the test polygon backwards **(MREPOL)**. Based on the values of the coefficient B of the male sex who is negative, the conclusion is that if the body weight **(BW)** increased by 1 kg, the results of the test dribble hand **(MKAVLR)** will be reduced to 0.32 seconds, the test with eight bending **(MAGGOS)** for 0.83 seconds, and the test polygon backwards **(MREPOL)** in 0.22 seconds. Regarding the morphological characteristics of thigh girth **(OBIMNATK)** if the measure is reduced by 1 cm to the test polygon backwards will decrease by 0.61 second. Regarding the morphological characteristics of the volume of the lower leg **(OBIMPOTK)** for female gender, if this measure is reduced by 1 cm to the test polygon backwards **(MREPOL)** will be reduced to 0.35 seconds.

TABLE 6 Transversal dimension influence on the results of tests of coordination and explosive power in subjects of both sexes

respondents	Indepentendt variable	Unstandardized coefficents		Standardized coefficents	T	Sig.	Depentent variable
		B	Std. eror	Beta			
men	konstanta	40.27	10.63		3.79	0.00	MKAVLR
	DIJAMZGKOLJ	-0.45	1.12	-0.12	-0.40	0.69	
	DIJAMSKZG	-3.09	3.12	-0.39	-0.99	0.33	
	SIRINASTOP	-0.51	1.75	-0.09	-0.29	0.78	
	konstanta	135.70	23.64		5.74	0.00	MAGOSS
	DIJAMZGKOLJ	0.87	2.49	0.09	0.35	0.73	
	DIJAMSKZG	-16.46	6.94	-0.78	-2.37	0.03	
	SIRINASTOP	-0.23	3.90	-0.02	-0.06	0.95	
	konstanta	-7.17	5.10		-1.41	0.17	MREPOL
	DIJAMZGKOLJ	2.23	0.57	0.62	3.94	0.00	
	konstanta	101.98	189.65		0.54	0.60	TROSKOK
	SIRINASTOP	46.72	21.15	0.40	2.21	0.04	
women	konstanta	40.22	11.13		3.61	0.00	MKAVLR
	SIRINASTOP	-3.28	1.22	-0.60	-2.69	0.02	
	konstanta	139.08	35.77		3.89	0.00	MAGOSS
	SIRINASTOP	-12.37	3.92	-0.66	-3.15	0.00	
	konstanta	-10.48	9.41		-1.11	0.29	MREPOL
	DIJAMZGKOLJ	-0.34	1.13	-0.07	-0.30	0.77	
	SIRINASTOP	2.94	0.85	0.76	3.49	0.00	

Regression analysis when examining the prediction results of tests for the assessment of coordination, based on morphological characteristics transversal dimension in both sexes, it was observed that in female subjects morphological characteristics of the foot width **(SIRINASTOP)** significantly affect the results of all three tests. With male size diameter of the ankle **(DIJAMSKZG)** affects the results of the test with eight bending **(MAGGOS)** in diameter wrist knee joint **(DIJAMZGKOLJ)** test results polygon backwards **(MREPOL)**. Based on the values of the coefficient B in female subjects with a negative sign can be concluded, if the foot width is increased by 1 cm, the results of the test dribble hand **(MAKVLR)** will be reduced to 3.28 seconds, the test with eight bending **(MAGGOS)** for 12.37 seconds in the test polygon backwards **(MREPOL)** for 2.94 seconds. Based on the values of the coefficient B of the male sex who is negative it is concluded that if the diameter of the ankle **(DIJAMSKZG)** increases by 1 cm, the results of the test with eight bending **(MAGGOS)** in 16.46 seconds. If the diameter of the knee joint **(DIJAMZGKOLJ)** reduced by 1 cm, the results of the test polygon backwards **(MREPOL)** will be reduced to 2.23 seconds. With male participants observed a statistically significant effect of morphological characteristics of the foot width **(SIRINASTOP)** the results of the test explosive power of the lower extremities, and test triple jump **(TROSKOK)**. Based on the values of the coefficient B of the male sex who has a positive sign is concluded that if the width of the foot **(SIRINASTOP)** increases by 1 cm, the results of the test triple jump **(TROSKOK)** will increase by 46.72 cm.

CONCLUSION

Based on the analysis of tests to assess the coordination and explosive power of the respondents in relation to morphological characteristics, led to the following conclusions. Measure longitudinal dimensionality of the skeleton in subjects of both sexes showed significant correlation with the test results to assess coordination , and with male and tests of explosive force. It was concluded that the respondents for

greater physical height or greater lengths of the lower limbs can achieve better results on tests of dribbling hand and eight with bending. It was also concluded that male respondents with higher length of the foot can better express the explosive strength of the lower extremities. Morphological characteristics of the mass and volume of the body showed a negative relationship with the results of coordination tests, and the results of tests of explosive strength showed no significant association. The results showed that participants with higher body mass and larger volumes of lower limbs can achieve better results in the coordination of the upper and lower extremities as well as the coordination of the whole body. A negative relationship was observed with the transverse correlation of morphological features with the results of the coordination tests and found that respondents with larger diameters of the knee joint, ankle and foot, faster execution of complex acts of coordination of the lower limbs or whole body. Regression analysis showed that of all the measures of longitudinal dimension only on the basis of height can be predicted scores on tests of coordination. You only based measure foot length it is possible to predict the results of tests of explosive strength. Body weight is the only measure of volume and weight of the body on which we can predict the results of tests of coordination. Test results can coordinate all of the measures transversal dimension, only predicted from the width of the foot in female subjects, based on the diameters of the knee joint and the ankle joint in the male subjects. Explosive power and test scores for the assessment of motor skills in male subjects can only predict based on foot width measure.

The most important application of the results of this survey is to be used for the selection of sports where the dominant coordination as fine motor skills. The results of this study showed that the longitudinal dimension associated significantly with the results of tests of coordination. However, as is well known longitudinal dimension has a greater coefficient of 0.98 inborn, so the training process can not affect its improvement. As further alleged, that the selection should be given to this morphological feature. During the selection should also take into account the morphological characteristics of mass and volume of the body, where it is also shown a significant effect on coordination. The reason lies in the fact that the morphological features and this with great inborn coefficient of 0.90. Significance of this is that it is shown that longitudinal and transversal dimension play an important role in the manifestation of the explosive power of the lower extremities. These results can find application in sports where you need to develop and possess good explosive power of the lower extremities.

POVEZANOST I UTICAJ MORFOLOŠKIH KARAKTERISTIKA NA KOORDINACIJU I EKSPLOZIVNU SNAGU UČENIKA UZRASTA 12 GODINA

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SAŽETAK

Uvod: Bazične motoričke sposobnosti koje su istraživane u ovom radu su koordinacija i eksplozivna snaga učenika uzrasta 12 godina. Prostor morfologije analiziran je longitudinalnim, transverzalnim dimenzionalnostima i prostorom voluminoznosti i mase tijela. Problem istraživanja je povezanost i uticaj morfoloških karakteristika na koordinaciju i eksplozivnu snagu učenika uzrasta 12 godina.

Metode: Istraživanje je provedeno na uzorku od 42 djece uzrasta od 12 godina i to 27 ispitanika muškog pola i 15 ispitanika ženskog pola. Kriterijske varijable: longitudinalna dimenzionalnost, masa i voluminoznost, transverzalna dimenzionalnost, a prediktorske varijable: vodjenje lopte rukom, osmica sa saginjanjem, poligon natraske, skok u dalj iz mjesta,troskok iz mjesta i bacanje medicinke. (Metikoš i saradnici, 1989.). Rezultati su obrađeni postupcima deskriptivne i komparativne statistike.

Rezultati: Korelaciona analiza je pokazala da mjere longitudinalne dimenzionalnosti skeleta kod ispitanika oba pola imaju značajnu povezanost sa rezultatima testova za procjenu koordinacije. Primjećen je negativan odnos rezultata testova za procjenu koordinacije sa mjerama voluminoznosti i mase tijela kod ispitanika oba pola. Negativan odnos je primjećen i kod povezanosti transverzalnih morfoloških karakteristika sa rezultatima testova koordinacije. Regresiona analiza prilikom analize longitudinalnih dimenzionalnosti skeleta utvrdila je da je na osnovu tjelesne visine moguće statistički značajno predvidjeti rezultate testa vođenje lopte rukom kod ispitanika oba pola, i testova osmica sa saginjanjem i poligon natraške kod ispitanika ženskog pola. Tjelesna masa iz grupe morfoloških karaktreristika mase i voluminoznosti tijela statsitički značajno može predvidjeti rezultate testova vođenje lopte rukom, osmica sa saginjanjem i poligon natraške kod ispitanika muškog pola. Analizom transverzalne dimenzionalnosti skeleta zaključilo se da se na osnovu mjere širina stopala statistički značajno predviđaju rezultati na testovima vođenje lopte rukom, osmica sa saginjanjem i poligon natraške kod ispitanika ženskog pola. Međutim, kod ispitanika muškog dijametar skočnog zgloba predviđa rezultate testa osmica sa saginjanjem.

Zaključak: Najvažnija primjena dobijenih rezultata ovog istraživanja je da se mogu iskoristiti prilikom selekcije za sportove gdje je dominantna koordinacija kao motorička sposobnost. Rezultati ovog istraživanja su pokazali da longitudinalna dimenzionalnost ima značajnu povezanost sa rezultatima testova koordinacije. Što dalje navodi, da se prilikom selekcije mora obratiti pažnja na ovu morfološku karakteristiku. Prilikom selekcije takođe treba voditi računa i o morfološkoj karakteristici mase i voluminoznosti tijela, gdje je takođe pokazan znatan uticaj na koordinaciju. Značaj ovog istraživanja je i u tome što se pokazalo da longitudinalna i transverzalna dimenzionalnost imaju značajnu ulogu u ispoljavanju eksplozivne snage donjih ekstremiteta.

Ključne reči: morfološke karakteristike, koordinacija, eksplozivna snaga

ASSESSMENT OF BASIC MOTOR ABILITIES OF BALANCE, COORDINATION OND FLEXIBILITY OF CHILDREN 6 YEARS OLD

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UDC 796.012_1-053.2

SUMMARY

Introduction: Basic motor skills that were investigated in this work are the balance, coordination and flexibility of children 6 years old. The research problem is to evaluate basic motor skills of balance, coordination and flexibility of children 6 years old.

Methods: The research was conducted on a sample of 165 children aged 6 years and 80 male and 85 female examinees. Criterion variable was sex, while predictor variables: standing on one foot transversely to the bench for balance with eyes open, standing on one foot longitudinal on the bench for balance with eyes open, standing on one foot transversely to the bench for balance with eyes closed,backwars training on polygon, bending down to eight, leading the ball with hand, deep bias on the bench, distortion with stick, leg-lift lying sideways test. (Metikoš i saradnici, 1989). Results were analyzed using descriptive, comparative and non-parametric statistics.

Results: Results of comparative statistical procedure analyzed with Kruskal-Wallis H test showed that examinees in relation to gender, are not showing difference in tests of standing on one foot transversely on the bench for balance with eyes open, standing on one foot longitudnal on the bench for balance with eyes open, standing on one foot transversely on the bench for the balance with eyes closed. Based on results of comparative statistical procedure analyzed by t-test at the 0.05 level, one can see that examinees depending on gender difference, are showing diversity in one of three coordination tests applied. T-test at the 0.05 level, showed that subjects with respect to gender are different in one of the three flexibility tests applied.

Conclusion: Male examinees showed less average values on results of tests like standing on one foot transversely to the bench for balance with eyes open and standing on one foot transversely to the bench for balance with eyes closed; while the female examinees showed lower values in results of the test stand one foot longitudinal on the bench for balance with open eyes. Male examinees achieved better results on all assessment coordination tests. Female subjects showed higher scores on the other two tests for aselasticity assessment. Based on all analysis, general conclusion is that examinees according to gender showed statisticaly significant differences in tests who analyzed coordination of upper extremities and elasticity of pelvic zone. While on tests for balance assessment with open and closed eyes, the whole body coordination and speed of movement and flexibility of upper extremities didn't show any difference.

Key Words: balance, coordination, flexibility

INTRODUCTION, PROBLEM AND SUBJECT OF WORK

Basic motor skills that were investigated in this work are the balance, coordination and flexibility of children aged 6 years. The reason these studies a just basic motor skill is that, as they represent the space motor which is the least explored. The balance is the most controversial factor motor that meets in the literature. "It represents the ability to maintain the body in a balanced position. It is the ability to timely correction of the position which, by the action of

gravity or other interfering factors, threatened violation of a balanced position" (Stanković, 2007. pg. 185). Investigations of motor skills to deal with a lot of authors. Among the others, Bass (1939.) highlights the possibility of two functional structures that are engaged depending on whether the eyes are open or closed. Fisher (1954.) determined that the tests with eyes open just as reliable as tests with eyes closed. Sturm (1970.) isolated the general equilibrium factor in a child of 8 years, and a girl of 8 years with balanced eyes closed. Using the results of previous research, this study analyzed the balance of open and closed eyes. Coordination as a basic motor skill, yet greatly attracted the attention of specialists. The reason is that the results of this research capability do not provide sufficient information on which could be considered a well-studied. For the study of these abilities are not enough, responsible enough knowledge of the functioning of processes in the brain, where even experts in the field of neurology have no definitive answers. In defining the mechanisms that govern the coordination of the CNS is responsible "for structuring mechanism of movement is defined as a control and integration system allowing the rapid formation of efficient motor programs and their controlled in response to the information coming in through the large number of channels" (Nićin, 2000. pg. 167.). Based on the above coordinates can be defined as "purposeful and controlled energy, the temporal and spatial organization of the movement into a whole" (Gajić 1985, cited in Nićin, 2000, pg. 167.). Research co-ordination which were used in this study were related to the research Huhlaeve (1976.) which states that under agility means the ability of a man to quickly master new movements and to changes in accordance with the needs of the situation suddenly changed. Matveev and Novikov (1976.) emphasize the agility mainly depends on the activity of analyzers, especially the motor.

Stambulova (1978.) upon years of research into psychological cognitive processes concluded that the visual perception and motor skills with each other are strongly correlated. Flexibility is the third basic motor skill, which is analyzed in this paper. Based on previous research, flexibility can be defined as “basic motor skill that are easy to generate large amplitude motion" (Nićin, 2000, pg. 182). Synergistic automaticity and control muscle tone are responsible for a demonstration of the flexibility mechanisms. This motor skill is essential in many sports, but in some sports is leading motor ability. "It is the ability to conduct joint system maximum range of motion, is to move out as high as possible (maximum) amplitude. Since muscle fibers are stretched it is, in fact, the ability of the muscle to achieve an optimal length that will enable the necessary range of motion to express the possibility of its strength, but also ligaments and joints" (Bijelić and Simović, 2005, pg. 107).

Test battery consisted of three tests for each of the three motor skills. The balance is analyzed tests that were performed open and closed eyes, coordination is analyzed as a coordination body parts and the body as a whole, flexibility is tested in the upper and lower extremities. The research problem is to assess the basic motor skills of balance, coordination and flexibility of children aged 6 years. It is focused on balance, coordination and flexibility as the primary motor skills. With regard to the issue of the treated, the aim was to investigate the differences in the results achieved for the assessment of balance, coordination and flexibility in children aged 6 years in relation to sex.

METHODS

This paper uses the method of theoretical analysis which provides the theoretical framework and the interpretation of the results of balance, coordination and flexibility of children aged 6 years. It was used also descriptive and causal methods are aimed to describe and explain the relationship between the obtained results and their inter-relationships.

The sample

The study was conducted on a sample of 165 children aged 6 years + / - 6 months, and 80 male and 85 female subjects.

The sample of variables

The variables in this study were divided into predictor and criterion:

Criterion variable:

- sex (POL)

Predictor variables:

- standing on one foot transversely to the bench for balance with eyes open (SPOOC)
- standing on one leg on the bench for longitudinal balance with eyes open (SUOOC)
- standing on one foot transversely to the bench for balance with eyes closed (SPZOC)
- ground-backward (MREPOL)
- Eight with bending (MAGOSS)
- keeping hand balls (MKAVLR)
- deep forward bend on the bench (DUPRETKL)
- flex rod (ISKRPALI)
- leg-lift lying sideways (ODLEZBOC), (Metikoš et al, 1989.).

Methods of data processing

In order to formulate valid conclusions, it is calculated as follows:

• Basic statistical parameters:

- mean,
- variation width,
- standard deviation,
- variance,
- measures of skewness and kurtosis of asymmetry,
- Kolmogorov-Smirnov test.

• Comparative statistics:

- test mean differences large independent samples (t-test).

• Non-parametric statistics:

- test mean differences large independent samples (Kruskal-Wallis H test)

Statistical analysis was performed on a PC Pentium IV, and used the statistical program SPSS (version 11.0).

RESULTS

TABLE 1 Descriptive statistics of the results of a battery of tests to assess balance in subjects of both sexes

male	N	Rang	Min	Max	M	S. D.	Variance	Skewness	Kurtosis	KS test
SPOOC	80	90,47	0,36	90,83	14,96	22,62	511,44	1,81	2,56	0,00
SUOOC	80	14,55	0,80	15,35	3,13	3,09	9,54	2,45	5,70	0,00
SPZOC	80	13,38	0,47	13,85	3,07	2,88	8,30	2,19	4,71	0,00
female	N	Rang	Min	Max	M	S. D.	Variance	Skewness	Kurtosis	KS test
SPOOC	85	89,37	0,87	90,24	16,58	24,13	582,08	1,63	1,78	0,00
SUOOC	85	14,57	0,77	15,34	3,00	3,19	10,20	2,49	5,80	0,00
SPZOC	85	11,80	0,37	12,17	3,32	2,83	8,00	1,61	1,74	0,00

Table 1 display results of the descriptive statistics results battery of tests to assess the balance of both sexes. Before the analysis of the results was tested normality of distribution of all the results from Komogorov-Smirnov test (KS test). By the results of a battery of tests to assess the balance of values of KS test showed that in all tests there is no normality distribution. When analyzing the difference between the maximum and minimum results and the rank values in subjects of both sexes, the results of the test stand on one foot transversely to the bench for balance with eyes open (SPOOC) showed the highest dispersion, while the results of the test stand on one foot transversely to bench for balance with eyes closed (SPZOC), the lowest observed scattering results.

Male respondents showed lower average values, and thus perform poorly on tests of standing on one foot transversely to the bench for balance with eyes open (SPOOC) and standing on one foot transversely

to the bench for balance with eyes closed (SPZOC), while the female respondents achieved lower average values and perform poorly on a test stand on one foot lengthwise on the bench for balance with eyes open (SUOOC). Skewness measures asymmetry (incidence curves) shows all the results in both sexes a positive value, which means that the distribution of predominantly positive direction, the curve tends towards greater results. It can also be concluded that these tests were relatively easy for children of both sexes. Kurtosis measures the asymmetry (round of curve) also shows a positive value, which is a deviation of results according leptokurtic curve, where the curve is convex and expressed greater clustering of results about the mean.

TABLE 1a The difference between the subjects in results battery of tests to assess balance in relation to the gender of respondents

pol	SPOOC	SUOOC	SPZOC
Chi-Square	1,39	0,60	0,59
Df	1	1	1
Asymp. Sig.	0,24	0,44	0,44

Table 1a presents the results of a comparative statistical procedure analyzed the Kruskal -Wallis H test. Based on the values of significance at the 0.05 level, one can see that the respondents with respect to gender do not differ in these tests. The lack of statistically significant differences between the results of these tests in subjects of both sexes can be justified on the basis of the sensitive period for the development of balance. Gužalovski (1984.) according to a critical phase in the sensitive period for the balance of the same among both sexes. That is, the maximum rate of progress the development of balance in both sexes occurs at the same time.

TABLE 2 Descriptive statistics of the results of a battery of tests to assess the coordination among the respondents of both sexes

Male	N	Rang	Min	Max	M	S. D.	Variance	Skewness	Kurtosis	KS test
MREPOL	80	40,90	12,50	53,40	26,24	9,59	92,06	0,92	0,31	0,14
MAGOSS	80	40,95	18,35	59,30	32,24	9,73	94,75	1,18	0,87	0,05
MKAVLR	80	34,22	12,00	46,22	22,98	7,76	60,14	0,88	0,91	0,47
female	N	Rang	Min	Max	M	S. D.	Variance	Skewness	Kurtosis	KS test
MREPOL	85	44,71	14,30	59,01	28,07	8,89	78,98	0,81	0,68	0,49
MAGOSS	85	37,31	22,45	59,76	33,97	9,14	83,57	1,25	1,20	0,05
MKAVLR	85	41,03	13,27	54,30	26,91	7,49	56,14	0,79	1,97	0,48

Table 2 displays the results of the descriptive statistics results battery of tests to assess the coordination of both sexes. Before the analysis of the results was tested normality of distribution of all the results from Komogorov-Smirnov test (KS test). By the results of a battery of tests to assess the value of coordination KS test showed that in all tests the normality of a distribution in subjects of both sexes. When analyzing the difference between the maximum and minimum results and the rank values in subjects of both sexes, the results of the test polygon backwards (MREPOL) showed the highest value, while the results of the test with eight bending (MAGOSS) observed the lowest value in both sexes. Male respondents showed lower average values, and therefore better results on all tests compared to those women. Skewness measures asymmetry (incidence curves) shows the results of all positive

value, which means that the distribution of predominantly positive direction, the curve tends towards greater results. It can also be concluded that these tests were relatively easy for children of both sexes. Kurtosis measures the asymmetry (round of curve) also shows positive values in all the results, which is a deviation of results according leptokurtic curve, where the curve is convex and expressed greater clustering of results about the mean.

TABLE 2a The difference in results between the subjects a battery of tests to assess coordination in relation to the gender of respondents

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig.	Mean Differ.	Std. Error Differ.	95% Confidence Interval of the Differ.	
								Lower	Upper
MREPOL	0,38	0,54	-1,27	163,00	0,20	-1,83	1,44	-4,67	1,01
			-1,27	159,98	0,21	-1,83	1,44	-4,68	1,02
MAGOSS	0,62	0,43	-1,18	163,00	0,24	-1,73	1,47	-4,64	1,17
			-1,18	160,55	0,24	-1,73	1,47	-4,64	1,17
MKAVLR	0,54	0,46	-3,31	163,00	0,00	-3,93	1,19	-6,28	-1,59
			-3,31	161,53	0,00	-3,93	1,19	-6,28	-1,59

Table 2a presents the results of a comparative statistical procedure analyzed t-test. Based on the values of significance at the 0.05 level, one can see that the respondents with respect to gender differ in one of the three applied dough. The difference is only in the test dribble hand (MKAVLR). Cvetković, Popović and Jaksić (2007) suggest that the dominance of boys in the coordination of the body, can be explained by their interest in certain activities. The boys in the free play and outside activities preschool exercise more varied and intensive forms of movement such as jumping, crawling, climbing, hours in the harness, lifting, carrying, running and so on. Logically, the exercise of these activities contribute to the greater development of those skills in these activities (games) engaged, and that's just coordination.

TABLE 3 Descriptive statistics of the results of a battery of tests to assess the flexibility of both sexes

Male	N	Rang	Min	Max	M	S. D.	Variance	Skewness	Kurtosis	KS test
DUPRETKL	80	63	0	63	28,19	15,53	241,15	-0,47	-0,50	0.06
ISKRPALI	80	70	30	100	61,73	14,44	208,46	0,27	0,05	0.98
ODLEZBOC	80	72	48	120	87,63	16,82	282,79	0,03	-0,76	0.30
Female	N	Rang	Min	Max	M	S. D.	Variance	Skewness	Kurtosis	KS test
DUPRETKL	85	65	0	65	27,36	15,90	252,86	-0,35	-0,69	0.06
ISKRPALI	85	68	36	104	61,79	13,89	192,99	0,67	0,29	0.25
ODLEZBOC	85	110	50	160	94,46	21,12	445,85	0,21	-0,05	0.60

Table 3 displays the results of the descriptive statistics results battery of tests to assess the flexibility of both sexes. Before the analysis of the results was tested normality of distribution of all the results from Komogorov-Smirnov test (KS test). By the results of a battery of tests to assess the

flexibility of both sexes, the values of KS test showed that there is a normality distribution. When analyzing the difference between the maximum and minimum results and the rank values in subjects of both sexes, the test results leg-lift lying sideways (ODLEZBOC) showed the highest dispersion, while the results of the test deep forward bend on the bench (DUPRETKL) observed the lowest dispersion results. The means of the results of tests to assess the resilience of the male subjects showed higher values only in the test deep forward bend (DUPRETKL), which means that the respondents are males better results on this test to assess the flexibility compared to those women. The same results where respondents are males were better in assessing the flexibility applying this test; we had the Rodić (2010.). Bala (2004.) points out in his research that the variable for assessing flexibility (DUPRETKL) has a smaller contribution to the discrimination between boys and girls but to point to significantly improved flexibility in girls. This confirms some earlier findings about the behavior of these features, or capacity, as it is suspected that the flexibility of motor ability or morphological-anatomical characteristics of the children. To certain conclusions regarding the test deep forward bend test (DUPRETKL), came and Gajević et al (2010.), where are based on the results found that there were statistically significant differences in performance between boys and girls aged: 8, 11, 12, 13 and 14 years, in favor of girls. The means of the results of two other tests (flex rod (ISKRPALI) and leg-lift lying sideways (ODLEZBOC) were higher in female subjects, which means that the female respondents have achieved better results in these tests to assess flexibility compared to those men. Skewness measures asymmetry (incidence curves) shows a positive and a negative value. A negative value was observed in the test deep forward bend on the bench (DUPRETKL) for children of both sexes, meaning that the distribution of predominantly negative direction, the curve tends to lower results. Based on this we can conclude that this test was relatively difficult for children of both sexes. Kurtosis measures the asymmetry (rounded curve) shows the positive and negative values. A negative value is observed when testing deep forward bend on the bench (DUPRETKL) and leg-lift lying sideways test (ODLEZBOC) for children of both sexes, which is a deviation of results according platikurtic curve, where the curve flattened and express greater dispersion of results. For flex test rod (ISKRPALI) value is positive and shows more clustering results about the mean.

TABLE 3a The difference in results between the subjects a battery of tests to assess flexibility in relation to the gender of respondents

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig.	Mean Differ.	Std. Error Differ.	95% Confidence Interval of the Differ.	
								Lower	Upper
DUPRETKL	0,43	0,51	0,34	163,00	0,73	0,83	2,45	-4,00	5,67
			0,34	162,77	0,73	0,83	2,45	-4,00	5,66
ISKRPALI	0,01	0,94	-0,03	163,00	0,98	-0,07	2,21	-4,42	4,29
			-0,03	161,40	0,98	-0,07	2,21	-4,43	4,30
ODLEZBOC	3,98	0,05	-2,29	163,00	0,02	-6,83	2,98	-12,72	-0,94
			-2,31	158,72	0,02	-6,83	2,96	-12,69	-0,98

Table 3a presents the results of a comparative statistical procedure analyzed t-test. Based on the values of significance at the 0.05 level, one can see that the respondents with respect to gender differ in

one of the three applied dough flexibility. The difference is only in the test leg-lift lying sideways test (ODLEZBOC). The difference can be justified by specifying Cvetković, Popović and Jakšić (2007), who concluded that unlike boys, most girls are more interested in the quieter games, games that require less dynamic, precise movements, a higher concentration of attention, a greater range of motion, leading to the development of flexibility.

CONCLUSION

Based on the analysis a battery of tests to evaluate balance, coordination and flexibility of the respondents with respect to gender, this led to the following conclusions. Male respondents showed lower mean values of the results of tests standing on one foot transversely to the bench for balance with eyes open (SPOOC) and standing on one foot transversely to the bench for balance with eyes closed (SPZOC), while female respondents showed less value of the results of the test stand on one foot lengthwise on the bench for balance with eyes open (SUOOC). However, statistical analysis, no significant differences in all tests compared males and females. The reason for the lack of differences justify the sensitive periods of development of balance.

Male respondents have achieved better results on all tests for the assessment of coordination. However, when they analyzed the difference of means test results in relation to the sex of the respondents, it was noted that significant differences exist in the tests that analyze the coordination of the upper extremities. There is no statistically significant difference in test results were analyzed whole body coordination and speed of movement. Male respondents have achieved better results only in the test deep forward bend (DUPRETKL) that is used to assess flexibility. The female subjects showed higher scores on the other two tests to assess flexibility. However, statistical analysis showed significant differences only in the test leg-lift lying sideways test (ODLEZBOC) than half of the respondents. The reason for the difference is justified by the fact that as opposed to boys, most girls are more interested in the quieter games, games that require less dynamic, precise movements, a higher concentration of attention, a greater range of motion, leading to the development of flexibility.

On the basis of analysis can be performed by a general conclusion that the respondents with respect to gender showed statistically significant differences in tests that analyzed the coordination of upper extremities and pelvic girdle flexibility. While the tests to assess the balance of open and closed eyes, the whole body coordination and speed of movement and flexibility of upper extremities showed no difference. Based on this it can be concluded that half of respondents represent the difference between the respondents in most of the tests in the battery of tests that have been applied in this study.

REFERENCES

Bala, G. (2004). Kvantitativne razlike osnovnih antropometrijskih karakteristika i motoričkih sposobnosti dečaka i devojčica u predškolskom uzrastu [Orginalni naučni rad]. Preuzeto 25.maja 2012. sa http://www.kinesis.co.rs/pdf/radovi_metodologija/kvantitativne_razlike.pdf

Cvetković, M., Popović, B. i Jakšić, D. (2007). Razlike u motoričkim sposobnostima predškolske dece u odnosu na pol [Orginalni naučni rad]. Preuzeto 25. maja 2012. sa http://www.masteri.ucoz.com/Radovi/CvetkovicPopovicJaksic2007.pdf

Gajević, A., Lalić, N., Bošković, L., Bićanin, P. i Atanasov D. (2010). Dinamika morfološkog i motoričkog razvoja učenika osnovnoškolskog uzrasta u Republici Srbiji [Orginalni naučni rad]. Preuzeto 25. maja 2012. sa http://www.ffvis.rs.ba/media/publikacije/radovi/2010/10/04/ACO_GAJEVIC_I_SAR..pdf

Horvatinović, S. (2008). Motoričke sposobnosti dojenčadi i djece u ranom djetinjstvu [Stručni radovi izvan teme]. Preuzeto 28. oktobra 2011. sa http://www.hrks.hr/skole/17_ljetna_skola/496-500.pdf

Jertec, N. (2011).Razlike u sposobnosti ravnoteže s obzirom na spol kod djece predškolske dobi [Znanstveni rad unutar teme]. Preuzeto 28. maja 2012. sa http://www.hrks.hr/skole/20_ljetna_skola/124-128-Jertec.pdf

Metikoš, D. i saradnici (1989): Mjerenje bazičnih motoričkih dimenizja sportaša, Zagreb

Nićin, Đ. (2000): Antropomotorika, Novi Sad (str. 167, 182)

Rodić, N. (2010). Uticaj „sportske igraonice" na motoričke sposobnosti dece predškolskog doba [Orginalni naučni rad]. Preuzeto 25. maja 2012. sa www.pef.uns.ac.rs/index.php?

Stanković, V. (2007): *Osnove primjenjene kineziologije,* Leposavić, (str. 185.)

PROCJENA BAZIČNIH MOTORIČKIH SPOSOBNOSTI RAVNOTEŽE, KOORDINACIJE I GIPKOSTI DJECE UZRASTA 6 GODINA

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SAŽETAK

Uvod: Bazične motoričke sposobnosti koje su istraživane u ovom radu su ravnoteža, koordinacija i gipkost djece uzrasta 6 godina. Problem istraživanja je procjena bazičnih motoričkih sposobnosti ravnoteže, koordinacije i gipkosti djece uzrasta 6 godina.

Metode: Istraživanje je sprovedeno na uzorku od 165 djece uzrasta od 6 godina i to 80 ispitanika muškog pola i 85 ispitanika ženskog pola. Kriterijska varijabla je bila pol, dok su prediktorske varijable: stajanje na jednoj nozi poprečno na klupici za ravnotežu s otvorenim očima, stajanje na jednoj nozi uzdužno na klupici za ravnotežu s otvorenim očima, stajanje na jednoj nozi poprečno na klupici za ravnotežu s zatvorenim očima, poligon natraške, osmica sa saginjanjem, vodjenje lopte rukom, duboki pretklon na klupi, iskret palicom, odnoženje ležeći bočno. (Metikoš i saradnici, 1989.). Rezultati su obrađeni postupcima deskriptivne, komparativne i neparametrijske statistike.

Rezultati: Rezultati komparativne statističke procedure analizirane Kruskal-Wallis H testom je pokazala da se ispitanici u odnosu na pol ne razlikuju u testovima stajanje na jednoj nozi poprečno na klupici za ravnotežu s otvorenim očima, stajanje na jednoj nozi uzdužno na klupici za ravnotežu s otvorenim očima, stajanje na jednoj nozi poprečno na klupici za ravnotežu s zatvorenim očima. Na osnovu rezultata komparativne statističke procedure analizirane T-testom, na nivou 0.05, može se vidjeti da se ispitanici u odnosu na pol razlikuju u jednom od tri primjenjena testa koordinacije. T-test na nivou 0.05, je pokazao da se ispitanici u odnosu na pol razlikuju u jednom od tri primjenjena testa gipkosti.

Zaključak: Ispitanici muškog pola su pokazali manje srednje vrijednosti rezultata kod testova stajanje na jednoj nozi poprečno na klupici za ravnotežu s otvorenim očima i stajanje na jednoj nozi poprečno na klupici za ravnotežu s zatvorenim očima, dok su ispitanici ženskog pola pokazali manje vrijednosti rezultata kod testa stajanje na jednoj nozi uzdužno na klupici za ravnotežu s otvorenim očima. Ispitanici muškog pola su postigli bolje rezultate na svim testovima za procjenu koordinacije. Ispitanici ženskog pola su pokazali bolje rezultate na druga dva testa za procjenu gipkosti. Na osnovu svih analiza može se izvesti jedan generalni zaključak da su ispitanici u odnosu na pol pokazali statistički značajne razlike u testovima koji su analizirali koordinaciju gornjih ekstremiteta i gipkost karličnog pojasa. Dok na testovima za procjenu ravnoteže otvorenim i zatvorenim očima, koordinacije cijelog tijela i brzine kretanja i gipkosti gornjih ekstremiteta, nisu pokazali razliku.

Ključne reči: ravnoteža, koordinacija, gipkost

Exercise and Health

THE FIT-BALL BALANCE TRAINING IN CHILDREN WITH BAD POSTURE

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UDC 613.73:615.825

SUMMARY

Introduction. The postural system is based on the senses of self-movement and balance. Balance is an essential component of any sport and an active lifestyle. If the child is unable to maintain his/her balance for about ten seconds, exercises to strengthen the sense of balance are recommended. Gymnastic Large Balls are air-filled balls used for fun, safe and effective exercise, improving strength, flexibility and balance. Using Fit-balls, the bad posture, poor body mechanics and inflexibility can be replaced with proper conditioning and balancing of trunk musculature.

THE AIM of this article is to study the development change of balance in pupils with bad posture after practicing of Fit-ball exercises in physical education lessons.

Methodology of the study. The Fit-ball training program was evaluated in a primary school in Sofia in 47 children with bad posture, poor body mechanics and inflexibility. The program included special exercises for balance, coordination and competitive games. The four balance tests were applied on two groups in the beginning and in the end of the study.

Results. The results show that using fit-ball exercises develop balance with bad posture children in primary school.

Conclusion. The teachers can incorporate games and activities that involve body changes in space. These promote the maturation of the senses of balance and self-movement, which are very important for motor development of EACH child.

Key words: postural system, development, Gymnastic Large Balls

INTRODUCTION.

The postural system is based on the senses of self-movement and balance. Balance is the ability to shift our weight and remain upright. Balance is a generic term describing the dynamics of body posture to prevent falling.

Balance is an essential component of any sport or active lifestyle. It is very important in a child's motor development. There are four possible causes for having poor balance: weak core muscles, bad posture, reduced leg strength, and inner ear problems. Balance is often ignored as a key cause of musculoskeletal dysfunction (Liebenson,C., 2005). Muscle imbalance in children usually begins in the upper part of the body, perhaps because the child's large and heavy head is supported by comparatively weak neck muscles and also because the center of gravity of the child's head is located forward (Janda 1987). The bad posture in children can result in problems with balance, coordination and upper body strength. If the child is unable to maintain his/her balance for about ten seconds, exercises to strengthen the sense of balance are recommended.

Gymnastic Large Balls are air-filled balls used for fun, safe and effective exercise, improving strength, flexibility and balance. Using Large balls, the bad posture, poor body mechanics and inflexibility can be replaced with proper conditioning and balancing of trunk musculature (Gencheva, N,.2003). Active sitting also improves balance because as a dynamic

base, the body drifts when it is relaxed. The large balls offer an opportunity for children to test and practice balancing on a safe, non threatening piece of equipment. (Spalding A. et all 1999).

Swiss Balls can be used to screen and evaluate balance problems when the children sit or do exercises. In addition, it is a valuable tool in working on postural control and strength (Carrier B. 1997).

The aim of this article is to study the developmental change of balance in pupils with bad posture after practicing Fit-ball exercises in physical education lessons.

METHODS

At the beginning of the 2013 school year, we examined 268 primary school children in Sofia. We conducted a diagnostic review for bad posture and balance. The Fit-ball training program was evaluated on 47 children (27 girls and 20 boys) ages 8-19 with bad posture, poor body mechanics and inflexibility. Only 5 boys and 2 girls are active athletes.

TABLE 1 Characteristics of the study participants

Sex / Number	boys		girls	
	3 class	4 class	3 class	4 class
Total	11	9	11	16
Active athletes	2	3	1	1

Assessment. Balance assessment can be performed in a reliable, valid way without any special equipment. For the main types of balance (static postural control, dynamic- anticipatory, and reactionary- postural control) there are numerous clinical tests to assess performance. All participants were evaluated in 4 balance tests before and after the kinesitherapy interventional program.

I test – One Leg Standing Balance with the eyes open is a simple test for measuring static aspects of balance that can be used in a variety of settings and requires minimal equipment or training.

Testing procedure:

Eligible subjects were asked to stand barefoot on the leg of their choice, with the other leg raised at a 45 degree angle and not touching the ankle of their stance leg. Each subject was asked to focus on a spot on the wall at eye level in front of him for the duration of the eyes open test. Prior to raising the limb, the subject was instructed to cross his arms over the chest. The investigator used a stopwatch to measure the amount of time the subject was able to stand on one leg. Time commenced when the subject raised their foot off the floor. Time ended when the subject either: (1) used his arms (ie, uncrossed arms), (2) used the raised foot (moved it toward or away from the standing leg or touched the floor), (3) moved the weight-bearing foot to maintain his balance (ie. rotated the foot on the ground). The procedure was repeated 3 times and the best result of the 3 trials was recorded.

II test – One Leg Standing Balance with the eyes closed.

Testing procedure:

This procedure was the same as the I test, but we asked the child to close both eyes. Subjects performed 3 trials with the eyes closed.

III test – Sitting on the large ball with legs raised is a specific test for measuring dynamic postural control.

Testing procedure:

Children sit on the large (55 or 65 cm.) ball correctly. Notice that a 90 degree angle at the knee provides the optimal leg position for good posture while sitting. Both arms were raised horizontally to the sides of the body and held. Time commenced when the subject raised their legs off of the ground. Time ended when the subject put one or both feet back on the ground. The procedure was repeated 3 times and the best result of the 3 trials was recorded.

In international literature there are norms for One Leg Standing Balance for ages from 20 to 80 but we couldn't find data for children. One study Condon C, Cremin K. 2013 confirms the improvement in balance performance as children age especially after the 7 to 8th year. A t 7 to 10 years of age, children are able to resolve a sensory conflict (mis-matched information coming from somatosensory and visual receptors) and appropriately utilize the vestibular system as a reference. (Sarah L Westcott, Linda Pax Lowes and Pamela K Richardson 1997). In children, static balance testing may be used as a measure of motor control development.

However, do children with bad posture and scoliosis have worse results on a test of static and dynamic balance than children with normal posture?

Children in the experiment were selected after a screening of the presence of spinal deformities and poor posture. 36 of the children in the survey had poor posture. 4 of them (2 girls and 2 boys) had scoliosis – Grade 1; 3 had kyphosis (2 girls and a boy) and 1 lordosis (1 girl) Table. 2

TABLE 2 Distribution of respondents according to the type of the spinal deformities in the beginning of the study

	Bad posture	Scoliosis	Kiphosis	Lordosis
Girls	20	2	2	1
Boys	16	2	1	0
Total	36	4	3	1

KINESITHERAPY

The Swiss ball activity is unlimited and offer children the opportunity to explore and practice movements that are appropriate and challenging for their own developmental stages. Physical exercises on the balls integrate three different sensory systems; visual, vestibular and tactile (kinesthetic and proprioseptive). Integrating these three systems facilitates optimal balance. The child develops good balance through doing activities against gravity that mobilize the automatic balancing reaction and improve spinal stability. The exercises on the ball are in different positions – sitting, prone, supine etc. The main part of the lesson is saturated with exercises for the abdominal, seat and dorsal seat of muscles, with balance and co –ordination exercises, exercises by pairs etc.

Activity sitting on the ball develops core control and postural control. Activity lying prone on the ball develops the automatic balance reaction and increase spinal strength and stability. Exercises while lying supine on the ball develop the stomach muscles and glutei. The Swiss Ball is an excellent piece of equipment for helping children develops muscular strength. At the end of the lessons we included competitive games. Games help children learn to interact while developing physical skills. They are practice, but they are fun. The balls games increase communication between pupils. Games with large ball can be one of the most effective types of coordination exercise. The games have included rolling the ball under the legs, passing the ball above the head, slalom between stands and running with ball by pairs with coverage of definite distances

RESULTS

For the statistical treatment of the results SPSS was used. We used T-test. The level of significance adopted for all the statistical analyses was $p<0.05$. Figures 1 and 2 represent the differences between the values at the beginning and at the end of the test of equilibrium stability with girls and boys. The graphs show that there is a statistically significant difference between the results of all 4 of the tests.

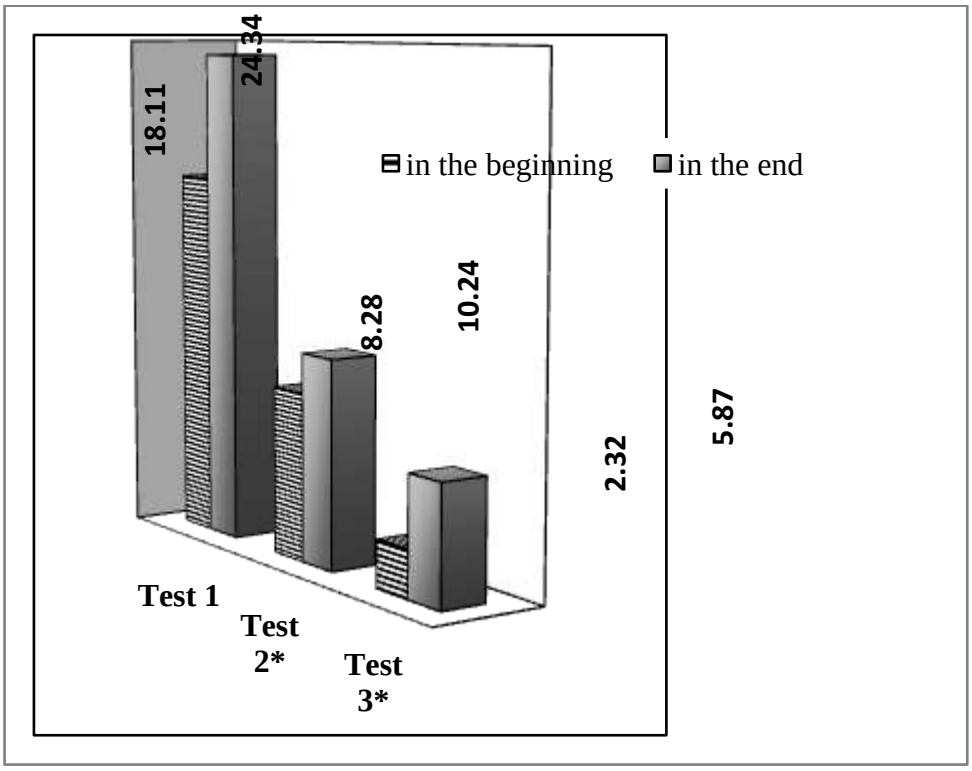
The figures show that there are improvements in the absolute values in three of the tests, especially the girls group in the third test which measured the dynamic balance sitting on a big therapeutic ball.

There is no significant difference between the classical tests for measuring balance stability, but there is a tendency for improvement at the end of the study period.

Such changes could be seen in the girls group too. In tests 2 and 3 the changes are statistically significant. The improvement in test 3 connected with the study of the dynamic balance on a ball is better in the girls group.

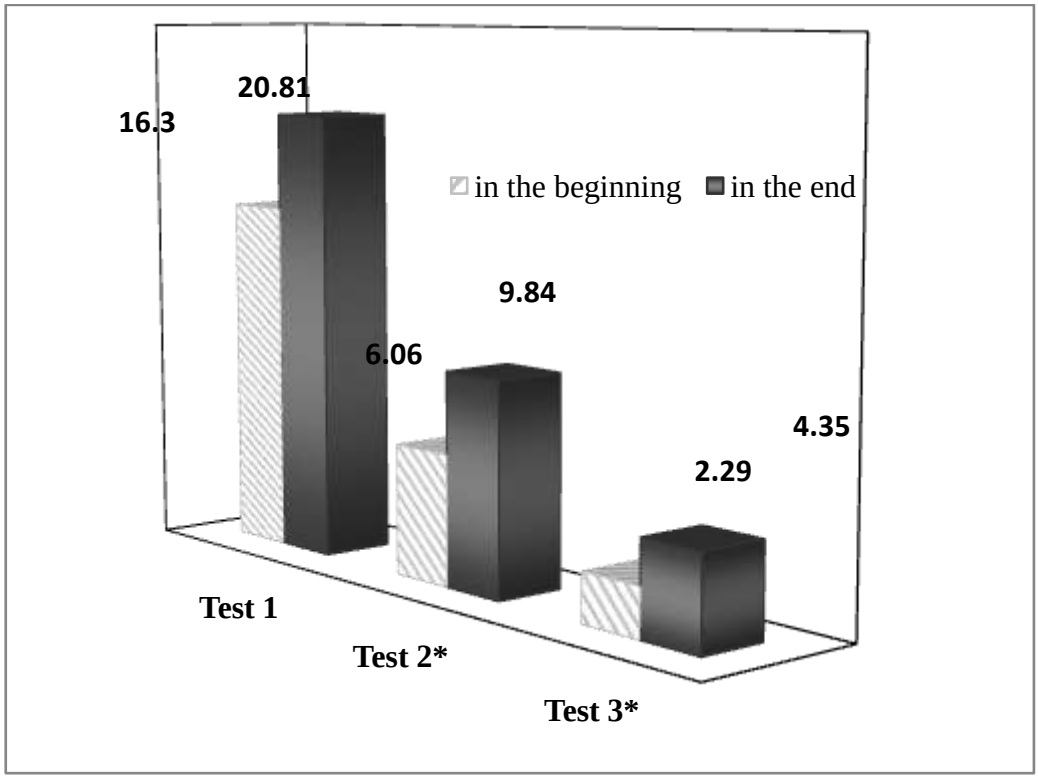
Fig. 3 shows the comparison of the results of balance stability in girls and boys at the beginning of the study. There is no statistically significant difference between the balance in the boys group and the girls' group in the three tests. Comparing the values for the three tests performed at the end of the study, we can conclude that there is a tendency for slightly elevated values in girls compared to those in boys although there are no statistically significant differences in the growth of all three tests. We explain this with the rapid development of physical characteristics of the girls in this age. Likely in a larger sample, these differences will be statistically significant.

The results confirm the improvement in balance performance in children especially after the age of 8 after exercising with the Swiss Ball. There are insignificant differences in balance between girls and boys but the girls tend to outperform boys across all balance tests.



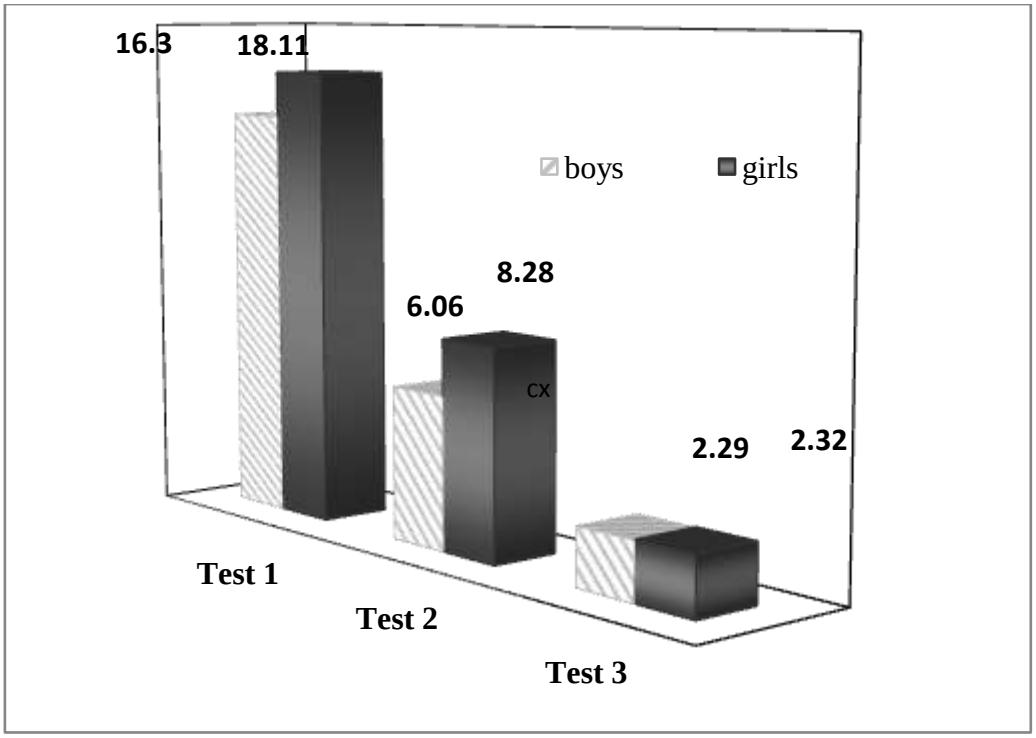
Legend * **α<0, 05, ** α<0, 01**

Fig.1 Comparison between the initial and final values of the balance tests in girls



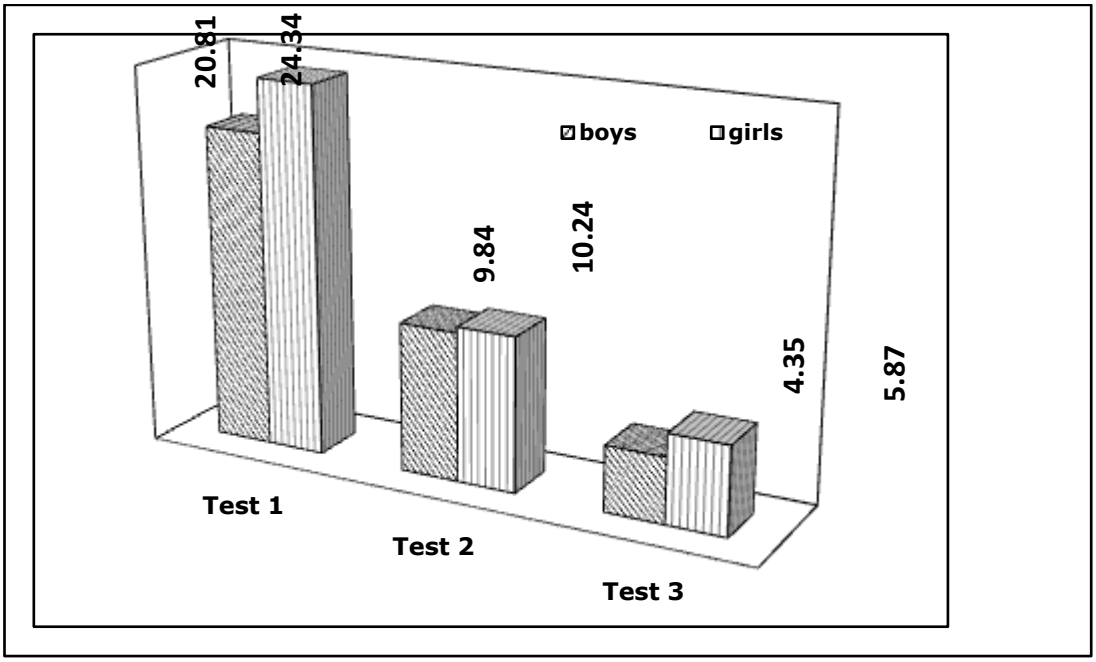
Legend * **α<0, 05, ** α<0, 01**

Fig.2 Comparison between the initial and final values of the balance tests in boys



Legend * **α<0,05, ** α<0,01**

Fig.3 Comparison between values of the balance tests in girls and boys in the beginning of the study



Legend * **α<0,05, ** α<0,01**

Fig.4 Comparison between the values of the balance tests in girls and boys in the end of the study

TABLE 3 The distribution of respondents according to the type of the spinal deformities in the end of the study

	Bad posture	Scoliosis	Kiphosis	Lordosis	Normal
Girls	2	1	1	1	22
Boys	3	1	1	1	14
Total	5	2	2	2	36

DISCUSSION

The Swiss ball activity is unlimited and offers children an opportunity to explore and practice movements that are appropriate and challenging for their own developmental stages. Physical exercises on the balls integrate three different sensory systems: visual, vestibular and tactile (kinesthetic and proprioseptive) Integrating these three systems facilitates optimal balance. The child develops good balance by doing the activities against gravity that mobilize the automatic balancing reaction and improve spinal stability. Correcting spinal deformities requires a longer treatment period. Improved steady resistance has impacted positively on the position and posture of the children and only 5 are still with poor posture at the end of the study. This is because of the entire physiotherapy program, which includes various exercises for balance resistance, exercises for strengthening back muscles, glutei and abdominal muscles. The study shows that 2 of the 4 children with scoliosis have reduced the tilt angle, and there is no change in only one child. The treatment period for the correction of spinal deformities should be longer.

Using a stability ball during resistance training also develops the body's stabilizing muscles that aren't employed when the child exercises on a solid surface. As these small muscles become stronger, natural motor reflexes progress, posture improves and the body functions better as a whole.

CONCLUSION

This pilot study shows that the use of a large therapeutic exercise balls has a greater efficiency and influence on the development of balance than traditional exercises in physical education classes. It is also a convenient method for the development of a quality balance resistance in adolescents with poor posture and spinal deformities. In the studied age group the girls show a greater development of balance abilities than boys.

Using different games and special exercises for balance resistance in physical education classes, teachers could effectively contribute to the motor development of the child.

REFERENCES

Фарфел В. С. Управление движениями в спорте 1977

Carrier B– The Suiss Ball - Springer –1997

Gencheva, N Fitt-ball and kinesitherapy Bolid Ins, Sofia , 2003

Dehant Andre - Playing and learning with the Ball –1999 –On the move-Ledraplastic spa, Osoppo – Italy

Liebenson,C.,Sensory-motor training—an update,Journal of Bodywork and Movement Therapies (2005) 9, 142–147

Jane E. Clark and Debra L. Watkins, Static Balance in Young Children, 1984, Society for Research in Child Development. http://www.jstor.org/pss/1130136

Janda V. Muscles and motor control in cervico-genic disorders, *Physical therapy in cercical e thoracic spine* , e1 st ed.,R.Grant. , **1994**; 195-215

THE PHYSICAL WORK CAPACITY OF THE STUDENTS FROM NOVI SAD

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UDC 796/799

SUMMARY

Introduction: The objective of this study was to determine the physical work capacity of th students from Novi Sad. Also, in this study physical work capacity is associated with the level of physical activity among students during leisure time.

Methods: The study included 160 students from Novi Sad (94 male, 66 female), 95 was from the Faculty of Sport and Tourism and 65 was from other Faculties. The maximal oxygen uptake was used for the assessment of the physiological performance, using the Queens College Step Test. A physical activity questionnaire was used to assess the levels of a weekly physical activity among the students, using the World Health Organization questionnaire.

The data are expressed as means ± SD. The statistical significance was assessed using the independent t-test.

Results: The results of this study show that the students' physical work capacity is not on the recommended levels. Compared with the current international standards, the most of the students, both male and female, have shown average values of the maximal oxygen uptake. Among both genders, both male and female students of the Faculty of Sports and Tourism have shown better values of aerobic capacity than their colleagues from other faculties.

Conclusion: A poor level of work (aerobic) fitness of the students from Novi Sad, as well as the information on the low-level physical activity, indicates that the general health of students from Novi Sad are exposed to significant risks. These data indicate the need for better awareness about the healthy lifestyle practices, and that can be recommended as the first step to improve health. The World Health Organization (WHO) highlights education process as the most effective and least expensive forms of the preventive action towards health improvement.

Key Words: students physical work capacity, maximal oxygen uptake, education.

INTRODUCTION

The subject of this research was the health status problems of the youth in the territory of AP Vojvodina - obesity and a reduced physical working capacity. Some important data that indicate the seriousness of the problem of obesity and immobility can be found in the analysis of the World Health Organization (WHO), who has classified obesity as a chronic disease, and warned that it could soon overtake some of the traditional causes of illness such as malnutrition and infectious diseases. According to the reports of the obesity in England from 2001. the four most common health problems linked to obesity include: high blood pressure, heart disease and vascular disease, type 2 diabetes and some forms of cancer. In a survey conducted by the Ministry of Health of the Republic of Serbia, in 2003, 43 % of men and 33 % of women were overweight. In the same year, 22 % of men and 23 % of women were obese. The research results indicate that in 2014, 19 % of boys and 22 % of girls 2-15 year old would be obese (according to APV, 2007).

The research conducted in the Autonomous Province of Vojvodina (Novakovic , 2004), relating to the determination of some of the causes of noncommunicable diseases, diabetes, hypertension and metabolic syndrome, indicated the great importance of physical activity in prevention of these diseases. In the context of the importance for the development and recreational activity, it is necessary to highlight some parts of that study. In Vojvodina the level of obesity was high in the 1970s, and obesity was found in 51.60% people (when there was no WHO classification of obesity, which now differs overweight from obesity). More recent epidemiological data in Novi Sad, in the field of obesity come from 1997 and indicate that 45.41% of adult men is overweight, and it is most common in the age group of 35-44 years. Also, 32.64% women was overweight, and it was most common in the 55-64 years old age group (38.82%). Obesity is, in the same survey, detected in 19.7% of males with the most distinctive incidence in the 55-64 years old age group (26.74%). The level of obesity in women in 1997 was 27.12%, and most commonly in the age group of 45-54 years.

In recent years, a high percentage of obesity and a lack of physical activity among the student population is present. It is assumed that the main causes of that are the unhealthy lifestyles and a lack of information of a properly dosed physical activity and nutrition. However, there is little empirical data. This is the reason why this transversal pilot study included only students. Besides the need for the exact information concerning the student population, the reason for treatment only of this part of the population are technical limitations and an inability to gather a large sample. Most of the sample consisted of the students from the Faculty of Sport and Tourism, who are attending classes in some of the following subjects: the theory of healthy living, exercise physiology, fitness, etc., and receive information about the importance of a regular physical activity and healthy eating principles. On the other hand, the rest of the sample was made of the students from other faculties, randomly selected, which are assumed to have a lower level of knowledge about the observed problems (primarily physical activity and healthy nutrition). This underlined the major hypothesis of this pilot study - the lack of information often the cause of an insufficient physical activity and malnutrition. Sedentary life style habits (Brettschneider et al., 2007; Rychtecký, 2007), such as physical inactivity, reduced energy consumption in the daily activities, and an increased energy intake (food) - lead to the imbalances which significantly affect human health. Based on these factors, the key problem of the modern society is manifested by the increase of body mass and adipose tissue (Ostojic et al., 2003; James, 2004) which increase the rates of the non-communicable chronic disease. Some researches, supported by the WHO (Health Behaviour in School-Aged Children, HBSC, 1982), indicate the importance of life style habits, and their influence on health, and link those habits to the attitudes and behavior of young people. In recent years, the studies that have examined health and behavior of children and adolescents, from 41 states (Richter, 2008), indicate that the behavior of young people is associated with the eating and living habits, and that those habits are characterized by the physical inactivity or the sedentary activities of young people (Stankovic, 2000; Kljakić, 2000), indicating the increasing health risks (EU Commission, 2004; Owen et al., 2010; Tremblay et al., 2011). The student population has specific time limits in terms of their academic schedules, and that affects their choice of daily activities. Student population's daily schedule is characterized by the static components: sitting in lectures, time spent using the computer (learning, communication, social networks etc.), watching television, and the use of public or personal transport over short distances. Numerous studies have shown that the complex combinations of individual, cultural, socio-economic, environmental and other factors negatively affect the level of daily physical activity (Rodek, 2010). It is known that physical activity is one of the important factors that affect the health and quality of life, so the data

gathered from various studies, indicating a lack of physical activity in the overall daily activities, are very worrying. That is reflected on the occurrence of the impaired locomotor status of the student population (Romanov et al., 2007), as well as weight gain and obesity (Nelson et al., 2007; Desai et al., 2008). The aim of this pilot study was to verify the claims made in previous studies and to indicate the importance of some other hypothetical laws.

METHODS

Subjects

The research was conducted on the sample of 160 students from Novi Sad (94 male and 66 female), 95 were from the Faculty of Sport and Tourism – tims., and 65 from other faculties; the data were collected from three anthropological spaces - morphological, functional and sociological.

All descriptive statistical analyses were performed at two levels – for the entire sample, and then at the level of the typical subsamples (defined by gender and faculty affiliation). For this study, particularly important were the results of the discriminant analysis in which the faculty was treated as the hypothetical significant predictor of acceptance (or rejection) of the initial hypotheses about the importance of education (information) for the formation of healthy habits in the area of physical activity and nutrition.

Procedures

The variables observed in this study come from three anthropological spaces: (1) morphological, (2) functional, and (3) sociological. To assess the variables from the first two areas standardized laboratory and field instruments were used, and for the collection of data on some social features (mainly related to the habits and physical activity) was used a questionnaire specifically designed for this pilot study.

From the morphological space the measures considered were the basic body dimensions - height and mass (BH and BW). From their attitude (BM/BH2) a relative indicator of body composition - body mass index (BMI) and body fat percentage (% fat) were calculated. The statistical analysis was used only for data related to BMI. Using a special electronic scales, Bioimedance (Body composition analyzer) the percentages of total body fat mass was determined. The only variable of the functional diagnostics, the maximum oxygen consumption (VO2max), was used as a measure of aerobic power or a representative indicator of the physical working capacity. The selection was based on a number of previous scientific studies who have confirmed the predictive value of the maximal oxygen consumption. For the purposes of this study, when assessing aerobic fitness, we used the Queens College Step Test, the test standardized precisely for the student population (McArdle et al., 1972). The test protocol is very simple. The respondents were required to (indicated by the computer according to gender) repeatedly climb up and down to a given rhythm for three minutes, on the bench height of 42 cm. After the work heart rate was measured, the formula to calculate the maximum oxygen consumption was used.

The questionnaire, applied in this study, included only two relevant predictors - gender and faculty affiliation. Gender is, in fact, in some previous works (Ahmetović, Popmihajlov, Pavlovic, 1990; Ugarković, 1999; Peric, 2011) recognized as an important factor of discrimination, especially in terms of defining the body composition of people. On the other hand, the Faculty is the potentially important factor of discrimination, and it was possible to confirm the hypothesis of the research on the crucial impact of education (information) on the formation of good knowledge of the related physical activity and nutrition. The third section asked the respondents to rate their level of weekly physical activity by choosing one of the six responses that were ranked ranging from failure to the regular activities of daily exercise in the form of sports training.

Statistical Analyses

The data collected during the survey were analyzed using both descriptive and comparative statistics. From the area of the descriptive statistics for each variable the frequency distribution is determined, and for the variables that are measured at least in the form of ordinal scales, representative central and dispersion parameters were calculated (Mean, standard deviation (Std. Deviation) as well as the standard error (Std. Error.)).

From the area of the comparative statistics we used the following procedures:

The T-test for independent samples (the independent samples t-test) during the discriminant analysis of body size and body composition on the criterion of belonging to the Faculty of the subsamples formed by gender;

The univariate analysis of variance (Univariate ANOVA) during the discriminant analysis of the complete sample of data relating to the maximum oxygen consumption, as the discriminatory factors, depending on the research (statistical) task, using gender and belonging to the Faculty, and the amount (level) of weekly physical activities;

The chi-square test (X2 - test) during testing the significance of the differences between the empirical frequencies, that are related to the physical activity participation in the weekly mode, individual subsamples, as well as in the discriminant analysis of body composition between different subsamples, expresed by the body mass index.

The Pearson correlation analysis model in determining the correlation between the aerobic power (maximal oxygen consumption), and obesity (body mass index);

The data were analyzed using the statistical package SPSS, PC program, (SPSS Inc., USA).

RESULTS

For a better overview presentation of the results, the data obtained by the statistical analysis were divided into three groups, depending on which anthropological status they belong to. So we separated three specific sections. In the first section, the results are interpreted based on the morphological characteristics of the sample (height, weight, body mass index). The second section contains information related to the aerobic capacity, and they were interpreted as the indicators of the physical working capacity of students. The third section contains data that were collected using a special questionnaire that aimed to uncover some elements of the quality of life of students, especially those related to the amount of weekly physical activity.

Body dimension

Body height and weight were not analyzed separately because a sample size was too small to be used to collect data to create certain standards or calculate percentile values. They were only used to calculate the body mass index, which is an indicator of body composition. Since all previous anthropological studies have shown that the body height and weight of adult males and females differ significantly and that among them there are specific proportions, the descriptive statistical parameters were determined, and are presented here, especially for male and female students (Tables 1 and 2). The data show that there is a significant difference between man, in relation to body weight (BW), body mass index (BMI) and body fat percentage, while there was a significant difference between women in relation to the body fat percentage.

TABLE 1 The descriptive indicators and differences between male students from tims., and from other faculties

Variable	Faculty	Mean	Std. Dev.	Std. Error Mean
BH	**tims.**	**182,31**	8,47	1,06
	Other	**181,64**	7,67	1,40
	T-test	***t** = ,369*	*Sig. = ,713*	
BW	**tims.**	**83,45**	12,47	1,56
	Other	**89,92**	10,89	1,99
	T-test	***t** = -2,436**	*Sig. =* ***,017***	
BMI	**tims.**	**25,07**	3,04	0,38
	Other	**27,22**	2,49	0,46
	T-test	***t** = -3,384**	*Sig. =* ***,001***	
%fat	**tims.**	**16,45**	5,67	0,71
	Other	**22,29**	3,03	0,55
	T-test	***t** = -5,285**	*Sig. =* ***,000***	

Table 2 The descriptive indicators and differences between female students from tims., and from other faculties

Variable	Faculty	Mean	Std. Dev.	Std. Error Mean
BH	**tims.**	**169,05**	6,36	1,14
	Other	**170,13**	5,98	1,01
	T-test	***t** = -,711*	*Sig. = ,480*	
BW	**tims.**	**60,45**	7,33	1,32
	Other	**65,02**	11,65	1,97
	T-test	***t** = -1,877*	*Sig. = ,065*	
BMI	**tims.**	**21,14**	2,09	0,38
	Other	**22,39**	3,28	0,55
	T-test	***t** = -1,830*	*Sig. = ,072*	
%fat	**tims.**	**22,98**	3,60	0,65
	Other	**26,73**	6,55	1,11
	T-test	***t** = -2,827**	*Sig. =* ***,006***	

According to BMI, the students were sorted into categories (Table 3, 4 and 5). Using the standards recommended by the World Health Organization, all respondents were distributed into four characteristic groups (underweight, people with a healthy weight, overweight and obese), (Perić, 2009). The results indicate that 58.5% of male students have a healthy weight, and 28.7% was overweight. Situation is slightly better in female students, where 66.7% have a healthy weight, and 12.1% was overweight.

TABLE 3 The BMI values and differences between male and female students

BMI	**Male students**	**Female students**	Σ
Underweight	**10,6%**	**21,2%**	*15,0%*
Healthy weight	**58,5%**	**66,7%**	*61,9%*
Overweight	**28,7%**	**12,1%**	*21,9%*
Obese	**2,1%**	**0**	*1,3%*
Σ	*100,0%*	*100,0%*	*100,0%*

χ^2 = 9,597*; *Sig.* = **,022**

TABLE 4 The BMI values, and differences between male students from tims. and from other faculty

BMI	**tims.**	**Other**	Σ
Underweight	**15,6%**	**0**	10,6%
Healthy weight	**60,9%**	**53,3%**	58,5%
Overweight	**21,9%**	**43,3%**	28,7%
Obese	**1,6%**	**3,3%**	2,1%
Σ	*100,0%*	*100,0%*	*100,0%*

χ^2 = 8,465*; *Sig.* = **,037**

The results from the BMI values for male students are shown in Table 4. With the subjects distributed into four characteristic groups (underweight, healthy weight, overweight and obese), the results indicate that there is a 21.9% of overweight students from tims., and 43.3% of overweight students among the students form other faculties.

TABLE 5 The BMI values, and differences between female students from tims. and from other faculty

BMI	**tims.**	**Other**	Σ
Underweight	**25,8%**	**17,1%**	21,2%
Healthy weight	**71,0%**	**62,9%**	66,7%
Overweight	**3,2%**	**20,0%**	12,1%
Obese	**0**	**0**	0
Σ	*100,0%*	*100,0%*	*100,0%*

χ^2 = 4,560; *Sig.* = ,102

The results from the BMI values for female students are shown in Table 5. The situation is better due to a slightly higher percentage of female students from tims. with healthy weight (71%), while the percentage of the female students from other faculties is also high (62.9%). However, the students from tims. Demonstrate lower occurrences of overweight (3.2%) compared to the students from other faculties (20.0%).

The working capacity

The aerobic capacity, estimated from the relative values of the maximal oxygen consumption (VO2max), was treated as an indicator of the physical working capacity. The average values obtained in different subsamples, based on different gender and faculty, were generally expected. Although different authors give different values, and classify subject into 3 to 7 categories, for this study we used the norms that are proposed by Cooper (1972) and Astrand (1974), and supported by the American College of Sports Medicine - ACSM (Lippincott, Williams & Wilkins, 2010). According to these sources, the adults between 20 and 29 years old, from the average healthy population, can be categorized into one of the following five categories:

TABLE 6 The recommended values of maximal oxygen uptake by the American College of Sports Medicine – ACSM (Lippincott, Williams & Wilkins, 2010).

The working kapacity	***Male*** *(VO_2max ml/kg/min)*	***Female*** *(VO_2max ml/kg/min)*
Very poor	≤38	≤28
Poor	39-43	29-34
Averge	44-51	35-43
Good	52-56	44-48
Very good	≥57	≥49

Based on these standards, from a large number of previous studies, it is observed that most of the sample, both male and female, has average values of VO2max, but the number of those with the average working capacity is significantly higher in female students (Table 8) .

TABLE 8 The maximal oxygen uptake values and working capacity with the differences, for male and female students

The working kapacity	***Male***	***Female***
Very poor	11,7%	0
Poor	12,8%	30,3%
Averge	37,2%	62,1%
Good	19,1%	7,6%
Very good	19,1%	0

χ^2 = 34,993*; *Sig.* = **,000**

TABLE 9 The maximal oxygen uptake values and working capacity with the differences for the entire sample, according to gender

Gender	***Mean***	*Std. Deviation*	*Std. Error*	*Min*	*Max*
Male	**48,86**	8,25	,85	29,01	65,97
Female	**37,29**	4,08	,50	28,87	45,85

t = 10,512*; *Sig.* = **,000**

The maximal oxygen uptake values and the working capacity with the differences for the entire sample, according to gender, are presented in Table 9. Based on these results,the male students demonstrate significantly higher values of the Maximal oxygen uptake compared to the female students.

TABLE 10 Mean values of Maximal oxygen uptake with differences for the entire sample, according to gender, and faculty

VO_2max	**Male**		**Female**		
Faculty	**Mean** (ml/kg(min)	Std. Dev. (ml/kg(min)	**Mean** (ml/kg(min)	Std. Dev. (ml/kg(min)	F-test (faculty)

tims.	**49,54**	7,99	**37,71**	4,06	F = 4,691
Other	**47,40**	8,74	**36,92**	4,12	*Sig.* = ,275
F-test (gender)	F = 274,874*		*Sig.* = **,038**		

The mean values of the maximal oxygen uptake with the differences for the entire sample, according to gender, and faculty, are presented in Table 10. The differences between are students are not significant (tims and other faculties). The highest average values are obtained in the subsample of the students from the Faculty of Sport and Tourism (49.54 ml/kg/min), and the lowest values in the group of female students from other faculties (36.92 ml/kg/min).

Physical activity

Estimating the volume of their weekly physical activity, the students were able to choose one of the six responses, sorted by the categories from a very pronounced immobility (hypokinesia), to a regular sports training. Table 11. provides information on the nature and extent of the weekly physical activity for the entire sample, with respect to gender. Regular training is the least frequent in both genders. Then, occasional training is most present in male students, and predominantly sitting with periodical walks in females. Based on these results, the male students were significantly more physically active in comparison to the female students.

TABLE 11 The amount of a weekly physical activity with the differences, for the entire sample, according to gender

Physical activity	**Male**	**Female**	Σ
Minimum	**13,8%**	**13,6%**	*13,8%*
Sitting position and walk	**12,8%**	**33,3%**	*21,3%*
Sometimes	**23,4%**	**19,7%**	*21,9%*
Often with colleagues	**21,3%**	**10,6%**	*16,9%*
2-3 time in fitness center	**17,0%**	**18,2%**	*17,5%*
Regular training	**11,7%**	**4,5%**	*8,8%*
Σ	*100,0%*	*100,0%*	*100,0%*

χ^2 = 12,879*; *Sig.* = **,025**

TABLE 12 The amount of a weekly physical activity with the differences, for the male students, according to faculty

Physical activity	**tims.**	Other	Σ
Minimum	**9,4%**	**23,3%**	*13,8%*
Sitting position and walk	**7,8%**	**23,3%**	*12,8%*
Sometimes	**23,4%**	**23,3%**	*23,4%*
Often with colleagues	**23,4%**	**16,7%**	*21,3%*
2-3 time in fitness center	**20,3%**	**10,0%**	*17,0%*
Regular training	**15,6%**	**3,3%**	*11,7%*
Σ	*100,0%*	*100,0%*	*100,0%*

χ^2 = 11,085*; *Sig.* = **,050**

TABLE 12 The amount of a weekly physical activity with the differences, for the female students, according to faculty

Physical activity	**tims.**	Other	Σ
Minimum	**9,7%**	**17,1%**	13,6%
Sitting position and walk	**25,8%**	**40,0%**	33,3%
Sometimes	**9,7%**	**28,6%**	19,7%
Often with colleagues	**16,1%**	**5,7%**	10,6%
2-3 time in fitness center	**29,0%**	**8,6%**	18,2%
Regular training	**9,7%**	**0**	4,5%
Σ	*100,0%*	*100,0%*	*100,0%*

χ^2 = 13,498*; *Sig.* = **,019**

The results of the nature and extent of the weekly physical activity, for the sub-sample of students (according to their faculty) are presented in Table 12. (male students) and Table 13. (female students). Important information for these results is the presence of physical exercise among the students of different faculties. It is reasonable to assume that the students from the sports faculty (in this case, the Faculty of Sports and Tourism-tims., Novi Sad) are more involved in a regular physical activity. This assumption was confirmed, both for male (Table 12) and female students (Table 13).

DISCUSSION

Overall, based on these results, it can be concluded that obesity is present to a large extent among the students of Novi Sad. Also, the physical working capacity is at an unsatisfactory level. If we add the low level of physical activity to the previous data, there is an impression that the general health of the students from Novi Sad is exposed to significant risks. These factors justified the implementation of this scientific study, because they confirmed the general trends, observed in the lifestyle of modern men and women (especially young people), and they can be applied to the population of the students from Novi Sad. A major starting hypothesis of this study -that the students from the so-called sports faculties (in this case the Faculty of Sport and Tourism) have a higher quality of the monitored variables (morphological, functional and sociological), compared to other students (non-sport faculties) was analysed. However, the assumption is not entirely implemented. Thus, significant differences in the percentage of the obese were confirmed only for the male students, where the students from the sports faculty have shown less body fat. However, among the female students there were no significant differences. This study also showed that female students are more concerned about obesity, because female students had significantly better indicators of body composition than male students.

And the least expected, when we talk about the assessment of the physical work capacity of the students from Novi Sad, there is a lack of the statistically significant differences between the average values of the maximum oxygen consumption of the sports and non-sports faculties. In the subjects of both genders, the students of the Faculty of Sports and Tourism had slightly higher average values of aerobic capacity than their colleagues from other faculties, but these differences were not sufficiently large to be declared statistically significant. In general, starting from the standards defined in previous researches, the physical work capacity of the students from Novi Sad is not on the desirable level. Compared with the current international standards, it is evident that the majority of the subjects, both male and female, has an average value of the maximal oxygen uptake, but the number of those with the average working capacity is higher among the female students. In the subsample of the males, we have seen three, almost equally divided

zones of working ability - below average, average and above-average. In the subsample of the females, there is an absence of the very poor and the very good working ability. However, just like in the males, 1/3 of the female students had poor work ability, which, with only 6.7 % of female students with a good aerobic power, ultimately creates a less favorable picture of the female students' working ability. The male students have not only higher absolute values of oxygen consumption, but they can also be classified as the subjects with a greater working capacity.

Taking the standards defined in previous researches (Cooper, 1972; Bruce, Kasumi & Hosmer, 1973; Astrand, 1974; Wilmore & Costill, 1999; Hampson, 2008; Lippincott, Williams & Wilkins, 2010), generally there is an unfavorable impression of the physical work ability of the students from Novi Sad. Although different authors give different thresholds, and offer the possibility of classifying the patients into 3 up to 7 categories, the norms proposed by can be used for this study Cooper (1972) and Astrand (1974), and supported by the American College of Sports Medicine - ACSM (Lippincott, Williams & Wilkins, 2010). According to these sources, the adults between 20 and 29 years of age, from the averagely healthy population, can be categorized into one of the following five categories of working capacity: very poor, poor, average, good and very good. In our study, male students had significantly higher average values than females (Table 6), which is consistent with the current researches. The significant differences were, somewhat unexpectedly, lacking when compared with the average values between the students from different faculties – sports and non-sports (Table 8). The statistically highest average obtained in the subsample of male students from the Faculty of Sport and Tourism (49.54 ml/kg/min), and the lowest in the group of female students from other faculties (36.92 ml/kg/min). Interesting, none of the females was extremely weak or good. However, as with men, 1/3 of the female students had poor work ability (30.3%). With only 6.7 % of the female students with a good working ability, it can be concluded that the situation is worse among female students (Table 8).

The analysis of the collected data of the amount of weekly physical activity, gives the statistically significant differences between the structures of the students' answers. In general, it has been observed that the male students are physically more active than the female ones. Although all of the provided answers were present in both genders, the male students showed twice the engagement in physical activities (playing football, basketball, etc.) and daily exercise (in terms of active sports). Significantly more female students said that they spent more time sitting and walking. The number of subjects of both genders was almost equal in the categories with minimum movement and regular exercise at the fitness center 2-3 times a week. Looking at the entire sample, it can be noted that almost 2/3 of the students were not physically active, and they are predominantly sedentary. It is certainly worrying that this study fits in the assessment of the similar recent studies. Based on these data, it is apparent that there are statistically significant differences between the structure answers of the male and the female students (Table 11). Based on the empirical frequency of the answers, it can be observed that the male students are physically more active than their colleagues. Although all of the provided answers were present in both genders, male students showed twice the engagement in physical activities (playing football, basketball, etc.), and daily exercise (in terms of active sports). Significantly more female students said that they spent more time sitting and walking. The number of subjects of both genders was almost equal in the categories with minimum movement and regular exercise at the fitness center 2-3 times a week. Looking at the entire sample, it can be noted that almost 2/3 of students were not physically active, and they are predominantly sedentary, and it fits in the assessment of the similar recent studies. It is interesting that the differences were more pronounced in women, which seems to indicate that the students from the non-sport faculties pay less

attention to regular physical exercise and/or they have less time to participate in them. This suggests that there must be more attention given to the students' physical activity. Necessarily physical education in faculties does not longer exist, and a better solution for greater involvement students in regular physical activity, the academic community has not yet found.

CONCLUSION

In the sample of 160 students from Novi Sad (94 male and 66 female), 95 were from the Faculty of Sport and Tourism-tims., and 65 from other faculties, the data were collected from three anthropological spaces - morphological, functional and sociological. The monitored morphological variables were the body mass index and the percentage of body fat, and the only functional variable, which assessed the physical work capacity of the respondents, was the maximum oxygen consumption. From the sociological space, only the amount of weekly physical activity is selected, as the fact that indicates some aspects of the quality of life. Based on the collected data and the application of the appropriate statistical procedures, it was possible to conclude the following:

• Overall, among the students of Novi Sad obesity was predominant, while the physical working capacity was at an unsatisfactory level. With data that indicate the low level of motion activity, there is an impression that the general health of the students from Novi Sad is exposed to significant risks.

• The differences in the percentage of the overweight was confirmed only for the male students, in favor of those who are studying at the Faculty of sport, while, among the female students, a significant difference was lacking. At the level of the entire sample, the female students have shown significantly better indicators of body composition than males.

• In comparison with the current international standards, it is evident that the majority of the subjects, both male and female, has an average value of maximal oxygen uptake. In the subsample of males, we have seen three, almost equally divided zones of working ability - below average, average and above-average. In the subsample of the females, there is absence of the very poor and very good working ability. However, just like in the males, 1/3 of the female students had poor work ability, which, with only 6.7 % of the female students with a good aerobic power, ultimately creates a less favorable picture of the female students' working ability. The male students, had not only higher absolute values of oxygen consumption, but they can also be classified as the subjects with a greater working capacity.

• In the subjects of both genders, the students from the Faculty of Sports and Tourism had more average values of aerobic capacity than their colleagues from other faculties, but these differences were not sufficiently large to be declared statistically significant. In general, starting from the standards defined in previous researches an unfavorable impression of the physical work capacity of the students from Novi Sad is formed.

• It is confirmed the there is a strong association between the physical work capacity and obesity. The correlation analysis shows that the students with higher values of maximum oxygen consumption have systematically less fat in their body.

REFERENCES

Ahmetović, Z., Pavlović, Đ. i Popmihajlov, D. (1990): *Fizički razvoj i fizičke sposobnosti stanovništva SAP Vojvodine*. Novi Sad: Zavod za fizičku kulturu Vojvodine

AP Vojvodina, Sekretarijat za sport i omladinu (2007): *Izveštaj o stanju sporta u APV sa predlozima za izradu strategije razvoja*. (Ur. M. Dokmanac i D. Perić) Novi Sad: APV

Astrand, I. (1974): Aerobic Work capacity in man and women with special reference to age. *Acta Physiologica Scandinavica, 49, suppl. 169, 14*

Brettschneider WD., Naul R., Bunnemann A. & Hoffmann D. (2007): *Obesity, physical activity patterns and sedentary lifestyles of young people in Austria, Germany and Switzerland*. V W.D

Brettschneider & R. Naul (eds.), Obesity in Europe: young people's physical activity and sedentary lifestyles, Sport sciences international, , vol. 4, pp: 281-323.

Bruce, R.A., Kusumi, F. & Hosmer, D. (1973): Maximal oxigen intake and homographic assessment of functional aerobic impairment in cardiovascular disease. *American Heart Journal; 85: 546*

Desai M.N., Miller W.C., Staples B. and Bravender T. (2008): Risk Factors Associated With Overweight and Obesity in **College Students.** *Journal of American **College** Health*, 57 (1) **109-114**

EU commission (2004): Study on young people's lifestyles and sedentariness and the role of sport in the context of education and as a means of restoring the balance. Final report (www.ehnheart.org*)*

Health Behavior in School-Aged Children, HBSC. (www.publichealth.gc.ca)

Hampson, D. (2008). *VO2 max: What is it, Why is it so important, and how do you improve it?* http://athletics.wikia.com

James P.T. Obesity (2004): The worldwide epidemic. *Clinics in Dermatology*. 276-80

Kljakić B. (2000): *Ponašanje srednjoškolske omladine u srbiji u oblasti ishrane, fizičke aktivnosti i korišćenja slobodnog vremena*. Stručno naučni skup: Zdravstveno ponašanje studentske i srednjoškolske omladine, Zlatibor: 11.-14.05.2000. Zavod za zdravstvenu zaštitu studenata Beigrad, 180-185

Kuper, K. (1972): *Aerobik*. Beograd: NIP Partizan

Lippincott, J. Williams, J. & Wilkins, H. (2010): *ACSM's Guidelines for Exercise Testing & Prescription*. 8th ed.

McArdle, W.D et al. (1972): *Reliability and interrelationships between maximal oxygen uptake, physical work capacity and step test scores in college women*. **Medicine and Science in Sports** (4) 182-186

Nelson T.F., Gortmaker S. L., Subramanian S.V., Cheung L. and Wechsler H. (2007): Disparities in Overweight and Obesity Among US College Students. *American Journal of Health Behavior* 31 (4) 363-373

Novaković, B.(2004): *Šećerna bolest, gojaznost i povišeni krvni pritisak stanovništva Vojvodine*. Novi Sad: Medicinski fakultet

Ostojić S., Mazić S. i Dikić N. (2003): *Telesne masti i zdravlje*. Udruženje za medicinu sporta Srbije. Beograd

Owen N., Healy G.N., Matthews C.H.E., and Dunstan D.W. (010): Too Much Sitting: The Population-Health Science of Sedentary Behavior. *Exercise and Sport Science Review*. 38(3) 105–113

Perić, D. (2009): *Dijagnostika u sportu*. Beograd: Ministarstvo omladine i sporta Republike Srbije

Rodek J., Bjelajac S. (2010): Kineziološka aktivnost i sedentarno ponašanje studenata. *Školski vjesnik: časopis za pedagoška i školska pitanja*. 59 (1) 159-174

Romanov R., Protić-Gava B**.,** Karanov B. (2007): Distribution of the fat tissue as an indicator of obesity of the students´ population. 10th Sport Kinetics Conference Belgrade, 153-156

Romanov R**.,** Protić-Gava B**.,** Krsmanović T. (2007): *Postural habits of the students at the University of Novi Sad*. 10th Sport Kinetics Conference Belgrade 157-160

Rychtecky A. (2007): *Active Lifestyles of Young People 7 Benefits and Outcomes*. Chapter 11 in Brettschneider WD. & Naul R. Obesity in Europe: young people's physical activity and sedentary lifestyles. Sport sciences international, 4: Frankfurt am Main

Stanković T. (2000): *Fizička aktivnost, slobodno vreme, higijenske navike i ishrana*. Stručno naučni skup: Zdravstveno ponašanje studentske i srednjoškolske omladine, Zlatibor. Zavod za zdravstvenu zaštitu studenata Beigrad, 155-157

Tremblay M.S., LeBlanc A.G., Kho M.E., Saunders T.J., Larouche R., Colley R.C., Goldfield G. and Gorber S.C. (2011): Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*. 8 (98) 3-22

Wilmore, H.J & Costill, L.D. (1999): *Physiology of sport and exercise*. 2nd ed. Champaign IL: Human Kinetics

FIZIČKA RADNA SPOSOBNOST NOVOSADSKIH STUDENATA

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SAŽETAK

Uvod: Problem ovog istraživanja predstavlja fizička radna sposobnost novosadskih studenata, povezana sa nivoom fizičkih aktivnosti u slobodno vreme.

Metode: Uzorak ispitanika čini 160 novosadskih studenata (94 studenta i 66 studentkinje), od čega je njih 95 bilo sa Fakulteta za sport i turizam, a 65 sa ostalih fakulteta. Prikupljeni su podaci iz dva antropološka prostora – funkcionalnog i sociološkog. Jedina funkcionalna varijabla, kojom je ocenjena fizička radna sposobnost ispitanika, bila je Maksimalna potrošnja kiseonika, iskazana kroz relativne vrednosti (ml/kg/min), a procenjena je primenom step testa (Queens College Step Test). Iz sociološkog prostora korišćen je upitnik Svetske zdravstvene organizacije, i on pruža podatke o količini nedeljnih fizičkih aktivnosti studenata.

Iz prostora deskriptivne statistike određena je aritmetička sredina i standardna devijacija, dok je iz prostora komparativne statistike, za utvrđivanje razlika u aritmetičkim sredinama između posmatranih varijabli korišćen nezavisni t-test.

Rezultati: Dobijeni rezultati ukazuju na nezadovoljavajući nivo radne (aerobne) sposobnosti novosadskih studenata. U poređenju sa aktuelnim svetskim standardima, najveći broj ispitanika, kako muškog tako i ženskog pola, imao je prosečne vrednosti maksimalne potrošnje kiseonika. Kod ispitanika oba pola, studenti i studentkinje Fakulteta za sport i turizam su imali nešto više prosečne vrednosti aerobnih sposobnosti od svojih kolega i koleginica sa drugih fakulteta.

Zaključak: Nezadovoljavajući nivo radne (aerobne) sposobnosti novosadskih studenata, kao i podaci o niskom nivou kretnih aktivnosti, ukazuju na utisak da je opšte zdravlje novosadskih studenata izloženo značajnim rizicima. Ovaj podatak ukazuje na to da se rad na boljem informisanju ljudi o zdravom načinu života može preporučiti praksi kao prvi korak unapređenja zdravlja. Svetska zdravstvena organizacija (WHO) zato i ističe informisanje (edukaciju) ljudi kao najefikasniji i najmanje skup vid preventivnog delovanja usmerenog na očuvanje zdravlja.

Ključne reči: fizička aktivnost studenata, maksimalna potrošnja kiseonika, edukacija.

THE URBAN-RURAL DIFFERENCE IN THE PHYSICAL ACTIVITY LEVEL AND FUNCTIONAL FITNESS BETWEEN OLDER MEN

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UDC 796.015.132

SUMMARY

The aim of this study was to determine the differences in the physical activity level and functional fitness between the urban and the rural older men. 276 elderly people, age 60-80, participated in this study. 181 participants were from urban areas while 95 were from rural pareas. The level of physical activity was assessed by the International Physical Activity Questionnaire (IPAQ). A senior fitness test was used to asses the functional fitness of the participants. The test consists of six measures of physical fitness: 1) Back scratch, 2) Chair sit and reach, 3) 8 foot up and go, 4) 30 sec stand from the chair, 5) Arm curl, 6) 2-minutes step test. The results showed that men from urban areas had statisticly significantly greater body mass than men from rural area. Also, flexibility of the upper limbs was statisticaly greater in the rural inhabitants compared to the urban ones. Total physical activity in transport and houswork domains was greater in the urban elederly people than in the rural. The other tested varaiables did not show any statisticaly significant difference ($p>0.05$) between the urban and the rural people. It could be concluded that the residence of living is not a factor which makes a difference between the urban and the rural people.

Key words: physical fitness, physical activity, residence, older people

INTRODUCTION

Despite the established health benefits of a regular physical activity (PA) on health status in adult population, the majority of them are not involved in sufficient levels of PA (30–60% depending on the country). There has been a lot of factors that have an impact on the regular PA, but socio-demographic and psychosocial factors, and physical environmental attributes have been mentioned as the most important in explaining the participation of older people in regular PA (Van Dyck, Cardon, Deforche, & De Bourdeaudhuij, 2011).

Several studies in the USA, Australia, and Europe have showed differences in the level of PA between the urban and the sub-urban inhabitants (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003; Leslie, McCrea, Cerin, & Stimson, 2007; Saelens, Sallis, & Frank, 2003; Van Dyck et al., 2010). The difference was evident in the walking activities because the urban inhabitants are more prone to engage in walking for transportation than the suburban, who are often more automobile-oriented. In addition, an increasing number of studies have also found positive relations between cycling for transportation and leisure-time walking in the urban compared to the sub-urban inhabitants (Ewing et al., 2003; Van Dyck et al., 2010).

One of the main reasons for a major involvement of the urban inhabitants is the environment that is characterized by a high residential density, and a well-connected street network, which enables them to finish everyday needs easily compared to the suburban environment where those places are more

distant (Frank, 2000; Handy, Boarnet, Ewing, & Killingsworth, 2002; Leslie et al., 2007; Savitch, 2003; Van Dyck et al., 2011). Next to urban and suburban areas, rural neighbourhoods are also important to consider when it comes to the PA of adults. Rural neighbourhoods are even more automobile-dependent than suburban areas because of a low residential density, and low street connectivity (Frank, 2000; Handy et al., 2002; Leslie et al., 2007; Savitch, 2003). Therefore, it is expected that the inhabitants of rural neighbourhoods show lower PA levels compared with urban neighbourhoods, thus the lower level of physical fitness. The studies conducted in the USA showed that the rural adults are less physically active compared to the urban adults (Eyler, Brownson, Bacak, & Housemann, 2003; Reis et al., 2004; Wilcox, Castro, King, Housemann, & Brownson, 2000). However, this results should be taken with caution because the level of PA is influenced by the socio-economic status of the participants (Van Dyck et al., 2011), which is in the case of the USA in favour of the urban inhabitants. Compared to studies conducted in the USA, in European studies no significant difference was found in the level of PA between the rural and the urban adults (Arnadottir, Gunnarsdottir, & Lundin-Olsson, 2009; Van Dyck et al., 2011). One of the reasons for contradictory results, in geographical maner, is socio-economic status which shows less differences between the rural and the urban adults in Europe compared to the USA. Moreover, European rural areas usually contain more green spaces than rural areas in the USA, and therefore most of the people living in rural regions are being involved in some part of PA within housework or gardening.

To the best of our knowledge, no research is available in Serbia that would determine the differences between rural and urban older adults in the level of PA and functional fitness. Therefore, the aim of this paper is to determine the differences in the level of PA and the parameters of functional fitness between older adults in urban and rural areas.

METHODS

Participants

The research was conducted on the total sample of 276 elderly men, age 60-80, who agreed to participate in this study. 181 participants (Mean±SD; height 175.94±9.01 cm; weight 81.45±12.99 kg) were from an urban while 95 (Mean±SD; height 175.66±7.35 cm; weight 80.13±11.65 kg) were from a rural area.

The criteria for selecting the participants were: age between 60 and 80 years, physically independent person - able to walk 20 feet without assistance or rest, without a cognitive impairment and dementia, achieved 24 points for the educated and 18 points for the unqualified respondents in a mini mental state evaluation (McDowell, 2006). Also, the participants who were in the recovery phase of an acute illness, also, the deaf and the blind were excluded. The research does not include subjects with cardiovascular system disorders because of the potential risks during the functional fitness tests.

Procedure

Each participant has given information about their demographic characteristics first and then they have assessed the level of physical activity by the IPAQ questionnaire (International Physical Activity Questionnaire), the anthropometric measures and the Senior Fitness Test (SFT). Participation in the study was voluntary and each of the participants could redraw from the study at any moment. The study was approved by the Research Ethics Committee of the Faculty of Physical Education and Sport, University in Nis and according to the Declaration of Helsinki. All participants were fully informed about the risks and benefits that this research has on their age group. The testing of all the participants was in the period from August to December 2011. All participants were mentally and physically healthy and able to participate in the study. Qualified researchers have conducted standard interviews with potential participants

individually or in small groups, at their homes or in the active centers for the elderly.

Anthropometric measures

The anthropometric variables were measured according to the instructions of the International Biological Program–IBP. Body height was measured to the nearest 0.1 cm by a metric measuring tape. Body weight was measured to the nearest 0.01 kg using a digital scale. The body mass index was calculated by formula: BMI=body mass (kg) / (body height (m))^2.

IPAQ questionnaire

Self evaluation of the participant's physical activity was conducted according to the Serbian version of the IPAQ questionnaire, whose reliability was confirmed on the Serbian population over 60 years (Milanović, Pantelić, Trajkovic, Jorgic, & Sporiš, 2013). For the purpose of this study the long version of the IPAQ questionnaire was used containing four domains of physical activity: work-related, transportation, housework/gardening and leisure-time activity. In addition, the questionnaire contains questions related to sitting and sedentary habits, which were not the subject of our research and were excluded from further analysis. In each of the four domains of testing, the participants have recorded the number of days and time spent during each day separately for vigorous and moderate intensity activities and also the time spent on walking. Then, the calculation for each item was conducted separately (vigorous activity, moderate activity and walking) according to the official IPAQ instruction (International Physical Activity Questionnaire) so the period of the PA of participants could be determined. Moreover, the Metabolic Equivalent Task (MET) was calculated for each domain separately (work-related, transportation, housework/gardening and leisure-time activity). The total weekly PA level (MET-min/week) was calculated by separate collecting of the MET values for each item. For calculating the MET values the following coefficients were used: vigorous PA=8.0 METs, moderate PA=4.0 METs and walking PA=3.3 METs.

Vigorous activities are defined as the activities in which participants breathe more deeply than usual. These can be the activities such as lifting heavy things, digging, heavy construction work or climbing stairs. Moderate physical activities are those in which a person is breathing a little harder than usual and may include the activities such as carrying light loads. Walking is not considered to be a moderate physical activity. Vigorous and moderate activities are those that last for at least ten minutes continuously.

Senior fitness test

The senior fitness test is a battery of tests for the assessment of the functional fitness of older persons. This test assesses the physiological capacity for carrying out normal daily activities independently and safely without the appearance of fatigue. Before testing, the subjects have performed 10 minutes warm up with the instructions given by highly skilled persons, and then a complete SFT with the tasks order referred in this test (Rikli & Jones, 2001). This test was given validity by Rikli and Jones (2001). The test consists of six measures of functional fitness: 1) *Back scratch* that assesses upper body (shoulder) flexibility. With one hand reaching over the shoulder and one up the middle of the back, the result is the number of inches (cm) between the extended middle fingers (+ or -), 2) *Chair sit and reach* is a test that assesses the flexibility of the lower extremities. As with the previous test, each subject performed two test trials and two attempts to be measured and included in further analysis. From a sitting position at the front of chair, with legs extended and hands reaching toward toes, the result is the number of inches (cm) (+ or -) between extended fingers and the tip of toes, 3) *8-foot up and go* assess agility/dynamic balance. The result is the number of seconds required to get

up from a seated position, walk 8 feet (2.44 m), turn, and return to a seated position, 4) *Chair stand up for 30 sec* assesses lower body strength. The result is the number of full stands that can be completed in 30 seconds with arms folded across chest, 5) *Arm curl* assess upper body strength. The result is the number of bicep curls that can be completed in 30 seconds holding a hand weight of 5 lbs (2.27 kg) for women; 8 lbs (3.63 kg) for men, 6) 2-minutes step test is an alternate aerobic endurance test, used when space limitations or weather prohibits taking the 6-minute walk test. The result is the number of full steps completed in 2 minutes, raising each knee to a point midway between the patella (kneecap) and iliac crest (top hip bone).

Statistical analysis

The statistical Package for Social Sciences SPSS (v18.0, SPSS Inc., Chicago, IL) was used for the statistical analysis. Descriptive statistics were calculated for all experimental data. To determine the difference between urban and rural areas the t-test for independent subject was used. The statistical significance was set at $p < 0.05$.

TABLE 1 General descriptive parameters

	Rural ***n*=95**	**Urban** ***n* =181**	**Total** ***n* =276**
Age	68.59±6.27	67.01±7.42	67.61±7.05
Body Height	175.66±7.35	175.94±9.01	175.84±8.42
Body Weight	80.13±11.65*	81.45±12.99*	80.95±12.52
BMI	26.03±3.41	26.26±3.28	26.17±3.33

*- statistically significant difference p<0.05

RESULTS

As shown in Table 1, the participants living in an urban area (81.45±12.99 kg) are significantly heavier compared to those from a rural area (80.13±11.65 kg). The flexibility of the lower extremities significantly differs in the rural inhabitants compared to the urban ones (Table 2). The total PA involving transportation and housework is higher in older adults that live in an urban area in comparison to a rural one. Among all other tested variables there are no statistically significant differences (p>0.05) between the participants of urban and rural areas.

TABLE 2 Parameters of Senior fitness test and IPAQ questioner

	Rural ***n*=95**	**Urban** ***n* =181**	**Total** ***n* =276**
Back scratch (cm)	-5.12±5.38*	-3.63±5.54*	-4.21±5.52
Chair sit and reach (cm)	-.21±10.78	1.08±10.28	.56±10.50
8-foot up and go (sec)	6.87±1.55	6.70±1.62	6.77±1.59
Chair stand up for 30 sec (sec)	13.21±6.11	13.99±5.35	13.68±5.68
Arm curl (reps)	16.45±6.57	16.94±6.48	16.75±6.52
2-minutes step test (number of steps)	91.91±23.22	91.33±23.07	91.54±23.10
Total PA at work	843.33±2818.91	979.52±2426.87	925.82±2587.43
Total PA in transportation	716.58±1596.36*	996.14±2069.65*	886.26±1901.53
Total PA in housework	2124.59±3383.68*	1453.99±2015.64*	1699.50±2618.85
Total PA leisure time	939.98±2191.16	930.24±1832.36	934.05±1979.12
Total MET walking	1281.21±2346.85	1441.05±2179.09	1378.23±2246.33
Total MET moderate PA	3145.01±4479.03	2659.21±3640.52	2837.07±3971.68
Total MET vigorous PA	536.06±1723.00	466.86±1343.15	494.05±1503.06
Total PA MET	4429.67±6425.57	4157.08±4946.37	4257.74±5535.19

*- statistically significant difference p<0.05; PA-physical activity; MET-Metabolic equivalent task

DISCUSSION

The aim of this study was to examine the PA and the functional fitness differences between the older adults living in an urban area and the adults living in a rural area. Generally, the results partly showed that there are no significant differences between the urban and rural participants. Most of the variables did not show significant differences. Therefore, it can be stated that our results agree with the similar researches conducted in Europe (Arnadottir et al., 2009; Van Dyck et al., 2011), while they differ from the researches conducted in the USA (Eyler et al., 2003; Wilcox et al., 2000).

The results of our study have showed that the urban individuals were more physically active than the rural participants in the transport domain from their houses to their everyday jobs. This could be expected because the rural participants are more automobile-dependent than the urban because of a low residential density, and low street connectivity (Frank, 2000; Handy et al., 2002; Savitch, 2003), which prevent them to do everyday activities without transportation. Therefore, it was expected that the participants from rural areas have been physically less active than the participants from urban areas, which led to the conclusion of the lower physical fitness also, in favour of the rural participants. On the other hand, they are much more engaged in the housework domain that is primarily related to housework and gardening compared to the urban participants. This could be explained by the fact that rural areas usually contain more green spaces than urban areas, and therefore most of the people living in rural areas are involved in some kind of PA within housework or gardening. Furthermore, most of the participants in rural areas are mainly engaged in agriculture as their primary business so this is one of the reasons why are they much more involved in this domain.

Based on these results, we can conclude that there are slight differences between urban and rural areas in terms of the level of PA and the level of functional fitness of older adults. The main limitation of this study is the selection criteria which involved only older male adults. Therefore, future studies should try to determine whether there is a difference between older women in urban and rural areas. In addition, we have examined only older adults, over 60 years, so it is necessary to expand the sample to other age populations.

Acknowledgements.

This research has been supported by the project: "Physical activity and fitness components of elderly people" approved in 2010, financed by the Ministry of Education and Science of Republic Serbia (number 179056). This project is conducted by the Faculty of sport and physical education, University of Nis.

REFERENCES

Arnadottir, S. A., Gunnarsdottir, E. D., & Lundin-Olsson, L. (2009). Are rural older Icelanders less physically active than those living in urban areas? A population-based study. *Scandinavian journal of public health, 37*(4), 409-417.

Ewing, R., Schmid, T., Killingsworth, R., Zlot, A., & Raudenbush, S. (2003). Relationship between urban sprawl and physical activity, obesity, and morbidity. *American Journal of Health Promotion, 18*(1), 47-57.

Eyler, A. A., Brownson, R. C., Bacak, S. J., & Housemann, R. A. (2003). The epidemiology of walking for physical activity in the United States. *Medicine and Science in Sports and Exercise, 35*(9), 1529-1536.

Frank, L. D. (2000). Land Use and Transportation Interaction Implications on Public Health and Quality of Life. *Journal of Planning Education and Research, 20*(1), 6-22.

Handy, S. L., Boarnet, M. G., Ewing, R., & Killingsworth, R. E. (2002). How the built environment affects physical activity: views from urban planning. *American Journal of Preventive Medicine, 23*(2), 64-73.

Leslie, E., McCrea, R., Cerin, E., & Stimson, R. (2007). Regional Variations in Walking for Different

Purposes The South East Queensland Quality of Life Study. *Environment and behavior, 39*(4), 557-577.

McDowell, I. (2006). *Measuring health : a guide to rating scales and questionnaires*. Oxford ; Toronto: Oxford University Press.

Milanović, Z., Pantelić, S., Trajkovic, N., Jorgic, B., & Sporiš, G. (2013). Reliability of the Serbian Version of the International Physical Activity Questionnaire (IPAQ) for Older Adults. *Archives of Geriatrics and Gerontology, (in press)*.

Reis, J. P., Bowles, H. R., Ainsworth, B. E., Dubose, K. D., Smith, S., & Laditka, J. N. (2004). Nonoccupational physical activity by degree of urbanization and US geographic region. *Medicine and Science in Sports and Exercise, 36*, 2093-2098.

Rikli, R. E., & Jones, C. J. (2001). *Senior fitness test manual*. Champaign, IL: Human Kinetics.

Saelens, B. E., Sallis, J. F., & Frank, L. D. (2003). Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Annals of Behavioral Medicine, 25*(2), 80-91.

Savitch, H. (2003). How suburban sprawl shapes human well-being. *Journal of Urban Health, 80*(4), 590-607.

Van Dyck, D., Cardon, G., Deforche, B., & De Bourdeaudhuij, I. (2011). Urban–rural differences in physical activity in Belgian adults and the importance of psychosocial factors. *Journal of Urban Health, 88*(1), 154-167.

Van Dyck, D., Cardon, G., Deforche, B., Sallis, J. F., Owen, N., & De Bourdeaudhuij, I. (2010). Neighborhood SES and walkability are related to physical activity behavior in Belgian adults. *Preventive Medicine, 50*, S74-S79.

Wilcox, S., Castro, C., King, A. C., Housemann, R., & Brownson, R. C. (2000). Determinants of leisure time physical activity in rural compared with urban older and ethnically diverse women in the United States. *Journal of Epidemiology and Community Health, 54*(9), 667-672.

URBAN-RURAL RAZLIKE NIVOA FIZIČKE AKTIVNOSTI I FUNKCIONALNOG FITNESA STARIH MUŠKARACA

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SAŽETAK

Cilj ovog istraživanja bio je da utvrdi razlike u nivou fizičke aktivnosti i parametrima funkcionalnog fitnesa izmedju muškaraca koji žive u gradu i na selu. 276 muškaraca starosti od 60-80 godina je učestvovalo u istraživanju od kojih je 181 ispitanik bio iz urbane sredina a 95 iz ruralne. Nivo fizičke aktivnosti ispitanika procenjen je pomoću IPAQ upitnika. Za procenu funkcionalnog fitnesa korišćen je Senior Fitnes Test koji sadrzi šest varijabli: 1) pokretljivost ramena, 2) pretklon na stolici, 3) osam stopa, 4) ustajanje sa stolice za 30 sekundi, 5) fleksija u zglobu lakta, 6) dvominutni step test. Rezultati istraživanja pokazuju da muškarci iz urbane sredine imaju statistički značajno veću telesnu masu u odnosu na ruralnu sredinu ($p<0.05$). Takodje, pokretljivost gornjih ekstremiteta se statistički značajno razlikuje kod ispitanik sa sela u odnosu na grad. Ukupna fizička aktivnost vezana za transport i kućne poslove je veća kod muškaraca koji žive u urbanoj sredini u odnosu na ruralnu. Kod svih ostalih testiranih varijabli ne postoji statistički značajna razlika ($p>0.05$) izmedju ispitanika urbane i ruralne sredin. Na osnovu dobijenih podataka možemo da zaključimo da mesto stanovanja (selo ili grad) kod muškaraca stariji od 60 godina neznatno utiče na razlike u funkcionalnom fitnesu i nivou njihove fizičke aktivnosti.

Ključne reči: fizički fitnes, fizička aktivnost, mesto stanovanja, stare osobe

DO THE PHYSICAL ACTIVITY LEVEL AND FUNCTIONAL FITNESS DIFFER IN OLDER WOMEN FROM URBAN AND RURAL AREAS?

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UDC 796.015.132

SUMMARY

The aim of this study was to determine the difference in the level of functional fitness and physical activity between urban and rural older women. 219 elderly women, age 60-80, participated in this study. 146 participants were from an urban while 73 were from a rural area. The physical activity level was assessed by the International Physical Activity Questionnaire (IPAQ). The senior fitness test was used to asses the functional fitness of the participants. The test consists of six measures of physical fitness: 1) Back scratch, 2) Chair sit and reach, 3) 8 foot up and go, 4) 30 sec stand from the chair, 5) Arm curl, 6) 2-minutes step test. The resutls showed that the flexibility (upper and lower limbs) and agility are statistically different in the women from urban areas from the women from rural area. The other parameters of functional fitness (strength and endurance) did not show statistical difference. Also, the women from urban area were physicaly more active in the transport and walking domains than the women from rural areas. The other domains did not show any difference between the urban and rural women. It colud be concluded that the women from different areas are slightly different.

Key words: physical fitness, IPAQ questionnaire, urban, rural, older adults

INTRODUCTION

The physical activity (PA) level is lower in women than in men and this ratio decreases with age. (Caspersen, Pereira, & Curran, 2000). Gender differences in PA and functional fitness are well-known but so far insufficiently researched (Morala-Dimaandal, 2009). Scharff, Homan, Kreuter, and Brennan (1999) determined that the older women from rural area are less physicaly active than those in urban areas. There are several reasons for the differences such as the limited financial resources and social isolation, which is more common in women in rural areas compared to the urban ones (Carruth & Logan, 2002). Many studies showed significant difference in the health status, functional fitness and PA level between urban and rural areas esspecially in a developing country.

The older people from rural area are less PA in the leisure time domain (Fogelholm et al., 2006). In comparison with the life in an urban area, the life in a rural area is often associated with the reduced possibilities of use and access to activities carried out in their leisure time, the level of education is lower and lower revenues per capita as the overall impact on the overall level of PA. On the other hand, older people from rural areas could be more physicaly active in the housework domain and gardening.

In addition to the research conducted up to now there is a need to determine the difference between the PA levels and functional status of people from

urban and rural areas in each of the countries of Europe. These results could be compared and that will be to make certain strategies for improving the level of the PA of the elderly. There is the problem that urban and rural areas are defined differently from country to country, so the consensus on this issue is necessary. We assume that: 1) the overall PA level did not differ between women in urban and rural areas; 2) some domains of PA are different in relation to the place of living, esspecially transport and housworking; 3) functional fitness is the same in women from urban and rural areas. Therefore, the aim of our study was to determine the difference in the PA level and functional fitness between women from urban and rural areas.

METHODS

Participants

The research was conducted on the total sample of 219 elderly women, age 60-80, who agreed to participate in this study. 146 participants (Mean±SD; visina 166.01±28.59 cm; težina 70.07±12.70 kg) were from urban while 73 (Mean±SD; visina 164.25±6.52 cm; težina 70.07±11.72 kg) were from rural areas.

The criteria for selecting participants were: age between 60 and 80 years, a physically independent person - able to walk 20 feet without assistance or rest, no cognitive impairment and dementia, achieved 24 points for the educated and 18 points for the unqualified respondents in a mini mental state evaluation (McDowell, 2006). Also,the participants who were in the recovery phase of an acute illness, the deaf and the blind were excluded. The research does not include the subjects with cardiovascular system disorders because of the potential risks during the functional fitness tests.

TABLE 1 General descriptive parameters

	Rural *n*=73	Urban *n* =146	Total *n* =219
Age	67.87±5.73	67.71±6.39	67.77±6.16
Height	164.25±6.52	166.01±28.59	165.38±23.22
Weight	70.07±11.72	70.07±12.70	70.07±12.35
BMI	25.76±3.83	25.48±4.10	25.59±4.00

BMI-body mass index

Procedure

Each participant has given information about their demographic characteristics first and then their level of physical activity was assessed by the IPAQ questionnaire (International Physical Activity Questioinnaire), the anthropometric measures and the Senior Fitness Test (SFT). Participation in the study was voluntary and each of the participants was able to withdraw from the study at any moment. The study was approved by the Research Ethics Committee of the Faculty of Physical Education and Sport, University in Nis and according to the Declaration of Helsinki. All participants were fully informed about the risks and benefits that this research has on their age group. The testing of all participants was in the period from August to December 2011. All participants were mentally and physically health and able to participate in the study. Qualified researchers have conducted standard interviews with the potential participants individually or in small groups, at their homes or in the active centers for the elderly.

Antropometric measures

The antropometric variables were measured according to the instructions of the International

Biological Program–IBP. Body height was measured to the nearest 0.1 cm by a metric measuring tape. Body weight was measured to the nearest 0.01 kg using a digital scale. The body mass index was calculated by the formula: BMI=body mass (kg) / (body height (m))^2.

IPAQ questionnaire

Self evaluation of the participant's physical activity was conducted according to the Serbian version of the IPAQ questionnaire, whose reliability was confirmed for the Serbian population of over 60 years old (Milanović, Pantelić, Trajkovic, Jorgic, & Sporiš, 2013). For the purpose of this study the long version of the IPAQ questionnaire was used containing four domains of physical activity: work-related, transportation, housework/gardening and leisure-time activity. In addition, the questionnaire contains questions related to sitting and sedentary habits, which were not the subject of our research and were excluded from further analysis. In each of the four domains in testing, the participants have recorded the number of days and the time spent during each day separately for vigorous and moderate intensity activities and also the time spent on walking. Then, the calculation of each item was conducted separately (vigorous activity, moderate activity and walking) according to the official IPAQ instruction (International Physical Activity Questionnaire) so the period of the PA of participants could be determined. Moreover, the Metabolic Equivalent Task (MET) was calculated for each domain separately (work-related, transportation, housework/gardening and leisure-time activity). The total weekly PA level (MET-min/week) was calculated by a separate collecting of the MET values for each item. For calculating the MET values the following coefficients were used: vigorous PA=8.0 METs, moderate PA=4.0 METs and walking PA=3.3 METs.

Vigorous activities are defined as the activities in which the participants breathe more deeply than usual. These can be the activities such as lifting heavy things, digging, heavy construction work or climbing stairs. Moderate physical activities are those in which a person is breathing a little harder than usual and may include the activities such as carrying light loads. Walking is not considered a moderate physical activity. Vigorous and moderate activities are those that lasted for at least ten minutes continuously.

Senior fintes test

The senior fitness test is a battery of tests for the assessment of the functional fitness of older persons. This test assesses the physiological capacity for carrying out normal daily activities independently and safely without the appearance of fatigue. Before testing, the subjects have performed 10 minutes warm up with the instructions given by highly skilled persons, and then a complete SFT with the tasks order referred in this test (Rikli & Jones, 2001). This test was given validity by Rikli and Jones (2001). The test consists of six measures of functional fitness: 1) *Back scratch* that assess upper body (shoulder) flexibility. With one hand reaching over the shoulder and one up the middle of the back, the result is the number of inches (cm) between the extended middle fingers (+ or -), 2) *Chair sit and reach* is a test that assesses the flexibility of the lower extremities. As with the previous test, each subject performed two test trials and two attempts to be measured and included in further analysis. From a sitting position at the front of a chair, with legs extended and hands reaching toward toes, the result is the number of inches (cm) (+ or -) between the extended fingers and the tips of the toes, 3) *8-foot up and go* assess agility/dynamic balance. The result is the number of seconds required to get up from a seated position, walk 8 feet (2.44 m), turn, and return to a seated position, 4) *Chair stand up for 30 sec* assess lower body strength. The result is the number of full stands that can be completed in 30 seconds with arms folded across the chest, 5) *Arm curl* assess upper body strength. The result is the number of bicep curls that can be completed in 30

seconds holding a hand weight of 5 lbs (2.27 kg) for women; 8 lbs (3.63 kg) for men, 6) 2-minutes step test is the alternate aerobic endurance test, used when space limitations or the weather prohibits taking the 6-minute walk test. The result is the number of full steps completed in 2 minutes, raising each knee to a point midway between the patella (kneecap) and iliac crest (top hip bone).

Statistical analysis

The statistical Package for Social Sciences SPSS (v18.0, SPSS Inc., Chicago, IL) was used for the statistical analysis. The descriptive statistics were calculated for all experimental data. To determine the difference between urban and rural areas the t-test for independent subjects was used. The statistical significance was set at $p < 0.05$.

TABLE 2 IPAQ and Senior fitness test parameters

	Selo ***n*=73**	**Grad** ***n* =146**	**Total** ***n* =219**
Back scratch (cm)	-3.55±4.92*	-2.31±4.57*	-2.77±4.74
Chair sit and reach (cm)	3.95±12.07*	.62±12.47*	1.94±12.41
8-foot up and go (s)	6.63±1.52*	6.99±1.43*	6.85±1.47
Chair stand up for 30s (repetitons)	12.49±5.36	13.20±5.23	12.92±5.29
Arm curl (repetitons)	12.90±6.48	13.16±5.81	13.06±6.07
2-minutes step test (repetitons)	83.05±25.81	81.87±24.79	82.26±25.09
Total work-related (MET)	337.62±1397.33	528.66±1946.98	454.01±1754.14
Total transportation (MET)	578.54±1253.30*	597.80±1288.08*	590.33±1273.78
Total housework (MET)	2695.47±3049.03	1935.70±2507.86	2209.78±2737.47
Total leisure-time (MET)	727.84±2092.41	800.97±2156.31	772.55±2130.38
Total walking (MET)	948.23±1876.95*	1148.83±2129.18*	1071.03±2035.95
Total moderate (MET)	3298.26±3821.07	2563.00±3471.13	2828.68±3615.63
Total vigorous (MET)	227.24±1154.05	192.51±944.93	205.98±1030.32
Total Physical Activity (MET)	3960.97±4529.72	3766.44±4861.37	3836.54±4741.51

*- statisticaly significance $p<0.05$

RESULTS

The general descriptive parameters did not show a statistically significant difference between women from urban and rural areas. There was a statistically significant ($p<0.05$) difference between urban and rural areas in flexibility and agility. Flexibility is different in the upper arm (-3.55±4.92 vs 2.31±4.57) as well as the lower arm (3.95±12.07 vs .62±12.47). Other parameters of functional fitness (strength and endurance) did not show statistically significant differences with respect to the place of residence ($p <0.05$). Also, women in urban areas are much more physically active in the transport and walking domains compared to the women in rural areas. Other domains did not show statistically significant differences.

DISCUSSION

According to the author's knowledge this is the first study in Serbia on the topic of urban-rural differences in the level of PA and functional fitness in older women. The results of this study partially confirmed our assumption that the overall level of PA is no different between urban and rural areas. However, there was difference in some domains. On the other hand, the results did not confirm the assumption, posted on the basis of the lack of difference in the overall level of PA, that there is no difference in functional fitness.

Our resutls showed that the women from an urban area are more physically active in the transportation domain. These results are expected

because the women in rural areas are more depend on motor vehicles than the women from urban areas due to the low population density and poor road network (Frank, 2000; Handy, Boarnet, Ewing, & Killingsworth, 2002; Savitch, 2003). These factors condition them to finish their normal daily activities without motor vehicles. The results of our study are in relation with previous studies on the same topic (Frank, 2000; Handy et al., 2002; Savitch, 2003). Also, the same reasons influence the fact that the level of PA in the domain of walking is much lower among the women in urban compared to rural areas. Practically, the PA transportation domain and walking domain are closely associated with respect of the level of PA in the elderly.

In cotrast to the PA level, functional fitness parameters were different between urban and rural areas esspecially flexibility and agility. Currently there are no relevant researches to prove the process of making this distinction so that future studies are needed to determine the mechanism of the growth of the differences in the level of flexibility, depending on the place of residence. Also, future research should determine whether there is a difference between the children of urban and rural areas because, so far a number of studies have been focused primarily on the adults. The limitation of this study is the large difference in the number of participantss from urban and rural areas. The results achieved by this study should be interpreted with caution and possibly a repeated study, with approximately the same number of respondents, should be carried out.

Based on the previously mentioned, we can conclude that the women of urban and rural areas differ slightly when it comes to the levels of PA, while there are some differences, primarily in the parameters of flexibility and agility, among the older women of urban and rural areas.

Acknowledgement

The research is a part of the project financed by the Ministry of Science of the Republic of Serbia entitled “Physical activity and the fitness components of the elderly“ (no. 179056), approved in 2010, which is being realized at the Faculty of Sport and Physical Education of the University of Nis.

REFERENCE

Carruth, A. K., & Logan, C. A. (2002). Depressive symptoms in farm women: effects of health status and farming lifestyle characteristics, behaviors, and beliefs. *Journal of Community Health, 27*(3), 213-228.

Caspersen, C. J., Pereira, M. A., & Curran, K. M. (2000). Changes in physical activity patterns in the United States, by sex and cross-sectional age. *Medicine and Science in Sports and Exercise, 32*(9), 1601-1609.

Fogelholm, M., Valve, R., Absetz, P., Heinonen, H., Uutela, A., Patja, K., . . . Nissinen, A. (2006). Rural—urban differences in health and health behaviour: A baseline description of a community health-promotion programme for the elderly. *Scandinavian journal of public health, 34*(6), 632-640.

Frank, L. D. (2000). Land Use and Transportation Interaction Implications on Public Health and Quality of Life. *Journal of Planning Education and Research, 20*(1), 6-22.

Handy, S. L., Boarnet, M. G., Ewing, R., & Killingsworth, R. E. (2002). How the built environment affects physical activity: views from urban planning. *American Journal of Preventive Medicine, 23*(2), 64-73.

McDowell, I. (2006). *Measuring health : a guide to rating scales and questionnaires*. Oxford ; Toronto: Oxford University Press.

Milanović, Z., Pantelić, S., Trajkovic, N., Jorgic, B., & Sporiš, G. (2013). Reliability of the Serbian Version of the International Physical Activity Questionnaire (IPAQ) for Older Adults. *Archives of Geriatrics and Gerontology, (in press)*.

Morala-Dimaandal, D. T. (2009). Differences of functional status among elderly women in urban and rural settings-Self-report and performance-based measures. *Advances in Physiotherapy, 11*(1), 13-21.

Rikli, R. E., & Jones, C. J. (2001). *Senior fitness test manual*. Champaign, IL: Human Kinetics.

Savitch, H. (2003). How suburban sprawl shapes human well-being. *Journal of Urban Health, 80*(4), 590-607.

Scharff, D. P., Homan, S., Kreuter, M., & Brennan, L. (1999). Factors associated with physical activity in women across the life span: implications for program development. *Women and Health, 29*(2), 115-134.

DA LI SE NIVO FIZIČKE AKTIVNOSTI I FUNKCIONALNI FITNES RAZLIKUJU KOD STARIH ŽENA URBANE I RURALNE SREDINE?

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SAŽETAK

Cilj ovog istraživanja bio je da utvrdi eventualne razlike u nivou fizičke aktivnosti i parametrima funkcionalnog fitnesa izmedju žena urbane i ruralne. Istraživanje je sprovedeno na ukupnom uzorku od 219 žena, starosti izmedju 60 i 80 godina od kojih je 146 živelo u urbanoj a 73 u ruralnoj sredini. Nivo fizičke aktivnosti ispitanika procenjen je pomoću IPAQ upitnika. Za procenu funkcionalnog fitnesa korišćen je Senior Fitnes Test koji sadrzi šest varijabli: 1) pokretljivost ramena, 2) pretklon na stolici, 3) osam stopa, 4) ustajanje sa stolice za 30 sekundi, 5) fleksija u zglobu lakta, 6) dvominutni step test. Rezultati istraživanja pokazuju da se žene urbane sredine statistički značajno razlikuju u parametrima fleksibilnosti i agilnosti u odnosu na žena ruralne sredine. Ostali parametri funkcionalnog fitnesa (snaga i izdržljivost) ne pokazuju statistički značajne razlike u odnosu na mesto stanovanja. Takodje, žene iz urbane sredine su mnogo više fizički aktivne u domenu transporta i pešačenja u odnosu na žena iz ruralne sredine. Ostali domeni ne pokazuju statistički značajne razlike. Na osnovu sprovedenog istraživanja možemo d azaključimo da mesto stanovanja samo delimično utiče na parametre funkcionalnog fitnesa i nivoa fizičke aktivnosti starih žena.

Ključne reči: fizički fitnes, IPAQ upitnik, selo, grad, stare osobe

INNOVATIONS IN PROGRAM OF RECREATIONAL ACTIVITIES

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SUMMARY

Introduction: Recreational classes presents important item in primary school curriculum because of the opportunities offered and various effects it has on children's body. The main subject of the study is program of recreational classes. The researches were aimed to gain insight into the interest of boys and girls in recreational classes for the program that was implemented, and to determine appropriate guidelines for the realization of future programs.

Methods: The sample consisted of 414 respondents (210 boys; 204 girls), aged 9 and 10 years. Non-standardized questionnaire was applied for the purpose of this research, which consisted of 19 questions. The survey was conducted for two years in a row, so that respondents are divided on the basis of when the survey was conducted. Calculating the statistical significance of differences between groups was realized by using the chi-square test (χ^2) independence, at the conclusion of a significance level of 0.05.

Results: This research showed the statistically significant differences in certain attitudes between the two groups of respondents. Based on the results, between groups of respondents was observed difference in the interests in the programs carried out during the day. The first group showed more interest in afternoon activities (53.2%), while a second group favored more evening activities (47.4%). Also a difference was noticed in the type of activities that were carried out in the evening program, the most interesting part of the evening program for the first group was carnival (37.4%), while the second group liked games without frontiers more (32.8%). The curriculum in realized recreational classes was more involved in second group of respondents, and the subjects that desired both groups in the first place for realization were art, then mathematics and nature study.

Conclusion: Based on these results it can be concluded that there are differences in opinion between the survey conducted two years in a row. Group of questions in which was noticed significant difference in attitudes belongs to the pleasures and interests of children and also to the group future product of innovation of recreational classes. This survey can traced trend of children's interest in certain activities that are carried out in a recreation class. Considering that a large number of issues were characterized by the same attitude in both groups, results obtained can be used for certain changes in order to improve the program and recreational classes.

Key Words: recreation classes, programs, interest

INTRODUCTION

Recreational class is an integral part of the curriculum in primary schools. It includes organized stay in nature of early school age (from first to fourth grade), for a period of five to ten days. Recreational class is optional item in child's school education, it was even discussed about her exclusion from the curriculum. Because of the multiple importance to children's organism it still takes part and it is realized once a year. According to Ivanovski (2010) recreational classes in nature (in comparison to other forms of work in the family, kindergarten and elementary school) has a wide and significant tasks with a high educational level of organization of life

and work for kids and rich functional structure. Place of realization of recreation classes is different from school to school, usually they are well-known tourist resorts, mountains and spas that offer the most advantageous conditions for the realization of the program.

A positive influence of nature on children's body is confirmed by many authors in their works (Piaget, 1962; Fjørtoft & Sageie, 2000; Karen & Turner, 2003; Sobel, 2004). The natural environment provides a variety of physical activities, which by its topography and vegetation provides children an even greater challenge. Physical activities adjusted in dosage programs whit guided skilled professionals (animators) are the basis for recreational classes.

Spending time in nature during recreational class is insufficient for some major changes in a child's growth and development, but programs which are rich with various contents can wake up child interest in sports - recreational activities and allows assembly and firming new friendships. Knowledge of the children's interest is very important for the planning and programming recreational classes. Based on previous research it was determined that there is almost always a visible differences between the sexes, both in engagement in sports activities and in their interests (Caspersen et al., 2000; Riddoch et al., 2004; Milosevic et al., 2012). Recreational program is realized regardless of gender, where groups are formed on the basis of belonging to classes. Based on the research Zivkovic et al. (2012) found that the interest in the recreational program is also different according to gender, and they suggest, if it is possible, to specifically adjust the program for boys and girls.

This study is about program of recreational class. The goal of this research is to improve the program and recreational classes. After identifying the interests and attitudes of children of the realized programs and recreational classes, seeks to determine certain trends that will draw attention to certain changes. The monitoring of the recreational classes were divided on the basis of time of maintenance of programs (morning workout, afternoon and evening program) . The obtained results will be established for future innovation programs and recreational classes.

METHODS

The sample

The sample consisted of 414 respondents, of which 210 were boys and 204 girls, ages 9 and 10. All respondents attended primary school "Sveti Sava" from Nis, and the condition for the research was that they were in a recreation teaching carried out in the school. Recreation program was held on Zlatibor, Lukovska spa, Kopaonik and Sokobanja. Respondents were interviewed in their classrooms, after the approval of the parents and schools. Before the survey, respondents were explained the process and flow of the interview.

A sample of measuring instruments

For the purpose of this research was applied anonymous, non-standardized questionnaire that included a total of 19 questions. The survey was conducted for two years in a row, so that respondents were divided on the basis of when the survey was realized. Questions are conditionally divided into three groups. The first group was defined as 1) *General characteristics of the recreational program and children familiarity with him*, and was made of three questions. 2) The second group consisted of ten questions, which were singled out as *The pleasure and interest of children with realized the recreational program*. 3) The third set of questions consisted of six items, and the group is defined as *Interest and innovation for the future program of recreational classes*. In this research was applied a three-stage, four step and five-point scale.

Statistical analysis of data

For statistical analysis was used nonparametric tests for significance of the difference chi-square test

(χ^2). To determine differences among groups according to the year of realization the recreational class, we applied chi-square test of independence (χ^2). For the level of significance it was chosen level, P <0.05. Results were analyzed using SPSS (version 20.0).

RESULTS

Table 1 shows the observed frequency, percentages, chi - square test (χ^2) of independence between groups, for group of questions defined as the General characteristics of recreational education programs and familiarity of children with him.

In this group of questions there is only one statistically significant difference between the groups. Second group of respondents (61.5%) was more familiar in recreational education program before going, compared to the first (40.1%)

TABLE 1. General characteristics of the recreational programs of teaching and children's familiarity with it

Question	Answer	I group	II group	I vs II	
		Frq (%)	Frq (%)	χ^2	Sig.
I went to RC because	friend,	25 (11,3)	17 (8,9)	2.598	.459
	spending time in nature	123 (55,4)	110 (57,3)		
	sports,	44 (19,8)	31 (16,1)		
	other	30 (13,5)	34 (17,7)		
Were you familiar whit RC before living	yes;	89 (40,1)	118 (61,5)	18.805	.000*
	partially,	77 (34,7)	43 (22,4)		
	no	56 (25,2)	31 (16,1)		
RC is good for	helth,	65 (29,3)	61 (31,8)	2.901	.407
	socializing,	82 (36,9)	73 (38,0)		
	learning,	17 (7,7)	20 (10,4)		
	fun,	58 (26,1)	38 (19,8)		
	not good				

Legend: Frq. - Frequency - the number of the subject, χ^2- Chi-square test, * - p <.05, Sig - level of significance, RC - recreational classes.

Results from the set of questions that are related to pleasure and interests of children in performed recreational classes are shown in Table 2. In this group of questions from a total ten items were identified four significant differences.

A statistically significant difference of 0.008 shows that the first group more liked afternoon activities (53.2%), in contrast to second group of respondents (34.7%), who liked more evening program. The morning program was found in third place in both groups.

As for the evening program, the first group more liked masquerade (37.4%), while the second group was more interested in games without frontiers (32.8%), a statistically significant difference was 0.002 (Sig <.05).

A statistically significant difference of 0.041 indicates that the second group of respondents was more involved in the teaching process, which was implemented in the recreational classes. 31.3% of the second group had classes, while first group had only 21.2%.

The results in Table 2 show that over fifty percent of both groups gained positive experience thanks to animators and learned lots of new things (First group 55.9% and second group 75%).

Table 2. Pleasure and interests of children in carried out recreational education program

Question	Answer	I group Frq (%)	II group Frq (%)	χ^2	I vs II Sig.
Which of the following activities do you like most about RC	morning workout,	27 (12,2)	28 (14,6)	9.664	.008*
	afternoon activities,	118 (53,2)	73 (38,0)		
	evening program	77 (34,7)	91 (47,4)		
Would you like to morning exercise be replaced by another activities	yes,	74 (33,3)	48 (25.0)	5.923	.052
	sometime,	70 (31,5)	55 (28,6)		
	no	78 (35,1)	89 (46,6)		
Do you like morning walk in RC	yes,	168 (75,7)	147 (76,6)	.906	.924
	mostly,	36 (16,2)	30 (15,6)		
	no, its exhausting,	10 (4,5)	9 (4,7)		
	I would like to replece it	7 (3,2)	6 (3,1)		
Which sport on RC do you like most	football,	84 (37,8)	72 (37,5)	6.174	.103
	volleyball,	63 (28,4)	37 (19,3)		
	between two fires,	39 (17,6)	40 (20,8)		
	other	36 (16,2)	43 (22,4)		
From evening programs I especially like	costume ball,	83 (37,4)	50 (26,0)	19.456	.002*
	making haircut,	23 (10,4)	31 (16,1)		
	miss i mister,	23 (10,4)	14 (7,3)		
	show what you can,	33 (14,9)	26 (13,5)		
	dencing night,	19 (8,6)	8 (4,2)		
	games without frontiers	41 (18,5)	63 (32,8)		
Would you like that evening program is diffrent	yes	28 (12,6)	26 (13,5)	1.020	.600
	mostly	44 (19,8)	45 (23,4)		
	no	150 (67,6)	121 (63,0)		
Did you have teaching on RC	yes	47 (21,2)	60 (31,3)	6.392	.041*
	sometime	95 (42,8)	79 (41,1)		
	no	80 (36,0)	53 (27,6)		
Did animators doing good their job	yes	168 (75,7)	145 (75,5)	.186	.911
	mostly	43 (19,4)	39 (20,3)		
	no	11 (5,0)	8 (4.2)		
Did you learn something new on RC from animators	yes, a lot	124 (55,9)	144 (75,0)	20.086	.000*
	little	74 (33,3)	39 (20,3)		
	no, everything I knew	24 (10,8)	8 (4,2)		
How would you mark RC	five	151 (68,0)	153 (79,7)	7.996	.092
	four	49 (22,1)	30 (15,6)		
	three	16 (7,2)	6 (3,1)		
	two	2 (0,9)	1 (0.5)		
	one	4 (1,8)	2 (1,0)		

Legend: Frq. - Frequency - the number of the subject, χ^2- Chi-square test, * - p <.05, Sig - level of significance, RC - recreational classes.

In Table 3 the results show answers to the set of questions that are related to the interests and innovations for the future program of recreational classes. From the third group of questions that consist of six items was obtained only one statistically significant difference at the level of

0.015, which indicates that there are different opinions about subjects that were realized in recreation program. The largest number of respondents in both groups was interested in art (first group 45%, second group 44.3%).

TABLE 3 Interests and innovation for the future program of recreational classes

Question	Answer	I group Frq (%)	II group Frq (%)	I vs II χ^2	Sig.
Exercise in the morning change with	waking up with music,	34 (15,3)	42 (21,9)		
	morning walk,	81 (36,5)	76 (39,6)		
	talk about a healthy lifestyle ,	13 (5,9)	11 (5,7)	9.393	.052
	longer sleeping ,	74 (33,3)	40 (20,8)		
	other	20 (9,0)	23 (12,0)		
Replace walk with	dont replace,	100 (45,0)	99 (51,6)		
	sports,	67 (30,2)	43 (22,4)		
	games,	48 (21,6)	43 (22,4)	3.673	.452
	teaching,	2 (0,9)	3 (1,6)		
	other	5 (2,3)	4 (2,1)		
Which sports activities would you like to have on RC	handball,	20 (9,0)	18 (9,4)		
	basketball,	32 (14,4)	34 (17,7)	0.986	.912
	swimming,	95 (42,8)	77 (40,1)		
	games,	55 (24,8)	45 (23,4)		
	Other	20 (9,0)	18 (9,4)		
I would like That evening program have	going to the disco,	97 (43,7)	89 (46,4)		
	quiz,	72 (32,4)	54 (28,1)	4.473	.215
	sports activities,	49 (22,1)	39 (20,3)		
	other	4 (1,8)	10 (5,2)		
Would you like that everyday on RC you have teaching	yes,	35 (15,8)	34 (17,7)		
	maybe,	39 (17,6)	41 (21,4)	1.525	.466
	no	148 (66,7)	117 (60,9)		
Which subject would you like to have on RC	serbian language,	21 (9,5)	18 (9,4)		
	math,	35 (15,8)	53 (27,6)		
	nature study,	28 (12,6)	18 (9,4)	12.336	.015*
	art,	100 (45,0)	85 (44,3)		
	other	38 (17,1)	18 (9,4)		

Legend: Frq. - Frequency - the number of the subject, χ^2- Chi-square test, * - p <.05, Sig - level of significance, RC - recreational classes.

DISCUSSION

Recreational class is just one of a series of stimulus spectrum of activities that should encourage children's proper growth and development (Zivkovic et al., 2012). Its influence is transcribed impact of natural environments on children's organism, it allows the child interacts with the natural environment, with an organized program of activities makes the whole experience more interesting and positive. Based on the results it can be concluded that over half of both groups wanted to participate in the recreation classes because of the nature. In second place were sports activities. Attendance of children in the natural environment stimulates motor development, allows multiple experiences, stimulate learning through play and cognitive development, develop imagination, creativity, self-confidence, and allows development of friendship and communication (Fjortoft & Sageie 2000; White, 2004). Respondents' opinions on the

impact of recreational classes and its benefits were also the same in both groups. In the first place respondents opined that the recreational classes is good for socializing (I group 36.9%, II group 38%), followed by the health (I group 29.3%, II group 31.8%) and the third for fun (I group 36.9%, II group 38%). According to the author Parsons (2011) a combination of spending time in nature and outdoor activities will initiate the process of learning, development, and impact on overall health.

The second group of questions was related to the satisfaction and interest of the children in realized program, where they evaluated the program realized on recreational classes. Program of recreational class was observed through three segments compared to the time of implementation of activities, divided into morning exercise, afternoon and evening program. Opinion of respondents about most favorite part of the program in recreational classes varied, the first group of respondents most liked afternoon activities, while the second group was interested in evening program.

Morning exercise is the least interesting to respondents, which can be considered for future to introduce certain changes. The morning exercise as a part of program have walk which respondents in both groups positively evaluated as a pleasant activity (I group 75.7%, II group 76.6%). Walking is a low intensity activity, but if you use the topographic characteristics of the land, increase the length of traveled distance and thus aggravate conditions it can be very useful, whit stimulating effect on children's body. Authors Fjortoft & Sageie (2000) recommend that at early school age the slope in realizing walk does not exceed 30 degrees.

As part of afternoon activities at the recreation classes depending on weather conditions and place of realization sports activities are the most popular. Activities used in outdoors offers children the freedom to explore, use their senses and be physically active (Ambrose & Armstrong, 2009). The most interesting sports activity in both groups was football and volleyball. However, a large percentage of the respondents chose other activities (I group 16.2%, II group 22.4%), because the winter period initiated the winter games. Sports activities are always carried out when conditions allow outdoor, whatever sports game is chosen for the realization in combination with the natural environment will dynamically affect and stimulate children organism. Kellert (2002) in his research talks about particular "moment" that occurs between 6 to 12 years, and says that in this period children must be included in outdoor activities. He called that moment "imprint" that creates long-term experience and shapes children's attitudes toward nature. Authors Dyment and Bell (2008) in their work that followed the physical activity of children in the natural environment have noticed improvement of coordination and balance, which confirms the impact on motor development of children. Sports activities occupy most of the day according to the schedule of recreation class, but for the entire duration of the program seems more like stimulus for children which can create a positive image and experience to continue practicing a sports activity.

The evening's program includes a variety of animations games, in order to competitions and expression of creativity and originality. As the most interesting activities respondents chose a costume party, games without frontiers and play all you can. More than half of both groups said they were satisfied with the evening program and they would not change its contents.

Teaching is a significant part of recreational class, but it depends on the initiative, teachers and their affinities. The results showed that at realized recreational classes teaching was sometimes conducted (I group 42.8%; I group 41.1%).

As a part of recreational class, the one who determines its overall performance, in charge of the implementation of the recreation program is an instructor. Animators activity start from the moment when guests arrives and lasts throughout their stay, which is why the animators require specific psychophysical characteristics, talents and sense of contact with the guest, as well as a certain level of education (Ivanovski, 2010). The results showed

that over fifty percent in both groups of respondents learned a lot of new and positive things from animators, than it can be concluded that the recreational classes uses for educational purposes. The recreation program includes a wide area, which represents the relationship between the child, the nature and physical activity. For general impression of realized recreational program, both study groups chose mark five (I group 68%, II group 79.7%).

After introductions to the interests and attitudes of the respondents whit realized recreation class, we will now introduce separate set of questions which includes their suggestions and wishes. The survey covered every segment of recreational classes and offered a series of activities that can be carried out and implemented in some future cycle and also offered respondents to write their own proposals.

The respondents from both groups expressed interest in replacing morning exercise with early walk (I group 36.5%, II group 39.6%), or waking up with a music (choreography, exercise with music). Although the morning exercise ranked last place of interest, it cannot be excluded from the program, and it is recommended whenever it is possible to be carried out in open air. Stay outdoors area contains a large concentration of oxygen in the air up to 25% more than the closed space with open windows and doors (Ambrose & Armstrong, 2009).

For all other programs (afternoon activities, evening programs, teaching) we observed a trend of the same interests in both groups, the selected activities were given equal positive responses and found themselves in the same place. On image 1 we presented the activities that drew the greatest attention in both study groups. From afternoon activities, sport activity that is ranked in first place is swimming (I group 42.8%, II group 40.1%). From sports activities on recreation classes usually we most of the time carry out sports games. They are the easiest to realize, primarily because of simple, generally known rules, equipment which is easy to provide, and also because the concept of the game requires a large number of children. The results of this study shown that the swimming is the most favorite activity. Realization of swimming on recreation class is possible only in object that have indoor pool, because recreational class is not realized in summer. It is recommended always to have present expert (or more animators, swimming coach, lifeguards), that classes are realized in small groups, separated to non-swimmers and swimmers and implemented in the medium or smaller pools depending on conditions and program implementation (Zivkovic and al., 2012).

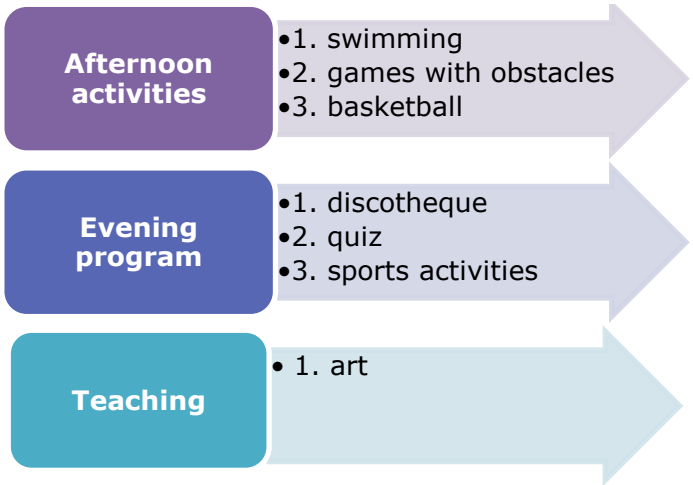

Image 1 Graphical representation of trends of interest in both groups.

According to the wish of the respondents going to a disco, as a part of the evening program is in the first position (I group 43.7%, II group 46.4%). One role of the recreational class is a social development

of children, so if we increase going to the disco, or other types of gatherings we will promote the development of social components (Zivkovic et al., 2012).

The results show that more than half of both groups are not interested in the implementation of the teaching process every day, but as a subject that would prefer to listen and to practice is the art (I group 45%, II group 44.3%). We could increase the interest of children for learning if we teaching process implemented in natural environment. Spending time in nature promotes a form of learning where children learn about the natural environment, specially can be effective in the realization of subjects nature and society (Benđur & Veinović, 2008). It is recommended that if it is possible that all subjects and the learning process be carried out in nature. Kahn and Kellert (2002) point out that the experience gained in the nature have great importance in childhood, because it enables physical and mental development. Sobel (2008) claimed that learning in nature and experience gained in it is more lasting and significant in comparison with learning the facts from books, he also noticed that an experience in nature is worth a thousand facts from the literature.

CONCLUSION

The recreation program contain of sports – fun activities and along with spending time in nature enriches the experience of children. Whit this survey we can trace trend of children's interest in certain activities that are carried out in a recreation class. The results of this study showed that respondents are satisfied with the realization of the entire program (I group 68%, II group 79.7%). The content that is being realized in recreation class, as the most interesting part of the respondents singled out the evening and afternoon program. It can be said that spending time in nature is the main reason for children to come to recreational education.

In order to improve recreational programs it is recommended to devote the most attention to the content in the morning. Morning workout as part of the program is a significant and important part of the recreation class, but according to the results of the survey and desires of respondents is recommended to replace it on certain days by another action. In order to break the stereotype it can be include music during the morning gymnastics.

Afternoon activities include sports activities of a different character. The most common of the sports games that are realized on the recreation classes are football and volleyball. Based on the results and desire of the respondents, swimming is the most favorite of all subjects (I group 42.8%, II group 40.1%). A tourist - recreation centers offers ability for realizing swimming, but also limiting the choice for realization of recreational class. Swimming activity has positive effects on the whole children organism, also it's fun activities, but it should be approached with responsibility. It is necessary and required to have professional persons who will work with children divided in swimmers and non-swimmers group. If conditions on recreation class allows it is recommended that swimming is conducted every other day.

Teaching is a part of recreational program and depends upon the teacher, but it is not so present and preferred by respondents. Is recommended to be relaxing character, small scope and intensity, and often can be realized in the nature. Fine arts as a subject, is ranked first in the desire of the respondents for the realization on recreation class.

Evening program for its diversity contents and activities that are competitive - entertaining character is one of the most popular programs at recreational class. Content that is generally realized changes every night, and this research confirms that is desired by the respondents to go to the discotheque more often.

The entire contents of recreational education program are designed to follow the needs of children of a given age. Following their interests and desires we will contribute and improve the program, which will get greater satisfaction and a more positive experience.

REFERENCES

Ambrose, L., Armstrong, J. (05.12.2009). *Early years Outdoor Learning*. Norfolk Contry Council. Nađen 06.06.2013, www.norfolk.gov.uk/outdoorlearning

Benđur, V., Veinović, Z. (2008).School in nature and education for environment. *Pedagogical reality,* 9 (10), 973-980.

Dyment, J.E. & Bell, A.C. (2008). Grounds for movement: green school grounds as sites for promoting physical activity. *Health Education Research,* 23(6), 25–34.

Živković, M., Stamenković, M. & Pantelić, S. (2012). Interests and opinions of children and recreational education program. In M. Dopsaj (Eds.) Proceedings - *Effects of physical activity on the anthropological status of children, youth and adults* (pp. 226-234) Belgrade: FSFV.

Ivanovski, A. (2010). *Profile animators recreation in tourism* (MA thesis). Belgrade: Faculty of Sport and Physical Education.

Kahn, P. Jr. & Kellert, S. R. (2002). Introduction. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations,* Cambridge: MIT Press, MA.

Kellert, S. R. (2002). Experiencing Nature: Affective, Cognitive, and Evaluative Development in Children. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations,* Cambridge: MA.

Milosavljević, V., Petrović, A. & Živković, M. (2012). Interest in physical activity of primary school students in Sremska Mitrovica, Jagodina are not. In M. Dopsaj (Eds.) Proceedings - *Effects of physical activity on the anthropological status of children, youth and adults* (pp. 503-508) Belgrade: FSFV.

Parsons, A. (2011). *Young Children and Nature: Outdoor Play and Development, Experiences Fostering Environmental Consciousness (master dissertation),* Virginia: Faculty of the Virginia Politechnic Institue.

Piaget, J. (1962). *Play, dreams, and imagination in children.* New York: Norton.

Riddoch, C.J., Andersen, L.B., Wedderkopp, N., Harro, M., Klasson-Heggeb, L., Sardinha, L.B., Cooper, A.R., & Ekelund, U. (2004). Physical activity levels and patterns of 9 and 15-year-old European Children. *Medicine and Science in Sport and Exercise*, 36, 86-92.

Sobel, D. (2004). *Place-Based Education, Connecting Classrooms & Communities.* Great Barrington, MA: The Orion Society.

Sobel, D. (2008). *Childhood and Nature: Design Principles for Educators.* Portland: Stenhause Publishers .

Tanter, P. & Karen, M. (2003). School Grounds as Sites for Learning: making the most of environmental opportunities . *Environmental Education Research,* 9 (3),Nadjen: 23.09. 2012.,http://uws.academia.edu/KarenMalone/Papers/367964/School_Grounds_As_Sites_for_Leaning_Making_the_Most_of_Environmental_Opportunities.

Fjortoft, I. & Sageie, J. (2000). The natural environment as a playground for children Landscape description and analyses of a natural playscape. *Landscape and Urban Planning,* 48, 83-97.

Caspersen, C.J., Pereira, M. A. & Curan, K.M. (2000). Changes in physical activity patterns in the United Sttes, by sex and cross-sectional age. *Medicine and Science in Sports and Exercise*, 32, 1601-1609.

White, R. (2004) Young Children's Relationship with Nature: Its Importance to Children's Development & the Earth's Future, White Hutchinson Leisure & Learning Group. Nađen: 30.11.2012.,http://myscienceplace.org/uploads/3/0/8/2/3082677/young_childrens_relationship_with_nature.pdf

INOVACIJE U PROGRAMU REKREATIVNE NASTAVE

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SAŽETAK

Uvod: Rekreativna nastava predstavlja značajnu stavku osnovno školskog plana i programa upravo zbog mogućnosti koje nudi i raznovrsnog uticaja koji ima na dečiji organizam. Predmet ovog rada je program rekreativne nastave. Istaraživanje je imalo za cilj da stekne uvid u interesovanja dečaka i devojčica za program rekreativne nastave koji je realizovan, i odredi adekvatne smernice za realizaciju budućih programa.

Metode: Uzorak ispitanika činilo je 414 ispitanika (210 dečaka; 204 devojčica), uzrasta 9 i 10 godina. Za potrebe ovog istraživanja primenjen je nestandardizovani anketni upitnik, koji je sadržao ukupno 19 pitanja. Anketa je sprovedena dve godine za redom, tako da su ispitanici podeljeni na osnovu godine kada je realizovano anketiranje. Izračunavanje statističke značajnosti razlika između grupa realizovano je pomoću Hi-kvadrat testa (χ^2) nezavisnosti, pri zaključivanju na nivou značajnosti 0.05.

Rezultati: Ovim istraživanjem dobijene su statistički značajne razlike u pojedinim stavovima između dve anketirane grupe. Na osnovu dobijenih rezultata zapažena je razlika između grupa ispitanika u interesovanjima za programe koji se realizuju u toku dana. Prva grupa je pokazala veće interesovanje za popodnevne aktivnosti (53,2%), dok je druga grupa više preferirala večernje aktivnosti (47,4%). Uočena je razlika i u tipu aktivnosti koje su se sprovodile u večernjem programu, kao najinteresantniji deo večernjeg programa prvoj grupi je bio maskembal (37,4%), dok su kod druge grupe bile igre bez granica (32,8%). Nastavni program na rekreativnoj nastavi bio je zastupljeniji kod druge grupe ispitanika, a predmeti koji su po želji ispitanika obe grupe bili na prvom mestu za realizaciju jesu likovno, zatim matematika i poznavanje prirode.

Zaključak: Na osnovu dobijenih rezultata može se konstatovati da postoje razlike u stavovima između anketiranja koje je sprovedeno dve godine za redom. Grupa pitanja kod koje je zapažena razlika u stavovima pripada zadovoljstvima i interesovanjima dece sprovedenim programom i inovacijama za budući program rekreativne nastave. Ovim anketiranjem može se pratiti trend interesovanja dece za određene aktivnosti koje se sprovode na rekreativnoj nastavi. S obzirom da je veliki broj pitanja okarakterisan istim stavom kod obe grupe, može poslužiti za određene izmene u cilju poboljšanja programa rekreativne nastave.

Ključne reči: rekreativna nastava, program, interesovanja

A REVIEW OF THE RESEARCH OF PHYSICAL ACTIVITY AND THE QUALITY OF LIFE IN OLDER PEOPLE: THE PERIOD FROM 2000 TO 2012

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UDC 796 – 053.88(2000-2012)

SUMMARY

Introduction: During life, the natural aging process inevitably brings many structural and morphological changes in the body that affect the daily lives of individuals. Regular physical exercise provides optimal health and overall physical ability and ensures a better quality of life and contributes to social adaptation. In recent years, emphasis is placed on improving the physical health of older people, through regular recreational activities. The aim of this study was to determine the research methodology, the relationship between physical activity and the quality of life, and the results obtained by foreign and domestic authors.

Methods: The selection of works was based on the issues relating to physical activity and the quality of life of older persons. In order to review the selected works, descriptive methods have been used. Field selection includes 36 papers, noting that the respondents were over 60 years old.

Results: The analysis of the selected studies showed that there is a positive correlation between physical activity and the perception of the quality of life, and it depends on what domain of life quality is assessed. The quality of life and the questioned domains in the selected studies (psychological, sociological and health) have a positive association with the practice of some forms of physical activity.

Conclusion: There was no statistically significant difference in methodology between the authors. Since there is a positive correlation between physical activity and the quality of life, further research is directed to examine the link between physical activity and various domains of the quality of life, especially in the middle and lower class. Therefore, it is important to develop the awareness that successful aging requires regular recreational activity that promotes health, resulting in a good quality of life, social and psychological well-being.

Key Words: physical activity, quality of life, studies, older people.

INTRODUCTION

During life, the natural aging process inevitably brings many structural and morphological changes in the body that affect the everyday lives of individuals. The question is how to meet the aging process and what to do for it to be a quality, integral part of the overall life of an individual.

From the historical point of view, aging is a consequence of the gradual loss of specific life energy, nascency of chronic and degenerative disease, disability and premature death.

During the aging process, many structural and morphological changes in the body occur which have an impact on the activity of all body organs and systems. These changes are included in more or less all the vital functions of an individual and those are the inevitable prelude to age- biological category that can not be separated from other life periods. On the other hand, the psychological changes take place on the intellectual, emotional and motivational levels. Loss of social roles (especially the retirement) that are primarily active in the individual's activity often leads to the loss of motivation for any activity.

Successful aging encompasses multiple dimensions of health, including physical, functional, social and psychological well-being (Phelan et all., 2004).

It has been scientifically proven that insufficient and inadequate physical activity leads to serious health problems of elders, and they should be encouraged for new challenges (Spencer, 2000).

Physical activity has a beneficial effect on the life quality of patients with depression (Singh et all., 1997), coronary heart disease (Lavie & Milani, 1997), those with the dysfunction of multiple organs (Wehler et all., 2003) . It also reduces the risk of diabetes, hypertension, cancer, and almost all causes of death (Di Pietro, 2001; Lim & Taylor, 2005).

Many reviewed articles and research studies pointed to the benefits of increasing physical activity to reduce chronic disease in old age population (Hambrecht et al., 2004; Helmrich et al., 1994; Hoidrup et al., 2001; Hu et al., 2005; Laaksonen et al., 2005; McTiernan et al., 2003; Schnohr et al., 2003; Whelton et al., 2002).

Persons involved in the recommended physical activity have a better quality of life than their less active colleagues (Brown et all., 2003).

Physical activity in the form of endurance or strength is positively related to the quality of life, regardless of age, health status and previous activity (Rejeski & Mihalko, 2001).

Quality of life is a concept that reflects the desired life conditions of the individual associated with eight main dimensions of his life: emotional well-being, relationships, material well-being, personal development, physical well-being, self-actualization, a place in the society and his/her rights (Schalock, 2000). Although it is associated with physical health and functioning, it may not be directly dependent on the health status. Some people live well and are satisfied with their lives despite of ill health, and vice versa.

However, the positive correlation between the levels of physical activity and the quality of life could motivate healthy people to be more physically active, to reduce the risk of chronic diseases, especially when there is a general tendency for the individuals to underestimate their health and the risk of diseases (Weinstein, 1989). The relationship of physical activity and the quality of life is associated with a better mood, positive self-perception, higher self-esteem, self-efficacy, reducing the psychological and physiological stress (Berger & Motl, 2001).

Authors Leslie, Fotheringham, Owen, & Bauman (2001) found that women have lower levels of participation in sports and recreational activities compared to men older than 60 years. However, interoperability between recent studies indicates that there is no statistically significant difference in the level of physical activity between men and women. Generally, men and women have very little physical activities and barriers that exist are the same with both men and women, preventing them to engage in physical activity (Пантелић и сарадници, 2011).

METHODS

Literature search

Search studies by local and foreign authors was conducted using a Google Scholar search and Kobson journal in the field of sport science (*International Journal of Sports Medicine Journal of Sports Science and Medicine, Journal of strenght and conditioning research, Am J Cardiol.*, *Journal of Aging and Physical Activity, Health Qual Life Outcomes*, *Journal of Epidemiology*, *Aust N Z J Public Health, Qual Life Res.*, *Br J Sports Med.,* itd.) and key words: physical activity, physical fitness, functional fitness, physical fitness, the quality of life and older women and men. Search was limited to the papers done in the last 12 years.

Selection of studies

The studies were selected primarily on the basis of titles and keywords. The field selection includes 36 papers, mentioning that in this occasion the study included is concerned on the physical activity and

quality of life of elderly people, women and men. Another respected selection criterion is the analysis of the studies relating to the age (over 60 years).

Method of research

In order to review the needs of the selected studies, the descriptive method has been used. Table 1 shows the study of physical activity and the quality of life of older men and women.

RESULTS

The problems of the studies on physical activity and the quality of life (**Table 1)** were included in 36 international and local studies. In their research, the authors were mainly using subjective methods such as a questionnaire and an experiment, except for those (Izawa et al., 2004; Okano et al., 2004; Yasunaga et al., 2006; Fox et al., 2007; Lobo et al., 2008; 2008; Aoyagi et al., 2010) who used objective methods, such as a pedometer, accelerometer.

TABLE 1 Overview of studies on physical activity and quality of life

Author	No. samples	Gender	Age	Measures of physical activity / quality of life	Conclusion
Culoe-Reed & Brawley, 2000	86	M,F	49,2 ±11,2	Not defined / SF-12	People who were involved in physical activity three times a week ≥ had higher values in the quality of life in the physical component (32.3 [SD=7.3] to 27.9 [SD=5.4], p<0.005).
Koltyn, 2001	200	F	>60	Questionnaire- Yale Physical Activity / WHOQOL-BREF	There was a statistically significant correlation between the quality of life with energy consumption (r=0.45, p<0.05) and a high-intensity physical activity (r=0.58, p<0.05). There was a statistically significant correlation between the basic physical activity (r=0.47, p<0.01), energy expenditure (r=0.46, p<0.01) and a high-intensity physical activity (r=0.54, p<0.01).
Painter et al., 2001	180	M,F	55 ±11.6	Not defined / SF-36	Active subjects had higher scores in the fundamentals of physical functioning (p<0.001), physical role (p=0.041), body pain (p=0.002), general health (p<0.001), vitality (p=0.001) and physical components (p<0.001).
Stojiljkovic et al., 2002	12	F	62	Eurofit tests for adults	The patients in the group that regularly engage in physical exercise, had better results in all tests , but the difference was statistically significant (significance level 0.01), in only 2 tests : increase in sitting and balance on one leg.
Lee et al & Russell, 2003	1006 3	F	70-78	Not defined / SF-36	Active respondents had higher scores in all domains of the quality of life. Those that continued physical activity had higher scores in vitality, social and environmental domains.
Stewart et al., 2003	82	M,F	55-75	Questionnaire- Stanford 7-day Physical Activity Recall / SF-36	The higher the level of physical activity, the better quality of life is, on the basis of body pain (r=0.28, p=0.01).
Cassidy et al., 2004	278	F	>70	Not defined / SF-36	The active group has shown higher results in life quality altogether (p<0.001) than inactive group.
Collins et al., 2004	27	M	64 ±10	Questionnaire- Three-day Physical Activity Recall / SF-36	The active group showed 14 % result increasing in the domain of physical functioning. There was also a significant increase of 10.4 [SD=18.5] in the results of life quality in the active group and a decrease of 4.7 [SD=12.4] in the control group (p<0.001).
Izawa et al., 2004	109	M,F	63.5 ±10.1	Pedometer / SF-36	The active group had a better overall quality results of life scores (p < 0.001) in the domain of physical functioning, physical role, emotional role, vitality, mental health, bodily pain and general health (p < 0.001).

Mummery et al., 2004	337	F	55-89	Active Australia Questionnaire / SF-12	The moderate and the active group had significantly higher scores of life quality in the physical and mental components relative to the inactive group.
Okano et al., 2004	97	M,F	22-77	Accelerometer / SF-36	A positive relationship between physical activity and physical function (p <0,02) and the role of the emotional domain (p=0,01) was found .
Smith et al., 2004	198	M,F	>55	Questionnaire- Physical Activity Scale for the Elderly / SF-36	Groups that practiced at home had a better quality of life in the physical and mental components before and after the intervention and also after 12 months, compared to the hospital group (r = 0.047 and r = 0.049) . After 12-month the mental component result was not significantly reduced in both groups.
Olson et al., 2005	140	M,F	>18	Not defined / SF-36	The group of respondents who were involved in physical activity per week ≥1 showed higher results in the measures of life quality in the physical and mental component (p<0,01).
Acree et al., 2006	112	M,F	60-89	Questionnaire- Jonson Space Center Physical Activity Scale / SF-36	The groups with high intensity of physical activity had higher scores in physical functioning (p= 0.029), physical role (p=0.022), role physical pain (p=0.001), vitality (p= 0.001) and social functioning (p = 0.040) in relation to gender and hypertension.
Chyun et al,2006	106	M,F	50-75	Questionnaire- Framingham Physical Activity Index/ SF-36	The respondents who were engaged ≥ 3 hours /week had higher scores of life quality in physical functioning and vitality.
Morimoto et al., 2006	5107	M,F	>20	Not defined / SF-36	The respondents with a high -energy loss (>1000kcal/week) had higher scores in all domains of life quality (p < 0,01) . The women who engaged in a dynamic physical activity have higher quality of life scores in almost all domains (p<0.05), except functioning, thus social and mental health.
Yasunaga et al., 2006	181	M,F	65-85	Accelerometer / SF-36	The higher the level of physical activity, the higher overall performance in life quality for men (p <0.01) and women (p<0.001).
Blacklock et al., 2007	351	M,F	>30	Godin Leisure-Time Exercise Questionnaire / SF-36	There is a significant correlation between the total scores of life quality and frequency (p<0.05), time (p<0.01) minutes of walking (p<0.005), frequency of moderate (p<0.01) and dynamic exercise (p<0.01) total time moderate (p<0.01) and dynamic physical activity (p <0.01) and total free time physical activity (p<0.001).
Fox et al., 2007	176	M,F	>70	Accelerometer / WHOQOL-BREF	Moderate physical activity per day and higher energy consumption has given better quality of life overall results (p<0.05) in physical domain (p<0.05), the field of environmental protection (p<0.01) and psychological domain (p<0.05).
Lawton et al., 2007	1089	F	40-74	International Physical Activity Questionnaire, (IPAQ) / SF-36	The active group improved the quality of life results in more areas than the control group.
Bond et al., 2008	199	M,F	18-65	International Physical Activity Questionnaire, (IPAQ) / SF-36	The active group had improved mental component (p=0.004), general health (p=0.009), vitality (p=0.005) and mental health (p =0.008) compared to the inactive group.
Lobo et al., 2008	185	M,F	>65	Accelerometer / SF-36	Moderately active men have higher levels of physical functioning (p = 0.01), vitality (p = 0.05), and mental health (p=0.05) compared to the inactive ones.
Van den Berg et al., 2008	1141	M,F	18-63	Questionnaire- Stanford Wellness Inventory / SF-12	There is no connection between the quality of life and the implementation of recommendations for dealing with moderate physical activity, after age, sex, work related to psychosocial factors related to work, lifestyle, body mass index, and oxygen consumption adjustment.
Valenti et al., 2008	212	F	42-65	Godin Leisure-Time Exercise Questionnaire / WHOQOL-BREF	Active women have higher scores in the physical and psychological domain, social relationships and environment during treatment and after treatment.
Winter et al.,	47	M,F	21-69	Short Questionnaire to	Respondents with cardiac dysfunction (less active)

2008				Assess Health-Enhancing Physical Activity / SF-36	had similar results for the quality of life compared to the apparently healthy people (more active) in the mental component. The physical components of the domain and bodily pain scores were significantly lower.
Coups et al., 2009	175	M, Ж	39-89	Godin Leisure-Time Exercise Questionnaire / SF-36	In the domain of physical functioning, the active had better quality of life ($p<0.001$). In the domain of vitality, inactive group had lower values than the less active group ($p<0.042$) and the active group ($p<0.004$). In the domain of physical roles, the inactive group had lower scores than the active ($p<0.006$) and the less active group had lower scores than the active group ($p<0.001$).
Ekwall et al., 2009	4360	M,F	>70	Not defined / SF-12	Moderate ($p=0.003$) and vigorous exercise ($p<0.001$) are associated with the physical component of life quality. It's the same with mental component, moderate ($p = 0.003$) and dynamic exercise ($p=0.001$).
Johnson et al., 2009	843	M,F	>65	CHAMPS Physical Activity Questionnaire for Older Adults / SF-36	More active patients had higher quality of life scores in the physical domain functioning compared with the less active
Smith et al., 2009	1183	F	>45	Упитник Modifiable Activity Questionnaire / SF-36	The group of active women had better outcomes in social functioning, emotional role domains and mental health ($p<0.01$).
Toscano & Oliveira., 2009	238	F	>60	International Physical Activity Questionnaire, (IPAQ) / SF-36	More active older women had a better quality of life in physical functioning, physical role domain, general health, bodily pain, social functioning, emotional domain and mental health ($p<0.001$).
Alencar et al, 2010	30	F	>60	Modified Baecke Questionnaire for the Elderly / WHOQOL-BREF	Active older women have higher scores in the past, present, future activities and social inclusion domain.
Aoyagi et al., 2010	109	M,F	65-85	Pedometer and accelerometer / SF-36	The respondents who spent 20 % of time in physical activity had better results in physical functioning ($p<0.001$), bodily pain ($p =0.020$), vitality ($p=0.007$) and mental health domains ($p=0.228$).
Silva et al., 2010	863	M,F		Questionnaire of Habitual Physical Activity / WHOQOL-BREF	Active individuals had significantly better scores in physical, psychological and environmental domain ($p<0.001$).
Pantelic et al., 2011	612	M,F	68.3 ±5.7	Questionnaire	There was no statistically significant difference in the level of physical activity between men and women, they both are generally not very physically active and the barriers exist that are the same in both men and women, preventing them from engaging in physical activity.
Pantelic et al., 2012	354	M,F	69.23 ±7.81	Questionnaire (IPAQ)	According to the type of physical activity, the results suggest that there is a statistically significant difference ($p < 0.05$), between young - old and old - older groups of the subjects in the variables Total walking and Total vigorous MET. Among older women, the value of MET in total physical activity and moderate and high activity decreased significantly.

DISCUSSION

When searching the literature, we had choosen reference from over 200 foreign and domestic authors. Based on keywords, we separated 36 studies on the topic of physical activity and life quality of elders. From the selected studies, most of them are the transversal type (Culoe-Reed & Brawley, 2000; Koltyn., 2001; Painter et al., 2001; Stewart et al., 2003; Cassidy et al., 2004; Mummery et al., 2004; Okano et al., 2004; Olson et al., 2005; Acree et al., 2006; Chyun et al., 2006; Morimoto et al., 2006; Yasunaga et al., 2006; Blacklock et al., 2007; Lobo et al., 2008; Van den Berg et al., 2008; Winter et al., 2008; Coups et al., 2009; Ekwall et al., 2009; Johnson et al., 2009; Toscano & Oliveira, 2009; Silva

et al., 2010; Aoyagi et al., 2010; Alencar et al., 2010), six of them are experimental studies types (Collins et al., 2004; Izawa et al., 2004; Smith et al., 2004; Fox et al., 2007; Bond et al., 2008; Valenti et al, 2008; Lawton et al., 2009), two are cohort (Lawton et al., 2009; Smith et al., 2009) and study by Lee & Russell (2003) which is a combination of two types of research, cross- sectional and longitudinal.

The studies on physical activity and the quality of life were conducted on a large sample of respondents. The most numerous samples, 4000-10000 respondents found in studies (Lee & Russell, 2003; Morimoto et al., 2006; Ekwall et al., 2009), followed by a sample of 1000 to 2400 (Van den Berg et al., 2008; Lawton et al., 2009; Smith et al., 2009). The authors' (Johnson et al., 2009; Silva et al., 2010) sample consisted of 800 subjects and all the other numbers are significantly lower (Culoe-Reed & Brawley, 2000; Koltyn., 2001; Painter et al., 2001; Stojiljkovic et al., 2002; Pantelic et al., 2011; Pantelic et al., 2012; Stewart et al., 2003; Cassidy et al., 2004; Collins et al., 2004; Izawa et al., 2004; Mummery et al., 2004; Okano et al., 2004; Smith et al., 2004; Olson et al., 2005; Acree et al., 2006; Chyun et al., 2006; Morimoto et al., 2006; Yasunaga et al., 2006; Blacklock et al., 2007; Fox et al., 2007; Bond et al., 2008; Lobo et al., 2008; Valenti et al, 2008; Winter et al., 2008; Coups et al., 2009; Toscano & Oliveira, 2009; Alencar et al., 2010; Aoyagi et al., 2010).

When it comes to gender in research , we can conclude that the authors generallly researched both sexes (Culoe-Reed & Brawley, 2000; Painter et al., 2001; Stewart et al., 2003; Izawa et al., 2004; Okano et al., 2004; Smith et al., 2004; Olson et al., 2005; Acree et al., 2006; Chyun et al., 2006; Morimoto et al., 2006; Yasunaga et al., 2006; Blacklock et al., 2007; Fox et al., 2007; Shibata et al., 2007; Bond et al., 2008; Lobo et al., 2008; Van den Berg et al., 2008; Winter et al., 2008; Coups et al., 2009; Ekwall et al., 2009; Johnson et al., 2009; Aoyagi et al., 2010; Silva et al., 2010; Pantelic et al., 2011; Pantelic et al., 2012). There are two authors (Collins et al., 2004; Mummery et al., 2004) who only included male gender and the authors (Koltyn, 2001; Stojiljkovic et al., 2002; Lee & Russell, 2003: Cassidy et al., 2004; Valenti et al., 2008; Lawton et al., 2009; Smith et al., 2009; Toscano & Oliveira, 2009; Alencar et al., 2010) who included only female sex.

The authors were usually studying the elderly: 40 years or more (Culoe-Reed & Brawley, 2000; Koltyn, 2001; Painter et al., 2001; Stojiljkovic et al., 2002; 2002; Lee & Russell, 2003; Smith et al., 2004; Stewart et al., 2003; Cassidy et al., 2004; Collins et al., 2004; Izawa et al., 2004; Mummery et al., 2004; Acree et al., 2006; Chyun et al., 2006; Yasunaga et al., 2006; Fox et al., 2007; Lobo et al., 2008; Valenti et al., 2008; Coups et al., 2009; Ekwall et al., 2009; Johnson et al., 2009; Lawton et al., 2009; Smith et al., 2009; Toscano & Oliveira, 2009; Alencar et al., 2010; Aoyagi et al., 2010; Pantelic et al., 2011; Pantelic et al., 2012) but a number of studies included a greater range of age: those older than 18 years (Okano et al., 2004; Olson et al., 2005; Morimoto et al., 2006; Blacklock et al., 2007; Shibata et al., 2007; Bond et al., 2008; Van den Berg et al., 2008; Winter et al., 2008).

Healthy older people were largely studied by the following authors: (Stojiljkovic et al., 2002; Morimoto et al., 2006; Blacklock et al., 2007; Van den Berg et al., 2008; Lawton et al., 2009; Silva et al., 2010; Pantelic et al., 2011; Pantelic et al., 2012). In a number of studies the health status of the respondents had not been defined (Koltyn, 2001; Lee & Russell, 2003; Cassidy et al., 2004; Mummery et al., 2004; Acree et al., 2006; Yasunaga et al., 2006; Fox et al, 2007; Lobo et al., 2008; Ekwall et al., 2009; Toscano & Oliveira, 2009; Alencar et al., 2010; Aoyagi et al., 2010). For the respondents' sample in some surveys people with a diagnosed medical disease were observed: obesity (Bond et al., 2008), breast cancer (Valenti et al., 2008; Smith et al., 2009), hypertension (Stewart et al., 2003; Okano et al., 2004), diabetes (Chyun et al., 2006), lung cancer (Coups et al., 2009), fibromyalgia (Culoe-Reed & Brawley, 2000), heart disease (Collins et al., 2004; Izawa et al., 2004; Smith et al., 2004; Winter et al., 2008), colon cancer (Johnson et al., 2009), hepatitis

(Olson et al., 2005), people with liver transplantation (Painter et al., 2001).

When we talk about the applied methods for the assessment of physical activity , the authors often use questionnaires (Koltyn., 2001; Stewart et al., 2003; Collins et al., 2004; Mummery et al., 2004; Smith et al., 2004; Acree et al., 2006; Chyun et al., 2006; Van den Berg et al., 2008; Winter et al., 2008; Johnson et al., 2009; Smith et al., 2009; Silva et al., 2010; Alencar et al., 2010; Pantelic et al., 2011) then - The International Physical Activity Questionnaire (Bond et al., 2008; Lawton et al., 2009; Toscano & Oliveira, 2009; Pantelić i saradnici, 2012) and Godin Leisure-Time Exercise (Blacklock et al., 2007; Valenti et al., 2008; Coups et al., 2009). For an objective measurement of physical activity was used a pedometer and an accelerometer (Izawa et al., 2004; Okano et al., 2004; Yasunaga et al., 2006; Fox et al., 2007; Lobo et al., 2008; Aoyagi et al., 2010). Authors Stojiljkovic et al. (2002) used the Eurofit battery tests for adults.

On the other hand, the quality of life is the most evaluated in the SF -36 questionnaire (Painter et al., 2001; Lee & Russell, 2003; Stewart et al., 2003; Cassidy et al., 2004; Collins et al., 2004; Izawa et al., 2004; Okano et al., 2004; Smith et al., 2004; Olson et al., 2005; Acree et al., 2006; Chyun et al., 2006; Morimoto et al., 2006; Yasunaga et al., 2006; Blacklock et al., 2007; Bond et al., 2008; Lobo et al., 2008; Winter et al., 2008; Coups et al., 2009; Johnson et al., 2009; Lawton et al., 2009; Smith et al., 2009; Toscano & Oliveira, 2009; Aoyagi et al., 2010), and SF-12 (Culoe-Reed & Brawley, 2000; Mummery et al., 2004; Van den Berg et al., 2008; Ekwall et al., 2009). The WHOQOL-BREF questionnaire was found in five studies (Koltyn., 2001; Fox et al., 2007; Valenti et al., 2008; Alencar et al., 2010; Silva et al., 2010).

All the research in this area indicates that it is a necessity and the need of the modern elderly. A number of studies have shown that active participation in physical activity leads to better outcomes in social functioning (Yasunaga et al., 2006), the emotional role domains (Bond et al., 2008; Smith et al., 2009), mental health (Bond et al., 2008; Smith et al., 2009; Lawton et al., 2009), the physical domain, psychological domain, the social relationships and environment (Valenti et al., 2008) and physical functioning (Johnson et al., 2009; Lawton et al., 2009).

There is a high correlation between the quality of life with energy consumption and high intensity of physical activity, as well as the basic relationship of physical activity, energy expenditure and physical activity of high intensity (Koltyn, 2001).

The quality of life assessed in relation to the time spent in physical activity, points to the fact that the persons who were engaged in studies ≥ 3 hours/week had higher values of the quality of life in the physical role domain, bodily pain, general health, vitality, physical components (Culos-Reed & Brawley, 2000; Painter et al., 2001) and physical functioning (Chyun et al., 2006). It should be noted that both of the patients participating in a moderate physical activity > 1 times/week or more intense physical activity ≥ 30 min/week noted better results in physical functioning , physical role, body pain, vitality and social functioning (Acree et al., 2006), the physical and mental components (Olson et al., 2005).

Physical activity estimated from participation in a moderate physical activity (5 days a week for ≥ 30 minutes a day) and participating in a dynamic physical activity (3 days a week for ≥ 20 minutes a day) indicate that the respondents who participated in the dynamic physical activities had a higher quality of life deterioration results in the mental and physical components (Van den Berg et al., 2008).

Physical activity during leisure time (duration ≥150 minutes per week of moderate physical activity or 60 minutes ≥ dynamic physical activity) also indicates that the active respondents have better results in the domain of physical role, physical functioning and vitality (Coups et al., 2009).

The intensity (moderate and dynamic) and the frequency (never, rarely, sometimes, often) of exercise is associated with the physical and mental components of life quality (Ekwall et al., 2009). The results of the cardiac dysfunction patients (less

active) compared to the apparently healthy people (more active) are similar to the results of the quality of life in the mental component. However, the physical components and body pain domain scores were significantly lower in the patients with cardiac dysfunction (Winter et al., 2008).

The higher the level of physical activity was, the higher overall performance of life quality for women was. More active women had a better quality of emotional role, vitality and mental health domain (Lee & Russell, 2003), physical functioning, social functioning and body pain domain (Yasunaga et al., 2006). Women who engaged in a dynamic physical activity and high energy consumption (>1000kcal/week) have a higher quality of life scores in almost all domains (Morimoto et al., 2006). Moderate physical activity per day and higher energy consumption has given better overall results of life quality in the physical and psychological domain and the domain of the environment (Fox et al., 2007). Also important is the connection between a moderate physical activity and bodily pain (Lobo et al., 2008).

People, who regularly engage in physical exercise, achieve better results in all tested physical activities (Stojiljkovic et al., 2002).

In a study by Lee and Russell (2003) inconsistent results had been found. The transversal analysis showed that higher levels of physical activity is associated with a higher quality of life of those mental components. After three years of follow-up, longitudinal analysis showed that women who start or maintain physical activity have a higher quality of life scores. However, active women who have dropped physical activity had lower scores of life quality. The results showed transient effects of exercise on the quality of life. Despite the mixed results of these studies, physical activity is associated with an improved mental health in older women (Lee & Russell, 2003).

CONCLUSION

Based on all survey studies, the results show that there is a positive correlation between physical activity and the perceptions of the quality of life, and it depends on what the domain of quality of life assessed. A large number of people, both men and women are not involved in recreational activities and in every society it is an obligation to promote a healthy and active lifestyle.

It is necessary to develop awareness that successful aging requires regular recreational activity that promotes health, and better quality of life, social and psychological well-being. On the basis of physical functioning people who achieve better results are those who regularly practice some form of activity. Thus it improves the physical and mental aspects of health care for the elderly and shows a positive correlation of physical activity with vitality, social domain, the environment and various social adaptations.

A positive impact and the contribution of regular physical activity on the general health status of the elderly is a sufficient indication of the necessity to promote greater involvement and a large number of people in various forms of recreational exercise.

REFERENCES

Acree, L. S., Longfors, J., Fjeldstad, A. S., Fjeldstad, C., Schank, B., Nickel, K. J. & al. (2006). Physical activity is related to quality of life in older adults. *Health Qual Life Outcomes*, 4:37.

Alencar, N. A., Souza, Jr, J. V., Aragão, J. C. B., Ferreira, M. A. & Dantas, E. (2010). Nível de atividade física, autonomia funcional e qualidade de vida em idosas ativas e sedentárias. *Fisioter Mov*., 23(3),473-481.

Aoyagi, Y., Park, H., Park, S. & Shephard, R. J. (2010). Habitual physical activity and health-related quality of life in older adults: interactions between the amount and intensity of activity (the Nakanojo Study). *Qual Life Res*., 19(3),333-338.

Berger, B. & Motl, R. (2001). Physical activity and quality of life. Life Spain Development. In R. Singer, H. A., Hausenblas, C. M., Janelle (Eds.), *Handbook of Sport Psychology* (pp. 636 – 671) Canada: J. Wiley & Sons, Inc.

Blacklock, R. E., Rhodes, R. E. & Brown, S. G. (2007). Relationship between regular walking, physical activity, and health-related qu.lity of life. *J Phys Act Health,* 4(2),138-152.

Bond, D. S., Phelan, S., Wolfe, L. G., Evans, R. K., Meador, J. G., Kellum, J. M. et al. (2008). Becoming physically active after bariatric surgery is associated with improved weight loss and health-related quality of life. *Obesity (Silver Spring)*, 17(1),78-83.

Brown, D. W., Balluz, L. S., Heath, G. W., Moriarty, D. G., Ford, E. S,, Giles, W. H. & Mokdad, A. H. (2003). Associations between recommended levels of physical activity and health-related quality of life: Findings from the 2001 Behavioral Risk Factor Surveillance System (BRFSS) survey. *Prev Med.,* 37,520-528.

Cassidy, K., Kotynia-English, R., Acres, J., Flicker, L., Lautenschlager, N. T. & Almeida, O. P. (2004). Association between lifestyle factors and mental health measures among community-dwelling older women. *Aust N Z J Psychiatry*, 38(11-12),940-947.

Chyun, D. A., Melkus, G. D., Katten, D. M., Price, W. J., Davey, J. A., Grey, N. et al. (2006). The association of psychological factors, physical activity, neuropathy, and quality of life in type 2 diabetes. *Biol Res Nurs*., 7(4),279-288.

Collins, E., Langbein, W. E., Dilan-Koetje, J., Bammert , C., Hanson, K., Reda, D. et al. (2004). Effects of exercise training on aerobic capacity and quality of life in individuals with heart failure. *J Acute Critical Care*, 33(3),154-161.

Coups, E. J., Park, B. J., Feinstein, M. B., Steingart, R. M., Egleston, B. L., Wilson, D. J. et al. (2009). Physical activity among lung cancer survivors: changes across the cancer trajectory and associations with quality of life. *Cancer Epidemiol Biomarkers Prev*., 18(2),664-672.

Culos-Reed, S. N. & Brawley, & L. R. (2000). Fibromyalgia, physical activity and daily functioning: the importance of efficacy and health-related quality of life. *Arthritis Care Res*., 13(6),343-351.

DiPietro, L. (2001). Physical activity in aging: changes in patterns and their relationship to health and function. *J Gerontol A Biol Sci Med Sci.*, 56,13-22.

Ekwall, A., Lindberg, A., & Magnusson, M. (2009). Dizzy - why not take a walk? Low level physical activity improves quality of life among elderly with dizziness. *Gerontology*, 55(6):652-659.

Fox, K. R., Stathi, A., McKenna, J. & Davis, M. G. (2007). Physical activity and mental well-being in older people participating in the Better Ageing Project. *Eur J Appl Physiol*., 100(5),591-602.

Izawa, K. P., Yamada, S., Oka, K., Watanabe, S., Omiya, K., Iijima, S. et al. (2004). Long-term exercise maintenance, physical activity, and health-related quality of life after cardiac rehabilitation. *Am J Phys Med Rehabil*., 83(12),884-892.

Johnson, B. L., Trentham-Dietz, A., Koltyn, K. F. & Colbert, L. H. (2009). Physical activity and function in older, long-term colorectal cancer survivors. *Cancer Causes Control*, 20(5),775-784.

Koltyn, K. F. (2001). The association between physical activity and quality of life in older women. *Womens Health Issues*, 11(6),471-480.

Lawton, B. A., Rose, S. B., Raina Elley, C. R., Dowell, A. C., Fenton, A. & Moyes, S. A. (2009). Exercise on prescription for women aged 40-74 recruited through primary care: two year randomised controlled trial. *Br J Sports Med*., 43(2),120 -123.

Lavie, C.,J., Milani, R.,V. (1997). Effects of cardiac rehabilitation, exercise training, and weight reduction on exercise capacity, coronaryrisk factors, behavioral characteristics, and quality of life in obese coronary patients. *Am J Cardiol*., 79,397-401.

Lee, C. & Russell, A. (2003). Effects of physical activity on emotional well-being among older Australian women: cross-sectional and longitudinal analyses. *J Psychosom Res*., 54(2),155-161.

Leslie, E., Fotheringham, M. J., Owen, N. & Bauman, A. (2001). Age-related differences in physical activity levels of young adults. Medicine & Science in Sports & Exercise, 33,255–258.

Lim, K. & Taylor, L. (2005). Factors associated with physical activity among older people – a population-based study. *Prev Med*., 40,33-40.

Lobo, A., Santos, P., Carvalho, J. & Mota, J. (2008). Relationship between intensity of physical activity and healthrelated quality of life in Portuguese

institutionalized elderly. *Geriatr Gerontol Int*., 8(4),284-290.

Hambrecht, R., Walther, C., Mobius-Winkler, S. et al. (2004). Percutaneous coronary angioplasty compared with exercise training in patients with stablecoronary artery disease: a randomized trial. *Circulation,* 109(11),1371–1378.

Helmrich, S. P., Ragland, D. R. & Paffenbarger Jr. R. S. (1994). Prevention of noninsulin- dependent diabetes mellitus with physical activity. *Med. Sci. Sports Exerc*., 26(7),824–830.

Heuvelen, M. J. G., Stevens, M., & Kempen, G. I. J. M. (2002). Differences in physical-fitness test scores between actively and passively recruited older adults: Consequences for norm-based classification. *Journal of Aging and Physical Activity*, 10, 143-159.

Hoidrup, S., Sorensen, T. I., Stroger, U., Lauritzen, J. B., Schroll, M. & Gronbaek, M. (2001). Leisure-time physical activity levels and changes in relation torisk of hip fracture in men and women. *Am. J. Epidemiol.,* 154(1),60–68.

Hu, G., Jousilahti, P., Barengo, N. C., Qiao, Q., Lakka, T. A. & Tuomilehto, J. (2005). Physical activity, cardiovascular risk factors, and mortality among Finnish adults with diabetes. *Diabetes Care,* 28(4),799–805.

McTiernan, A., Kooperberg, C., White, E. et al. (2003). Recreational physical activity and the risk of breast cancer in postmenopausal women: the Women's Health Initiative Cohort Study. *JAMA,* 290(10),1331–1336.

Morimoto, T., Oguma, Y., Yamazaki, S., Sokejima, S., Nakayama, T. & Fukuhara, S. (2006). Gender differences in effects of physical activity on quality of life and resource utilization. *Qual Life Res*., 15(3),537-546.

Mummery, K., Schofield, G. & Caperchione, C. (2004). Physical activity dose-response effects on mental health status in older adults. *Aust N Z J Public Health*, 28(2),188-92.

Okano, Y., Hirawa, N., Tochikubo, O., Mizushima, S., Fukuhara, S., Kihara, M. et al. (2004). Relationships between diurnal blood pressure variation, physical activity, and health-related QOL. *Clin Exp Hypertens*, 26(2),145-155.

Olson, S. H., Iyer, S., Scott, J., Erez, O., Samuel, S., Markovits, T. et al. (2005). Cancer history and other personal factors affect quality of life in patients with hepatitis C. *Health Qual Life Outcomes*, 3:39.

Painter, P., Krasnoff, J., Paul, S. M. & Ascher, N. L. (2001). Physical activity and health-related quality of life in liver transplant recipients. *Liver Transpl.,* 7(3),213-219.

Pantelic, S., Kostić, R., Milanović, Z., Uzunović, S. & Aleksandrovic, M. (2011). Physical activities of the elederly population of southeast Serbia: a pilot study. *Facta universitatis-series: Physical Education and Sport*, 10(4), 289 - 296.

Pantelic, S., Randjelović, N., Milanović, Z., Trajković, N., Sportiš, G. & Kostić, R. (2011). Physical activity of elederly women in terms of age. *Facta universitatis-series: Physical Education and Sport*, *9*(4), 427 - 438.

Phelan, E. A., Anderson, L. A., LaCroix, A. Z. & Larson, E. B. (2004). Older adults views of "successful aging" – how do they compare with researcher's definitions? *J Am Geriatr Soc.,* 52,211-216.

Rejeski, W. J. & Mihalko, S. L. (2001). Physical activity and quality of life in older adults. *J Gerontol A Biol Sci Med Sci.*, 56,23-35.

Schalock, R. L. (2000). Three Decades of Quality of Life. *Focus Autism Other Dev Disabl*., 15(2), 116-127.

Shibata, A., Oka, K., Nakamura, Y. & Muraoka, I. (2007). Recommended level of physical activity and healthrelated quality of life among Japanese adults. *Health Qual Life Outcomes*, 5,64.

Silva, R. S., Silva, I., Silva, R. A., Souza, L. & Tomasi, E. (2010). Atividade física e qualidade de vida. *Cienc Saude Coletiva*., 15(1),115-20.

Smith, K. M., Arthur, H. M., McKelvie, R. S. & Kodis, J. (2004). Differences in sustainability of exercise and healthrelated quality of life outcomes following home or hospital-based cardiac rehabilitation. *Eur J Cardiovasc Prev Rehabil*., 11(4), 313-319.

Smith, A. W., Alfano, C. M., Reeve, B. B., Irwin, M. L., Bernstein, L., Baumgartner, K. et al. (2009). Race/ethnicity, physical activity, and quality of life in breast cancer survivors. *Cancer Epidemiol Biomarkers Prev*., 18(2),656-663.

Singh, N. A., Clements, K. M., & Fiatarone, M. A. (1997). A randomized controlled trial of progressive resistance training in depressed elders. *J Gerontol A Biol Sci Med Sci.,* 52,27-35.

Spencer, A. R. (2000). *Temelji psihologije.* Zagreb: Naklada Slap.

Stewart, K. J., Turner, K. L., Bacher, A. C., DeRegis, J. R., Sung, J., Tayback, M. et al. (2003). Are fi tness, activity, and fatness associated with health-related quality of life and mood in older persons? *J Cardiopulm Rehabil*., 23(2),115-121.

Stojiljković, S., Eremija-Macura, M., Mazić, S., Suzić, S. N., Popović, D., Nešić, D. M. & Mitrović, D. (2002). Physical capabilities of women of the third age who regularly practice - Yoga program. *Physical Culture,* 56(1-4),74-83.

Toscano, J. J. O. & Oliveira, A. C. C. (2009). Qualidade de vida em idosos com distintos níveis de atividade física. *Rev Bras Med Esporte*, 15(3),169-173.

Valenti, M., Porzio., G., Aielli, F., Verna, L., Cannita, K., Manno, R. et al. (2008). Physical exercise and quality of life in breast cancer survivors. *Int J Med Sci*., 5(1),24-28.

Van den Berg, T. I. J., Alavinia, S. M., Bredt, F. J., Lindeboom, D., Elders, L. A. M. & Burdorf, A. (2008). The influence of psychosocial factors at work and life style on health and work ability among professional workers. *Int Arch Occup Environ Health*, 81(8),1029-1036.

Whelton, S.,P., Chin, A., Xin, X., & He, J., (2002). Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Ann. Intern. Med.,* 136(7),493–503.

Wehler, M., Geise, A., Hadzionerovic, D., Aljukic, E., Reulbach, U., Hahn, E. G. & Strauss, R. (2003). Health-related quality of life of patients with multiple organ dysfunctions: individual changes and comparison with normative population. *Crit Care Med.*, 31,1094-1101.

Weinstein, N. D. (1989). Optimistic biases about personal risks. *Science,* 246(4935),1232–1233.

Winter, M. M., Bouma, B. J., van Dijk, A. P., Groenink, M., Nieuwkerk, P. T., van der Plas, M. N. et al. (2008). Relation of physical activity, cardiac function, exercise capacity, and quality of life in patients with a systemic right ventricle. *Am J Cardiol.*, 102(9),1258-1262.

Yasunaga, A., Togo, F., Watanabe, E., Park, H., Shephard, R. J. & Aoyagi, Y. (2006). Yearlong physical activity and health-related quality of life in older Japanese adults: the Nakanojo Study. *J Aging Phys Act*.,14(3),288-301.

PREGLED ISTAŽIVANJA FIZIČKE AKTIVNOSTI I KVALITETA ŽIVOTA STARIJIH OSOBA: PERIOD OD 2000. DO 2012. GODINE

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SAŽETAK

Uvod: Tokom života, prirodni proces starenja neminovno nosi mnogobrojne strukturne i morfološke promene u organizmu, koje se odražavaju na svakodnevni život pojedinca. Redovno telesno vežbanje pruža optimalno zdravlje i opštu fizičku sposobnost, utiče na bolji kvalitet života i doprinosi socijalnoj adaptaciji. Poslednjih godina stavlja se akcenat na unapređenje fizičkog zdravlja starijih osoba, kroz redovne rekreativne aktivnosti. Cilj ovog

istraživanja je da se utvrdi metodologija istraživanja, odnos fizičke aktivnosti i kvaliteta života, i rezultati do kojih su došli domaći i inostrani autori.

Metode: Selekcija radova je izvršena na osnovu problematike koja se odnosi na fizičku aktivnost i kvalitet života starijih osoba. U svrhu potrebe pregleda selektovanih radova korišćena je deskriptivna metoda. Uža selekcija obuhvata 36 rada, uz napomenu da su uzorak ispitanika činili stariji od 60 godina.

Rezultati: Analizom selektiranih studija utvrđeno je postoji pozitvna korelacija između fizičke aktivnosti i percepcije kvaliteta života, i ona zavisi od toga koji se domen kvaliteta života procenjuje. Kvalitet života i ispitivani domeni u selektiranim studijama (psihološki, sociološki i zdravstveni) ostvaruju pozitivnu korelaciju sa upražnjavanjem nekih od vidova fizičke aktivnosti.

Zaključak: Ne postoji statistički značajna razlika u metodologiji rada između autora. Kako postoji pozitivna korelacija između fizičke aktivnosti i kvaliteta života, neophodno je dalja istraživanja usmeriti na ispitivanje povezanosti fizičke aktivnosti i različitih domena kvaliteta života, posebno u srednjoj i nižoj klasi. Zato treba razviti svest da je za uspešno starenje neophodna redovna rekreativna aktivnost koja unapređuje zdravlje, a čime se dobija na kvalitetu života, socijalnom i psihološkom blagostanju.

Ključne reči: fizička aktivnost, kvalitet života, studije, stare osobe

THE RULES OF TEACHING SWIMMING AND THE MODIFICATIONS OF SWIMMING TECHNIQUES FOR THE INDIVIDUALS WITH CEREBRAL PALSY

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UDC 797.21:616.8-009.11

SUMMARY

The basis of cerebral palsy are motor disorders which lead to difficulties in performing everyday motor tasks such as walking, sitting, standing and running. Adopting swimming abilities is even more difficult since swimming takes place in the water, which can sometimes lead to the fear of drowning. The goal of this paper is to point out certain rules which should be followed during swimming instruction and modifications of swimming techniques for people with cerebral palsy. A sport swimming in patients with cerebral palsy involves learning swimming techniques (freestyle, breaststroke, backstroke and butterfly) and participating in competitions. To be able to engage in recreational and competitive swimming, these individuals must first learn how to swim. In addition to the general instructions relating to the application of appropriate exercises for swimming and didactic principles, there are also rules for swimming applicable to people with cerebral palsy. The rules are related to the elimination of the possibilities of drowning and designing a more effective process of learning how to swim. Swimmers with cerebral palsy often have difficulties adopting the standard techniques of swimming due to several large variations in terms of the range of motion, muscle function and physical status. Therefore, the modification of standard swimming techniques is required. Modifications can be done in terms of the distribution of the disability (hemiplegia, quadriplegia, etc.). This paper lists the typical problems in the adoption of swimming techniques and possible solutions through modifications of the body position, arm stroke and leg kicks. The application of the rules and how to modify the swimming techniques in patients with cerebral palsy listed in this paper enables faster, more efficient and above all safer swimming instruction and training for the unaided movement in the pool.

Key Words: cerebral palsy, swimming techniques, drowning, efficiency

INTRODUCTION

There are several definitions of cerebral palsy, all of them stating it is a motor disorder combined with some other type of tissue damage (Mutch, Alberman, Hagberg, Kodama, & Perat 1992, Bax, Goldstein, Rosenbaum, Leviton, Paneth et al., 2005; Dimitrijevic, Čolović, Mikov, & Stankovic, 2009).The motor disorders that arise are complex and may be divided into primary and secondary ones (Papavasiliou, 2009). The primary deficits include: abnormal muscle tone, deterioration of balance and coordination, a decrease in strength and a loss of movement control. The secondary deficits include muscle contractions and skeletal deformities (Gormley, 2001; Flett, 2003; Papavasiliou, 2009). These motor disorders create difficulties in the development of normal movement patterns (Getz, 2006), which lead to problems in the adoption of everyday motor activities such as sitting, standing, walking and running.

The adoption of swimming skills is even more difficult considering that swimming takes place in the water, where the fear of drowning may occur. According to Madić, Okičić and Aleksandrović (2007) swimming is the ability to keep the body in the water

and move through the water with the help of hand, leg and whole body movement. Accepting this definition of swimming, we can agree with Daly & Lambeck (2007), according to whom there is no adaptive swimming, and that learning swimming techniques is adapted to the capabilities of each individual, regardless of whether he or she has or does not have any form of disability. Accordingly, the goal of this paper is to point out certain rules that should be followed when teaching swimming and modification techniques in individuals with cerebral palsy.

SWIMMING INSTRUCTION RULES APPLIED IN THE CASE OF INDIVIDUALS WITH CEREBRAL PALSY

Swimming may be used for therapeutic purposes as well as sports recreation activity for persons with disabilities, including those with cerebral palsy. Sports and swimming for individuals with cerebral palsy involves learning swimming techniques (freestyle, breaststroke, backstroke and butterfly) and participating in competitions according to certain rules. Swimming allows them to raise their level of physical fitness and improve their quality of life. When it comes to swimming competitions or any other sport, it is better to classify persons with cerebral palsy in relation to the competition requirements of a particular sport than the medical division of cerebral palsy, including GMFCS levels or others. Thus, the athletes with cerebral palsy can be classified into eight categories according to the American division depending on their competitive ability in swimming or any other sport (Lockette & Keyes, 1994; Sherrill, 2004). For example, the individuals in the first and second category cannot move independently and they can only swim by their own rules and float with swimming floats, while the individuals in the eighth category virtually have no impairments and can swim in the events such as the 100 m butterfly and 800 m crawl. When swimming in the official competitions such as the state championships and the Paralympic Games, the individuals with cerebral palsy are classified in relation to the assessment of the degree of their disability.

The individuals with cerebral palsy first have to learn to swim in order to be able to deal with recreational and competition swimming. The Halliwick method may be used for swimming instruction (Jorgić, 2009). This method involves the principle of body motion in water and allows the individuals with cerebral palsy to learn how to swim on their backs with simultaneous arm movements in a 10 step program (McMillan, 1978; Martin 1981; Lambeck & Gamper, 2009). In addition to this program, and depending on the degree of disability, exercises can be used for learning swimming techniques which are used for the healthy population.

Some methods of learning motor activities (analytical, synthetic and combined methods) may be used when teaching swimming techniques in the case of the individuals with cerebral palsy. When it comes to teaching methods, the following can be used: the method of instructing, demonstration and exercise (Kurbanović, 2012). All these methods are applied depending on the degree of disability of the individual with cerebral palsy, which again refers to the number of the affected limbs, the possibility of independent movement, and the level of physical and intellectual disability; all of which affect the performance of different levels of the motor skills (Lepore, 2005).

In addition to the general instructions related to the application of appropriate exercises for swimming instruction and the related methodological and didactic principles, there are also certain rules that allow more effective learning and reduce the possibility of adverse effects, primarily drowning.

According to Lepore (2005), the rules to be applied during swimming instruction are the following:

1. The water temperature should be between 30 and 32 degrees Celsius

and the air temperature about 4 degrees higher.

2. The individual should be protected from sudden face immersion in the water, since the individuals with cerebral palsy usually have a weaker coughing capacity and cannot efficiently expel water from their throat;
3. Consider the use of swimming floats or use a board for swimming with swimmers with wrist flexion contraction;
4. Practice swimming on their backs in order to avoid the need for constant supervision of the position of the head during rhythmic breathing;
5. Use a swimming belt or other accessories to raise the level of the chest and head in the prone position;
6. Sudden noise, splashing etc., may provoke sudden reflex actions that can lead to the swimmer experiencing a loss of the sense of safety in water and drowning. Hence the need to always be close to swimmers;
7. For swimmers who have retained primitive reflexes, you should allow usage of floating collars that can keep their heads above water;
8. Neck hyperextension or turning the head to the side when breathing can lead to impaired control of limb movement in individuals who have retained the primitive reflex. You should therefore insist on the rotation of the whole body when inhaling or using a snorkel;
9. Avoid quick movements and a sudden release of swimmers. Slow movements and constant contact are best for individuals with an increased muscle tone;
10. When the swimmers are floating on their backs, ask them to gently bend their head forward, because when their head is in extension it leads to their mouth being open unnecessarily and to their arms being outstretched;
11. Keep the swimmers in a stable position, because an unstable position and the feeling that they will fall leads to involuntary extension and flexion of the arms and legs and to the mouth opening.
12. Use primarily symmetrical strokes in the water such as the breaststroke technique, germanium, scaling swimming movement etc.;
13. Be careful when using alternating leg work in the crawl technique, as it may cause reflexes that cause the crossing of the legs. If it happens, place a rubber cushion between the knees of the swimmer;
14. Modification of the swimming technique is based on a limited range of movement; it is therefore better to use an underwater arm movement technique (retropropulsive phase) especially when swimming crawl.

MODIFICATION OF THE SWIMMING TECHNIQUE IN RELATION TO THE DISTRIBUTION OF LIMB DEFORIMITIES

Swimmers with disabilities and with cerebral palsy often have difficulties adopting the proper swimming technique due to the large variation in terms of range of motion, muscle function and body status (Sherrill & Dummer, 2004). A modification of standard swimming technique is therefore required. The modification of swimming techniques is based on the typical problems that occur during the process of learning and adopting swimming techniques in relation to the limbs affected by cerebral palsy.

In hemiplegia (paralysis of one side of the body), due to the changes in muscle tone and a lack of motor control in the hemiplegic side of the body, a rotation of the body occurs which is why these swimmers have difficulties keeping their body afloat. They therefore usually use compensatory head movements to compensate for the body rotation. If the hemiplegia is not very pronounced they can

swim without any auxiliary equipment (Dunlap, 2009). When swimming with both arms and feet only creates more resistance than swimming propulsion, it is best that the swimmers with hemiplegia swim only with healthy limbs. In this case the hemiplegic limb should stand in the best possible floating position (Sherrillet al., 2004). Table 1. lists some of the typical problems that occur when teaching swimming techniques to individuals with hemiplegia and the methods of modification of the swimming techniques so as to solve these problems.

The swimmers with quadriplegia (the disability of all four extremities) must first learn to float on the water and to assume a stable position before they start learning to swim. They use neck muscle movements and any other possible arm movements to compensate the loss of the torso and legs movements. It is almost always necessary to use floating devices with these swimmers, such as a mask and a snorkel, and a constant supervision is required (Dunlap, 2009). Table 2. lists some of the typical problems that occur during swimming instruction of the individuals with quadriplegia and the methods of modification of the swimming techniques so as to solve these problems.

TABLE 1 Modification of the swimming techniques for swimmers with hemiplegia

Swimming techniques	Typical errors	Modification
Elementary swimming in the supine position*	Shortened torso on the hemiplegic side that leads to the turning of the body to that side	Lateral head flexing opposite of the hemiplegic side
	Torso rotation with hypertonic side downwards	Head rotation opposite of the hypertonic side
		Place down the healthy shoulder and pelvis deeper into water to avoid torso contractions
		Use the float belt
	Weak stroke with the hemiplegic arm	Lateral head flexing opposite of the hemiplegic hand
		Balance stroke power of the healthy arm with the hemiplegic arm
		Leg kick force directly towards the hemiplegic side
	Poor motor control in leg movements for the breaststroke, leading to leg sinking and weak propulsion	Emphasize small controlled movements, by reducing abduction and rotation of the hips and emphasizing relaxation in the sliding phase
		Reduce spasticity by slightly bending the knees and hips in the sliding phase
Backstroke technique	Torso rotation with hypertonic side downwards	Same as with the elementary swimming in the supine position
	Reduced range of motion or pain in the shoulder during arm retropulsion through the air	If a swimmer does not have good mobility in the shoulder, feels pain and a subluxation then he should not swim this technique
Breaststroke technique	Problems with breathing due to poor motor control and spasticity	Use a mask and snorkel when swimming
		Put a floating device around the chest and under the axillary pits
	Sinking due to poor leg work due to poor motor control or spasticity	Use leg kicking with less hip rotation
		Use assistance until the swimmer learns leg work
	Uneven arm stroke due to poor motor control or spasticity	Perform arm stroke with healthy arm closer to the body midline and balance both arm stroke power
Crawl technique	Problems with breathing due to poor motor control and spasticity	Practice the complete turn from stomach to back while inhaling
		Use a mask and snorkel and modify the stroke, in order to perform the retropropulsive phase through the water
	Weak stroke with the hemiplegic arm	Same as with elementary swimming in the supine position
	Sinking during leg work	Emphasize small controlled movements instead of strong leg kicks
		Reduce spasticity, if possible, by slightly bending the legs at the knees
		Use a floating device or assistance

*Elementary swimming in a supine position means swimming with both arms simultaneously involving leg work as in the breaststroke technique

TABLE 2 Modification of the swimming techniques for swimmers with quadriplegia

Swimming techniques	Typical errors	Modification
Elementary swimming in the supine position	Reduced stroke power stroke due to the lack of extension of the elbow joint	Increase the internal rotation of the shoulder that allows the water to passively stretch the elbow joint during the movement of bringing the shoulders into the propulsive phase of the stroke
	Sinking due to leg spasticity	Raise the chest, inhale and stretch the neck when the arms are near the body
		Use assistance until the swimmer masters the strokes
Backstroke technique	Difficulties in returning the arm above the water due to the lack of shoulder flexion and extension in the elbow	Let the elbow remain bent in the return phase and let the elbow enter first into the water or modify the return of the arm by using external rotation and abduction of the shoulder joint
	Sinking due to leg spasticity	Raise the chest and stretch the neck
		Use assistance until the swimmer masters the strokes
Breaststroke technique	Difficulties with breathing control due to poor muscle strength of the neck extensors and low stroke power	Inhale only after several strokes with head in the water, increase the strength of the arm stroke in order to let the body rise enough for inhaling with minimum extension of the neck joint
		Use a mask and snorkel if necessary
		Use a float belt
Crawl technique	Reduced stroke power due to the inability to fully stretch the arms during the stroke cycle which affects the poor control of breathing	Emphasize the long rotation to the side when inhaling; drill complete rotation from the stomach to the back when inhaling
		Use a mask and snorkel if necessary
	Sinking due to leg spasticity	Use assistance until the swimmer masters the strokes

The swimmers with paraplegia (paralysis of the lower limbs) and those with quadriplegia must first learn to float and learn the skill of assuming a stable position before they start to learn how to swim. They have a limited ability to use their legs which results in a decreased propulsive force and an increased resistance of the body during swimming. They can use the neck, torso and arm movements to compensate for the loss of leg movement during swimming and may eventually learn to swim independently without accessories and assistance (Dunlap, 2009). Table 3. lists some typical problems that occur during swimming instruction of the individuals with paraplegia and the methods of modification of the swimming techniques so as to solve these problems.

Typical problems that lead to errors in any technique are due to the limited hip and shoulder movements, asymmetry in arm strokes, low stroke power (short stroke) and breathing problems. Muscle spasticity prevents placing arms in the correct position for the onset of the stroke (water intake phase). Contractions prevent the body from assuming a proper position in the water (streamline body position) which leads to an increased water resistance (Sherrillet al., 2004). In accordance with the above mentioned advices, apart from the exercises in water and the corresponding modification of the swimming techniques, certain exercises may be performed on dry land. Exercises that increase motion range and flexibility play an important role here. If possible, stomach and back muscle strengthening exercises should be practiced so that the body would be in the most optimal position while swimming. Also, exercises with mimicked strokes and positions, those performed in the water, may be practiced on land (Sherrill et al., 2004).

TABLE 3 Modification of the swimming techniques for swimmers with paraplegia

Swimming techniques	Typical errors	Modification
Elementary swimming in the supine position	Sinking of the legs due to spasticity	Raise chest, inhale and stretch the neck when the arms are near the body
		Use a belt until the arm stroke power gets strong enough to lift the legs
Backstroke technique	Inability to control the rotation when the arm returns overhead into the water	Increase the arm stroke power through the water in order to reduce the negative impact on the rotation of the other arm which is moving through the air
		Drill rotation from the back to stomach until the swimmer starts to perform with self-control
Breaststroke technique	Difficulties in lifting the body and the head when inhaling due to limp legs which causes the legs to float and head to sink into the water	Increase the power stroke in order to raise the body enough above the water in order to inhale with minimum neck extension
		Use small weights placed on the ankles to keep the feet deeper in the water until the swimmer has reached sufficient hand stroke force in order to control breathing
Crawl technique	Difficulties in lifting the body and the head when inhaling due to limp legs which causes the legs to float and head to sink into the water	Inhaling after several strokes if possible and increasing the propulsive force of the drive when preparing to inhale
		Emphasize long rotation to the side when inhaling; drill complete rotation from the stomach to the back when inhaling
		Use small weights placed on ankles like in the breaststroke technique

CONCLUSION

The application of the proposed rules and methods for the modification of the swimming techniques among individuals with cerebral palsy enables a faster, more efficient and above all safer swimming instruction and training for an independent movement in the pool. This enables faster practice and an improvement in the swimming techniques and moving on to a training process for developing appropriate motor and functional abilities if the goal is competitive and recreational swimming for the individuals with cerebral palsy.

REFERENCES

Bax, M., Goldstein, M., Rosenbaum, P., Leviton, A., Paneth, N., Dan. B., Jacobsson. B., Damiano, D., & Executive Committee for the Definition of Cerebral Palsy. (2005). Proposed definition and classification of cerebral palsy. Developmental Medicine & Child Neurology, 47 (8), 571-576.

Daly & Lambeck, J. (2007). New trends in adapted swimming. In R. Colomina, J. Molina, F. Valdivieso, E. Ortiz, & G. Contreras (Eds.), Swimming science I (pp. 19-30). Granada, Spain:. Editorial Universidad de Granada.

Dimitrijević, L., Čolović, H., Mikov, A., & Stanković, I. (2009). Cerebal palsy – definition, etiology, classification, early diagnosis. Balneoclimatologia, 33 (3), 81-86.

Dunlap, E. (2009). Swim stroke training and modification for rehabilitation. In: L. Brody, & P. Geigle, Aquatic Exercise for Rehabilitation and Training (pp. 129-176). Champaign: Human Kinetics.

Flett, P. (2003).Rehabilitation of spasticity and related problems in childhood cerebral palsy. Journal of Paediatrics & Child Health, 39 (1), 6-14.

Getz, M. (2006a). Aquatic Intervention in Children with Neuro-Motor Impairments. Unpublished Doctoral thesis, Utrecht: University of Utrecht.

Gormley, M. (2001).Treatment of neuromuscular and musculoskeletal problems in cerebral palsy. Pediatric Rehabilitation, 4 (1), 5-16.

Jorgić, B. (2009). The Halliwick method for teaching swimming to disabled persons. In N. Živanović (Ed.), 5th European FIEP Congress (pp.

639-646). Niš: Faculty of Sport and Physical Education, University of Niš.

Курбановић, С. (2012). Књига о пливању. СИА: Београд.

Lambeck, J., & Gamper, U. (2009). The Halliwick Concept. In: L. Brody, & P. Geigle, Aquatic Exercise for Rehabilitation and Training (pp. 45-71). Champaign: Human Kinetics.

Lepore, M. (2005). Aquatics. In: J.P. Winnick, Adapted Physical education and Sport (pp. 435-454). Champaign: Human Kinetics.

Lockette, K.F., & Keyes, A.M. (1994). *Conditioning with physical disabilities.* Champaign: Human Kinetics.

Madić, D., Okičić, T., & Aleksandrović, M. (2007). Plivanje. Niš: Fakultet sporta i fizičkog vaspitanja, Univerzitet u Nišu.

Martin, J. (1981). The Halliwick method. Physiotherapy, 67 (10), 288-291.

McMillan, J. (1978). The role of water in rehabilitation. Fysioterapeuten, (45), 87-90.

Mutch, L., Alberman, E., Hagberg, B., Kodama, K., & Perat, M. (1992). Cerebral palsy epidemiology: where are we now and where are we going? Developmental Medicine & Child Neurology, 34 (6), 547-551.

Papavasiliou, A. (2009). Management of motor problems in cerebral palsy: A critical update for the clinician. European Journal of Paediatric Neurology, 13 (5), 387-396.

Sherrill, C. (2004). Cerebral palsy, stroke, and traumatic brain injury. In: C. Sherrill, Conditioning with physical disabilities (pp. 673-694). New York: McGraw-Hill.

Sherrill, C., & Dummer, G.M. (2004). Adapted Aquatics. In: C. Sherrill, Conditioning with physical disabilities 6th edition (pp. 454-484). New York: McGraw-Hill.

PRAVILA UČENJA PLIVANJA I MODIFIKACIJA PLIVAČKIH TEHNIKA KOD OSOBA SA CEREBRALNOM PARALIZOM

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SAŽETAK

U osnovi cerebralne paralize su motorički poremećaji što dovodi do poteškoća u obavljanju svakodnevnih motoričkih radnji kao što su hodanje, sedenje, stajanje i trčanje. Usvajanje plivačkih sposobnosti je još teže obzirom da se plivanje odvija u vodi gde postoji i strah od utapanja. **Cilj ovog stručnog rada** je ukazati na određena pravila kojih se treba pridržavati pri učenju plivanja i modifikacije tehnika plivanja kod osoba sa cerebralnom paralizom. Sportsko plivanje kod osoba sa cerebralnom paralizom podrazumeva učenje plivačkih tehnika (kraul, prsno, leđno i delfin) i učestvovanje na takmičenjima. Da bi mogli da se bave rekreativnim i takmičarskim plivanjem ove osobe moraju prvo da nauče da plivaju. Pored opštih uputstava koja se odnose na primenu odgovarajućih vežbi za učenje plivanja i odgovarajućih didaktičkih principa postoje i pravila plivanja kod osoba sa cerebralnom paralizom. Ta pravila se odnose na eliminisanje mogućnosti utapanja i efikasnije učenje plivanja. Plivači sa cerebralnom paralizom često imaju poteškoća da usvoje standardne tehnike plivanja zbog velikih varijacija u pogledu obima pokreta, mišićne funkcije i telesnog statusa. Zbog toga je potrebna modifikacija standardnih plivačkih tehnika. Modifikaciju je moguće uraditi u odnosu na distribuciju deficita (hemiplegija, kvadriplegija itd). U ovom radu nabrojani su tipični problemi pri usvajanju plivačkih tehnika i moguća rešenja putem modifikacije položaja tela zaveslaja ruku i udaraca nogu. Primena pravila i načina za modifikaciju plivačkih tehnika kod osoba sa cerebralnom paralizom navedenih u ovom radu omogućava brže, efikasnije i pre svega bezbednije učenje plivanja i osposobljavanja za samostalni boravak u bazenu.

Ključne reči: cerebrala paraliza, plivačke tehnike, utapanje, efikasnost

THE PHYSICAL ACTIVITY OF CHILDREN (13-14 YEARS), AND POTENTIAL BARRIERS TO THE ACTIVITY - A PILOT STUDY

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UDC 796.053.2

SUMMARY

The aim of this research was to analyze the involvement of the older primary students in physical activities, depending on gender. In addition, the factors which could be potential obstacles and serve to prevent the students from taking part in physical activities will be analyzed. It was hypothesized that significant differences exist between boys and girls aged 13 and 14 years in terms of participation in PA. The sample of participants consisted of a total of 721 individuals of an average age of 14.3±0.7, 372 of whom were boys and 349 of whom were girls. For the purpose of this research, a questionnaire was used which consisted of 17 questions. On the basis of the obtained frequencies (Frq), we can state that a great number of children exercises regularly (47.6 % boys and 38.7 % girls), and occasionally (30.4% boys and 26.4 girls). By analyzing the obtained answers it can be concluded that the greatest number of boys (54,8%) and girls (57,3%) sometimes choose to participate in physical activities with their friends during their free time. A great number of participants from both groups cited that they miss their exercise habits (23,4% boys and 21,8% girls) and that they do not feel the need to exercise (26,6% boys and 21,5% girls). In the area of Nis, there are statistically significant differences in terms of the participation in physical activities of the children aged 13 and 14 years in terms of gender. This study concluded that significant differences exist beetwen boys and girls in terms of participation in PA. There are a lot of barriers for participation in PA. Our study has revealed some of them, which is of great importance to answering the question of overcoming these barriers.

Key Words: Kids, exercise, participation

INTRODUCTION

Physical activity (PA) is defined as any bodily movement produced by the skeletal muscle, which results in energy expenditure (Caspersen, Powell & Christenson, 1985). Department of Health and Children's (DHC) 2009 physical activity guidelines state that children and youth should participate in moderate to vigorous physical activity for at least 60 minutes every day (> 60 mins MVPA daily). This activity should be developmentally appropriate for the age of the child, it should involve a variety of activities and it should be enjoyable. These guidelines also exist in the US, Australia and all member states of the European Union. Participation in this amount of regular health enhancing physical activity has many benefits for children and youth.

Despite these benefits many national and international population studies have found that a high proportion of children and youth do not meet the established recommendations. Males are more active than females, and the participation in moderate to vigorous Physical Activity declines with age - as older, children are less likely to meet the 60 minutes of moderate to vigorous Physical Activity daily, than younger children (Pate et al.,2002; Andersen et al., 2006; Strong et al., 2005; Borraccino et al., 2009). Christodoulos, Douda, Polykratis and Tokmakidis (2006) stated that the school health

education programs have the possibility to slow the age related decline in physical activity and help pupils establish lifelong, healthy physical activity patterns. In addition, the study revealed that childhood's illness and early death in Greek population may have been prevented by promoting healthy habits in the early stage of life. Nelson, Benson and Jensen (2010) found that the considerable effects of insufficient physical activity in childhood and in adolescence are seen throughout lifespan. This study further reveals that the most common among these are the risk of obesity and other related physical and psychological diseases.

Physical education activities in schools and colleges play an important role in the promotion of regular involvement in physical activities that also help in promoting healthy lifestyle in the coming years of their life (Christodoulidis, 2001). The engagement of the students in Physical Activities in the early stage not only develops their physique but also inculcates positive attitude toward these activities. It is evident that the students who show more positive attitudes towards PA in an institution are also participants in PA outside the institution (Biddle, 1999). One study stated a positive attitude toward exercise may be the primary determinant of a physically active lifestyle (Terry, 1996). A study of children's use of urban space for physical activity revealed that parents of children find the impossibility of monitoring the children outside the house to be a risk factor, which results in it being a the limiting factor in children's activities, as well (O'Brien et al. 2000). In the study by Burrows et al. (1999) 'Access to Buildings "is least often mentioned as a barrier to physical activity. Eleven percent of the children in the study by Tuxworth (1997) refers to" the lack of money and 7% "lack of transport" as reasons for not participating in the "sport" or "exercise" outside the school.

Physical activity has important health benefits on youth and many young people are not meeting established guidelines in order to improve the physical activity levels which are an important public health challenge. To develop effective physical activity interventions in youth, more research is needed concerning the possible barriers of the youth involvement in PA. Therefore, the primary aim of this research was to analyze the involvement of the older primary students in physical activities, depending on their gender. In addition, the factors which could be potential obstacles for preventing the students from taking part in physical activities will be analyzed. It was hypothesized that significant differences exist between boys and girls 13 and 14 years old in terms of participation in PA.

THE METHOD

Sample of participants

The sample of participants consisted of a total of 721 individuals of an average age of 14.3±0.7, 372 of whom were boys and 349 of whom were girls (Table 1). All of the participants were randomly selected from 5 schools in Niš, while the condition for participating in the research was that they were 7th and 8th grade in primary school. Once they had given their consent, the participants were questioned about their health state. Before they filled out of the questionnaire, the participants were informed about the procedure involved and the permission of a parent was obligatory for participation in the survey.

TABLE 1 The sample of participants

School	N	Boys	Girls
Bubanjski heroji	192	99	93
Mika Antić	166	86	80
Dositej Obradović	173	92	81
Vožd Karađorđe	112	55	57
Car Konstantin	78	40	38

Measuring instruments

For the purpose of this research, a questionnaire was used (Mitić et al., 2010) which consisted of 17 questions, which were divided into three groups. The first group of questions was defined as

1) Frequency, organisation and place of activity, and was evaluated by means of 4 items in the questionnaire.

2) The second group of questions included 4 items and this group was defined as the type of exercise.

3) The third group of questions consisted of 9 items, and this group of questions was defined as the Barriers preventing participation in physical activities.

All of the items were of a closed type, and the questions were clearly and precisely designed to follow a certain order. In this research, a three-point and four-point Lykert scale was used.

Statistical analysis

The basic descriptive statistical parameters were calculated for each group by calculating the frequency and percentage. The statistical analysis was based on the use of non-parametric tests for the evaluation of the significance of the differences, the Chi-square test ($\chi 2$). In order to test the significance of the difference between the detected and theoretical frequencies in each group, we used the Chi-square test (χ 2) for the evaluation of the quality of the match. In order to determine the differences between the groups of boys and girls, we used the Chi-square test ($\chi 2$) of independence. The level of significance was defined as 0.05. The results were processed with the help of the Statistical Package for the Social Sciences for Windows (SPSS) (Version 18.0) (Chicago, IL, USA).

RESULTS

Table 2 shows the determined frequencies, percentages, the Chi-square test ($\chi 2$) for the evaluation of the quality of the match for each group individually and the Chi-square test ($\chi 2$) of independence between the groups for the group of questions which was defined as the frequency, organization and place of activity.

TABLE 2 Frequency, organization and place of activity

		Boys(372)		Girls(349)		Boys vs girls	
Claim	**Response**	**Frq (%)**	$\chi 2$	**Frq (%)**	$\chi 2$	$\chi 2$	**Sig.**
How often do you take part in PA during your free time	never	29(7.8)	141.42**	50(14.3)	44.96**	15.56	.001
	Sometimes	113(30.4)		92(26.4)			
	1-2/week	53(14.2)		72(20.6)			
	3/week	177(47.6)		135(38.7)			
Did you, and how often, go, in the past year, with your school on a jaunt in your region?	never	169(45,4)	429,23**	152(43,6)%	245,07**	1,41	,842
	≤ 5	175(47,0)		168(48,1)			
	6-10	19(5,1)		21(6,0)			
	>11 times	9(2,5)		8 (2,3)			
Did you, and how often, go, in the past year, with your parents on a jaunt in your region?	never	113(30,4)	103,46**	90(25,8)	101,16**	2,312	,510
	≤ 5	164(44,1)		163(46,7)			
	6-10	52(14,0)		48(13,8)			
	>11 times	43(11,6)		48(13,8)			
Did you, and how often, go, in the past year, with your friends on a jaunt in your region?	never	135(36,3)	143,31**	130(47,6)	70,49**	10,566	,014
	≤ 5	163(43,8)		122(30,4)			
	6-10	51(13,7)		56(14,2)			
	>11 times	23(6,2)		41(7,8)			

Legend: PA - Physical activity, Frq. - frequency - number of participants, $\chi 2$- Chisquare test,** - level of significance $p < .05$ within group, Sig – between-group test

By analyzing the obtained frequencies of the proposed claims, and the values of the χ2 test of the quality of the match, we can note that all the values, whether in the case

of boys or girls, show a statistically significant difference at the .01 level of significance (**).

On the basis of the obtained frequencies (Frq), we can state that a great number of children exercises regularly (47.6 % boys and 38.7 % girls), and occasionally (30.4% boys and 26.4 girls). A great number of boys and girls have never, or went less than five times with their school on a jaunt in their region (Table 2). It can be seen that a statistically significant difference exist between boys and girls in terms of the frequency of PA (p≤0.01). In addition, there is a statistically significant difference between boys and girls in participation in PA in their immediate region with their friends.

TABLE 3 The type of exercise

		Boys(372)		Girls(349)		Boys vs girls	
Claim	**Response**	**Frq (%)**	χ2	**Frq (%)**	χ2	χ2	**Sig.**
In my free time I run, play soccer, basketball . . . with my friends	never	58(15,6)	88,32**	68(19,5)	90,98**	4,507	,105
	sometimes	204(54,8)		200(57,3)			
	regularly	110(29,6)		81(23,2)			
In my free time I take part in PA by visiting a sports center	never	173(46,5)	50,53**	187(53,6)	245,07**	4,503	,105
	sometimes	136(36,6)		103(29,5)			
	regularly	63(16,9)		59(16,9)			
In my free time I take part in PA by taking part in my personal exercise program	never	169(45,4)	42,59**	169(48,4)	47,38**	,827	,661
	sometimes	135(36,3)		116(33,2)			
	regularly	68(18,3)		64(18,3)			
In my free time I take part in PA by visiting a sports club	never	128(34,4)	148,75**	138(39,5)	10,18**	5,401	,145
	sometimes	87(23,4)		90(25,8)			
	regularly	157(42,2)		121(34,7)			

Legend: PA - Physical activity, Frq. - frequency - number of participants, χ2- Chisquare test,** - level of significance p< .05 within group, Sig – between-group test

By analyzing the obtained frequencies of the proposed claims, and the values of the χ^2 test of the quality of the match, we can note that all the values, whether in the case of boys or girls, show a statistically significant difference at the .01 level of significance (**).

By analyzing the obtained answers it can be concluded that the greatest number of boys (54,8%) and girls (57,3%) sometimes choose to participate in physical activities with their friends during their free time. When it comes to the location of the realization of those physical activities, a very small number of the participants, either boys or girls visits a sports center (16,9% boys and 16,9% girls). The results of the χ^2 test (with Yates' correction) have shown that there are no statistically significant differences between the groups of men and women in the choice of location and organization and the type of exercise (Sig. > .05) (Table 3).

TABLE 4 The Barriers preventing participation in physical activities

		Male (346)		Female (266)		Male vs Female	
claim	**Ocena**	**Frq (%)**	**χ^2**	**Frq (%)**	**χ^2**	**χ^2**	**Sig.**
I do not feel the need	yes	99 (26,6)	10,50**	75 (21,5)	36,48**	4,365	,113
	partially	123 (33,1)		108 (30,9)			
	no	150 (40,3)		166 (47,6)			
I miss my habits	yes	87 (23,4)	19,08**	76 (21,8)	21,70**	2,824	,244
	partially	130 (34,9)		143 (41,0)			
	no	155 (41,7)		130 (37,2)			
My age is a problem	yes	17 (4,6)	364,98**	13(3,7)	320,069**	1,193	,551
	partially	59(15,9)		65(18,6)			
	no	296(79,6)		271(77,7)			
I have no time	yes	73(19,6)	179,61**	68(19,5)	45,42**	4,507	,105
	partially	121(32,5)		200(57,3)			
	no	178(47,9)		81(23,2)			
The material costs are high	yes	65(17,5)	218,74**	59(16,9)	81,99**	1,251	,741
	partially	108(29,1)		97(27,8)			
	no	198(53,4)		193(55,3)			
I am bothered by the lack of understanding in my environment	yes	38(10,2)	355,89**	31(8,9)	185,507**	1,387	,709
	partially	93(25,0)		86(24,6)			
	no	241(64,3)		232(66,5)			
The lack or distance of facilities	yes	61(16,4)	224,45**	55(15,8)	61,98**	2,209	,530
	partially	112(30,1)		119(34,1)			
	no	199(53,5)		175(50,1)			
There is no one to organize it	yes	51(13,7)	246,28**	52(14,9)	68,32**	1,935	,586
	partially	117(31,5)		119(34,1)			
	no	204(54,9)		178(51,0)			
I have no place to exercise	yes	49(13,2)	276,79**	46(13,2)	107,62**	,970	,809
	partially	105(28,3)		101(28,9)			
	no	217(58,5)		202(57,9)			

Legend: PA - Physical activity, Frq. - frequency - number of participants, χ2- Chisquare test,** - level of significance p< .05 within group, Sig – between-group test

The obtained results show that for all the values, whether in the case of boys or girls, a statistically significant difference was found at the .01 level of significance (**). A great number of participants from both groups cited that they miss their exercise habits (23,4% boys and 21,8% girls) and that they do not feel the need to exercise (26,6% boys and 21,5% girls). The distance to the exercise court, the lack of locations for exercise and the organization itself are also a kind of barrier which prevents the children from taking part in physical activities. On the basis of the obtained results (Sig.) we can conclude that there are no statistically significant differences between the groups. The results have

shown that in the case of both boys and girls there are barriers that prevent people from taking part in physical activities, but that they do not differ in relation to the groups of participants (Table 4).

DISCUSSION

In the area of Nis, there are statistically significant differences in terms of the participation in physical activities of the children aged 13 and 14 years in terms of gender. In the studies comparing the differences in the attitudes toward physical education between girls and boys by Birtwistle and Brodie (1991), Folsom-Meek (1992) and Hick *et al*. (2001), girls chose the activities that emphasize aesthetics, whereas boys chose more challenging and risk-taking activities (Folsom-Meek, 1992; Papaioannou, 1994). In addition, Greenwood and Stillwell, (2001) reported that boys demonstrated strong interests in archery, bowling, flag football and wrestling, whereas girls preferred gymnastics, softball and volleyball (Greenwood and Stillwell, 2001). Furthermore, boys were reported to have more positive attitudes than girls toward physical activities bringing them risk-taking experiences, whereas girls had a more positive attitude than boys to physical activities with beautiful and graceful movements (Colley *et al*., 1994; Hick *et al*., 2001; Parkhurst, 2000). Zeng, et all (2010) also found that boys were more in favor of the sports such as soccer, basketball, weight lifting, outdoor adventure and martial arts and chose them more often than than girls. According to Jandric (2010) the girls opted for significantly fewer activities involving games (time spent outside) than the boys did. Girls were recorded to spend more time in sedentary activities and less time in light, moderate and vigorous activity.

The results have shown that in the case of both boys and girls there are barriers that prevent people from taking part in physical activities, but that they do not differ significantly between these two groups of participants. Restricted access to opportunities for participating in a 'sport' or 'exercise' was identified by children and parents as a barrier in four studies. There were four ways in which access could be restricted: the cost of, distance to,a lack of safe means of travel to or the availability of the facilities (Brunton et al., 2003). In the study by Burrows *et al.* (1999) the 'availability of facilities' was the least commonly expressed barrier. Eleven per cent of the children in the study by Tuxworth (1997) indicated 'a lack of money and 7% 'a lack of transport' as reasons for not participating in a 'sport' or 'exercise' outside school lessons. Significantly, children from rural areas were more likely than those from urban areas (15% v 2%) to report lack of transport, but were less likely to report 'lack of money' (2% v 22%). Children in two studies of mixed sex samples aged 6 to 11 years described not enjoying 'sport' or 'exercise' in general or not enjoying particular types of 'sport' or 'exercise' (Burrows *et al.*, 1999; Mason, 1995). However, it is not clear whether a lack of enjoyment would stop children from taking part in the unstructured forms of physical activity.

A lack of knowledge about the advantages and benefits of PA, environmental influences and possible psychological barriers such as a lack of motivation or problems with transport facilities are the main causes for not participating in PA. Other barriers identified by a specific literature are:the lack of time, interest, social support and the lack of exercise in childhood (Schutzer & Graves, 2004). The main factors that have been pointed out in our study are that a great number of participants from both groups cited that they miss their habits and that they do not feel the need to exercise. The distance to the exercise court, the lack of locations for exercise and the organization itself are also a kind of barrier which prevent the children from taking part in physical activities which is similar to the results obtained in other studies.

CONCLUSION

This study showed that significant differences exist beetwen boys and girls in terms of participation in PA. There are a lot of barriers for participation in PA. Our study has revealed some of them, which is of great importance to answering the question of

overcoming these barriers. Children and parents could directly improve this state with their ideas about how children's physical activity could be better promoted. In addition, the knowledge of benefits or the importance of physical activity for health is very important. Thus, a great number of studies have mentioned fun and enjoyment as very important reasons for children's participation in a 'sport' and 'exercise'. There has been a significant amount of research activity in this area. However, a good quality research evaluating the effectiveness of interventions, strategies for overcoming barriers for participating in PA but also the promotion of physical activity for socially excluded groups of children is insufficient.

REFERENCES

Andersen, L.B., Harro, M., Sardinha, L.B., Froberg, K., Ekelund, U., Brage, S., et al. (2006). Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study). *The Lancet*, 368(9532), 299-304.

Biddle, S.J.H., and Chatzisarantis, N. (1999). Motivation for a physically active lifestyle through physical education In Y.Vanden Auweele, F. Bakker, S. Biddle, M. Durand, R. Seiler (Eds.), *Psychology for Physical Educators*, pp. 5-26. Champaign, IL: Human Kinetics.

Birtwistle, G. E. and Brodie, D. A. (1991). Children's attitudes towards activity and perceptions of physical education. *Health Education Research*, 6, 465-478. doi: 10.1093/her/6.4.465

Borraccino, A., Lemma, P., Iannotti, R.J., Zambon, A., Dalmasso. P., Lazzeri, G., et al. (2009). Socioeconomic effects on meeting physical activity guidelines: comparisons among 32 countries. *Medicine and Science in Sports Exercise*, 41(4), 749.

Brunton, G., Harden, A., Rees, R., Kavanagh, J., Oliver, S., Oakley, A. (2003). Children and Physical Activity: A systematic review of barriers and facilitators. London: EPPICentre, Social Science Research Unit, Institute of Education, University of London.

Burrows, C., Eves, F., and Cooper, D.M. (1999). Children's perceptions of exercise – are children mini adults? *Health education*, 99, 61-69.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness:definitions and distinctions for health-related research. *Public health reports*, 100(2), 126-131.

Christodoulidis, T., Papaioannou, A., Digelidis, N. (2001). Motivational climate and attitudes towards exercise in Greek senior high school: A year-long intervention. European Journal of Sport and Science, 1(4).

Christodoulos, A. D., Douda, H. T., Polykratis, M., Tokmakidis, S. P. (2006). Attitudes towards exercise and physical activity behaviours in Greek schoolchildren after a yearlong health education intervention. *British Journal of Sports Medicine,* 40 (4), 367-371.

Colley, A., C. Comber and D.J. Hargreaves. (1994). Gender effects in school subject preferences: A research note. Educ. Studies, 20, 13-18. DOI: 10.1080/0305569940200102

Department of Health and Children, Health Service Executive. Get Ireland Active: The National Guidelines on Physical Activity for Ireland. 2009; Available at: www.getirelandactive.ie

Folsom-Meek, S. L. (1992). A comparison of upper elementary school children's attitudes toward physical activity. Paper presented at the Annual Meeting of the American Alliance for Health, Physical Education, Recreation and Dance. Indianapolis, April. (ERIC Document Reproduction Service No. ED 350-297).

Greenwood, M. and Stillwell, J. (2001). Activity preferences of middle school physical education students. *Physical Education*, 58, 26-29.

Hick, M.K., M.S. Wiggins, R.W. Crist and F.M. Moode, (2001). Sex differences in grade three students' attitudes toward physical activity. Perceptual Motor Skills, 93, 97-102. DOI: 10.2466/PMS.93.5.97-102

Hick, M.K., Wiggins, M. S., Crist, R.W. and Moode, F. M. (2001). Sex differences in grade three students'

attitudes toward physical activity. *Perceptual Motor Skills*, 93, 97-102. DOI: 10.2466/PMS.93.5.97-102

Jandrić, S. (2010). Differences between boys and girls in the level of the physical activity FACTA UNIVERSITATIS Series: Physical Education and Sport, 8(1), 1 – 7.

Mason, V. (1995). Young People and Sport in England 1994: The views of teachers and children. London: Sports Council.

Mitić, D., Radisavljević-Janić, S., Milanović, I., Pantelić, S., Marković, S., Stanković, S., et al. (2010). Angažovanost u rekreaciji građana Republike Srbije. Beograd: Ministarstvo omladine i sporta [in Serbian]

NASPE. (2007). Moving into the future: National standards for physical education: A guide to content andÖğretim Programı ve Kılavuzu. Ankara: Devlet Kitapları Müdürlüğü.

Nelson, T., D., Benson, E. R. and Jensen, C. D. (2010). Negative Attitudes toward Physical Activity: Measurement and Role in Predicting Physical Activity Levels among Preadolescents. *Journal of Pediatric Psychology*, 35(1), 89-98.

O'Brien, M., Rustin, M., Jones, D., Sloan, D. (2000). Children's independent spatial mobility in the urban public realm. *Childhood*, 7, 257-277.

Papaioannou, A. (1994). Development of a questionnaire to measure achievement orientations in physical education. Research Quarterly in Exercise and Sport, 65, 11-20.

Parkhurst, D.L. (2000). Comparison of attitudes toward physical activity and physical activity levels of sixth grade boys and girls of various ethnic origins. Thesis/dissertation, Manuscript, University of Oregon.

Pate, R. R., Freedson, P. S., Sallis, J. F., Taylor, W. C., Sirard, J., Trost, S. G., et al. (2002). Compliance with Physical Activity Guidelines Prevalence in a Population of Children and Youth. *Annals of Epidemiology*, 12(5), 303-308.

Schutzer, K. A., & Graves, B. S. (2004). Barriers and motivations to exercise in older adults. *Preventive Medicine*, 39(5), 1056-1061.

Strong, W. B., Malina, R. M., Blimkie, C. J. R., Daniels, S. R., Dishman, R. K., Gutin, B., et al. (2005). Evidence based physical activity for school-age youth. *Journal of Pediatrics*, 146(6), 732-737.

Terry, J. (1996). Changing habits by changing attitudes, *Journal of Health, Physical Education, Recreation, and Dance*, 48, 13.

Tuxworth, B. (1997). The St Edmundsbury Fitness Survey 1993-1995. Bury St. Edmunds: St Edmundsbury Borough Council.

Zeng, H. Z., Hipscher, M. and Leung W. R. (2011). Attitudes of High School Students toward Physical Education and Their Sport Activity Preferences. *Journal of Social Sciences*, 7 (4): 529-537.

FIZIČKA AKTIVNOST DECE UZRASTA (13-14 GOD), I POTENCIJALNE BARIJERE U AKTIVNOSTI-PILOT STUDIJA

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SAŽETAK

Uvod: Fizička aktivnost ima značajne zdravstvene koristi kod mladih, ali mnogi ne ispunjavaju utvrđene smernice kako bi se poboljšao nivo fizičke aktivnosti, što je značajan zdravstveni izazov. Kako bi se razvila svest za fizičkim aktivnostima u mladosti, više istraživanja je potrebno u vezi sa mogućim barijerama u učešću mladih u fizičkim aktivnostima. Na osnovu toga, primarni cilj ovog istraživanja bio je da se analizira angažovanje učenika starijih razreda osnovne škole u fizičkim aktivnostima, u zavisnosti od pola. Pored toga , biće analizirani faktori

koji bi mogli biti potencijalne prepreke za sprečavanje učenika da učestvuju u fizičkim aktivnostima. Pretpostavlja se da postoje značajne razlike između dečaka i devojčica uzrasta 13 i 14 godina u pogledu njihovog učešća u fizičkim aktivnostima.

Metode: Uzorak ispitanika se sastojao od ukupno 721 ispitanika prosečne starosti od 14,3 ± 0,7, od kojih 372 dečaka i 349 devojčica. Za potrebe ovog istraživanja primenjen je anketni upitnik (Mitić i sar., 2010) koji sadrži ukupno 17 pitanja, uslovno podeljenih u tri grupe. Za statističku obradu upotrebljeni su neparametarski testovi za ispitivanje značajnosti razlike Hi-kvadrat test (χ^2). Za testiranje značajnosti razlike između opaženih i teorijskih frekvencija u svakoj grupi primenjen je Hi-kvadrat test (χ^2) za procenu kvaliteta podudaranja. Za utvrđivanje razlika između grupa muškaraca i žena primenjen je Hi-kvadrat test (χ^2) nezavisnosti.

Rezultati: Vrednosti $\chi 2$ testa nezavisnosti pokazale su da postoji statistički značajna razlika između dečaka i devojčica u frekvenciji vežbanja ($p \leq 0.01$). Rezultati χ^2 testa pokazali su da ne postoje statistički značajne razlike između grupa dečaka i devojčica u izboru mesta i načinu vežbanja (Sig. > .05). Rezultati su pokazali da i kod dečaka i devojčica postoje barijere za upražnjavanje fizičkih aktivnosti, ali da se one značajno ne razlikuju u odnosu na grupu ispitanika.

Zaključak: Ova studija je pokazala da postoje značajne razlike između dečaka i devojčica u pogledu frekvencije učešća u fizičkim aktivnostima. U poslednje vreme su značajno povećane istraživačke aktivnost u ovoj oblasti. Međutim, ne postoji dovoljno dobar kvalitet istraživanja o evaluacijama i efektivnosti intervencija, strategijama za prevazilaženje barijera za učestvovanje u fizičkim aktivnostima, kao i o promovisanju fizičke aktivnosti za socijalno ugrožene grupe dece.

Ključne reči: dečaci, devojčice, vežbanje, učešće

THE INFLUENCE OF CORRECTIVE GYMNASTICS ON THE CORRECTION OF BAD BODY POSTURE AND THE CHANGES OF MOTOR STATUS IN THE PREPUBERTAL SCHOOLCHILDREN

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UDC 613.71/.72:796

SUMMARY

The longitudinal study of the influence of corrective gymnastics on improving postural and motor status of children is a brief description of the topic of this research. The research sample consists of schoolchildren aged 11 years (plus or minus six months) at the initial measurement. Two groups of variables comprise: the variables for determining the spine deformities in the sagittal plane (kyphotic and lordotic bad body posture) and the variables for determining the motor status of the researched subjects (nine motor tests for the assessment of the flexibility, explosive and repetitive strength of the body). A program of corrective gymnastics was used as an extracurricular activity of schoolchildren; it lasted three school semesters, with two to three teaching hours per week. The initial, control and final tests gave results that were expressed through the canonical discriminative analysis and have showed that the applied program of corrective gymnastics contributed to the total rehabilitation of the kyphotic and lordotic bad body posture, and to the improvement of some dimensions of the motor status.

Keywords: kyphotic bad body posture, lordotic bad body posture, motor skills, corrective gymnastics, programmed exercise, discriminative analysis.

INTRODUCTION

This research study is a longitudinal study of the effects of the programmed exercise as corrective or therapeutic gymnastics on disorders of the spinal column in the sagittal plane and the motor status of schoolchildren during the pre-puberty period.

Classes of corrective gymnastics were given to the schoolchildren as their extracurricular activities two to three hours per week.

In the master thesis entitled "The possibility of eliminating bad body posture by means of physical education", D. Ulic deals with the problem of correcting bad body posture (kyphotic, lordotic and scoliotic) through certain physical exercises. The sample consisted of 150 schoolchildren from elementary schools in Novi Sad, grades 5-8. The experiment included three groups (1 and 2 experimental and 3 control group). The first group performed physical exercises three times a week for 45 minutes within the regular classes, the second group also performed physical exercises three times a week, but in the course of 30 minutes during specially organized classes for this purpose, while the control group of schoolchildren was involved in the implementation of a regular physical education curriculum program.

N. Stefanovic in his work entitled "Determining the kyphotic state" points out that a ruler and a plumb are the most suitable measuring instruments to determine the posture status of schoolchildren but on the condition that a compulsory prior observation was made and he states the possible ways in which to determine the kyphotic bad body posture. The way which he depicts has become well known in literature and is generally accepted.

B. Bokan in the paper entitled “The methodology for determining the body statuses" proposed the unification of assessing body posture. He points out that the segments of the body are marked with the initial letters of that segment. If two names began with the same letter, then the next letter was added, but it is a small letter. Another important issue is that the deviation from a normal body posture is to be denoted with the initial letter of the Latin name of the found deformities. The third group would consist of labels, A, B, C and D. These are the markings as follows: good posture, kyphotic posture, lordotic posture and scoliotic posture. These labels were made by Smout and Mc Dowell, and they were modified by Lj. Radojičić-Finkelstein and her associates.

Lj. Koturović in the paper “The need for a greater use of corrective exercises within the frame of regular teaching process," explains the use of certain terms such as rehabilitation, kinesitherapy and corrective gymnastics. The author further argues for some ways to determine the deviation from the normal, and indicates the need for the harmonization of the criteria on the evaluation of the body status so as to avoid blunders and mistakes leading to the designation of a bad body posture to a fixed deformity. This adjustment would be done through seminars where the teachers would be highly competent experts in this field.

METHODS

The subject sample was drawn on the basis of the stated deformities of the spine in the sagittal plane, of 25 schoolchildren of fifth grade of primary school, aged 11 years, plus or minus 6 months.

Two groups of variables represent the variables for the assessment of the postural and motor status. For the assessment of the postural status the following variables were selected: kyphotic bad body posture (KKIF) and lordotic bad body posture (KLOR). The motor status of the research subjects was rated by the following battery of tests: to assess the flexibility (trunk flexion with a bat (MISK) leg pick up from lying on the stomach (MZLE) and deep forward bend on the bench (MDPR), to assess the explosive strength (throwing a medicine ball from lying down (MBME), standing long jump (MDSK) standing high jump (IASC) and for the assessment of the repetitive strength - push-ups on the floor (MSKLE), forward bend from lying down (MTRB) and backword bend from lying down (MLED).

The measurements of the deviation of the spine in the sagittal plane were performed in the morning hours with the use of clinical methods, of the somatometric type (plumb, ruler and dermograph). A more lenient criterion was used with its mean values. All results which are in the thoracic region had values greater than 3.5 cm, and in the lumbar region the values greater than 4.5 cm were subjected to further treatment.

To measure motor skills, the generally accepted tests, whose validity was demonstrated through previous research, were used.

The group of subjects formed on the basis of the identified disorders, performed exercises to correct the disorders in the following order: exercises to increase spinal mobility, exercises to strengthen the weak (stretched) muscles (agonists), exercises to stretch shortened muscles (antagonists) and breathing exercises.

The exercise program to strengthen the weakened muscles, up to the control measurement and from the control to the final measurement, differs by the initial positions, volume and intensity. The differences are in the direction of the increasing workload of the researched subjects (trainees) as they approach the end of the experiment, which is predetermined by the work plan.

Working with the subjects started at the beginning of the school year, after the measurements of the postural and motor status. The first part of the experimental program lasted until the end of the school year, when the control measurements were made. The second part began with the beginning of the next school year and it finished at the end of the semester, when the final measurings were performed.

RESULTS AND DISSCUSION

The results of the measurements were statistically processed by the canonic discriminative analysis and the obtained relations were explained in the discussion section.

TABLE 1 Canonic discriminative functions

Fcn	Eigen V.	Pct of Var	Cum pct	Can Cor	Wilks λ	χ2	DF	Sig
1	1.19	86.82	86.82	.73	.38	96.48	14	.00
2	.18	13.18	100.00	.39	.84	16.88	06	.01

TABLE 2 Correlation functions

Test	FUNC 1	FUNC 2
KKIF	.33*	-.23
KLOR	.26*	.20
MZLE	-.09	-.05
MBME	.10	-.55*
MDSK	.01	-.53*
MSKL	-.47	-.51*
MTRB	-.12	-.42*
MISK	-.20	.38*
MVSK	-.02	-.37*
MLED	-.02	-.26*
MDPR	.06	-.20*

TABLE 3 Centroids of groups

Groups	FUNC 1	FUNC 2
1	1.40	-.28
2	-.11	-.30
3	-1.31	-.36

The results of the discriminative analysis of the experimental group of boys, ie. their postural and motor skill tests, show great progress in correcting bad body posture, while the results of the motor status showed slight progress in the period from the initial to the final measurement.

In the area of motor behavior and postural disorders in the spinal cord, by condensation of the variables, there were isolated two statistically significant discriminative variables, one of which explains the postural area of the spine and the other explains the motor area.

The first isolated discriminative variable (Eigen V.=1.19), separates the spine deformities on the basis of the discriminative coefficients (cum pct=86.82) and its canonical correlation is .73 (can cor = .73). The significance of this discrimination was tested by the Wilks lambda test (λ=.38) and the Bartlett chi-square test (χ2=96.48) and 14 (DF = 14) degrees of freedom. The first of the isolated discriminative function explains the differences with

86.82% of the intergroup variability (pct of var = 86.82).

Based on the size and sign of the projection centroid of the first discriminative function, it can be concluded that the postural disturbances of the spine , kyphosis (KKIF = .33) and lordosis (KLOR=.26) which had a positive sign on the first measurement (1.40), upon the implementation of the corrective treatment, resulted in the improved body postural status of the boys, which is shown by the second (control) and third (final) measurements.

Already in the control measurement the result of the projection of centroids on the discriminative function showed a negative sign (- .11), which proves the success of the corrective treatment.

The final measurement has, by the increase in the negative projection of centroids on the discriminative function (-1.31) proved that by applying the corrective gymnastics exercises, we have fully rehabilitated the disorders of the spine in the sagittal plane.

The second isolated discriminative variable (Eigen V. = .18), separates the motor area on the basis of the discriminative coefficients (cum pct = 100.00) whose canonical correlation is .39 (can cor = .39). The significance of this discrimination was tested by the Wilks lambda test (λ=.84) and the Bartlett chi - square test ((χ2=16.88) with 6 (DF = 6) degrees of freedom. The second isolated discriminative function explains the differences with 13.18 % of the intergroup variability (pct of var = 13.18) .

Based on the size and sign of the projection of the centroids on the second discriminative function, it can be concluded that the motor tests, except for the tests of flexibility, showed a modest advance from the initial to the final measurement. The biggest projection showed the tests MBME = - .55 , MDSK = - .53 , MSKLE = - .51 and MTRB = - .42 , IASC = - .37 , while the tests MLED = - .26 and MDPR = - .20 showed somewhat weaker projections.

The motor test for the evaluation of the shoulder girdle flexibility (MISK = .38) has no adequate projection on the second (control) and third (final) measurements and disrupts the continuity of other variables which, given the poor projections of other tests of flexibility, can show a bad influence of the programmed exercises on the development of this motor area.

Despite this, the tests (their projections) for the assessment of the explosive strength of the shoulder girdle (MBME) and legs (MVSK and MDSK), as well as tests for the assessment of the repetitive power of the shoulder girdle (MSKL), abdominal muscles (MTRB) and extensors of the spine, that is, of the trunk (MLED) showed a slight improvement, as seen from the first (initial) to the third (final) measurement.

CONCLUSION

On the basis of this discussion of the measurement results, it can be concluded that the application of a corrective treatment successfully repaired bad body posture, by strengthening the weak muscle group, however with just a slight improvement in the flexibility of some joints and muscle groups. The reasons for the poor results of the tests for the assessment of the flexibility is to be found in the work program where the emphasis was placed on strengthening the muscles rather than stretching them, because the problem was the rehabilitation of the first degree of the kyphotic and lordotic bad body posture.

The influence of the selected corrective exercises and the implementation of the principles of corrective gymnastics has all got us closer to the realization of the final goal, that is the resolution of the stated problem.

REFERENCES

Bokan, B.: Methodology for determining the physical status. Physical Culture, Belgrade, 1977.

Radosavljevic, M.: Corrective gymnastics with the basics of physical training. Faculty of Physical Education, Belgrade 2001

Stefanovic, N. Determination of the kyphotic condition. Physical Culture, Belgrade, 1971.

Street, D.: Physical education class as an important factor in the prevention of bad body posture of the 10-11 year schoolchildren. Physical culture, Podgorica, 1995.

Smout, CFV, Mc Dowell, RJS: Anatomy and physiology for students of physiotherapy. Occupational therapy and gymnastics, London, 1949.

Todorovic, V. Possibility to prevent bad posture in the final part of the class. Physical culture, Podgorica, 1995.

Zivkovic, D., Karaleic, S.: Relation of lordotic body posture and morphological characteristics of pre-puberty age schoolchildren. FIS Communications, Fifth International Symposium, Nis, 1996.

Zivkovic, D., Karaleic, S.: Relation of irregular kyphotic posture and morphological characteristics of pre-puberty age schoolchildren. FIS Communications, Fifth International Symposium, Nis, 1996.

Zivkovic, D.: Fundamentals of Kinesiology with elements of clinical kinesiology. Faculty of Sport and Physical Education, Nis, 2009

UTICAJ KOREKTIVNE GIMNASTIKE NA KOREKCIJU LOŠEG DRŽANJA TELA I PROMENE MOTORIČKOG STATUSA KOD UČENIKAPRETPUBERTETSKOG UZRASTA

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SAŽETAK

Longitudinalna studija uticaja korektivne gimnastike na poboljšanje posturalnog i motoričkog statusa dece, je kratak opis ovog istraživačkog rada. Uzorak ispitanika sačinjavaju učenici starosti 11 godina (plus-minus šest meseci) na inicijalnom merenju. Dve grupe varijabli sačinjavaju: varijable za utvrdjivanje poremećaja na kičmenom stubu u sagitalnoj ravni (kifotično loše držanje i lordotično loše držanje) i varijable za utvrdjivanje motoričkog statusa ispitanika (devet motoričkih testova za ocenu fleskibilnosti, eksplozivne i repetitivne snage organizma). Program korektivne gimnastike je korišćen kao vančasovna aktivnost učenika, trajao je tri školska polugodja, sa po dva do tri časa nedeljno. Inicijalno, kontrolno i finalno merenje dali su rezultate koji su kroz obradu kanoničkom diskriminativnom analizom, pokazali da je primenjeni program korektivne gimnastike doprineo potpunom saniranju kifotičnog i lordotičnog lošeg držanja, kao i poboljšanju nekih dimenzija motoričkog statusa.

Ključne reči: kifotično loše držanje, lordotično loše držanje, motorika, korektivna gimnastika, programirano vežbanje, diskriminativna analiza.

THE CHANGES OF MOTOR SKILLS OF WOMEN UNDER THE INFLUENCE OF DIFFERENT MODELS OF SPORT AND RECREATIONAL ACTIVITIES

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SUMMARY

Introduction Motor skills as a component of physical fitness are decisive for maintaining working abilities and health, especially for a modern/sedentary man. Recreation is the best prevention/medicine for the illness of modern mankind and sedentary lifestyle, while different models of sport and recreational activities can have a positive impact on the overall anthropological status of a person. The study was conducted in order to determine the level of changes of motor skills of women aged 35 to 45 under the influence of three months of recreational swimming and aerobics program.

Method A sample of women from Banja Luka who regularly exercise for recreation was divided into two experimental groups (swimming N=38 and aerobics N=38). Six motor variables (walking the distance of 2 km, forward bend on a bench, sit ups, body sways, holding pull ups and squats) were tested. The data was processed by the method of technical descriptive statistics, by the T-test and by the mutlivariant analysis of variance and co-variance.

Results Recreational models of swimming and aerobics resulted in positive changes of motor skills with the experimental groups. Statistically significant changes were made in all measuring variables with both groups (p=0,000). The groups statistically significantly differed during the final measuring of the variables. Walking 2 km 2km (p=0,001, F=12,958 - Swimming) and Flexibility forward bend while sitting (p=0,044, F=4,220 - Aerobics). Descriptive numerical values of the variables Walking 2km for I and II measuring: group swimming; pre test 17,075±2,608, post test 14,661±2,546, t=8,368, p=0,000, aerobics; pre test 16,769±2,386, post test 15,421±1,988, t=10,330, p=0,000, and for the variable Flexibility forward bend while sitting for I and II measuring: group swimming; pre test 25,712±7,032, post test 34,684±6,514, t=7,872, p=0,000, aerobics; pre test 23,744±7,504, post test 35,175±7,968, t=-10,119, p=0,000.

Conclusion The obtained results of the study indicate that different models of sport and recreational activities have a positive effect on transformation of motor skills in middle-aged women, thus proving the possibility of the application of such models to this population and presenting a recommendation for other age categories of people engaging in recreation.

Key words: physical fitness, mean age, swimming, aerobics

INTRODUCTION

Modern lifestyle (urbanization and high technological development) has influenced the character of work (highly-profiled work) increasing the demands placed before a worker. Since the new technology has, in a majority of jobs, provided the same quality of work at any time and place, the worker is exposed to a constant pressure and load, which leads to the deterioration of his health

condition. However, a modern man, although exposed to modern illnesses, can, if he introduces discipline into organizing his time (an active way of life and removing risk factors), prevent the appearance of chronic fatigue and take preventive measures to maintain his health and working abilities, if he regularly engages in recreational activities under the guidance and control of an expert/sport recreation trainer.

Highly-developed motoric abilities can help a modern man to by-pass the difficulties imposed on him by the modern IT society. The motoric abilities are those abilities which help in solving motoric tasks and condition successful moving, regardless of whether they are gained through training or not (Malacko, 2000). Highly-renowned authors (Kurelić, 1959; Matveev, 1969; Harre, 1971; Zaciorski, 1975; Platonov, 1984; Ozolin, 1999;) believe that the structure of physical abilities is comprised of the following anthropomotoric abilities: strength, speed, endurance, elasticity, co-ordination, agility and balance. According to Stojiljković (2005) the most important physical abilities in recreation include aerobic endurance, strength and movability. Aerobic abilities and muscle endurance training highly contribute to a generally good state of health. Furthermore, muscle abilities training (strength and endurance) increases the total muscle mass, which is in direct relation to the enhanced muscle combustion. In addition, the exercise for increasing muscle strength reduces demineralisation of bones and prevents or slows the development of osteoporosis. Likewise, strength training enables avoidance of backache including frequent injuries due to sudden and abrupt movements. A constant training of muscle strength enhances the quality of life and prolongs independence and movability until old age (Sharkey, Gaskill, 2008).

Modern lifestyle is very dynamic, thus a woman's body is prone to higher pressure and stressful situations, especially in larger cities. The specific structure of a woman's body, especially her physiological stages, daily load she is exposed to, require careful selection, planning, training and programming. At the same time, special attention should be paid to an increased ability of damaging the locomotor apparatus, osteoporosis (loss of bone marrow), distorted statics induced by degenerative changes on the joints due to long-term loads, hormone changes and a series of other characteristics that make a woman's body so unique (Heimer, 1979; Banović, 1984,). The effects of physical inactivity are highly dominant in middle-aged women, especially those assigned to sedentary work posts (Fučkar, 1997; Zrnić, 2011).

Sedentary jobs are a great risk to people's health, and sitting position throughout the day leaves negative effects on the worker. After the invention of vehicles, computers, television and desks, the frequency of the sitting position has increased to incredible 9.3 hours per day! That is more time than we spend sleeping (average 7.7 hours per day). Daily 8-hours' sitting brings our body into a critical condition, and negative consequences are: risk of many types of cancer and premature death up to 40%, obesity, a higher percentage of obese people, in the sitting position energy can hardly be burned (electric activity in our muscles is turned off, calories combustion drops to 1 calorie per minute), the level of enzymes drops by 90% (level of good cholesterol drops by 20%), the production of insulin is reduced by 24% (thus there is a high risk of diabetes), the sitting position increases the risk of cardiovascular diseases, pain in the neck, lower back, knees and coccyx, an irregular sitting position deforms the spine, excessive work with the computer weakens the eyesight, excessive sitting position increases the risk of rachitis in young people, it distorts the work of the metabolism(Mišigoj Duraković, 1999). Long-term sitting lures the body into shifting into a passive working method. Thus, it is necessary to assume activities that boost the heart and blood circulation, since the organs are thus motivated to function in a healthier way (Relac, 1975).

An appropriate physical activity is a necessary defensive mechanism that reduces or removes the decay of physical and mental system due to work (Caspersen, 1985). Sports recreation programmes

must satisfy several important principles (Andrijašević, 2012): 1) the activity should be harmonised with the objective needs (the choice of activity and intensity, duration and training continuity), wishes and abilities (physical, material, temporal, spatial); 2) the activity should be harmonised with personal inclinations and interests (habits, knowledge, interests); 3) it is necessary to ensure a regular,if possible, daily training; 4)the activity should produce emotional and physical pleasure (positive social environment; an affirmative approach of the leader, pleasant environment, the feeling of pleasure after training); 5) the activity should have positive effects (better psychosomatic status), etc. Experts at sports recreational centres and wider, provide high-quality sports recreational programmes respecting the principles of training management (diagnostics, programme, performance and effect control). Depending on the character of work training programmes can now be adjusted to the needs and conditions, thus contributing to the at least partial solving of the problem and the negative effects of work load (Relac, 1975; Jurakić, 2009). The effects of a physical activities programme can improve the work itself, especially the status of the worker, mentally and physically (Zrnić, 2011). The programme of physical activities can be introduced into enterprises, and where it is not possible, it is necessary to introduce acceptable forms of out-of-work sports recreation.

The problem of this study is based on the need to comprehend if and to what extent different models of sports and recreational activities (swimming and aerobics) instigate the changes in the motoric abilities of middle-aged women, and the objective of this study is to establish the changes of motoric abilities of women of the age from 35 to 45 under the influence of a three-months recreational programme of swimming and aerobics.

METHODS

The sample of study group was comprised of 76 recreationists from Banja Luka of the age from 35 to 45. According to the study criteria, the examinees were supposed to perform sedentary activities, to be exposed to medical check-up, not to have somatic deficiencies and illnesses, not to attend any organized forms of physical activities, and to regularly exercise. The sample was divided into two experimental groups: first group - swimming (n = 38) and second group aerobics (n = 38).

During the study of the motoric status, the following variables were measured: (1) walking 2km (MUKK2km); (2) flexibility forward bend on a bench (MFLPRS); (3) lying on a bench (MRLSJE); (4) body shelter (MRZTRU); 5) plank in a nuckle (MSIZGI); (6) squat (MRČUČ). The first measuring of the initial state had been performed before the three-months treatment, and the second, final check-up, after 36 hours of recreational exercising.

The results of the initial and final check-up, had been processed with a statistical package for data processing *STATISTICA for Windows, ver. 18.0*. at the Faculty of Physical Education and Sports of the Banja Luka University. Within descriptive statistics the basic parametres of the following variables had been calculated: minimal value of the results (MIN), maximum value of the results (MAX), arithmetic mean (AS) and standard deviation (SD). The evaluation of the form of distribution of the results and the normality of the distribution of the results was done through calculating the coefficient of curvature (skjunis – Skew), as a measure of the asymmetry of distribution. From the field of comparative statistics for establishing quantitative differences between the initial and the final measurings within the studied groups the T-test for dependant samples was used. Establishing the statistical significance between the groups on the initial measuring was realised with the help of the multivariant analysis of variance *(MANOVA),* and on the final measuring with the help of the multivariant analysis of co-variance (MANCOVA). Testing the differences between the groups for certain variables was realised by applying thhee univariant analysis of variance (ANOVA) and co-variance (ANCOVA). At both studies the level of importance of differences was tested on the level of $p < 0.05$.

RESULTS

TABLE 1 The descriptive statistical parameters of motoric variables on the initial measuring - *Swimming*

Variables	Min.	Max.	AS	SD	Sk.	Kt.
MUKK2km	12.00	21.30	17.0755	2.60831	-.215	-.753
MFLPRS	8	41	25.71	7.032	-.279	.094
MRLSJE	2	22	11.95	4.261	-.389	.530
MRZTRU	3	28	19.32	5.991	-.879	.495
MSIZGI	1.0	19.0	4.413	4.5325	1.931	3.228
MRČUČ	8	22	15.39	2.667	-.052	.969

Table 1 shows the descriptive statistical parametres of motoric variables for the group *Swimming* on the initial measuring. Out of six motoric variables only the variable *Plank in a knuckle*, *MSIZGI (1.931)* shows express asymmetry of distribution and significant deviation from the normal distribution. Considering the characteristics of the test *Plank in a knuckle* (MSIZGI) and the characteristic of the sample represented by the middle-aged adults, it is possible to conclude that the test was too difficult for the sample group, having in mind an extreme grouping of the results in the low values zone and a high frequency of the lowest values. Other tests show moderately positive and negative asymmetry which does not significantly deviate from the normal distribution. The asymmetry measure Kurtosis (roundness of the curve) is with the variable *Plank in a knuckle,* (MSIZGI) (3.228) a bit higher from the average (2.75), while other variables do not significantly deviate from the normal distribution, which leads us to believe that the group is homogenous when evaluating motoric abilities.

TABLE 2 The descriptive statistical parametres of motoric variables on the final measuring - *Swimming*

Variables	Min.	Max.	AS	SD	Sk.	Kt.
MUKK2km	11.00	18.17	14.9921	1.78201	-.093	-.663
MFLPRS	16	45	34,68	6.514	-.583	.795
MRLSJE	8	30	18.08	4.296	.206	1.165
MRZTRU	5	46	25.58	6.911	-.259	2.505
MSIZGI	.1	36.0	7.991	8.7128	1.931	3.213
MRČUČ	13.0	27.0	21.184	3.2203	.066	-.117

Table 2 shows the descriptive statistical parametres of motoric variables for the group *Swimming* on the final measuring. Out of six motoric variables only the variable *Plank in a knuckle, MSIZGI (1.931)* shows express asymmetry of the distribution and a significant deviation from the normal distribution. Although the results of the final measuring were far better than at the initial measuring, it has to be said that the test was difficult for this sample of examinees. Other tests show moderately positive and negative asymmetry which does not significantly deviate from the normal distribution. The measure of asymmetry Kurtosis (roundness of the curve) in the variable *Plank in a nuckle (MSIZGI) (3.228)* is a bit higher from the average (2.75), while other variables do not significantly deviate from the normal distribution.

TABLE 3 The descriptive statistical parametres of motoric variables at the initial measuring - *Aerobics*

Variables	Min.	Max.	AS	SD	Sk.	Kt.
MUKK2km	12.00	22.31	16.7692	2.38592	.212	.267
MFLPRS	7	39	23.74	7.504	-.373	.283
MRLSJE	2	19	12.55	3.277	-1.042	2.081
MRZTRU	1	30	18.74	6.172	-.647	.627
MSIZGI	1.0	13.3	3.549	2.8545	1.583	2.403
MRČUČ	8	23	15.24	3.774	-.121	-.621

Table 3 shows the descriptive statistical parameters of motoric variables for the group *Aerobics* at the initial measuring. In the group of the observed motoric variables only the variable *Plank in a knuckle, MSIZGI (1.583)* shows a positive asymmetry of the distribution and a significant deviation from the normal distribution, thus it can be concluded that the test was difficult for this sample group. Other variables show slightly negative asymmetry, which means the tests were not difficult when evaluating the motoric abilities of the sample. The measures of asymmetry Kurtosis (roundness of the curve) in a majority of tests do not show significant deviations from the normal distribution.

TABLE 4 The descriptive statistical parametres of motoric variables at the final measuring - *Aerobics*

Variables	Min.	Max.	AS	SD	Sk.	Kt.
MUKK2km	12.00	19.45	15.4211	1.98792	.041	-.330
MFLPRS	20	46	35.68	6.103	-.807	.444
MRLSJE	9	29	19.08	4.155	.177	.348
MRZTRU	8	37	26.63	6.326	-.498	.635
MSIZGI	2.0	24.0	6.369	4.5789	2.188	5.555
MRČUČ	14.0	28.0	21.711	4.1454	-.220	-1.149

Table 4 shows the descriptive statistical parameters of motoric variables for the group *Aerobics* at the initial measuring. In the group of the observed motoric variables only the variable *Plank in a knuckle*, MSIZGI (2.188) shows a positive asymmetry of distribution and a significant deviation from the normal distribution, thus it can be concluded that the test was too difficult for this sample group. Other variables show mildly negative asymmetry, meaning the tests were not difficult for the assessment of the motoric abilities of the sample. The measures of asymmetry Kurtosis (roundness of the curve) show the normal distribution. The only exception is variable ukazuju *Squat (MRČUČ (-1.149),* whose value shows a bit higher deviation toward the platykurtic curve and shows a higher scatteredness of the given results.

TABLE 5 The *T–test* between the initial and the final measuring of motoric variables – *Swimming*

Variables	AS	SD	R	t	P
MUKK2km in. – fin.	17,076 14,661	2,608 2,546	0.820	8.368	0,000
MFLPRS in. – fin.	25,711 34,684	7,032 6,514	0.464	-7.872	0.000
MRLSJE in. – fin.	11,947 18,079	4,261 4,296	0.603	-9.909	0.000
MRZTRU in. – fin.	19,316 25,579	5,991 6,911	0.763	-8.534	0.000
MSIZGI in. – fin.	4,413 7,991	4,532 8,713	0.607	-3.167	0.003
MRČUČ in. – fin.	15,395 21,184	2,667 3,220	0.504	-12.017	0.000

Testing the effects of the changes in motoric variables in the group *Swimming* (Table 5) showed that statistically significant changes had occurred in all studied variables, at the estimated level of $p < 0.01$. In all variables, the differences are higher at the final measuring.

Testing the changes in motoric variables in the group *Aerobics* (Table 6) shows a statistically significant change in all studied variables at the estimated level of $p < 0.01$. In all variables the differences are higher at the final measuring (negative results) in the variables of motoric abilities it is clear that a realized treatment had statistically significantly affected ($p = 0,000$) the quantitative changes in the treated variables. This means the programme was well designed and accepted by the examinees, but also the trainers had found the right measure to realize the goal and achieve good results with the examinees.

TABLE 6 The *T–test* between the initial and the final measuring of motoric variables - *Aerobics*

Variables	AS	SD	R	t	p
MUKK2km in. – fin.	16,769 15,421	2,386 1,988	0.948	10.330	0.000
MFLPRS in. – fin.	23,737 35,175	7,504 7,968	0.443	-10.119	0.000
MRLSJE in. – fin.	12,553 19,474	3,277 4,273	0.818	-16.828	0.000
MRZTRU in. – fin.	18,737 26,895	6,172 5,708	0.740	-10.798	0.000
MSIZGI in. – fin.	3,549 6,734	2,855 4,781	0.779	-5.880	0.000
MRČUČ in. – fin.	15,237 21,455	3,774 4,869	0.815	-16.385	0.000

TABLE 7 The study of the differences between groups in motoric variables at the initial measuring

Variables	Group	AS	SD	F	p
MUKK2km	Swimming	17.075	2.608	0.368	0.546
	Aerobics	16.769	2.386		
MFLPRS	Swimming	25.712	7.032	1.505	0.224
	Aerobics	23.744	7.504		
MRLSJE	Swimming	11.951	4.261	0.325	0.570
	Aerobics	12.55	3.277		
MRZTRU	Swimming	19.323	5.991	0.127	0.722
	Aerobics	18.738	6.172		
MSIZGI	Swimming	4.413	4.533	1.050	0.309
	Aerobics	3.549	2.855		
MRČUČ	Swimming	15.39	2.667	0.122	0.728
	Aerobics	15.24	3.774		
	F = 0.639	SS_1 = 6	SS_2 = 69	p = 0.598	

The study of the differences between the groups of examinees in motoric variables at the initial measuring did not show the presence of statistically significant differences (Table 7). The value of the *F-test* for the whole system of the studied variables is below the border value and none of the studied variables had shown statistically significant difference.

TABLE 8 The studied difference between groups in motoric variables at the final measuring

Variables	Group	AS	Kor. AS	SD	F	p
MUKK2	Swimming	14,661	14,844	2,546	12,958	0,001
	Aerobics	15,421	15,569	1,988		
MFLPRS	Swimming	34,684	33,922	6,514	4,220	0,044
	Aerobics	35,175	36,446	7,968		
MRLSJE	Swimming	18,079	18,291	4,296	0,652	0,422
	Aerobics	19,474	18,867	4,273		
MRZTRU	Swimming	25,579	25,306	6,911	2,542	0,115
	Aerobics	26,895	26,905	5,708		
MSIZGI	Swimming	7,991	7,453	8,713	0,180	0,672
	Aerobics	6,734	6,908	4,781		
MRČUČ	Swimming	21,184	21,065	3,220	1,475	0,229
	Aerobics	21,455	21,830	4,869		
		F = 2,826	DF_1 = 6	DF_2 = 63	P = 0,017	

Testing the differences between the groups for the whole system of the applied motoric variables (Table 8) showed that after the applied treatment a statistically significant difference was observed between the studied groups at the level of significance of p = 0.017. The review of the values of the *F-test* for certain variables shows that the established difference was marked by the differences in variables *Walking 2km (MUKK2km)* and *Flexibility forward bending on a bench (MFLPRS). The v*ariable *Walking 2km (MUKK2km)* shows statistically significant difference at the estimated level of p < 0.01 for the group *Swimming*, and in the variable *Flexibility forward bending on a bench (MFLPRS)* at the level of p < 0,05 for the group *Aerobics*.

Thus, the review of the values of the *F-test* and the level of significance for certain variables we can conclude that the difference between the groups is established marked by the difference in the variable *Walking 2km (MUKK2km)* in the group *Swimming*,

and the variable *Flexibility forward bending on a bench (MFLPRS)* in the group *Aerobics*.

DISCUSSION

Based on the performed studies it can be concluded that there are statistically significant differences in motoric abilities in experimental groups between the initial and final measuring at the estimated level of $p < 0.01$, i.e. the changes appeared as the result of the realized programmes of swimming and aerobics. In all variables the differences are higher at the final measuring. This study is in compliance with the studies performed by Shahana et al. (2010) referring to the influence of aerobic exercise on the health and physical abilities of middle-aged women (35-45). After 12-week' training the experimental group improved their cardiorespiratory endurance, flexibility and muscle endurance, while the control group did not show any significant changes.

The study of differences between the groups of examinees in motoric variables at the initial measuring did not show the presence of statistically significant differences (Table 7). The value of the *F-test* for the whole system of the studied variables is below the border value ($F = 0.639$) and none of the studied variables showed statistically significant difference ($p = 0,598$).

Testing the differences between the groups for the whole system of the applied motoric variables (Table 8) showed that after the applied treatment a statistically significant difference was noticed between the studied groups at the level of significance of $p = 0.017$, $F = 2.826$. The review of the values of the *F-test* for certain variables showed that the established difference was marked with the differences in the variables *Walking 2km (MUKK2km)* and *Flexibility forward bending on a bench (MFLPRS).* In the variable *Walking 2km (MUKK2km)* the difference is statistically significant at the estimated level of $p < 0.01$; ($F = 12.958$, $p = 0.001$) for the group *Swimming*, and in the variable *Flexibility forward bending on a bench (MFLPRS)* at the level of $p < 0.05$ ($F = 2.826$, $p = 0.017$) for the group *Aerobics*.

The influence of recreational exercising on the morphological and motoric features of middle-aged women was studied by Rubeša (1985). The experimental and the control group were composed of 40 women from the area of Zagreb. The experimental exercising programme for the examinees of the experimental group lasted 6 months, 2 times a week for 60 minutes. Based on the given results, after the experimental programme was completed, the author concluded that the applied programme had made a positive influence on the changes of the variables in the experimental group.

The influence of recreational aerobics on the morphological, motoric and functional status of women was studied by Babijak and Milošević (1992). The examinees were exercising two times a week for three months in continuity. The control group did not exercise, but the same variables were measured in both groups. In the motoric field the following variables were tested: fast breathing for 30 seconds and 20 m running. The results confirmed the positive influence of aerobics exercising on reducing the body weight, lowering pulse at rest and a higher vital capacity of the lungs in comparison to women who did not do recreational exercising. The authors suggested some possibilities for the correction of the given programme with the aim to reach better positive effects.

Mikalački and Vragović (1996) studied a combined model of sports and recreational activities of aerobics conception. The paper presented the structure of the load in the combined interval aerobics model of exercising. The model structure contained: running in the water, breaststroke swimming and front crawl swimming. Time sturcture of the model was comprised of the intervals of 1 minute water running, 1 minute breaststroke swimming, 1 minute front crawl swimming, 1 minute rest, 5 minutes recovery and 20 minutes model duration. This model was applied on the sample of 20 students of the Faculty of Sports and physical training in Novi Sad, majoring in Sports

recreation. Based on the given results, the authors concluded that the combined model of the aerobic programme was suitable for observing the effects of their application and represented the type of test for the assessment of adaptability to certain programmes, i.e. the assessment of aerobic abilities.

Fučkar (1997) studied the influence of a sports recreation programme (aerobics) on the morphological characteristics and motoric abilities of women aged between 30 and 45. The five-months' experiment (two times a week for 60 minutes) showed quantative changes in all measured variables (push-ups on knees in 30 seconds, elevating the body from lying position with legs slightly bent in 25 seconds, deep squats without load 25 times) in relation to the initial condition. For better transformational effects of aerobics, the author concluded that it was necessary to make other properly designed studies.

The sample of 32 middle-aged women served Tkalčić et al. (2004) to study the effects of kinesiological activities on certain motoric dimensions. The programme encompassed different contents for the preparation of the locomotoric apparatus, bodyforming exercises with and without requisites, functional gymnastics, round and other forms of exercising. After five-months' training the greatest changes were reached in the repetitive strength of the body in the following tests: lying on a bench – 60 seconds and dynamic bends. In addition, high changes were measured in the tests for the assessment of *explosive strength* (long jump from the spot) and (sprint 20 m high start), while the least change occurred in the test for the assessment of *flexibility* (forward bend leg apart) which could, at some point, be related to the age of the examinees, when it was more difficult to achieve positive changes.

Makivić et al. (2007) studied the effects of recreational training in the gym on women's health, then the motoric and functional abilities of the examinees. Seven women were tested, average age 31 ± 8.1 years. The examinees had all been assigned to jobs with dominant sitting positions. The results of the tests in the motoric field showed average values of relative strength, while an especially good result was achieved in the stomach muscles test, while the shoulder muscles strength was a bit above the average. The flexibility of the muscle flexor in the hip joint, measured by the forward bend on a bench test, was excellent (29.7± 3.5 cm). The authors recommended corrected energetic inflow and/or increased energy burn through exercising.

By using the sample of thirty women aged between 35–45 Sarika (2010) studied the influence of aerobic and strength training. He tested functional variables, metabolic parameters and anthropometric parameters of women. The given results showed statistically significant changes in the measured variables. The author recommended aerobic training as more useful, which can be used as a preventive measure with persons who fall into the group of those who risk to develop cardiovascular diseases due to obesity.

CONCLUSION

This study has confirmed the presence of statistically significant changes in the motoric field of the studied sample, after realizing the recreational programme of swimming and aerobics. The realized programme and its practical improvement have enabled development/improvement of certain physical abilities. Based on six motoric tests in the total field of manifestation, after realizing a three-month programme, statistically significant changes have been noticed in every one of them ($p < 0.01$). The review of the values of the *F-test* and the level of significance for certain variables, the difference between the groups has been noticed in the variable *walking 2km (*MUKK2km – *group swimming*), and the variable *flexibility forward bending on a bench* (MFLPRS) for the group aerobics. Based on the given results, the realized models of recreational swimming and aerobics can be recommended as a model of activity which can be applied on the same population for the improvement of motoric abilities, especially with sedentary work posts. One of the key elements for the successful realization of the

programme with this population is the trainer (specialized in sports recreation). Firstly, he must be an expert in this field with good practical experience, a good entertainer, with an ability to pay attention to every trainee and with the intention to help him reach the best individual success.

REFERENCES

Andrijašević, M. (2010). *Kineziološka rekreacija (Kineziological recreation).* Kineziološki fakultet Sveučilišta u Zagrebu.

Balaban, M. (2001). *Nivoi rizičnih faktora vodećih nezaraznih bolesti kod odraslog stanovništva Banja Luke (Levels of risk factors of leading non-infectuous diseases in adults of Banja Luka)*. Neobjavljena doktorska disertacija (unpublished doctoral thesis), Banja Luka: Medicinski fakultet.

Banović, I. (1984). *Utjecaj jednogodišnjeg kineziološkog tretmana na kvantitativne promjene nekih morfoloških, funkcionalnih i motoričkih dimenzija (The influence of one-year kineziological treatment on quantitative changes of some morphological, functional and motoric dimensions)*. Neobjavljeni magistarski rad (unpublished master thesis). Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu.

Berčič, H. (2005). Ali se v slovenska podjetja vrača obdobje vlaganja v človeške vire, v športno rekreativno dejavnost, zdravje in delovno sposobnost zaposlenih?. *Šport*, 53(3), 33-39.

Caspersen, C.J., Powell, K.E. i Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health related research. *Public Health Reports*, 100(2), 126-130.

Fučkar, K. (1997). Promjene nekih morfoloških i motoričkih karakteristika žena srednje dobi pod uticajem sistematskog treninga aerobike (Changes of some morphological and motoric characteristics of middle-aged women under the influence of systemic aerobics training). *Zbornik radova - Međunarodno znanstveno-stručno savjetovanje Suvremena aerobika* (str. 172-175). Zagreb: Fakultet za fizičku kulturu,

Gredelj, M., Hošek, A., Metikoš, D., Momirović, K. (1975). Model hijerarhijske strukture motoričkih sposobnosti (Motoric abilities hierarchical structure model). *Kineziologija, Zagreb,* vol. 5, br. 1-2, str. 7-82

Heimer, S. (1979). *Pokazatelji sposobnosti nekih organskih sistema u funkciji preventivnog sportsko medicinskog djelovanja (Indicators of abilities of some organic systems functioning as preventive sports medicine)*. Neobjavljena doktorska disertacija (unpublished doctoral thesis). Zagreb: Medicinski fakultet Sveučilišta u Zagrebu.

Jurakić, D., (2009). *Taksonomske karakteristike zaposlenika srednje dobi kao osnova izrade sportsko-rekreacijskih programa (Taxonomic characteristics of middle-aged employees as the basis for drafting sports recreational programme)*. Neobjavljena doktorska disertacija (unpublished doctoral thesis). Zagreb: Kineziološki fakultet.

Koković, D. (1992). *Uvod u sociologiju sportske rekreacije (Introduction into the sports recreation sociology)*. Beograd: Stručna knjiga.

Mitić, D. (2001): *Rekreacija (Recreation)*. Beograd: Fakultet sporta i fizičkog vaspitanja.

Mišigoj-Duraković, M., Duraković, Z., Findak, V., Hajmer, S., Horga, S., Latin, V., Matković, B., Matković, B., Medved, R., Relac, M., Sučić, M., Škavić, J., Vojvodić, S., i Žugić, Z. (1999). *Tjelesno vježbanje i zdravlje (Physical training and health)*. Zagreb: Grafos.

Oja, P. and Tuxworth, B. (1995). *Eurofit for adults – Assessment of healthrelated fitness*. Finland, Tampere: Counsil of Europe, Committee for the development of sport and UKK Institute for health promotion research.

Relac, M. (1975). *Rekreacija tjelesnim vježbanjem u procesu rada (Recreation in the form of physical exercising at work).* Zagreb: Sportska tribina.

Sharkey, B.J., & Gaskill, S.E. (2008). *Vežbanje i zdravlje (Exercising and health).* Beograd: Data Status.

Shahana, A., Nair, S., Hasrani, S.S. (2010). Effect of aerobic exercise programme on health related physical fitness components of middle aged women. *Br J Sports Med.* 2010;44:i19 doi:10.1136/bjsm.2010.078725.60.

Zrnić, R. (2011). *Nivoi transformacionih promjena antropoloških dimenzija žena podu uticajem različitih modela sportsko-rekrativnih aktivnosti (Levels of transformational changes of anthropological dimensions of women under the influence of different models of sports recreational activities)*. Neobjavljena doktorska disertacija (unpublished doctoral thesis). Banja Luka: Fakultet fizičkog vaspitanja i sporta.

PROMJENE MOTORIČKIH SPOSOBNOSTI ŽENA POD UTICAJEM RAZLIČITIH MODELA SPORTSKO-REKRATIVNIH AKTIVNOSTI

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SAŽETAK

Uvod Motoričke sposobnosti kao komponenta fizičkog fitnesa su presudne za održavanje radnih sposobnosti i zdravlja, naročito kod modernog/sjedećeg čovjeka. Rekreacija je najbolja brana/lijek protiv bolesti civilizacije i sjedalačkog načina života, a različiti modeli sportsko-rekrativnih aktivnosti mogu pozitivno uticati na cjelokupni antropološki status čovjeka. Istraživanje je sprovedeno s ciljem utvrđivanja promjena motoričkih sposobnosti žena hronološke dobi od 35 do 45 godina pod uticajem tromjesečnog rekreativnog programa plivanja i aerobika.

Metod Uzorak rekreativki iz Banja Luke je podijeljen u dvije eksperimentalne grupe (plivanje N=38 i aerobik N=38), a testiran je sa šest motoričkih varijabli (hodanje 2km, pretklon u sjedu, ležanje sjed, zakloni trupom, izdržaj u zgibu i čučnjevi). Podaci su obrađeni pomoću tehnike deskriptivne statistike, t-testom i multivarijantnom anlizom varijanse i kovarijanse.

Rezultati Rekreativni modeli plivanja i aerobika uticali su na pozitivne promjene motoričkih sposobnosti kod eksperimentalnih grupa. Statistički značajne promjene ostvarene su u svim mjerenim varijablama kod obe grupe (p=0,000). Grupe se statistički značajno razlikuju na finalnom mjerenju kod varijabli Hodanje 2km (p=0,001, F=12,958 - Plivanje) i Fleksibilnost pretklon u sjedu (p=0,044, F=4,220 - Aerobik). Deskriptivno numeričke vrijednosti varijabli Hodanje 2km za I i II mjerenje: grupa plivanje; pre test 17,075±2,608, post test 14,661±2,546, t=8,368, p=0,000, aerobik; pre test 16,769±2,386, post test 15,421±1,988, t=10,330, p=0,000, a za varijablu Fleksibilnost pretklon u sjedu za I i II mjerenje: grupa plivanje; pre test 25,712±7,032, post test 34,684±6,514, t=7,872, p=0,000, aerobik; pre test 23,744±7,504, post test 35,175±7,968, t=-10,119, p=0,000.

Zaključak Dobijeni rezultati istraživanja ukazuju da različiti modeli sportsko-rekrativnih aktivnosti pozitivno utiču na transformaciju motoričkih sposobnosti žena srednje dobi, što ukazuje na mogućnost primjene ovakvih modela na ovu populaciju, ali i preporuku za druge starosne kategorije rekreativaca.

Ključne riječi: fizičke sposobnosti, srednja dob, plivanje, aerobik

THE EMPLOYEES' ATTITUDES TOWARD THE IMPACT OF CORPORATE WELLNESS IN SERBIA ON THE HEALTH STATUS

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UDC 796.015.132

SUMMARY

Introduction: The impact of modern life has brought about rapid changes which have the consequences that cannot be easily overcome. Health problems, caused by sedentary lifestyle, mental disorders, excessive intake of food, drinks and drugs, have derived from the parallel social development and technical and technological revolution. The need to come up with practical knowledge about the evolution of the idea concerning the management and organization of work and physical exercise has imposed itself. Surely, this cannot lead to scientific prediction and legitimacy, but the intention is to attempt to identify and define ways to understand Corporate Wellness in the turbulent environment in Serbia.

The subject of the research is to determine the attitudes of the employees and the management towards Corporate Wellness (and their impact on health status in Serbia), while, on the basis of the results obtained, its objective is to suggest improvement in health status and the personal satisfaction of employees, which would contribute to the increase in profits and the improvement of society.

Methods: The survey was conducted on a sample of 200 employees in private, state-owned, public and equity companies. The health status of the respondents was observed by using seven items of a complex questionnaire.

Results: The results indicate that the majority of the respondents, namely 82.5%, assess their health as good, a small number of them (6%) assess it as bad, and none of the respondents assess their health as poor. Also, the fact is that half of the respondents consider that their current health problems interfere with their normal work performance. A disturbing fact is that a large number of employees undergo medical examinations irregularly, or remember to do so, only when they feel that there is some kind of a problem.

Conclusion: The general impression is that corporate wellness is at the bottom of the priority lists of almost all companies in Serbia, regardless of the ownership structure and the level of education. This indicates that the level of awareness of the need to improve the health status through exercise does not comply with the knowledge on how to live a better and longer life through better health care.

Key Words: employee recreation, health, profit

INTRODUCTION

Physical exercise has long been considered not only a way of achieving a more beautiful figure, but a need imposed by a modern lifestyle. Everyday tasks, accompanied by stress, improper dieting, and a sedentary lifestyle have created the need for exercise.

With the development of society physical exercise, which in primitive societies meant the fight for life and in modern times the preservation of health and satisfaction, developed as well. Through evolution and various transition processes, environmental impact, the excessive intake of food, alcohol and other substances, accompanied by a sedentary lifestyle and mental disorders, the modern

man is moving towards premature death, chronic illnesses and disability.

In the 20th century, the need for the physical exercise programs to be developed presented itself, which in turn brought about a revolution in promoting physical exercise, and later work ability.

The concept of ***Corporate Wellness*** represents employee recreation, and is designed to guide an individual back into good physical shape and make him/her feel well. The term taken from the English language is self-explanatory – "feeling well", "well-being", however it does not mean that the idea behind it was also taken, through the material and spiritual unity of human relations, and in this case, relations between labor, management, organization and preservation of health and quality of life. Halbert (1961) introduced the concept of wellness, stating that wellness is a philosophy, an institution and a movement related to the mind and the body, which integrates physical, spiritual, emotional, professional, and intellectual well-being.

The professional dimension of wellness is related to the achievement of personal satisfaction and finding a way to enrich personal life through work. *Wellness* has a different meaning for everyone; everyone can and must find their own way and their own goals, but the outcome is the same for all - GOOD LIFE, HEALTHY LIFE, and FULFILLED LIFE. *Wellness* is a foreign word, but its essence is what people have aspired to for centuries - A HEALTHY ACTIVE LIFE!

According to Aura (2006) physical activity has been used in the workplace for many purposes for decades (starting from company Schrimer 1925; Gebhardt & Crump, 1990), under the following names: fitness programs in the workplace (AWP), corporate fitness programs (CFP), fitness programs for employees, company sports (companies Kerr & Vos, 1993; Shephard, 1996).

The Finnish Institute of Occupational Health stated its findings in its journal "Occupational Medicine" which indicate that physical exercise improves all aspects of health: physical, mental, and social. Regular physical activity helps to quickly recover from the effects of psychosocial and physical stress and prevents depression. It is also proven that stress and depression, lasting more than six months, can lead to an atrophy of the frontal lobe and a reduced learning capacity (Aura, 2006).

Attitudes are subjective experiences of a problem represented as the evolutionary dimension. They can be linguistically expressed, relatively durable, learned and acquired. According to Rot (1973) cognitive function: perception, information, understanding, knowledge and assuredness of the objects towards which there is an attitude, includes judgments whether something is good or bad. Related terms are assuredness, beliefs, superstitions, sentiments or opinions, values. Attitude dimensions: authority, complexity, extremity, coherence, consistency, strength, openness and expressiveness of attitudes. Attitude research is very common in the area of physical education (Galic, 1984; Radovanovic, 1992; Vuckovic, 2006; Juhas, Orlic, Lazarevic, Jankovic, Matic, 2011).

For years experts in related fields have been trying to find answers to the questions concerning employee recreation (Mitic, 2001; Kacavenda-Radic, 1989; Stojiljkovic et al., 2005; Stojiljkovic et al., 2012). In our country, the researches were recorded in the 1990s, as evidenced by papers, doctoral theses and published books (Mitic, 1990; Mitic, 2001; Mujic, 1980). On the basis of the insight into the scientific literature in the field of recreation, studies concerning the relationship between attitudes and recreation are still on the sidelines of the research interests.

The subject of this research is to determine the attitudes of the employees in Serbia towards the impact of physical exercise on health status, and, on the basis of the results obtained, its **objective** is to suggest some improvements that can contribute to health preservation, personal satisfaction and an increase in the profits in companies.

METHODOLOGY

Sample of respondents

The research was conducted on a sample of 200 respondents (50 respondents from each company) who use the services of corporate wellness in companies with different models of organized capital (private, public, state-owned, joint-stock companies).

Sample of measuring instruments

The employee attitudes were investigated through a single questionnaire, which consists of several parts.

The variable sample was composed of the criterion variable - different companies, and the predictor variables - the attitudes of the employees towards recreation and their impact on health status.

The health status of the respondents was observed by using seven items of the complex questionnaire. The respondents were asked: to (1) assess their health, and to (2) compare it with the health of the people of similar age, then to say (3) how health-conscious they are, to (4) indicate possible health problems, and (5) assess how they interfere with their work, while the last two items asked of the respondents to evaluate how they take care of their health, first (6) by assessing how much they care about their health in general and then answer the question (7) when the last time they had their blood tested was.

Statistical analysis of data

All the data collected during the research were analyzed by means of descriptive and comparative statistics. From the area of descriptive statistics for each variable expressed in the form of the interval scales or continuous statistical series, representative central and dispersion parameters were determined and for all the variables expressed in the form of the discontinuous (discrete) statistical series only frequency distribution was determined as the only meaningful descriptive indicator. From the area of comparative statistics primarily discriminatory procedures were used including: contingency analysis (χ^2 test) when comparing the variables expressed by the frequencies, the univariate analysis of variance (ANOVA) when comparing the descriptive central parameters (arithmetic mean) of several subsamples.

RESULTS AND DISCUSSION

The results of the research concerning the health status of the employees in private, public, state-owned and joint-stock companies are presented in a tabular form for each item.

TABLE 1 The distribution of the respondents from different companies in relation to the subjective evaluation of personal health

Company	Very bad	Bad	Good	Excellent	**Σ**
Telenor	0	2 (4%)	38 (76%)	10 (20%)	50
Post Office Serbia	0	5 (10%)	42 (82%)	3 (6%)	50
Simpo	0	3 (6%)	44 (88%)	3 (6%)	50
Water-management company	0	2 (4%)	41 (82%)	7 (14%)	50
Σ	0	12 (6%)	165 (82.5%)	23 (11.5%)	200

$\chi^2 = 8.498$ *Sig.* = .204

The obtained data indicate that the majority of the respondents (82.5%) assessed their health as good, and much less of them as bad (6%) or excellent (11.5%). Here, it is important to notice that none of the 200 respondents surveyed assessed his/her health as very bad (Table 1).

TABLE 2 The distribution of the respondents from different companies according to their subjective assessment of health formed in comparison with other people of similar age

Company	Much worse	A bit worse	Similar	Somewhat better	Much better
Telenor	0	1 (2%)	30 (60%)	14 (28%)	5 (10%)
Post Office Serbia	1 (2%)	3 (6%)	26 (52%)	14 (28%)	6 (12%)
Simpo	0	5 (10%)	28 (56%	11 (22%)	6 (12%)
Water-management company	0	1 (2%)	30 (60%)	12 (24%)	7 (14%)
Σ	1 (0,5%)	10 (5%)	114 (57%)	51 (25.5%)	24 (12%)

$\chi^2 = 8.649$ *Sig.* = .733

Most respondents consider that they have similar health status to their peers (Table 2). When comparing their own health with the health of others, namely, as it was the requirement stated in the second item, it was shown that there is by far the least number of the two extreme responses on the value scale (only 0.5% of respondents consider their health to be much worse than the health of other people, and 12% of respondents consider their health to be much better).

TABLE 3 Distribution of answers to the question "How much you care about your health?"

Company	Not at all	A bit	From time to time	A lot
Telenor	2 (4%)	19 (38%)	20 (40%)	9 (18%)
Post Office Serbia	4 (8%)	20 (40%)	20 (40%)	6 (12%)
Simpo	4 (8%)	20 (40%)	21 (42%)	5 (10%)
Water-management company	6 (12%)	10 (20%)	28 (56%)	6 (12%)
Σ	16 (8%)	69 (34.5%)	89 (44.5%)	26 (13%)

$\chi^2 = 9.497$ *Sig.* = .393

Although people's need to brighten up th thee image of themselves should be taken into consideration, as well as the fact that the majority of respondents take irregular care of their health (Table 3), i.e. the majority of the respondents (nearly 80%) start to think about their health only when a minor or bigger health problem occurs (Table 6), it can be said that the majority of the sample consisted of the respondents in good health condition (and thus having good work ability). What raises doubt in the completely positive picture about the health of the employees in the four companies surveyed is the fact that nearly one-third of the respondents reported that they have some kind of a health problem (Table 4), while yet more importantly, nearly half of the respondents claim that their current health problems interfere with their normal performance at their workplace (Table 5).

Table 4 The presence of health problems among the respondents employed in different companies

Problems	Telenor	Post Office	Simpo	Water-management company	Σ
I do not have any problems	33 (66%)	31 (62%)	31 (62%)	43 (86%)	138 (69%)
I do have problems	6 (12%)	4 (8%)	4 (4%)	2 (4%)	16 (8%)
Stress	2 (4%)	1 (2%)	8 (16%)	2 (4%)	13 (6.5%)
Backpain	5 (10%)	5 (10%)	1 (2%)	2 (4%)	13

					(6.5%)
Headache	2 (4%)	3 (6%)	3 (6%)	1 (2%)	9 (4.5%)
Blood Pressure, blood sugar levels	1 (2%)	2 (4%)	1 (2%)	0	4 (2%)
Eyesight	0	2 (4%)	0	0	2 (1%)
Alergies	0	1 (2%)	2 (4%)	0	3 (1.5%)
Stiff neck	1 (2%)	1 (2%)	0	0	2 (1%)
Σ	50	50	50	50	200

$\chi^2 = 33.143$ *Sig.* = .101

Statistically significant differences were recorded in two items - one concerning the question "To what extent do your health problems interfere with your work?" (Table 5) and the other concerning the frequency of health controls (Table 6). The identified differences, however, were not due to the different direction, but only due to the level of the expressed opinions of the respondents from different companies. Namely, in all four subgroups the responses "not a bit" dominated, while the response "not at all" represented the smallest share of answers. Therefore, it was difficult to conclude in which company the surveyed employees feel more disruptive difficulties during work, and in which company the employees take care of their health more regularly. Thus, as among the employees' attitudes to their health in four different companies the differences were observed in only two of the seven items devoted to this problem, and in addition, these differences were not caused by the direction, but only the level of the expressed opinions, it could be concluded that the attitude towards health, generally speaking, was not dependent on the type of the company in which the respondents were employed.

TABLE 5 The distribution of the answers to the question "To what extent do your health problems interfere with your work?"

Company	Not a bit	A bit	From time to time	Significantly	No answer
Telenor	17 (34%)	14 (28%)	10 (20%)	0	*9*
Post Office Serbia	25 (50%)	8 (16%)	8 (16%)	2 (4%)	*7*
Simpo	24 (48%)	8 (16%)	14 (28%)	0	*4*
Water-management company	32 (64%)	10 (20%)	5 (10%)	0	*3*
Σ	98 (49%)	40 (20%)	37 (18.5%)	2 (1%)	*23*

$\chi^2 = 21.59^*$; *Sig.* = .0424

TABLE 6 The distribution of the answers to the question concerning the frequency of health controls

Company	Never (I do not have time)	Only when I have major problems	As soon as a problem occurs	Regularly, as well as when I am healthy
Telenor	0	20 (40%)	19 (38%)	11 (22%)
Post Office Serbia	2 (4%)	13 (26%)	28 (56%)	7 (14%)
Simpo	5 (10%)	24 (48%)	16 (32%)	5 (10%)
Water-management company	6 (12%)	13 (26%)	22 (44%)	9 (18%)
Σ	13 (6.5%)	70 (35%)	85 (42.5%)	32 (16%)

$\chi^2 = 18.16^*$ *Sig.* = .0334

TABLE 7 The distribution of the answers to the question "When was the last time you had your blood tested?"

Problems	Telenor	Post Office	Simpo	Water-management company	Σ
I do not remember	5 (10%)	6 (12%)	7 (14%)	5 (10%)	23 (11.5%)
More than a year ago	6 (12%)	7 (14%)	10 (20%)	8 (16%)	31 (15.5%)
A year ago	6 (12%)	3 (6%)	6 (12%)	8 (16%)	23 (11.5%)
6 months ago	11 (22%)	10 (20%)	8 (16%)	6 (12%)	35 (17.5%)
3 monts ago	11 (22%)	14 (28%)	8 (16%)	12 (24%)	45 (22.5%)
Recently	11 (22%)	10 (20%)	11 (22%)	11 (22%)	43 (21.5%)
Σ	50	50	50	50	200

$\chi^2 = 7.247$ *Sig.* = .950

In order to test the possible differences in the health status of the employees in the four companies with different organizational models the comparison between the empirical frequencies of the responses obtained through seven characteristic items of the research questionnaire was performed. The results showed that some aspects of health among the respondents from all four companies had almost the same response structure. In fact, by using χ^2-test, it was found that statistically significant differences were lacking in five of the total of seven items analyzed (Tables 1 to 5). Namely, in these two cases the achieved significance levels were below the theoretical limit (SIG.< .05) which is the minimum statistical requirement for the differences between the empirical frequency distributions to be declared systematic.

CONCLUSION

A survey accompanied by seven items of a complex questionnaire was conducted on a sample of 200 respondents, the employees of four companies with different models of organization and structure of capital (Telenor, Post Office Serbia, Simpo and Water-management company), in order to observe their health status. The questions are designed so that they better reflect the employees' opinions on and attitudes towards various issues related to the current state of health. Data were organized and analyzed by using descriptive and comparative statistics and on the basis of the obtained results certain conclusions could be reached.

Most respondents consider their health status to be good and significantly fewer assess it as bad or excellent. None of the respondents assessed their health status as very bad, which is encouraging. What raises doubt in the objectivity of this health assessment, i.e. in the high percentage of the positive attitude, is the fact that nearly one-third of the respondents reported that they have some kind of a health problem, while yet more importantly, with nearly half of the respondents the current health problems interfere with their normal performance at their workplace. Even more worrying is the fact that the vast majority of the respondents takes care of their health irregularly, and remembers to do so only when they feel that there is a problem.

It can be concluded that the employees, in addition to lacking good habits and a well-organized budget of free time, are not engaged in a systematic practice of recreational activities. The general

impression is that the corporate wellness is on the bottom of the list of their priorities, that the awareness of the need for it exists, but that PREVENTION is still not well-understood for its importance for the health status and that there is a lot to be done in the field of developing the habit of and the need to exercise, for the sake of health, and attaining a more beautiful and better quality of life.

REFERENCES

Aura, O. (2006) Worksite Fitness Policy in an Intellectual Capital Framework. PhD dissertation, in Swedish School for Economics and Business Administration in Helsinki. Downloaded from internet: http://brunnen.shh.fi/portals/pubmanager/pdf/164-951-555-935-9.pdf

Halbert, D. (1961). Downloaded from internet: www.seekwellness.com/wellness

Vuckovic, I. (2006). Stavovi igraca Prve kosarkaske lige Srbije i Crne Gore

Galic, M. (1984). Obrazovno kulturno obrazovanje odraslih. Neobjavljena magistarska teza. Beograd: Filozofski fakultet, Odeljenje za pedagogiju.

Juhas, I., Orlic, A., Lazarevic, D., Jankovic, N., i Matic, M. (2011). Stav studenata Fakulteta sporta i fizickog vaspitanja prema krosu. Fizicka kultura, 65(1), pp. 46-51.

Kacavenda-Radic, N. (1989). Slobodno vreme i obrazovanje. Beograd: Zavod za udzbenike i nastavna sredstva.

Mitic, D. (2001). Rekreacija. Beograd: Fakultet sporta i fizickog vaspitanja.

Radovanovicc, I. (1992). Stil ponašanja nastavnika i stavovi ucenika o vrednostima fizickog vaspitanja. Neobjavljena doktorska disertacija. Beograd: Fakultet fizicke kulture.

Rot, N. (1975). Opsta psihologija. Beograd: Zavod za udzbenike i nastavna sredstva.

Stojiljkovic, S., Mitic, D., Mandaric, S., Nesic, D. (2005). Fitnes. Beograd: Fakultet sporta i fizickog vaspitanja.

Stojiljkovic, S., Mitic, D., Mandaric, S., Nesic, D. (2012). Personalni fitnes, naucna monografija. Beograd: Fakultet sporta i fizickog vaspitanja.

STAVOVI ZAPOSLENIH O UTICAJU CORPORATE WELLNESS-A U SRBIJI NA ZDRAVSTVENI STATUS

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SAŽETAK

Uvod: Uticaj savremenog načina života doneo je brze promene, što ostavljaju posledice koje ne mogu lako da se prevaziđu. Priblemi zdravstvene prirode, izazvani nekretanjem, psihičkim poremećajima, prekomerni unosom hrane, pića i narkotika, izvedeni su iz uporednog razvoja društva, tehničko-tehnološkom revolucijom. Nametnuta je potreba da se dođe do praktičnih saznanja o evoluciji ideje o menadžmentu i organizaciji rada i fizičkog vežbanja. Sigurno, da to ne može da dovede do naučnog predviđanja i zakonitosti, ali je namera, pokušaj identifikacije i definisanje načina shvatanja korporativnog velnesa u turbulentnom okruženju u Srbiji.

Predmet istraživanja je utvrditi stavove zaposlenih i menadžmenta o uticaju korporativnog velnesa u Srbiji na njihov zdravstveni status, a cilj je, na osnovu dobijenih podataka, predložiti poboljšanje zdravstvenog statusa i ličnog zadovoljstva zaposlenih, što bi doprinelo povećanju profita i unapređenju društva.

Metode: Istraživanje je sprovedeno na uzorku 200 zaposlenih u kompanijama privatnog, državnog, društvenog i akcionarskog uređenja. Zdravstveni status ispitanika opserviran je pomoću sedam ajtema kompleksnog upitnika.

Rezultati: Rezultati istraživanja ukazuju da većina ispitanika, tačnije 82,5% svoje zdravstveno stanje ocenjuje kao dobro, mali broj 6 % kao loše, a niko ne navodi da je im je zdravstveno stanje ugroženo. Činjenica je da polovina anketiranih, smatra, da ih aktuelni zdravstveni problemi ometaju u normalnom obavljanju posla. Zabrićavajući podatak je da veliki broj zaposlenih nerado brine o svom zdravlju, ili se sete, tek kada osete neki problem.

Zaključak: Opšti utisak je da je korporativni velnes na kraju liste prioriteta, gotovo svih kompanija u Srbiji, bez obzira na vlasničku strukturu i nivo obrazovanja. Što ukazuje da nivo svesti o potrebi za poboljšanjem zdravstvenog statusa kroz fizičku aktivnost, nije usklađen saznanjem, kako brigom o zdravlju, do lepšeg i dužeg života.

Ključne reči: rekreacija zaposlenih, zdravlje, profit

ANALYSIS OF SUBCUTANEOUS FAT TISSUE IN STUDENTS OF THE FACULTY OF SPORT AND PHYSICAL EDUCATION IN MONTENEGRO

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UDC 796.012.612(497.16)

SUMMARY

The problem of this research is the determination of subcutaneous fat tissue in the students of the Faculty of Sports and Physical Education from Niksic.

The sample included 90 students of both sexes (male = 76; female = 14) who regularly attend classes at the Faculty of Sports and Physical Education at the University of Montenegro. The measurements were carried out in the diagnostic center at the Faculty of Sports and Physical Education at the University of Montenegro. Skin folds (back, the upper arm, abdomen and thigh) were measured with the caliper of John Bull type.

The survey data were analyzed using the statistical program v.SPSS 19.0, customized to run on personal computers. Descriptive statistical values are expressed in terms of the mean value (SD) for each of the predicted variables, as well as the minimum and maximum values.

Skinfold thickness, in male students has the lowest value at the first year of studies, while it reaches its maximum at the fourth year of studies. When it comes to the female student population, the curves for each of the measured skin folds have a different shape, so it is very difficult to conclude which is the dynamics for accumulation of subcutaneous fat tissue, and the reason is most likely located in a small number of respondents.

Obesity is a multicausal disease that usually occurs as a result of the interaction of genotype (inherited genetic characteristics of individuals), and environmental factors. Besides it represents one of the main risk factors for a wide range of cardiovascular diseases, it acts indirectly causing other diseases.

From all the above, and from the obtained results related to skin folds (back, upper arm, abdomen and thigh) we can conclude that the average values, for both sexes separately and for the total population, are in the range of standard values for treated population.

Key Words: analysis, students, fat tissue, caliper, morphological characteristics.

INTRODUCTION

Scientific research shows that excessive quantity of fat tissue in the body increases the risk of different, primarily cardiovascular diseases (Weineck 2000).. Obesity (Latin obesity) is a chronic disease (diseased condition), which is manifested by excessive accumulation of body fat and increased body weight. Any increase in body weight of 10% or more from the ideal weight is described as overweight. Morphological characteristics include the processes of growth and development as well as the structure of the human body.

Based on numerous researches, a model of the latent structure of morphological dimension is formed. It that contains four dimensions, namely: a factor of longitudinal skeleton dimensionality, that is responsible for bone growth in length (body height, leg length, foot length, ...); factor of transversal dimensionality of the skeleton, responsible for bone growth in width (width of the shoulders, hips width, knee diameter, elbow diameter, ...); factor of circular dimensionality of the body - the volume and mass of the body, that is responsible for the total weight and volume of the body (body weight, neck circumference, chest circumference , the volume of the forearm,...), and a factor of subcutaneous adipose

tissue, which is responsible for the total amount of body fat (skinfold thickness on the upper arm, on forearm, on the back, on the abdomen, ...). Since there is a strong correlation between subcutaneous fat tissue and total fat tissue, this factor is estimated by the measuring subcutaneous fat tissue. This factor in most sports is a disturbing factor, as it increases the passive mass. The coefficient of the innateness of this factor is from 40 - 60%.

(Malina 1991) states that by regular exercise or reduction in nutrition, the size of the subcutaneous fat tissue is being changed.

Official information of morphological and motor characteristics of the school population of Croatia (Findak et al. 1995), attribute descriptive assessment to the numerical values of the upper arm skinfold, which does not enable calculation of optimal body weight with regard to the amount of body fat. Marinović and Kvesić (2008) examined the percentage of skin folds in young tennis players and came to the conclusion that between the upper arm skinfold and percentage of body fat there is a significant correlation. Measurement of body weight and body fat using a Tanita scale model provides the possibility of presenting the body as a two-component model, so we can precisely determine the amount of body fat to be reduced, as well as training methods for that purpose should be applied. All of the above justifies the opinion about a useful application of Tanita scales in the measurement of some anthropological measures.

The aim of this research was to identify the correlation of fat tissue percentage between male and female student population at the Faculty of Sport and Physical Education in Niksic.

METOD

The sample included 90 students of both sexes (male = 76; female = 14) who regularly attend classes at the Faculty of Sports and Physical Education at the University of Montenegro.

Uzorak mjernih instrumenata: The measurements were carried out in the diagnostic center at the Faculty of Sports and Physical Education at the University of Montenegro. Skin folds (back, the upper arm, abdomen and thigh) were measured with the caliper of John Bull type.

Statistička obrada podataka: The survey data were analyzed using the statistical program v.SPSS 19.0, customized to run on personal computers. Descriptive statistical values are expressed in terms of the mean value (SD) for each of the predicted variables, as well as the minimum and maximum values.

RESULTS

Basic descriptive statistics are shown in the first table for both sexes, especially the number of subjects, the arithmetic mean of skinfolds (back, upper arm, abdomen, and lower leg), standard deviation as well as the maximum and minimum value.

TABLE 1 Basic descriptive statistics that describe the value of the fold of skin at the back of students

Sex	Number of respondents	AS	SD	Min	Max
M	76	10.6	2.3	6.2	18.0
F	14	9.9	2.9	4.5	14.5
Total	90	10.5	2.4	4.5	18.0

TABLE 2 Basic descriptive statistics that describe the value of the upper arm skin fold in students

Sex	Number of respondents	AS	SD	Min	Max
M	76	7.4	2.6	3.1	13.9
Ž	14	8.4	4.4	2.0	15.8
Total	90	7.6	3.0	2.0	15.8

TABLE 3 Basic descriptive statistics that describe the value of skin folds of the abdomen in students

Sex	Number of respondents	AS	SD	Min	Max
M	76	9.0	3.2	3.2	18.4
F	14	12.0	3.5	8.5	18.2
Total	90	9.5	3.4	3.2	18.4

TABLE 4 Basic descriptive statistics that describe the value of skin folds of the lower leg in students

Sex	Number of respondents	AS	SD	Min	Max
M	76	9.8	3.6	2.1	17.2
F	14	10.5	5.4	2.8	19.4
Total	90	9.9	3.9	2.1	19.4

From the obtained results related to skin folds (back, upper arm, abdomen and lower leg) we can conclude that the average values, for both sexes separately and for the total population, are in the range of standard values for treated population.

The graphical description (Diagram 1-4) shows the ratio of skinfolds (back, upper arm, abdomen and lower leg) in the male population of students at the Faculty of Physical Education as well as the years of study on which theywere in the moment of the measurement.

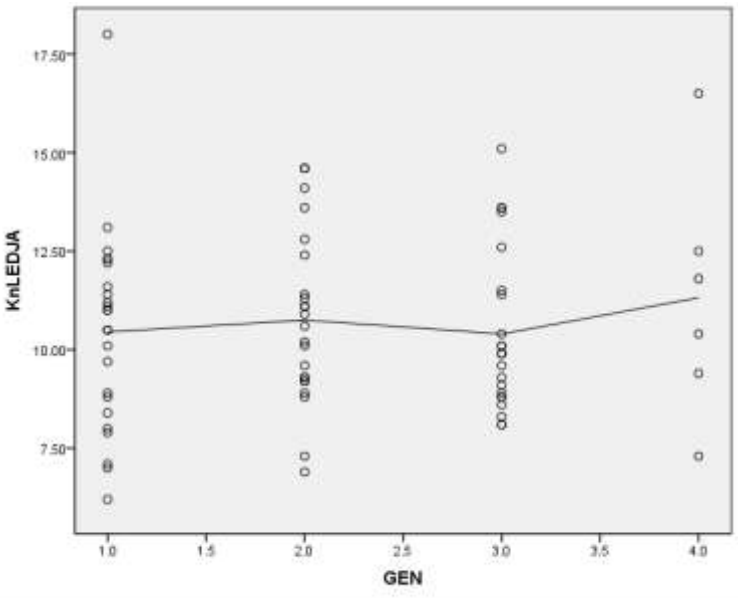


Diagram 1. Ratio of skin folds of back (N) in the male population of students and the years of study (GEN)

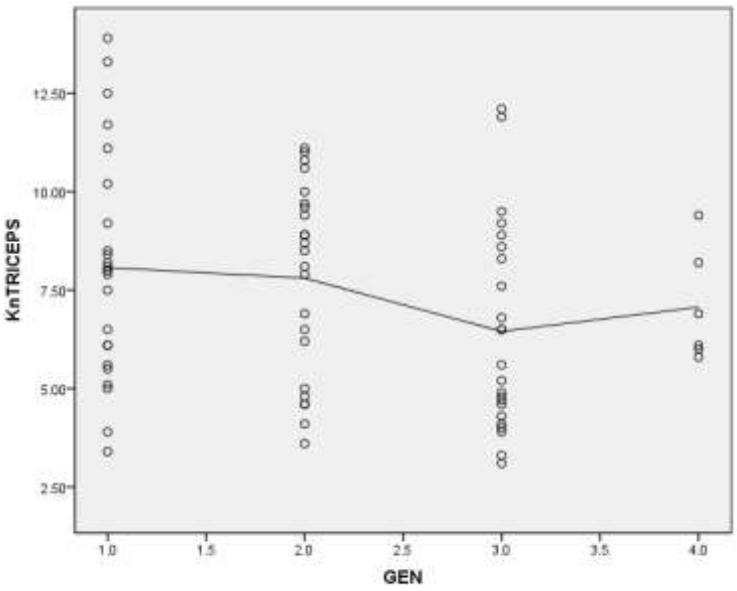


Diagram 2. Ratio of skin folds of the upper arm (N) in the male population of students and the years of study (GEN)

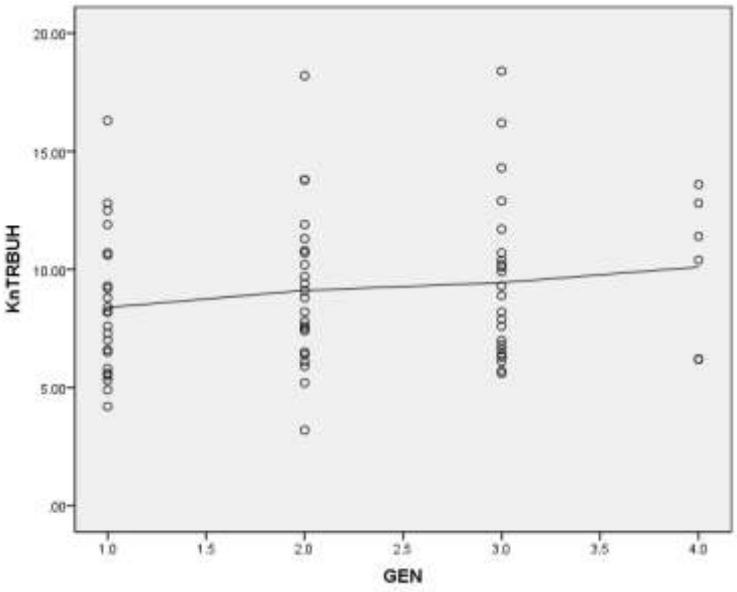


Diagram 3. Ratio of skin folds of abdomen (N) in the male population of students and the years of study (GEN)

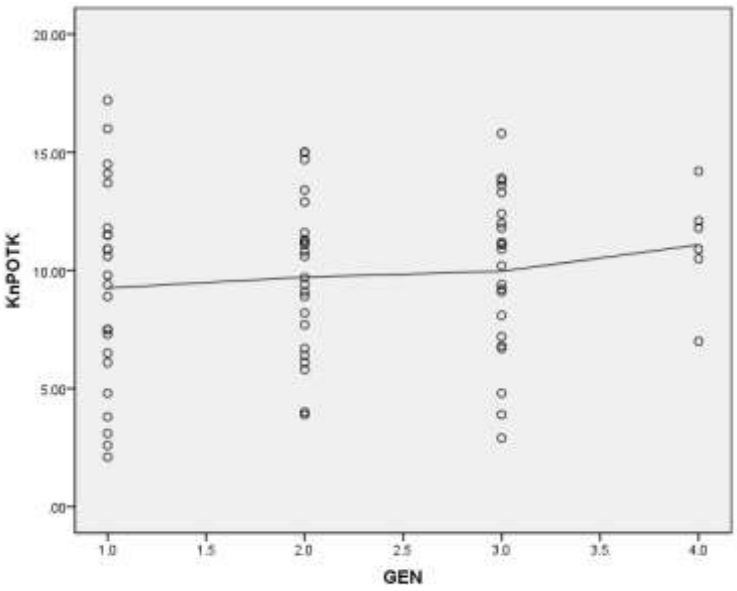


Diagram 4. Ratio of skin folds of lower leg (N) in the male population of students and the years of study (GEN)

The graphical description (Diagram 5-8) shows the ratio of skinfolds (back, upper arm, abdomen, and lower leg) among the female population of students in the Faculty of Physical Education and the year of studies on which were in the moment of the measurement

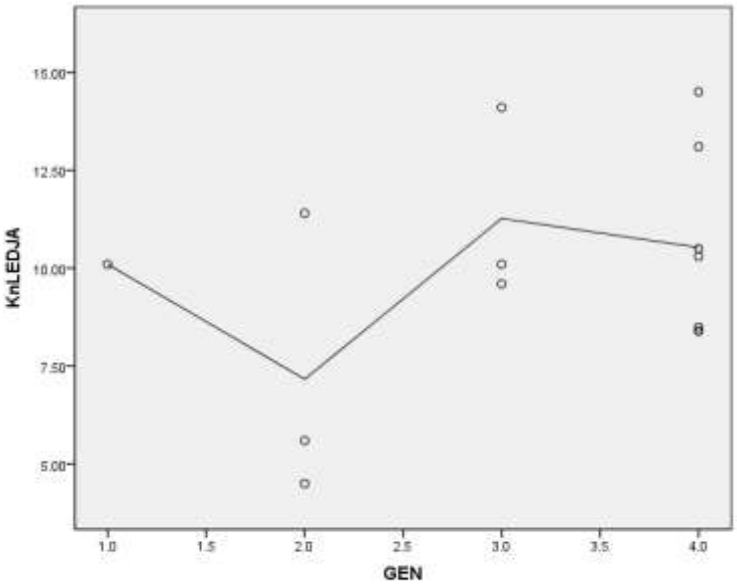


Diagram 5. Ratio of skin folds of back (N) in the female population of students and the years of study (GEN)

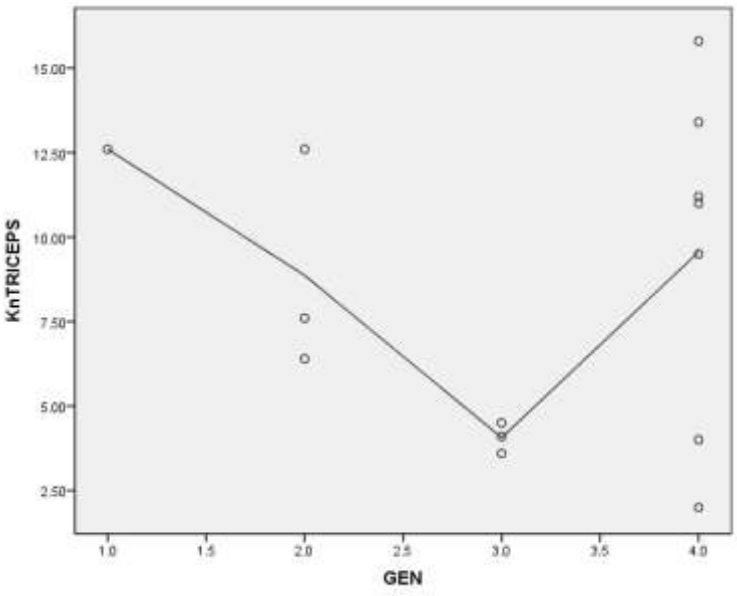
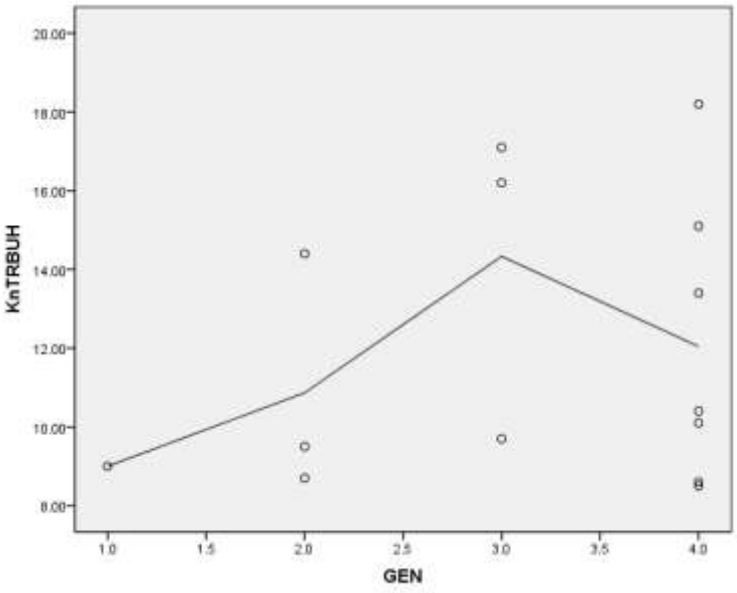


Diagram 6. Ratio of skin folds of the upper arm (N) in the female population of students and the years of study (GEN)



Dijagram 7. Ratio of skin folds of abdomen (N) in the female population of students and the years of study (GEN)

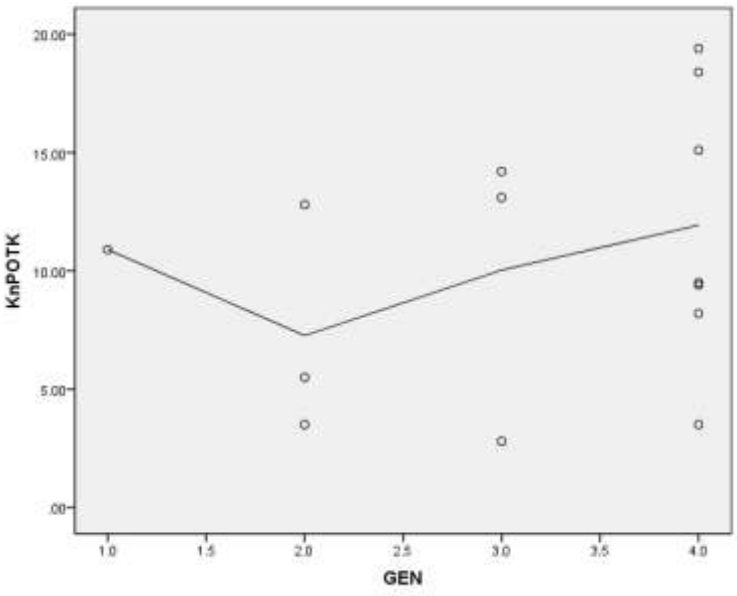


Diagram 8. Ratio of skin folds of lower leg (N) in the female population of students and the years of study (GEN)

DISCUSSION

When we compare the results of the research obtained by (Milinović Harasin and Mazinjanin, 2011), and wfich are related to differences in the amount subcutaneous fat tissue in students of Economics, Faculty of Kinesiology, the mean amount is 13.5% (Economics), and (7.9% of Kinesiology), with the students of the Faculty of Sports and Physical Education from Niksic (9.3%), there is a little difference between Kinesiology and Faculty of Sport, which was expected considering that they are students from these faculties.

(Marinovic and Kvesić, 2008) by measuring of triceps skinfolds have stated in their work that the arithmetic means in boys are (10.25%) in girls (12.68%), while in students they are (7.4%) and in female students (8 , 4%). Factors that may affect the results and explain the results achieved are those that the students of the Faculty of Sport have been in admission to the Faculty according to motor skills that are highly correlated with the percentage of body fat.

It is interesting to notice that skinfold thickness, in male students has the lowest value at the first year of studies while it reaches its maximum at the fourth year of studies.

However, these values differ slightly, so it's safe to say that the skinfold thickness in male students accumulate as we go the end of studies, except for skin folds of back, where the situation is slightly different.

When it comes to the female student population at the Faculty of Sport and Physical Education, the curves for each of the measured skin folds have a different shape, so it is very difficult to conclude which is the dynamics for accumulation of subcutaneous fat tissue, and the reason is most likely located in a small number of respondents

CONCLUSION

The subject of this research is the analysis of subcutaneous fat tissue among the students of the Faculty of Sports and Physical Education in Niksic. Obesity is a multicausal disease that usually occurs as a result of the interaction of genotype (inherited genetic characteristics of individuals), and environmental factors. Besides it represents one of the main risk factors for a wide range of cardiovascular diseases, it acts indirectly causing

other diseases. The subject of this research is the analysis of subcutaneous fat tissue among the students of the Faculty of Sports and Physical Education in Niksic. From all the above, and from the obtained results related to skin folds (back, upper arm, abdomen and thigh) we can conclude that the average values, for both sexes separately and for the total population, are in the range of standard values for treated population.

REFERENCES

Findak, V. i sar. (1996). *Norme.* Zagreb: Hrvatski pedagoško-književni zbor

Malina, R.M., Bouchard, C. (1991). *Growth, maturation and physical activity*. Human Kinetics, Champaign, Illinois.

Marinović, M., Kvesić, M. (2008). *Tanita vaga kao instrument za mjerenje nekih antroploškim mjera u školi i sportu.* Ljetnja škola kineziologa Republika Hrvatska.

Milinović, I., Harasin, D., Mazinjanun, P. (2011). *Razlike u morfološkom statusu studenata Ekonomskog fakulteta i Kineziološkog fakulteta u Zagrebu.* Ljetnja škola kineziologa Republika Hrvatska.

Weineck, J. (2000). *Optimales Training*. Spitta-Verlag, Balingen

ANALIZA POTKOŽNOG MASNOG TKIVA KOD STUDENATA FAKULTETA ZA SPORT I FIZIČKO VASPITANJE U CRNOJ GORI

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SAŽETAK

Problem ovog istraživanja predstavlja utvrđivanje potkožnog masnog tkiva kod studenata Fakulteta za sport i fizičko vaspitanje iz Nikšić

Uzorak ispitanika je obuhvatio 90 studenata oba pola (muški=76; ženski=14) koji redovno pohađaju nastavu na Fakultetu za sport i fizičko vaspitanje na Univerzitetu Crne Gore. Mjerenja su sprovedena u dijagnostičkom centru na Fakultetu za sport i fizičko vaspitanje na Univerzitetu Crne Gore. Kožni nabori (leđa, nadlakat, trbuh i potkoljenica) su mjereni sa kaliperom tipa John Bull.

Podaci dobijenu u istraživanju su obrađeni korišćenje statističko programa v.SPSS 19.0 prilagođenog za rad na personalnim računarima. Deskriptivne statističke vrijednosti su izražene u obliku srednje vrijednosti (SD) za svaku od predviđenih varijabli, kao i minimalnih i maksimalnim vrijednosti.

Debljina kožnih nabora kod studenata muškog pola ima najniže vrijednosti na prvog godini studija dok svoj maksimum dostiže na četvrtoj godini studija. Kada je ženska populacija studenata u pitanju krivulje za svaki od mjerenih kožnih nabora ima drugačiji oblik, pa je veoma teško konstatovati koja je dinamika nagomilavanja potkožnog masnog tkiva, a razlog se, najvjerovatnije nalazi u malom broju ispitanika.

Gojaznost predstavlja multikauzalno oboljenje koje najčešće nastaje kao posljedica interakcije genotipa (naslednih genetskih odlika individue) i faktora spoljne sredine. Osim što spada u glavne faktore rizika za nastanak široke lepeze kardiovaskularnih oboljenja, ona djeluje i indirektno uzrokujući druge bolesti.

Iz svega navedenog i na osnovu dobijenih rezultata koji se odnose na kožne nabore (leđa, nadlakat, trbuh i potkoljenica) može se konstatovati da se prosječne vrijednosti, kako za oba pola pojedinačno, tako i za ukupnu populaciju, nalaze u rasponu standardnih vrijednosti za tretiranu populaciju.

Ključne riječi: analiza, studenti, masno tkivo, kaliper, morfološke karakteristike.

Biomedicine

BONE STATUS IN THE YOUNG ADULT POPULATION OF ATHLETES AND NON-ATHLETES

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UDC 61:796.071

SUMMARY

The aim of the present research was to evaluate the bone status and determine the difference in bone density parameters in the young adult population of athletes and non-athletes. One hundred-nineteen healthy subjects (76 males and 43 females), aged 16,65±0,76 years, height 174.96±8.91 cm, weight 65.86±11.02 kg (Mean±Std.Dev.), were recruited and divided into two sub-samples according to their sport activity status: 53 athletes, and 66 non-athletes (controls). The skeletal status was assessed bilaterally, on the left and right calcaneus, by the clinical sonometer Sahara, and the following variables: 1) BUA in dB/MHz); 2) SOS in m/s; 3) STIFFNESS; 4) ESTBMD in g/cm2. For the data statistical analysis and the interpretation of the results, software SPSS version 11 was used. In data processing the Kolmogorov-Smirnov test and the t-test were implemented. Neither the t-test for independent samples, nor the t-test for paired samples revealed significant difference between the athletes and non-athletes, and males and females. Further researches are needed, which shall deal with the type of muscular contraction and the intensification of the training process, necessary for the peak bone mass increment in young athletes.

Key Words: bone mineral density, ultrasound densitometry, difference, males, females.

INTRODUCTION

The optimization of the bone status in young adults may provide a logical approach to the long-term prevention of osteoporosis, since a low bone mass is associated with an increased risk of fractures (Brébana et al., 2010). Among all the factors associated with the attainment of an optimal bone mineral density (BMD) and bone mineral content (BMC), that have not been clearly identified (Andreoli et al., 2001), physical exercise plays an important and positive role (Anderson, 2000, Welten et al., 1994). However, there are some negative findings about the influence of the physical exercise on skeleton status (Brahm, Strom, Piehl-Aulin, Mallmin, & Ljunghall, 1997; Hetland, Haarbo, & Christiansen, 1993). According to certain findings, the positive effects of the physical exercise on the bone status are not related to the movement itself, but to the weight-bearing activities in addition. In that sense, the activities of swimmers in a low-gravity environment are followed by the no beneficial skeletal effects on bone mass (Taaffe et al., 1995; Fehling, Alekel, Clasey, Rector, & Stillman, 1995), while thee weightless activities of astronauts are followed by the rapid and significant bone loss (Smith & Heer, 2002; Goodship et al., 1998). The participants in the studies of the influence of sports on BMD are generally exceptional athletes. By selecting those athletes who are currently active there is a bias toward the most successful and the best-adapted athletes (Morel, Combe, Francisco, &

Bernard, 2001). Having that in mind, but foremost by being concerned for what is going on with the bone status in growing subjects, we have evaluated the bone status in the young adult population of athletes and non-athletes. Other aims were to determine the difference in the bone density parameters in the young adult population, between athletes and non-athletes, as well as, between males and females.

MATERIAL AND METHODS

One hundred-nineteen healthy subjects (76 males and 43 females) aged 16,65±0,76 years, height 174.96±8.91 cm, weight 65.86±11.02 kg (Mean±Std.Dev.), were recruited and divided into two sub-samples according to their sport activity status: 53 athletes, and 66 non-athletes (controls). The athletes had professional sport activities duration of at least one year in their soccer, handball, volleyball, basketball, water polo, swimming, gymnastics, body building, table tennis, tennis, judo, karate, aikido, kick-box, dance and folklore teams and clubs, prior to the research. The skeletal status was assessed bilaterally, on the left and right calcaneus, by the clinical sonometer Sahara (Hologic, Inc., MA 02154, USA), that uses the non-ionizing ultrasound to assess BMD: 1) the broadband ultrasound attenuation i.e., the weakening of the audio signal (BUA expressed in dB/MHz); 2) the speed of sound signal i.e., the shortest time that elapses between the pulse transmission and the first reception of a signal (SOS, expressed in m/s); 3) the stiffness (STIFFNESS) or the Quantitative Ultrasound Index which combines the parameters SOS and BUA; 4) the estimated bone mineral density (ESTBMD, expressed in g/cm^2) is calculated from stiffness. It is a measurement of bone mass, expressed as the amount of mineral-in grams divided by the area scanned in cm^2 (The Free Dictionary, n.d).

The more complex the structure of the bone, the greater is the "block" to sound transmission. A normal bone thus has a higher attenuation than an osteoporotic bone. The speed of sound rises with an increased bone connectivity (Eleftheriou et al., 2012). A recently developed qualitative ultrasound (QUS) method for bone assessment is portable, relatively inexpensive, and does not involve any radiation in relation to the Dual-energy x-ray absorptiometry (Falk, Bronshtein, Zigel, Constantini, & Eliakim, 2003; Flohr, Lutz, App, Matthys, & Reincke, 2002), which is imperative when the subjects are children, and apriori because of the children, the X-ray methods for determining the BMD are forbidden in many countries. In addition, this method gives the information about the structure and density, which is more important for the risk of fracture, compared to the data on density, only (Obradović et al., 2010).

For the data statistical analysis and the interpretation of the results, software SPSS version 11 was used. In the data processing the Kolmogorov-Smirnov test and the t-test were implemented (Pallant, 2007).

RESULTS WITH DISCUSSION

TABLE 1 Descriptive statistics of the research variables

Variables	N	Minimum	Maximum	Mean	Std. Dev.
SOS_R (in m/s)	119	1505.208	1625.693	1556.794	25.563
BUA_R (in dB/MHz)	119	49.625	119.333	77.560	15.565
STIFFNESS_R	119	67.548	144.336	99.085	16.251
ESTBMD_R (in g/cm^2)	119	.351	.836	.550	.103
SOS_L (in m/s)	119	1504.907	1635.323	1555.835	25.614
BUA_L (in dB/MHz)	119	48.815	124.481	76.463	15.282
STIFFNESS_L	119	68.342	150.520	98.242	16.123
ESTBMD_L (in g/cm^2)	119	.356	.875	.545	.102

By applying the Kolmogorov Smirnov's test (table 2), the postulate about the normal distribution of values at the examined variables was tested, in order to justify the use of parametric or non-parametric tests.

TABLE 2 Kolmogorov Smirnov One-Sample test.

Kolmogorov Smirnov test	SOS_R	BUA_R	STIFFNESS_R	ESTBMD_R	SOS_L	BUA_L	STIFFNESS_L	ESTBMD_L
Sig.	.396	.731	.283	.283	.479	.399	.444	.444

The statistical significance for all variables was greater than 0.05, so the null hypothesis, which assumed that the variables had normal distribution, was accepted. Therefore, in testing for the existence of a significant difference, the T-test (parametric test) was applied (tables 3 and 4).

TABLE 3 T test for independent samples (athletes vs. non-athletes).

Variables	Athlete	N	Mean	Std. Dev.	Sig
SOS_R	No	66	1557.172	26.481	0.858
	Yes	53	1556.323	24.615	
BUA_R	No	66	78.133	15.980	0.656
	Yes	53	76.848	15.154	
STIFFNESS_R	No	66	99.475	16.914	0.772
	Yes	53	98.600	15.531	
SOS_L	No	66	1555.542	26.918	0.890
	Yes	53	1556.200	24.141	
BUA_L	No	66	76.590	16.120	0.920
	Yes	53	76.305	14.321	
STIFFNESS_L	No	66	98.174	17.033	0.959
	Yes	53	98.327	15.073	
ESTBMD_R	No	66	0.553	0.107	0.772
	Yes	53	0.547	0.098	
ESTBMD_L	No	66	0.544	0.108	0.959
	Yes	53	0.545	0.095	

Based on the results of the T test for independent samples (table 3) the conclusion is that there are no significant differences between the group of athletes and that of non athletes.

TABLE 4 T test for independent samples (males vs. females).

Variables	Sex	N	Mean	Std. Dev.	Sig
SOS_R	M	76	1556.866	23.552	0.968
	F	43	1556.667	29.076	
BUA_R	M	76	76.327	13.610	0.252
	F	43	79.740	18.502	
STIFFNESS_R	M	76	98.609	14.451	0.673
	F	43	99.927	19.181	
SOS_L	M	76	1555.586	22.876	0.889
	F	43	1556.275	30.141	

BUA_L	M	76	75.387	14.135	0.309
	F	43	78.365	17.134	
STIFFNESS_L	M	76	97.699	14.366	0.627
	F	43	99.202	18.982	
ESTBMD_R	M	76	0.547	0.091	0.673
	F	43	0.556	0.121	
ESTBMD_L	M	76	0.541	0.091	0.627
	F	43	0.551	0.120	

Based on the results of the T test for independent samples (table 4) the conclusion is that there are no significant differences between male and female subjects.

In order to compare the average values of the results achieved with the left and with the right lower extremity we used the T-test for paired samples.

TABLE 5 T-test for paired samples (whole sample).

		Mean	N	Std. Dev.	Sig
Pair 1	SOS_R	1556.794	119	25.563	0.258
	SOS_L	1555.835	119	25.614	
Pair 2	BUA_R	77.560	119	15.565	0.094
	BUA_L	76.463	119	15.282	
Pair 3	STIFFNESS_R	99.085	119	16.251	0.140
	STIFFNESS_L	98.242	119	16.123	
Pair 4	ESTBMD_R	0.550	119	0.103	0.140
	ESTBMD_L	0.545	119	0.102	

Based on the results of the T-test for paired samples (table 5) the conclusion is that there are no significant differences between the values achieved with the left and with the right lower extremity regarding the whole sample.

TABLE 6 T-test for paired samples (sub-samples of athletes and non-athletes).

		Mean	N	Std. Dev.	Sig	Mean	N	Std. Dev.	Sig
Pair 1	SOS_R	1557.172	66.000	26.481	0.193	1556.323	53.000	24.615	0.911
	SOS_L	1555.542	66.000	26.918		1556.200	53.000	24.141	
Pair 2	BUA_R	78.133	66.000	15.980	0.106	76.848	53.000	15.154	0.535
	BUA_L	76.590	66.000	16.120		76.305	53.000	14.321	
Pair 3	STIFFNESS_R	99.475	66.000	16.914	0.124	98.600	53.000	15.531	0.713
	STIFFNESS_L	98.174	66.000	17.033		98.327	53.000	15.073	
Pair 4	ESTBMD_R	0.553	66.000	0.107	0.124	0.547	53.000	0.098	0.713
	ESTBMD_L	0.544	66.000	0.108		0.545	53.000	0.095	

a. ATHLETE = NO ATHLETE = YES

Based on the results of the T-test for paired samples (table 6) the conclusion is that there are no significant differences between the values achieved with the left and with the right lower extremity regarding the sub-sample of athletes as well as the sub-sample of non-athletes.

Based on the results of the T-test for paired samples (table 7) the conclusion is that there are no significant differences between the values achieved with the left and those achieved with the right lower extremity regarding male and female subjects.

TABLE 7 T-test for paired samples (males and females).

		Mean	N	Std. Deviation	Sig	Mean	N	Std. Deviation	Sig
Pair 1	SOS_R	1556.667	43	29.076	0.785	1556.866	76	23.552	0.227
	SOS_L	1556.275	43	30.141		1555.586	76	22.876	
Pair 2	BUA_R	79.740	43	18.502	0.219	76.327	76	13.610	0.248
	BUA_L	78.365	43	17.134		75.387	76	14.135	
Pair 3	STIFFNESS_R	99.927	43	19.181	0.451	98.609	76	14.451	0.204
	STIFFNESS_L	99.202	43	18.982		97.699	76	14.366	
Pair 4	ESTBMD_R	0.556	43	0.121	0.451	0.547	76	0.091	0.204
	ESTBMD_L	0.551	43	0.120		0.541	76	0.091	

a. SEX =F SEX =M

The present results are hard to compare to the results of other researches, due to the methodological differences, heterogeneity of the subject population in relation to sex, age, sport activity, nutrition, testing conditions, etc.

Slemenda & Johnston (1993) compared young female figure skaters, aged 10-23, with the non-athletic control subjects to ascertain whether there were differences in skeletal densities at various sites. Although the skaters were thinner in comparison to the non-athletes, they had similar skeletal densities at the upper body sites (spine, arms, ribs) and significantly greater densities in pelvis and legs. As the authors stated, these differences were not evident until the mid-teens, suggesting that there is little likelihood of the selection bias as the cause of the observed differences.

Söderman, Bergström, Lorentzon, & Alfredson (2000) investigated and compared the bone mass of thighs in 51 female soccer players, age 16.3±0.3 years, with 41 non-active females, age 16.2±1.3 years. Compared with the non-actives, the soccer players had a significantly higher BMD of the total body (2.7%), lumbar spine (6.1%), the dominant and non-dominant hip (all sites). The largest differences were found in the greater trochanter on both sides (dominant, 16.5%, non-dominant, 14.8%), indicating a site-specific skeletal response of weight-bearing and impact-loading acting on the skeleton. According to the authors the differences in bone mass were already apparent in early adolescence, but became more pronounced in late adolescence, probably explained by a longer exposure to soccer training with time.

Nichols, Bonnick, & Sanborn (2000) also found an increased BMD in athletes that is 5-30% greater than the control values.

In the research of Boot et al. (1997) which included 500 children and adolescents (205 boys and 295 girls), aged between 4-20 years, there was no difference determined in a total body BMD between boys and girls. However, the girls had a higher lumbar BMD and volumetric BMD than boys at all ages. It was also determined that these two values increased with age (in girls and boys it started at the age of 11 years, i.e. 13 years, respectively), as well as, that the increment was higher during puberty than before puberty. After the age of 16 years, the age-dependent increase in BMD leveled off in girls, whereas in boys it continued.

In all of the above quoted researches, a statistically significant difference in BMD status in favor of the athletes was determined. So it is hard to explain the lack of a statistically significant

difference in BMD status in the present research. Perhaps the answer lies in the question of how intense, rather than how often or how long the training process was implemented previously?

Finally, the obtained values of a BMD status are within the range of normal for the young population of athletes and non-athletes that participated in the present research. As the bone mass increment is strongly influenced by the sex hormone secretion, and as it reaches a peak at approximately 18 and 20 years of life in females and males, respectively (Kaga et al., 2004), it can be supposed that there still is a place and time for the bone mass augmentation in subjects.

CONCLUSION

The present cross sectional data, as the part of the longitudinal study, clearly indicated no difference in bone density status between the young people engaged in different sport activities and the non-athletes. Further research is needed, which shall deal with the type of muscular contraction and the intensification of the training process, necessary for the peak bone mass increment in athletes.

ACKNOWLEDGMENTS

We gratefully acknowledge the Ministry of Education, Science and Technological Development of the Republic of Serbia, which supported and financed the current research within project № 179024.

REFERENCES

Anderson, J.J.B. (2000). The important role of physical activity in skeletal development: how exercise may counter low calcium intake. *American Journal of Clinical Nutrition*, 71 (6), 1384-1386.

Andreoli, A., Monteleone, M., Van Loan, M., Promenzio, L., Tarantino, U., & De Lorenzo, A. (2001). Effects of different sports on bone density and muscle mass in highly trained athletes. *Medicine and Science in Sports and Exercise*, 33 (4), 507-511.

Brahm, H., Strom, H., Piehl-Aulin, K., Mallmin, H., & Ljunghall, S. (1997). Bone metabolism in endurance trained athletes: a comparison to population-based controls based on DXA, SXA, quantitative ultrasound, and biochemical markers. *Calcified Tissue International*, 61 (6), 448-454.

Brébana, S., Padillab, F., Fujisawac, Y., Manod, I., Matsukawac, M., Benhamoua, C.L., Otanic, T., Laugierb, P., & Chapparda, C. (2010). Trabecular and cortical bone separately assessed at radius with a new ultrasound device, in a young adult population with various physical activities. *Bone*, 46 (6), 1620-1625.

Boot, A.M., de Ridder, M.A., Pols, H. A., Krenning, E.P., & de Muinck Keizer-Schrama, S.M. (1997). Bone mineral density in children and adolescents: relation to puberty, calcium intake, and physical activity. *Journal of Clinical Endocrinology & Metabolism*, 82 (1), 57-62.

Falk, B., Bronshtein, Z., Zigel, L., Constantini, N.W., & Eliakim, A. (2003). Quantitative ultrasound of the tibia and radius in prepubertal and early-pubertal female athletes. *Archives of Pediatrics and Adolescent Medicine*, 157 (2), 139-143.

Fehling, P.C., Alekel, L., Clasey, J., Rector, A., & Stillman, R. J. (1995). A comparison of bone mineral densities among female athletes in impact loading and active loading sports. *Bone*, 17 (3), 205-210.

Flohr, F., Lutz, A., App, E. M., Matthys, H., & Reincke, M. (2002). Bone mineral density and quantitative ultrasound in adults with cystic fibrosis. *European Journal of Endocrinology*, 146 (4), 531-536.

Goodship, A.E., Cunningham, J.L., Oganov, V., Darling, J., Miles, A.W., & Owen, G. W. (1998). Bone loss during long term space flight is prevented by the application of a short term impulsive mechanical stimulus. *Acta Astronautica*, 43 (3), 65-75.

Hetland, M.L., Haarbo, J., & Christiansen, C. (1993). Low bone mass and high bone turnover in male long distance runners. *Journal of Clinical Endocrinology & Metabolism*, 77 (3), 770-775.

Eleftheriou, K.I., Rawal, J.S., Kehoe, A., James, L.E., Payne, J. R., Skipworth, J.R., Puthucheary, Z.A., Drenos, F.,Pennell, D.J., Loosemore, M., World, M.,

Humphries, S.E., Haddad, F.S., & Montgomery, H.E. (2012). The Lichfield bone study: the skeletal response to exercise in healthy young men. *Journal of Applied Physiology*, 112 (4), 615-626.

Kaga, M., Takahashi, K., Ishihara, T., Suzuki, H., Tanaka, H., Seino, Y., & Makino, H. (2004). Bone assessment of female long-distance runners. *Journal of Bone and Mineral Metabolism*, 22 (5), 509-513.

Morel, J., Combe, B., Francisco, J., & Bernard, J. (2001). Bone mineral density of 704 amateur sportsmen involved in different physical activities. *Osteoporosis International*, 12 (2), 152-157.

Nichols, D.L., Bonnick, S.L., & Sanborn, C.F. (2000). Bone health and osteoporosis. *Clinics in Sports Medicine*, 19 (2), 233-249.

Obradović, B., Bubanj, S., Stanković, R., Dimić, A., Bubanj, R., Bubanj, M., Bojanić, V., & Perić, S. (2010). Calcaneal mineral density in children athletes and take-off leg. *Acta Medica Medianae*, 49 (2), 25-28.

Pallant, J. (2007). *SPSS Survival Manual*. Third Edition, Allen & Unwin.

Slemenda, C. W., & Johnston, C. C. (1993). High intensity activities in young women: site specific bone mass effects among female figure skaters. *Bone and Mineral*, 20 (2), 125-132.

Smith, S.M., & Heer, M. (2002). Calcium and bone metabolism during space flight. *Nutrition*, 18 (10), 849-852.

Söderman, K., Bergström, E., Lorentzon, R., & Alfredson, H. (2000). Bone mass and muscle strength in young female soccer players. *Calcified Tissue International*, 67 (4), 297-303.

Taaffe, D.R., Snow-Harter, C., Connolly, D.A., Robinson, T. L., Brown, M.D., & Marcus, R. (1995). Differential effects of swimming versus weight-bearing activity on bone mineral status of eumenorrheic athletes. *Journal of Bone and Mineral Research*, 10 (4), 586-593.

The Free Dictionary (n.d). Definition of bone mineral density. Available at: http://medical-dictionary.thefreedictionary.com/bone+mineral+density

Welten, D.C., Kemper, H.C.G., Post, G.B., van Mecheln, W., Twisk, J., Lips, P., & Teule, G.J. (1994). Weight-bearing activity during youth is a more important factor for peak bone mass than calcium intake. *Journal of Bone and Mineral Research*, 9 (7), 1089-1096.

KOŠTANI STATUS MLADIH OSOBA SPORTISTA I NESPORTISTA

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SAŽETAK

Cilj aktuelnog istraživanja bio je da se proceni koštani status i utvrde razlike u vrednostima parametara koštanog statusa u populaciji mladih sportista i nesportista. Stodevetnaest zdravih ispitanika (76 muškog i 43 ženskog pola), starosti 16,65±0,76 godina, visine 174.96±8.91 cm, težine 65.86±11.02 kg (Srednja vred.±Std.Dev.), učestvovalo je u istraživanju. Uzorak ispitanika je podeljen na dva sub-uzorka u skladu sa svojim sportskim statusom: 53 sportista i 66 nesportista (kontrolna grupa) Skeletni status je procenjen i u predelu leve i u predelu desne petne kosti, Uputrebom kliničkog sonometra Sahara. Varijable istraživanja bile su: 1) BUA u dB/MHz); 2) SOS u m/s; 3) STIFFNESS; 4) ESTBMD u g/cm2. Za statističku analizu i interpretaciju rezultata korišćen je softver

SPSS verzija 11. U obradi podataka korišćeni su Kolmogorov-Smirnov test i t-test. Ni t-testom za nezavisne uzorke, ni t-testom za parne uzorke nije utvrđena statistički značajna razlika između sportista i nesportista, kao i ispitanika muškog i ženskog pola. Dalja istraživanja su neophodna, koja će biti fokusirana na vrstu mišićne kontrakcije i intezifikaciju trenažnog procesa, neophodnih za prirast koštane mase kod mladih sportista.

Ključne reči: koštano mineralna gustina, ultrazvučna denzitometrija, razlike, muškarci, devojke.

SOMATOTYPE ANALYSIS OF THE FIRST-YEAR STUDENTS OF THE FACULTY OF SPORT AND PHYSICAL EDUCATION IN NIS

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SUMMARY

Introduction: Somatotypes were analyzed in thrity male first-year students of the Faculty of Sport and Physical Education, which were randomly selected and who voluntiraly agreed to participate in the research.

Methods: Somatotypes were determined by the software SOMATOTYPE 1.1 (taken from http://www. SOMATOPYPE.org / studies.php), according to the Heath/Carter method. The following anthropometric parameteres were measured: body weight and height,the diameter of the elbow and calf, upper arm and lower leg girth, as well as the skinfold thickness of the upper arm over the triceps and calf.

Results: The students have the inhomogeneous distribution of somatotypes – all combinations were present except endo-ectomorph. The most common are the meso-endomorph (33.33%) and endo-mesomorph (23.33%) somatotypes, and other combinations are present in a lower percent. The average somatotype among students was 4.1, 4.0, 2.8, that is mesomorphic-endomorphic.

Conclusion: A highly frequent endomorph component indicates obesity in individuals, and inhomogeneity indicates an inadequate selection of students with respect to the fact that they have chosen physical activity and sport as their main profession.

Keywords: anthropometric parameteres, Heath/Carter method, the meso-endomorph and endo-mesomorph somatotypes

INTRODUCTION

The first data on the human somatotype, i.e. constitution, date back from the period of ancient Greece, from Hippocrates (460-377 BC). A Roman doctor Galen, in the first century of BC, also dealt with the issues of constitution. Significant scientific names who researched the issues of constitution in 19 and 20th century were Rosten and Sigaud (French school), De Giovani, Viola and Pende (Italian school), Kretschmer and Conrad (German school), Sheldon, Reesand Eysenck (American school) and Tschernortzky, Serebrowskaja andKrilov (Russian school). The stated authors and numerous others, who have not been placed here, have contributed to the invention of the current and most implemented Heath-Cartermethod for determination of the human somatotype.

The first data on three somatotypes' components, endomorphic, mesomorphic and ectomorphdate date back from Sheldon (Sheldonet al. 1940), and they have been accepted as the modified ones by the American authors Heath and Carter. The stated authors, based on certain anthropometric parameters, have determined a somatotype by applying a formula, tables and nomograms (Heath and Carter 1967, Carter 1970, Carter, 1984, Carter, 1992). The stated authors, based on certain anthropometric parameters, have determined a somatotype by applying a formula, tables and

nomograms (Heath and Carter 1967, Carter, 1984, Carter, 1990). The endomorphic component has been connected with the amount of adipose tissue, the mesomorphic with the muscle mass and the ectomorph with the relation of body height to body weight. One of the components has been a dominant one and it is "a clear type" (endomorph 7-1-1, mesomorph 1-7-1 and ectomorph 1-1-7). The most frequently present constitutions have been the ones with two characteristics (5-7-1), and even with all three components (4-4-4). Some authors connect constitution exclusively for to genetic base, but it has been certain that the development of somatotypes depends on some other, both inner and outer factors (Bouchard et al. 1980). Since certain occupations, such as the army, police and others, demand muscle strength, a somatotype of an individual within male and female gender have been determined, regardless of their age.

Somatotyping is performed in children's age and adolescent age for directing the youth towards sport, having the appropriate constitution for it (Carlos, 2011). Somatotyping was connected to certain heart diseases (Williams SR, 1997); it has been analyzed in regard to the eating disorders and dyspepsia (Masom et al. 2003, Tovee et al. 2003); the difference in a somatotype has been recorded among the students of sport and other faculties (Мишигој-Дураковић, 1998), and also among sport persons and non-sport persons in different sport disciplines (Rahmawati et al. 2007). The issue discussed even by Flavius Philostratus in ancient Greece was connected to what was the role of somatotype in sport population, and he described which type of built a sport person should have , the person who should return from the Olympic Games as a winner (Мишогој – Дураковић Маријета, 2008). There have been opposite opinions in literature on somatotype merit for success in sport, but it is certain that pre-disposition is a part of the mosaic that in relation with other factors (a training process, food and motivation) would be a relevant one for success, as it has been stated by Tanner that "a sport person was born and created"(Tanner, 1964).

Numerous analyzes show that somatotypes have been subject to changes, influenced by the way of life (eating, physical activity) and the biological acceleration(Лозовина et al. 1989, adjusted from Мишигој- Дураковић, 2008). The researches of the somatotypes of the students at the Faculty of Sport and Physical Education in Nis were performed in 1997 and 2008, and a comparison between these two different generations groups was also conducted (Јовић Д., Ђурашковић Р., Пантелић С. and associates, 2010).

The aim of our research was to determine the somatotypes of the first year students at the same Faculty in the generation of 2011, and to compare the ones with the results of the stated authors.

METHODS

Examinees' Sample

The researches were conducted in May 2011 among male students (N = 30) of the Faculty of Sport and Physical Education in Nis (2010/2011 generation) at their first year of studies, and they were chosen by a chance sample. The students of the entire generation were included in the analysis since the research was performed in groups for more practical teaching (6 groups of 5 students per each). The examinees' age was from 19 to 20 years. The research examinees were informed about the aims, procedures and the time needed for it in advance, and there was their oral agreement to participate voluntarily in the researches.

A Measuring Instrument Sample

An anthropometry meter of a complete brand GPM-Swiss Made was used, a digital camera "Cassio FX" with an appropriate stand, a digital programme Image J, taken from the site http>//en. Wikipedia.org/wiki/ImageJ, a digital programme SOMATOTIP 1.1 (being overtaken from the site *http://WWW. SOMATOPYPE.org/studies.php*),a statistics packageSPSS17and a personal computer.

The anthropometry parameters needed for the determination of somatotype are: body height (TV), body weight (TT), the thickness of the skin folds on back (KLE), on stomach(KTR), upper arm (KNDL)and lower leg (KPKL), also the elbow diameter (DL), knee diameter (DKL), upper arm volume (ONDL), a corrected upper arm volume (KON), lower leg volume (OPKL) and a corrected lower leg volume (KOP).

1. TVand TT were measured with a classical anthropometry scale.
2. The diameters (DLand alone DKL) were determined in the ImageJprogramme in the following way: with the camera being placed onto the needed height and distance from the subject, and digital photographs were always made frontal, under the same conditions. At the same time, the known length (200см)was shot under the identical conditions as the subjects, and the ImageJ sorting was used before determining the anthropometry parameters by using the option "set scale".The programme Image J and a set of digital photographs of the examinees were placed on "desktop"of the computer for easier manipulation of it. The option "distance" from the software system of the length parameters was used, and their values were expressed in centimetres by the system (Стефановић and associates 2011 and 2012).
3. The volumes were measured by a measuring strip from the anthropometry set pursuant to the standard procedure.
4. Skin folds were measured by a calliper from the anthropometry set according to the standard procedure.

The accomplished data were placed into the digital programme SOMATOTIP 1.1 and a somatotype, expressing an appropriate somatogram were processed.

Statistical Data Processing

The accomplished quantitative data were processed statistically in the package SPSS17, where the middle value was determined (X) and the standard deviation (±SD),and the statistical significance was tested by the T-Test for independent samples at the level of the statistical significance of p≤0,05.Also, the presence of certain somatotype types was expressed in percentages. The results are shown in the tables and graphs (a software package Microsoft Office Excel 2007).

RESULTS

In Table 1, the general characteristics of the students' groups were shown, their age, height, weight and the BMI, and also the anthropometry parameters used for determining the somatotypes. The middle values for age, height and the BMI were very low, and this indicated the group's homogeneity. For weight, SD was higher and it was ±11.9018, indicating that examinees' weight was more varied compared to other determined characteristics. Besides the stomach skin fold, where SD was high (± 6.6572), for other parameters it was low, indicating a balance of the examined group. The values of the BMI show that the students' examinee group was fatter than being expected. Also, the minimal and the maximal values for all stated parameters were determined.

TABLE 1 The statistics of the anthropometry parameters and the BMI of the examined students

Varijabla	Valid N	Mean	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
TV (cm)	30	180.08	162.30	203.80	8.5351	0.79411	1.57992
TT (kg)	30	75.53	55.00	110.00	11.9018	0.72743	1.09242
BMI (%)	30	23.18	17.90	27.88	2.4071	-0.32484	-0.36444

ONDL(cm	30	29.83	24.20	36.40	2.5163	0.32721	0.86920
OPKL(cm)	30	38.55	32.00	48.00	3.1964	0.77747	1.78958
DL (mm)	30	8.93	7.11	11.61	1.1431	0.54295	-0.14001
DKL (mm)	30	11.60	9.60	14.49	1.3386	0.81614	-0.14751
KNDL (mm)	30	8.74	4.80	16.40	2.7328	1.08792	1.37831
KPKL (mm)	30	10.12	4.80	17.10	3.0456	0.69325	0.37034
KTR(mm)	30	17.13	8.00	32.00	6.6572	0.38324	-0.82956
KLE(mm)	30	11.49	7.20	16.00	2.5589	0.09411	-0.93636

Legend: TV- a body height;TT-body weight;BMI body mass index ;ONDL- upper arm volume; OPKL- lower leg volume;DL- elbow diameter;DKL- knee diameter;KNDL- upper arm skin fold;KPKL- lower leg skin fold;KTR- a stomach skin fold;KLE- the skin fold on the back

In Table 2 and graph 1, the frequency of a certain somatotype was shown in the examined students group, in percentages. All the possible combinations were present except the endo-ectomorph type. The most present one is the meso-endomorph type (33,30%) and the endo-mesomorph type (23,33%), while the other combinations are presented in less than 10 %. A central somatotype and a balanced ectomorph are present in 9, 998%, and this could be considered as a low value, since the primary students' activity of the Faculty of Sport is physical activity and they have a tendency for the accomplishment of better results in sport disciplines.

Graph 2 shows somatogram gained in the digital programme SOMATOTIP 1.1, and the distribution of the present somatotypes is clearly observable.

TABLE 2 The frequency of certain somatotypes in the students, in percentages

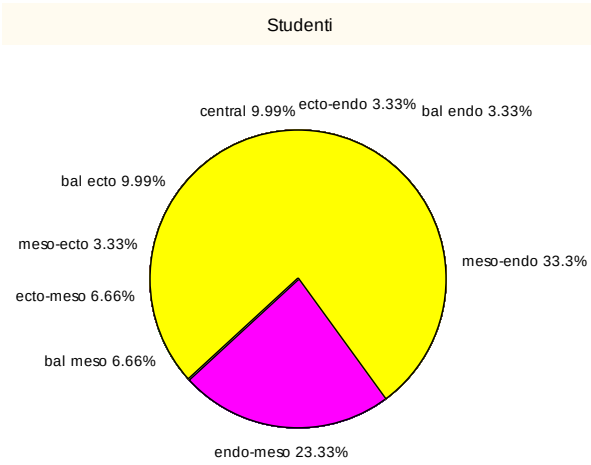
Somatotip	Studenti
ecto - endo	3.33% (1)
bal endo	3.33% (1)
meso - endo	33.3% (10)
endo - meso	23.33% (7)
bal meso	6.66% (2)
ecto - meso	6.66% (2)
meso - ecto	3.33% (1)
bal ecto	9.99% (3)
endo - ecto	0
central	9.99% (3)

In Table 3, the average students' somatotype is shown, and it is the mesomorph-endomorph one, i.e. 4, 1 – 4, 0 – 2, 8, where it is seen that the endomorph and mesomorph components are balanced, and the ectomorph one is significantly smaller; this indicates the presence of a muscle mass (the mesomorph component), but also of fat tissue, i.e. an increased body weight.

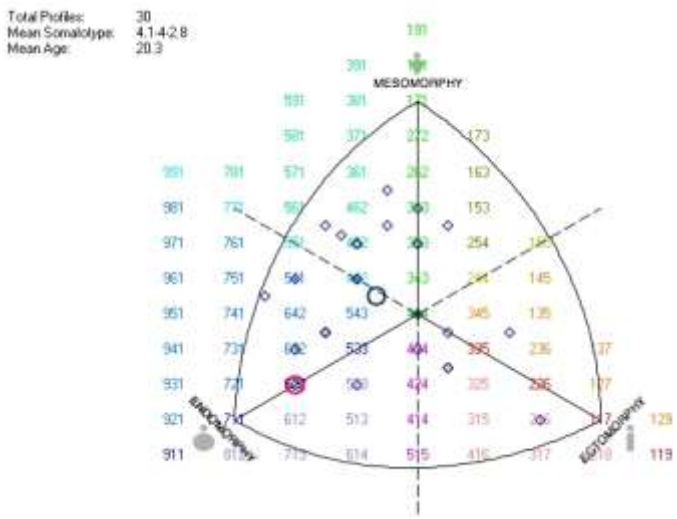
TABLE 3 The average somatotype of the students

	Somatotip			
Uzorak	**Endomorphic**	**Mesomorphic**	**Ectomorphic**	
Student	**4.1 (±0.24)**	**4 (±0.25)**	**2.8 (±0.23)**	**mesomorph endomorph**

Graph 1. The frequency of certain somatotypes in the students, in percentages -a graph



Graph 2. The somatogram of the students



DISCUSSION

Constitution or a somatotype can be defined as a specific range of structural-morphological, physiological-functional and cognitive-conative characteristics of an individual (Ђурашковић,2009). The mesomorph component is connected to the muscle mass and strength, the endomorph to the mass tissue of an individual and the ectomorph to the body's longitudinality, precision and skills.

It is necessary to perform the analysis of somatotype, especially within young members of the population, during their choices as to what sport they are going to take up, besides determining other specific anthropology parameters and physiological abilities. Our researches done on the students of the Faculty of Sport and Physical Education in Nis (hereinafter Faculty), for the 2010/2011 generation, show a huge inhomogeneity, i.e. the presence of all the combinations except the endo-ectomorph one. But in more than 50%, there are dominant combinations of the endomorph and the mesomorph components. By comparing the accomplished results for the somatotype of the students of the Faculty for 2010/2011 ,with the results of the author Jovic and associates (Јовић, Ђурашковић, Пантелић and associates 2010), who performed their measuring in 1997 and 2007 at the same Faculty, the dominant

one in their researches are the mesomorph and the endomorph component. In our researches, the average somatotype is the mesomorph-endomorph, 4,1 – 4,0 – 2,8, and for the mentioned authors, during their measuring from 2007, it is 4,0 – 4,6 – 2,5; the endomorph component is approximately the same, and the mesomorph one is slightly smaller, while the ectomorph component is higher. Still, both results show a higher presence of the mass component that is equal to the mesomorph component; it is connected to the muscle strength and individual sports. The data from 1997 show a lower endomorph component (3,39), a higher mesomorph (4,79) and ectomorph (2,71) ones, i.e. more muscle mass, and less subcutaneous mass tissue, and this can be due to a better choice of students during the entrance exam (Јовић, Ђурашковић, Пантелић and associates, 2010). The stated authors emphasize that the differences between the somatotypes of the students in 1997 and in2007 (the time difference of 10 years) can be a consequence of a changed way of life, and the biological acceleration (the change of the somatotype between population groups within one population). Our researches in 2011, with the time distance of 4 years, did not show significant differences compared to the researches from 2007, but the differences were evident compared to 1997.

The results of the wrestlers of the Greek-Roman style (Katarzyna, 2011),who have the average somatotype 2,0-6, 6-1, 2, and the somatotype of the Polish wrestlers3, 5-5, 9-1, 8, (Lewandowska et al. 2011), where the mesomorph component is the dominant one, emphasizes a strong muscle mass and strength. Our results with the mesomorph component 4,0 and the endomorph 4,1, do not fit in any way into the stated results, but somatotype can be changed through a training process, adequate eating and longer periods of doing sport activities.

It is interesting that a balanced mesomorph and a central somatotype, that according to the literature data (Carter, 1984) guarantee good results in sport activities with other conditions, in our researched population are present in less than 10%; this can still be considered as a satisfactory result, since the sample of 30 students is still small.

In further researches, similar measuring shall be performed with a higher number of students, and we shall classify them by the sport activities they do, either professionally or recreationally, and we shall include the female student population as well.

CONCLUSION

The somatotype of the analysed students' group of the Faculty of Sport and Physical Education in Nis shows a huge heterogeneity.

More than a half of the examinees have the mesomorph-endomorph and the endomorph-mesomorph somatotype. The average somatotype is the mesomorph-endomorph one (4, 1-4, 0- 2, 8).

A high frequency of the endomorph component emphasizes the increased body weight of an individual, and inhomogeneity in the inadequate choices of the students, since they have chosen physical activity and sport as their primary vocation.

A balanced mesomorph and a central somatotype are present in less than ten percentages of the examined students' population.

REFERENCES

Carter, J.E.L. (1970). The somatotypes of athletes: A review. *Human Biology*, 42, 535-569.

Carter, J.E.L. (1984). Somatotypes of Olympic athletes from 1948 to 1976. U.J.E.L. Carter (ur.), Physical structure of Olimpic athletes. *Paer II: Kinanthropometry of Olympic athletes.* Rasel: Karger, 80 – 109.

Carter, J.E.L., Hearth, B.H. (1990). *Somatotyping – development and applications. Cambrigen Studies in Biological Anthropology*. Cambrige University Press, Cambrige-New York-Port Chester-Melbourne-Sydney.

Carter, J.E.L., Heath, B.A. (1992).*Somatotyping – development and applications*. Cambrige: Cambrige University Press.

Đurašković, R. (2009). *Sportska medicina*. M KOPS Centar, Niš, 176-226.

Heath, B.H., Carter, J.E.L. (1967). A modified somatotype method. *Americen Jurnal of Anthropology*, 21,57-74.

Janos, M., Mohacsi, J., Szabo, T. & Szmodis, I. (2000). Anthropometry and competitive sport in Hungary. *Acta Biologica Szeged*, 44(1-4),189-182.

Jović, D., Đurašković, R., Pantelić, S. & Nabojša, Č. (2010). Konstitucionalne razlike studenata sporta i fizičkog vaspitanja u Nišu. *Glasnik Antropološkog društva Srbije*, 45, 335-342.

Sterkuwicz- Przybycien, K. L., Sterkowicz, S, Pyszard, T. Z. (2011). Somatotype, Body Composition and Proportionality in Polish Top Greco – Roman Wrestlers*. Jurnal of Human Kinetics,* 28, 141-154.

Lewandowska, J., Krzysztof, B., Pastuszak, A. & Boguszewska, K. (2011)., Somatotype Variables Related to Muscle Torque and Power in Judoists. *Jurnal of Human Kinetics,* 30, 21-28.

Marta, C., Marinho, D. A., Costa, A. M., Barbosa, T. M. & Marques, M.C. (2011). Somatotype is More interactive with Strength than Fat Mass and Physical Activity in peripubertal Children. *Jurnal of Human Kinetics, Specisl Issue*, 83-91.

Martin, T,. Benson, P., Emery, J., Mason, S. & Cohen- Tovee, E. (2003). Measurement of body size and shape perception in eating-disordered and control observers using body- shape . software. *British. Jurnal of psychology*, 94 (4), 501-16.

Mišigoj – Duraković, M. (2008). *Kinantropologia – biološki aspekti tjelesnog vežbanja,* Kinezološki Fakultet Sveučilišta u Zagrebu, Tiskara Zelina d.o.o., Zagreb

Peebles, L. and Beverley, N. (1998). *The Handbook of Adult Anthropometric and Strenght Measurements – Data for Design Safety.* London: Department of Trade and Industry, Goverment Consumer Safetly Research, 53-79.

Sheldon, W.H., Stevens, S.S., Tucker,W.B. (1940). *The variationes of human physique*. New York: Harer and Brothers.

Stefanović, N., Raković, A., Mladenović Ćirić, I., Pavlović, S., Stanković, D., Puletić, M. & Jorgić, B. (2011). The estimation of shoulder regularity in top athletes by determining the shoulder angle and thoracal angle in the imagej digital program. *Facta Universitatis series physical education and sport*, 9 (4), 417 - 426.

Stefanović, N., Mladenović Ćirić, I., Pavlović, S., Kundalić, B., Bubanj, S., Petković, E., Puletić, M. & Antić, V. (2012). Procena nekih anatomskih i antropometrijskih karakteristika grudnog kosa analizom digitalne slike prednjeg aspekta trupa kod vrhunskih atleticara. *Acta Facultatis Medicae Naissensis*, 29 (1), 73-76.

Steven, J. & Choat, B. PROTOCOL: Making wood are meassurements with ImageJ. http:// prometheuswiki.publish.csiro.au/tiki-index. Php? Page= PROTOCOL%3A+ Makin… 24. 4. 2011).

Suzanne, M. & Cohen-Tovee, E. (2003). Mearsurment of body size and shape perception in eating-disordered and control observers using body-shape software. *British Jurnal of Phychology*, 94 (4), 501-16.

Tanner, J.M. (1964). *The physique of the Olympic athlete*. London: George Allen and Unwin.

Trilusiana, R. N., Budiharjo, S. & Ashizawa, K. (2007). Somatotypes of young male athletes and non-athletes students in Yogyakarta, Indonesia. *Anthropological Science,* 115, 1-7.

Williams, S. R., Jones, E., Bell, W., Davies, B., Bourne, M. W. (1997). Body habitus and coronary heart disease in man. A review with reference to methodes of body habitus assessment. *European Heart Journal*, 18(3): 376-93.

ANALIZA SOMATOTIPA KOD STUDENATA PRVE GODINE FAKULTETA SPORTA I FIZIČKOG VASPITANJA U NIŠU

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SAŽETAK

Uvod: Analizirani su somatotipovi kod studenata Fakulteta sporta i fizičkog vaspitanja sa prve godine studija, muškog pola, ukupno 30, koji su odabrani metodom slučajnog uzorka i koji su dobrovoljno prihvatili da učestvuju u istraživanjima.

Metode: Somatotipovi su određivani u programu SOMATOTIP 1.1 (preuzet sa sajta *http://WWW.SOMATOPYPE.org/studies.php*), a prema Heath-Carter metodi. Od antropometrijskih parametara određivani su: telesna visina i težina, dijametar lakta i kolena, obim nadlakta i potkolenice i debljina kožnih nabora na nadlaktu iznad tricepsa i na potkolenici.

Rezultati: Studenti imaju nehomogenu distribuciju somatotipova; zastupljene su sve kombinacije osim endo-ektomorfne. Najzastupljeniji je mezo-endomorfni (33,33%) i endo-mezomorfni (23,33%) somatotip, a ostale kombinacije zastupljene su u znatno manjem procentu. Srednji somatotip kod studenata bio je 4,1. 4,0. 2,8, odnosno mezomorfno-endomorfni.

Zaključak: Visoko zastuljena endomopfna komponenta ukazuje na gojaznost pojedinaca, a nehomogenost na neadekvatni odabir studenata s obzirom da su odabrali fizičku aktivnost i sport kao svoju osnovnu delatnost.

Ključne reči: antropometrijski parametri, Heath-Carter metoda, mezo-endomorfni i endo-mezomorfni somatotip

THE APPLICATIONS OF THE DIGITAL IMAGEJ PROGRAM TO DETERMINE THE LENGTHS OF THE ANTHROPOMETRIC PARAMETERS

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UDC 681.32:796.572.87

SUMMARY

Introduction: The aim of this study was to see if the anrhopometrical parameters, vertical and horizontal can be successfully determined in the digital program ImageJ, downloaded from the website (htt://rsb.info.nih.gov/ij.). The quantitative anthropometric values, obtained by classic methods, using the anthropometer and ImageJ program, were compared and statistically processed.

Methods: The subjects were first year students from the Faculty of sports and physical education (generation 2010/2012), who were randomly selected and voluntarily agreed to use appropriate procedures. 30 male subjects, age from 19-20 years, were analyzed. The anthropometrical parameters were obtained by the GPM-Swiss Made anthropometer, by the usual procedure and always under the same circumstances. For the measuring in the digital program, digital photographs of the subjects were made, frontally (front and rear) and sagittally left and right by a "Casio FX" camera, placed on a certain height and distance from the subject, always in the same way and the same circumstances. Prior to measuring, the program was calibrated in cm based on the known distance, obtained the same way as the photographs of the subjects. The following parameters were determined in the same manner: body height, the acromio-acromio distance, the length of both arms, bicrystal and bitrochanteric distance. A statistical analysis was done by the statistical program package SPSS 10, which determined the mean values, standard deviation, maximal and minimal values, and using the student`s T-test the statistical significance was tested.

Results: No significant statistical differences were found in the measured parameters by the anthropometer and ImageJ program. Minor differences that can be observed were in the standard deviation values.

Conclusion: This shows that ImageJ method is very simple, fast and precise and can be used for measuring the anthropometric distance parameters, vertical and horizontal**.**

Keywords: anthropometrical parameters, anthropometer, ImageJ, comparison.

INTRODUCTION

Anthropometry is a science dealing with the quantitative measuring of the body dimensions of a man and it consists of the statistical and functional anthropometry and the strength anthropometry. Determining the angles and distances or intervals is a part of the statistical anthropometry (Peebles and Beverley, 1998). Anthropometry measuring is necessary in numerous areas of human activity such as ergonomics, anthropology, biomechanics, medicine and sport. Sport anthropometry has been developed in accordance to the techniques and it is the result of the general physical anthropology. A continuous progress in sport training methods for its consequence has a change of sport results and equipment, demanding the reports on human biological factors that can have their role in the competitive sport performances (Meszaros et al. 2000).

Anthropometry includes measuring the length parameters (horizontal and vertical), based on the

determined anthropometry dots, then measuring the volume of certain body parts and measuring the thickness of the skin folds in characteristic places on the body (Đurašković, 2009; Mišigoj – Duraković, 2008).Based on the anthropometry measuring, a somatotype has been determined, i.e. the endomorph, mesomorph and ectomorph components. The first data on these three components date back from Sheldon (Sheldonet et al. 1940) and the modified ones by Heath and Carter have been accepted, as well. The stated authors, based on certain anthropometry parameters, have determined a somatotype by applying formulae, tables and graphs (Heath and Carter 1967, Carter 1983, Carter, 1984b, Carter, 1992). Numerous analyzes show that somatotypes have been subject to changes, influencing in the first place eating and physical activity and a biological acceleration(Mišigoj- Duraković, 2008).

Anthropometry measuring and determining a somatotype is very significant precisely because they are changeable, especially in sport activities, with the selection of recruiting for certain sports, with evaluation and estimation of a training process, an objective evaluation of a general body development, control of eating condition and following a recovering process among the rehabilitation of sport persons.

The accomplishment analysis in sport anthropometry has been dominant in the last ten years, where the application of a digital imaging programme in anthropometry for understanding human body and postural approach have been intensified. There are numerous digital programmes being applied with different conveniences. One of these programmes is ImageJ, being freely accessible on the Internet, and the one has been developed by Java-based image within the National Health Institute (http>//en. Wikipedia.org/wiki/ImageJ).The programme Image J can be freely downloaded online, it is easy to be connected to Microsoft Windows, and it has an extremely simple application procedure (Jansen and Choat, 2011).

The aim of our researches has been to compare the same length anthropometry parameters (horizontal and vertical) that have been determined by a classical measuring of anthropometry and in the digital programme Image J within the same subjects. We expect there will not be significant differences in the quantitative values of the same parameters, accomplished in two completely different ways, and the efficiency of the Image J programme will be shown.

METHODS

The Examinees' Sample

The researches were conducted in May 2011 among male students (N = 30) of the Faculty of Sport and Physical Education in Nis (2010/2011 generation) at their first year of studies, and they were chosen by a chance sample. The students of the entire generation were included in the analyse since the research was performed per groups for practical teaching (6 groups of 5 students per each). The examinees' age was from 19 to 20 years. The research examinees were informed on the aims, procedures and time needed for it in advance, and there was their oral agreement to participate voluntarily in the researches.

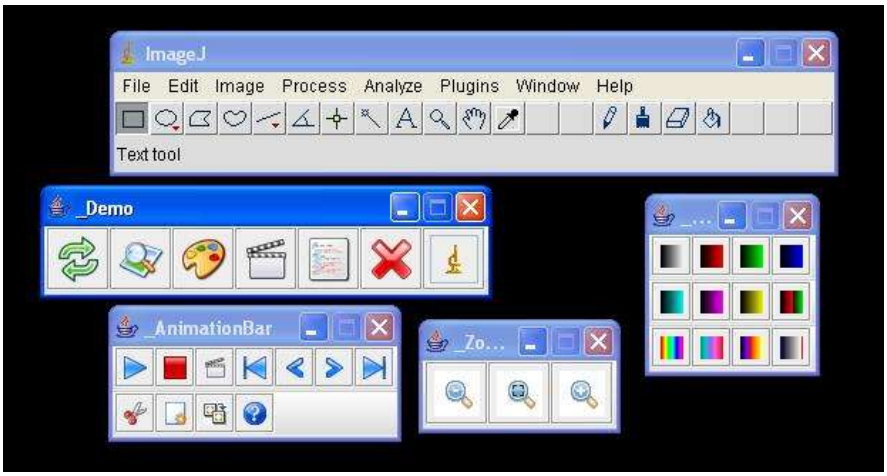
A Measuring Instrument Sample

An anthropometry meter of a complete brand GPM-Swiss Made was used, a digital camera "Cassio FX" with an appropriate stand, a digital programme Image J (Figure 1), taken from the site http>//en. Wikipedia.org/wiki/ImageJ,a statistics package SPSS17 and a personal computer.

Using the classical method, anthropometry, the following distances have been determined: body height (TV), the acromia-acromial distance (AA), left arm length (DLR) and right arm length (DDR), the bi-crystal distance (BCD) and the bi-trochanteric distance (BThD).

The same anthropometry parameters have been determined in the digital programme ImageJ (Figure 1.), and an appropriate procedure has been applied previously.

Figure 1. The digital programme Image J appearance



With the camera placed onto the needed height and distance from the subject, the digital photographs were made frontal (front and back), digitally left and right, under the same conditions. At the same time, a known length (200см) was shot under identical conditions like the subjects, and the Image J sorting was used before determining the anthropometry parameters by using the option "set scale".The programme Image J and a set of digital photographs of the examinees were placed onto a "desktop" of the computer for easier manipulation of it. The option "distance" from the software system of the length parameters was used, and their values were expressed in centimetres by the system (Stefanović and associates 2011 i 2012).

Statistical Data Processing

The accomplished quantitative data for the horizontal and the vertical anthropology parameters in the digital Image J programme were processed statistically in the package SPSS17, where the middle value was determined (X) and the standard deviation (±SD), and the statistical significance was tested by the T-Test for independent samples at the level of the statistical significance of p≤0, 05.

RESULTS

TABLE 1 Length anthropological parameters determined by anthropometry in the Image J digital system

	Group	N	Mean	Std. Deviation	Std. Error Mean
TV	Am	30	180,0767	8,53511	1,55829
	ImageJ	30	180,1833	8,67013	1,58294
AA	Am	30	41,4533	1,74825	,31918
	ImageJ	30	41,3433	1,92097	1,35072
DLR	Am	30	79,4700	4,36895	,79766
	ImageJ	30	78,7467	4,16635	,76067
DDR	Am	30	79,7400	4,49103	,81995
	ImageJ	30	78,7067	4,06464	,74210
BCD	Am	30	28,6667	1,78158	,32527
	ImageJ	30	29,1800	2,08035	,37982
BThD	Am	30	32,9767	1,95390	,35673
	ImageJ	30	32,9233	2,21604	,40459

In Table 1, the measured values of length anthropometry parameters have been presented by the classical anthropometry method and the Image J digital programme for three horizontal distances (AA, BCD, BThD) and three vertical distances (TV, DLR, DDR) among 30 first year students of the Faculty of Sport and Physical Education. The statistical data processing shows that there is no difference between the parameter values measured by one method and the other one ($p \geq 0,05$). Minimal differences, that can be noticed, belong to the area of the standard deviation.

TABLE.2

T-tests; Grouping: Var2 (Spreadsheet1) Group 1: aaan Group 2: aaij

Mean AAAN	Mean AAIJ	t-value	df	P
41,12000	41,31667	-0,320615	58	0,749654

TABLE 3

T-tests; Grouping: Var2 (Spreadsheet1) Group 1: TVIJ Group 2: tvan

	Mean TVIJ	Mean TVAN	t-value	df	P
Var1	180,1967	180,0767	0,054059	58	0,957074

In Table 2. and 3, the middle values for body height have been presented and also acromia-acromial distance measured, as usual, by anthropometry and in the Image J digital programme, and the values of the T-Test show there are no significant statistical differences.

DISCUSSION

Based on our results, it is evident that the length anthropometry parameters measured by the usual method and in the Image J programme have been identical ones, and minimal differences have been

within the limits of the standard deviation. The length parameters, vertical and horizontal, have been determined by the option “distance”, where the programme itself regulates horizontality and verticality. In the case of differences, the system itself has shown them, and recorded them in the levels of differences from Y-axis and X-axis. Also, the measuring results have been recorded automatically in tables, and they can be permanently stored in an appropriate folder.

The programme itself, besides the measuring option of the length parameters, has a line of possibilities for determining the angles using the option "angle", where an angle has been determined directly from a digital photograph, and it has been expressed in degrees, and the procedure does not require previous system sorting. In the current literature, there are papers where the angles have been determined in a digital programme we also worked in. The angle has been determined between a femur and tibia in rugby players, and one has been determined with a special position, when the ligaments in the joint have been injured freguently (Hewett et al. 2009). The paper where authors from the digital photographs within the stated programme determine infrasternal angle and the angle with the vertex points on umbilicus, and the branches passing through the acromial dots, as well as other length parameters, evaluate the chest anatomy of the top sport persons (Stefanović et al. 2012). Also, the shoulder angle (the angle between the shoulder tangent with its vertex in the place where the vertical part of neck begins) has been determined from digital photographs of the top sport persons, and based on it, the regularity of the shoulder position has been evaluated, as well (Stefanović et al. 2011).

The programme has the options for marking and circling, enabling a direct determination of the volume of the marked part and its plane in the predetermined measuring units, and this has been appropriate for determining the volume, body circumference and the width of pelvis (Peebles Laura and Beverley Norris, 1998). Also, it is possible, with the sagittal photographs and in the frontal aspect, to draw a spine from the back, and evaluate the presence or a lack of kyphosis or scoliosis and their variations from the vertical line (Linn, 2001, Omkar, Kumar & Mudigere, 2007 и 2007).

With the option "edit – draw", it is possible to fixate the anthropometry dots or tangents and other necessary assistance lines that a system can store permanently, if there is a need for it. It is very appropriate for determining short distances as the ones on the face or hands, the ones that need a lot of time and patience by the examinees when using the usual method and the same is with the one who is performing the measuring. In the Image J programme, at least two photographs (for a face, a frontal and sagittal one, and for a hand, a dorsal and palmar one) are necessary for this measuring. If there is a need for determining some specific parameters, it is necessary to make more photographs and it takes a few more seconds (Stefanović, 2012).

Before taking photographs, it is necessary to organise an adequate space where it shall take place for each individual case in the same way (the same distance of the camera from the subject and the same height it is being placed on). Under the same conditions, it is necessary to take a photograph of the known length that the digital programme Image J needs for calibration. For three basic photographs (frontal ahead and back, and back and sagittal left), it takes less than half a minute; if a specific measure is being determined, such as sitting height, arm span, leg length upright or some other, there should be more photographs, but all of these take more than a minute. There is no physical contact with a subject, and photorgraphs can be made very fast, and this gives favour to this method within the anthropology measuring of children, especially of a younger age, and also of the top sport persons. Besides taking photographs, everything else is done in the computer system and it does not require a lot of time, and the system itself records the measured parameters. Digital photographs are permanent and, in case of a need for checking, it is always possible to

repeat the calculation of certain parameters. We think that the digital programme Image J can be adequately applied in the anthropometry measuring in a combination with the classical methods, especially for sport persons.

CONCLUSION

Based on our research results, it can be concluded that there are no statistically significant differences between the length anthropometry parameters measured as usual, by anthropometry, and determined in the Image J digital programme. The differences that are present belong to the standard deviations of the measured parameters, and they have not been statistically significant.

REFERENCES

Carter, J.E.L., Heath, B.A., (1992).*Somatotyping – development and applications*. Cambrige: Cambrige University Press.

Carter, J.E.L., Hearth, B.H,. (1990). *Somatotyping – development and applications. Cambrigen Studies in Biological Anthropology*. Cambrige University Press, Cambrige-New York-Port Chester-Melbourne-Sydney.

Đurašković, R. (2009). *Sportska medicina*. M KOPS Centar: Niš, 176-226.

Heath, B.H., Carter, J.E.L. (1967). A modified somatotype method. *Americen Jurnal of Anthropology*, 21, 57-74.

Hewett, T. E., Torg J. S. & Boden, B. P. (2009). Video analysis of trunk and knee motion during noncontact anterior crutiate ligament injury in female athletes: lateral trunk and knee abducton motion are combined componentes of the injury mechanism. *British Journal of Sports Medicine*, 43, 417-422.

Jansen, S. & Bernard, C. PROTOCOL: Making wood are meassurements with ImageJ. Nađen 24. 4. 2011, http:// prometheuswiki.publish.csiro.au/tiki-index. Php? Page= PROTOCOL%3A+ Makin….

Linn, J.M. (2001). Using digital image processing for the assessment of postural changes and movement patterns in bodywork clients. *Jurnal of Bodywork and Movement Therapies,* 5, 11-22.

Meszaros, J., Mohacsi, J., Szabo, T. & Szmodis, I. (2000). Anthropometry and competitive sport in Hungary. *Acta Biologica Szeged*, 44(1-4), 189-182.

Mišigoj – Duraković, M. (2008). *Kinantropologia – biološki aspekti tjelesnog vežbanja*. Kinezološki Fakultet Sveučilišta u Zagrebu, Zagreb: Tiskara Zelina d.o.o.

Omkar, S. N., Manoj-Kumar M. & Dheevatsa, M.(2007). Posture assessment using ImageJ. *Indian Journal of Aerospace Medicine,* 51(1), 38-43.

Omkar, S.N., Manoj-Kumar, M. & Dheevatsa-Mudigere B.E. (2007b). Postural assessment of arbitrarily taken portal and profile photographes using ImageJ. *Jurnal of Bodywork and Movement Therapies,* 11(3), 231-237.

Peebles, L. & B, Norris. (1998). *The Handbook of Adult Anthropometric and Strenght Measurements – Data for Design Safety.* London: Department of Trade and Industry, Goverment Consumer Safetly Research, 53-79.

Sheldon, W.H., Stevens, S.S. & Tucker,W.B. (1940). The *variationes of human physique*. New York: Harer and Brothers.

Stefanović, N. (2012 a). Mogućnosti primene ImageJ digitalnog programa u anatomskim i antropometrijskim merenjima – **plenarno predavanje.** *III Kongres Srpskog anatomskog društva sa međunarodnim učešćem*. (str. 24-25).

Stefanović, N., Mladenović Ćirić, I., Pavlović, S., Kundalić, B., Bubanj, S., Petković, E., Puletić, M. & Antić, V. (2012). Procena nekih anatomskih i antropometrijskih karakteristika grudnog kosa analizom digitalne slike prednjeg aspekta trupa kod vrhunskih atleticara. *Acta Facultatis Medicae Naissensis*, 29 (1), 73-76.

Stefanović, N., Raković, A., Mladenović Ćirić, i., Pavlović, S., Stanković, D., Puletić, M. & Jorgić, B. (2011). The estimation of shoulder regularity in top athletes by determining the shoulder angle and thoracal angle in the ImageJ digital program. *Facta Universitatis series physical education and sport,* 9 (4), 417 - 426.

PRIMENE IMAGEJ DIGITALNOG PROGRAMA U ODREĐIVANJU DUŽINSKIH ANTROPOMETRIJSKIH PARAMETARA

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SAŽETAK

Uvod: : Cilj naših istraživanja bio je da utvrdimo da li se dužinski antropometrijski parametri, vertikalni i horizontalni, mogu adekvatno odrediti u digitalnom programu ImageJ, koji je preuzet sa sajta (htt://rsb.info.nih.gov/ij.). Kvantitativne vrednosti, koje su dobijene merenjem antropometrijskih parametara klasičnim metodama, antropometrom, i određivanje istih u ImageJ programu bile su upoređivane i statistički obrađene.

Metode: Ispitanici su bili student prve godine Fakulteta sporta i fizičko vaspitanja (generacija 2010/2011), koji su izabrani metodom slučajnog izbora i koji su dobrovoljno pristali na primenu odgovarajućih procedura. Starosti ispitanika bila je 19-20 godina, a analizirano je 30 pojedinaca muškog pola. Antropometrisjki parametri mereni su antropometrom marke GPM- Swiss Made uobičajnim postupkom i uvek pod istim uslovima. Za merenja u digitalnom program načinjene su fotografije ispitanika, frontalno (napred i pozadi) i sagitalno s leve i desne strane kamerom "Casio FH", koja je postavljena na određenoj potrebnoj visini i daljini od subjekta, uvek na isti način i pod istim uslovima. Pre početka merenja program je kalibriran u cm na osnovu poznate dužine, koja je slikana istim postupkom kao i fotografije subjekata. Na oba načina određivani su sledeći parametri: telesna visina, akromio-akromijalna distanca, dužina leve i desne ruke, bikristalna distance i bitrohanterična distanca. Statistička obrada učinjena je u statističkom programskom paketu SPSS 10 pri čemu je određivana srednja vrednost, standardna devijacija, maksimalna i minimalna izmerena vrednost, a t-testom je testirana statistička značajnost.

Rezultati: Utvrđeno je da nema statističkih značajnih razlika u veličinama izmerenih parametara antropometrom i u ImageJ programu. Minimalne razlike, koje se mogu uočiti, kretale su se u granicama standardnih devijacija.

Zaključak: Ovo ukazuje da je ImageJ metoda veoma jednostavna, brza i tačna, te se može uspešno primenjivati za merenje dužinskih antropometrijskih parametara, vertikalnih i horizontalnih.

Ključne reči: antropometrijski parametri, antropometar, ImageJ, upoređivanje

DIFFERENCES BETWEEN THE PHYSICAL FITNESS PROFILES OF MACEDONIAN ADOLESCENTS IN URBAN AND RURAL AREAS IN THE MUNICIPALITY OF KISELA VODA

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UDC 796.015.132(495.6)

SUMMARY

The degree of development of motor and morphological skills with the school - age children is dependent upon numerous factors, while the most prominent ones include: socio-economic factors, culture-related influence, lifestyle, health status, the environment where children learn and grow, the method and extent of implementation of the syllabi relating to physical education in primary and secondary schools. Particular significance should be given to the fact of whether the analysis refers to the state/situation in an urban or in a rural area. The sample size of this study is 490 respondents divided into two sub-samples: from the urban and from the rural areas. The trend identified in previous research works, has also been confirmed in this research. Namely, it refers to the fact that children from rural areas demonstrate better results in some of the specific motor, morphological and functional skills.

Key words: motor tests, anthropometrical measures, students.

INTRODUCTION

Urbanization is an integral part of our time. Research about how urban and rural environment affects the growth and sexual maturation of children is the focus of interest in recent decades. Experimental studies indicated that children in urban areas have generally more weight and have faster growth rates than children living in the countryside or on the outskirts of cities "(Tanner, 1989). Differences in height, weight (and other features) in children belonging to different socio - economic backgrounds or who live in towns or villages is going on in almost all the developed countries and in the countries that are undergoing development as is the Republic of Macedonia. Genetic factors affecting growth and maturation are better manifested in a better environment. The impact of two factors: socio-economic status and urban and rural areas on the anthropological dimensions overlap. In other words, it is not easy to separate their effects on growth and the development of children. On the other hand, in many countries the living conditions in the cities are more favourable to those in the countryside.

Back in 1820, Willerme (Villermé, 1828), suggests that infant mortality in France is much higher in poor social classes than in the higher ones.

Galton (Galton, 1873-74) suggests that children who worked in factories in England were smaller by about 3 cm than the children which did not work in factories, although they come from the working class families. Differences rose with age in both sexes. Bowditch (Bowditch, 1891) indicates that the

growth in the working- class boys in England is lower than those of the non-working class at all ages.

There are many other studies that have investigated the effects of residence on the anthropological dimensions in children (Boyd, 1980; Tanner, 1981; Eiben, 1989).

Although there is no school that is located in a rural environment in real sense in the Municipality of Kisela Voda, in order to obtain the preliminary information on whether there are statistically significant differences in the anthropometric measures, body composition and motor tests between the students who live closer to the downtown area and the students who live on the outskirts of the municipality, there has been made a comparative analysis between two schools that are located on the outskirts of the municipality and one primary school in the village of Dračevo, Kliment Ohridski "and others in the neighbourhood of Pintija, the local primary school "Rajko Zinzifov" and two schools that are located near the downtown area and the elementary school “Nevena Georgieva Dunja" and the elementary school “Cyril Pejchinovic".

METHODS

The sample of subjects

The research was conducted on a sample of 863 participants (divided into two sub-samples of urban and rural-living areas), from 6 to 10 years from the primary schools in the municipality of Kisela Voda, Republic of Macedonia in the framework of the project "The Development Trends of some anthropometric, motor and functional indicators among the students of both sexes from the elementary schools in the municipality of Kisela Voda". These two subsamples are divided into four subgroups as follows: 293 male responders from urban areas, 152 males from rural areas, 270 female responders from urban areas and 148 female respondents from rural areas, aged 6 to 10 years.

Sample measurement instrument

For conducting the purposes of the research 5 anthropometric measures were applied: body height (ATVIS), body weight (ATEZHI), sitting height (ASVIS), leg length (ADNOG) and the body mass index (ABMI) as a derived measure of weight and height. Two measures for assessing physical composition: the percentage of body fat and muscle mass were used. Eight motor tests were used, as follows: the flamingo balance test (MFLAM), taping a hand (MTRA) deep flexing in a sitting position (MDPKS), jump from place (MSDME), flexion of the hand (MFDLA), raising body/30 sec (MPOTR) durability in motion (MIZDZG) and running 4 times for 10m. (MTR4H10) Two measures for assessing functional capabilities were used: systolic (FSPRI) and diastolic pressure (FDPRI)

All participants were measured by the modified battery EUROFIT tests recommended by the Council of Europe, and some of them are modified and adapted to the international scientific projects "Feeding and Assessment of Nutritional Status of Spanish Adolescents (AVENA studies" and "The Health Lifestyle in European Nutrition Adolescence "(HELENA studies - Ruiz 2006).

Statistical data analysis

The data from the manifest variables are treated with th basic statistical parameters: the arithmetic mean (X) , a standard deviation (SD),the minimum score (MIN) and the maximum score (MAX) , and the normality of the distribution of the results is tested by the procedure of Kolmogorov and Smirnov (hp). The differences between the groups were determined by the t - test for large independent samples. The data are processed with the statistical package SPSS for Windows Version 15.0.

THE RESULTS

The distribution of the results in most variables among the respondents is normal, which was

methodologically made possible to perform further processing of basic data.

The results of the comparative analysis are presented in Tables 1 and 2. From the comparing of the results (Table 1) in boys of an early school age by place of education , it is obvious that the boys from early school age which are studying in rural areas have lower body weight (ATMAS), better flexibility in the hip joint and the lower part of the spine shows better results in the palm flexion test (absolute power), better static strength and the endurance of the arms and shoulder girdle, better agility, coordination, speed and higher systolic and diastolic blood pressure compared to the boys younger than school age which are studying in an urban environment.

The boys of an early school age who are studying in rural areas have less weight, improved flexibility in the hip joint and the lower part of the spine, they show better results in the palm flexion test (absolute power), have better static strength and the durability of arms and shoulder girdle, better agility, coordination and speed and higher systolic and diastolic blood pressure compared to the boys younger than school age who are studying in an urban environment. The girls of an early school age show better overall balance, improved flexibility in the hip joint and the lower part of the spine, have better agility, coordination and speed and higher diastolic blood pressure compared to the girls of school age who are studying in an urban environment. The girls from the urban environment showed better results in the raising body for 30 seconds test (they had better repetitive strength of the abdominal muscles).

TABLE 1 The differences in the anthropometric measures, body composition, motor tests and blood pressure among young boys of primary school age in urban and rural area of the municipality of Kisela Voda.

	Urban		Rural		t-value	df	p
	Mean	SD	Mean	SD			
ATVIS	134,45	10,09	132,76	9,92	1,68	443,00	,09
ATMAS	35,91	11,46	33,77	10,08	1,95	443,00	**,05**
ASVIS	72,44	5,06	71,52	4,76	1,87	443,00	,06
ADNOG	79,90	7,15	79,93	7,06	-0,04	443,00	,97
FSPRI	101,34	5,94	106,16	9,73	-6,46	443,00	**,00**
FDPRI	57,51	6,30	63,76	11,55	-7,38	443,00	**,00**
APRMM	30,21	3,46	29,56	3,83	1,82	443,00	,07
APOMT	25,01	7,70	24,11	8,01	1,15	443,00	,25
MFLAM	1,94	1,03	2,12	1,31	-1,65	443,00	,10
MTARA	19,62	4,01	19,52	3,75	0,26	439,00	,80
MDPVS	12,61	5,14	15,02	5,14	-4,70	443,00	**,00**
MSDOM	122,15	22,51	125,35	25,42	-1,35	438,00	,18
MFSAK	14,45	11,14	16,81	11,22	-2,11	443,00	**,04**
MPOTR	13,23	5,21	12,57	5,10	1,26	443,00	,21
MIZDZG	4,18	5,46	5,34	5,69	-2,08	443,00	**,04**
MTR4X10	15,23	2,28	14,27	1,89	4,43	441,00	**,00**
ABOMI	19,49	4,04	18,94	3,77	1,37	443,00	,17

Варијабли	Урбана	Руралнa	t-value	df	p
	Mean	Mean			
АТВИС	134,45	132,76	1,68	443,00	0,09
АТЕЖИ	35,91	33,77	1,95	443,00	**0,05**
АСВИС	72,44	71,52	1,87	443,00	0,06
АДНОГ	79,90	79,93	-0,04	443,00	0,97
АПРММ	30,21	29,56	1,82	443,00	0,07
АПОМТ	25,01	24,11	1,15	443,00	0,25
АБМИ	19,49	18,94	1,37	443,00	0,17
МФЛАМ	1,94	2,12	-1,65	443,00	0,10
МТАРА	19,62	19,52	0,26	439,00	0,80
МДПКС	12,61	15,02	-4,70	443,00	**0,00**
МСДМЕ	122,15	125,35	-1,35	438,00	0,18
МФСАК	14,45	16,81	-2,11	443,00	**0,04**
МПОТР	13,23	12,57	1,26	443,00	0,21
МИЗДЗГ	4,18	5,34	-2,08	443,00	**0,04**
МТР4Х10	15,23	14,27	4,43	441,00	**0,00**
ФСПРИ	101,34	106,16	-6,46	443,00	**0,00**
ФДПРИ	57,51	63,76	-7,38	443,00	**0,00**

TABLE 2 The differences in the anthropometric measures, body composition, motor tests and blood pressure among young girls of primary school age in urban and rural area of the municipality of Kisela Voda.

	Urban		Rural		t-value	df	p
	Mean	SD	Mean	SD			
ATVIS	132,45	9,79	131,08	8,94	1,40	416,00	,16
ATMAS	32,72	9,59	31,58	9,04	1,19	415,00	,24
ASVIS	71,10	4,97	70,37	4,47	1,49	416,00	,14
ADNOG	78,88	7,33	79,79	6,53	-1,25	416,00	,21
FSPRI	99,42	5,60	105,28	11,38	-7,06	416,00	**,00**
FDPRI	57,41	6,89	63,62	11,99	-6,73	416,00	**,00**
APRMM	96,86	13,27	97,45	13,83	-0,43	416,00	,67
APOMT	29,58	2,74	29,24	2,80	1,21	416,00	,23
MFLAM	23,08	7,97	22,51	8,06	0,69	416,00	,49
MTARA	1,93	1,01	2,21	1,18	-2,50	416,00	**,01**
MDPVS	20,34	4,37	20,76	4,08	-0,97	416,00	,34
MSDOM	15,18	4,86	16,50	4,36	-2,74	416,00	**,01**
MFSAK	111,20	20,83	109,36	18,49	0,90	416,00	,37
MPOTR	10,03	8,65	9,68	8,72	0,40	416,00	,69
MIZDZG	12,16	5,05	10,43	5,01	3,35	416,00	**,00**
MTR4X10	3,77	5,57	3,90	5,97	-0,22	416,00	,83
ABOMI	16,27	2,10	15,08	1,39	6,14	413,00	**,00**

Варијабли	Урбана	Руралнa	t-value	df	p
	Mean	Mean			
АТВИС	132,45	131,08	1,40	416,00	,16
АТЕЖИ	32,72	31,58	1,19	415,00	,24
АСВИС	71,10	70,37	1,49	416,00	,14
АДНОГ	78,88	79,79	-1,25	416,00	,21
АПРММ	29,58	29,24	1,21	416,00	,23
АПОМТ	23,08	22,51	0,69	416,00	,49
АБОМИ	18,41	19,20	-1,00	416,00	,32
МФЛАМ	1,93	2,21	-2,50	416,00	**,01**
МТАРА	20,34	20,76	-0,97	416,00	,34
МДПКС	15,18	16,50	-2,74	416,00	**,01**
МСДОМ	111,20	109,36	0,90	416,00	,37
МФДЛА	10,03	9,68	0,40	416,00	,69
МПОТР	12,16	10,43	3,35	416,00	**,00**
МИЗДЗГ	3,77	3,90	-0,22	416,00	,83
МТР4Х10	16,27	15,08	6,14	413,00	**,00**
ФДПРИ	57,41	63,62	-6,73	416,00	**,00**
ФПМИР	96,86	97,45	-0,43	416,00	,67

DISCUSSION

The impact of the environment on motor skills and capacity and other features is accomplished by indirect means, and these results should be viewed in a broader context. The life in an urban environment provides better conditions for the development of the genetic predisposition capabilities and features. But on the other side, the children living in an urban environment are prone to more pronounced sedentary habits (sitting in front of televisions and computers , passive transport, etc.), leading them to have poorer balance, flexibility, strength, agility and coordination . The children from rural areas have lower height and weight than the the urban ones.

The increasing presence of a passive lifestyle, especially in the children living in an urban environment reduces overall physical activity which further reduces the level of physical fitness and achievement. The results of our study suggest that the boys who are studying in a rural environment perform better results in the tests assessing physical fitness. The assumption is that the children in rural areas have more spontaneous physical outdoor activities and they use more outdoor space than the children living in urban areas do, and that's probably why they are achieving better results especially concerning the skills in which energy component is dominant. Of course, despite these factors, there is a major impact in the differences in the level of fitness in children from the teacher, school organization, and a very important issue, as well, is educating parents about the importance of physical activity in their personal and domestic education.

The results of the previous studies conducted in Europe showed that children living in urban areas are higher than their peers from rural areas and in many countries the differences remain present in adulthood. The reasons that are cited are the changes in the public health, nutrition and general living conditions associated with urbanization (Bielicki, 1986).

The studies of Peña Reyes M.E, and collaborators (2003), Okaca, in Mexico, indicate that children living in urban areas have better results in explosive power and the strength of the muscles of the front wall of abdomen. The studies of Sandhu (1983) that compare the level of physical fitness in urban and rural students in the area of Amritsar indicate that the girls from rural areas have superior physical fitness in relation to the urban ones. Mehtap O., Nihal

G., (2005), realized that the research team compared the level of physical fitness in rural compared to urban children in Turkey and found that the children living in an urban environment are higher , have more weight and are physically less active than the children living in rural areas. Tinazci and Emiroğlu (2010), explored the differences in the level of physical fitness among the students of primary schools in urban and rural areas in the group of respondents aged 9 to 11 years. The survey results showed that the students from rural areas have better results in the tests assessing flexibility, strength and durability. Badrić and Petračić explored the differences in the level of physical fitness among the students from urban and rural areas in Croatia. The analysis of the results of the students of different residential status in Croatia shows that the students from rural areas did better in flexibility tests, while in other tests there are no statistically significant differences (Badrić & Petračić, 2007). Eiben and collaborators have investigated the impact of the social and economic status on the biological phenomenon of acceleration in Hungary in children aged 3-18 years, and the researchers have found that the number of family members and the place of residence affect the anthropometric measures. The children belonging to the families with more members were shorter and had lower body weight and the percentage of body fat on average. In contrast, the children from urban areas like Budapest were taller, with more weight, had a greater volume of the chest and popliteal bone and a higher proportion of the subcutaneous adipose tissue on average (Eiben and collaborators, 2004).

The research conducted in Berlin (Pfister, G, & Reeg, A. 2006) on a sample of students from third and fourth grade of different social environments and different social heritage suggests that the level of physical fitness is conditioned by social factors. The reasons for the differences in the level of fitness are related to different social environments, but it also should be taken into account that the differences may occur due to the differences in the activities offered.

CONCLUSION

Based on the obtained results, i.e. the t - test to determine the differences between the two groups of subjects, it can be concluded that:

1. The pupils from rural areas compared to those from urban environment showed better results in the anthropometric measures of body weight (AMBW), and the tests: deep flex in sitting position (MDPKS) running 4X10m (MTR4X10) systolic (FSPRI) and diastolic pressure (FDPRI)

2. Female pupils from rural areas compared to the urban environment pupils showed better results in the following tests: Flamingo balance test (MFLAM) deep flex in sitting position (MDPKS), raising the body from a lying position on the back (MPOTR) running 4X10m (MTR4X10), systolic pressure (FSPRI).

The reasons for these differences expressed here lie in the fact that the students from rural areas have opportunities for more spontaneous physical activities, while the students from the urban environment have a sedentary lifestyle that does not allow them to be physically active in leisure time.

LITERATURE:

Badrić M., Petračić T., (2007). *Razlike u antropometrijskim obilježjima i motoričkim sposobnostima učenika urbanih i ruralnih sredina*. U G. Bala (ur.), Antropološki status i fizička aktivnost dece, omladine i odraslih. Novi Sad: Fakultet sporta i fizičkog vaspitanja. 107-113.

Bowditch, H.P.,(1891).*The growth of children studied by Galton's percentile grades.* in the 22nd Annual Report of the State Board of Health of Massachusetts. p 479-525. Wright and Potter, Boston.

Bielicki T. (1986). *Physical growth as a measureof the economic well-being of populations.* The twentieth century, [in:] Human Growth,2nd Edn., Vol. 3, F. Falkner & J.M. Tanner(eds.), New York: Plenum Press, 283-305.

Cetinić J., Petrić V., Vidaković-Samarđija D., (2011). *Urbano ruralne razlike antropometrijskih obilježja, motoričkih i funkcionalnih sposobnosti te motoričkih dostignuća (skokovi, trčanja i bacanja) učenika rane školske dobi*. 20 Ljetna Škola, Poreč, str. 233-238.

Eiben, O.G. and Pantó, E. (1986). The Hungarian national growth standards. *Anthropologiai Közlemények* (Budapest), (30), 5-23.

Gadžić, A, Vučković I. (2012). *Motoričke sposobnosti učenica osnovne škole urbanih i ruralnih sredina*, Glasnik Antropološkog društva Srbije / Journal of the Antropological Society of Serbia, Niš, vol. 47, str. 131-138.

Galton, F., (1873/74). Proposal to apply for anthropological statistics for school. J. Anthrop. Inst., 3: 308-311.

Mehtap O., Nihal G. (2005). Physical fitness in rural children compared with urban children in Turkey. *Pediatrics International,*47(1), 26-31.

Özdirenç, M., Özcan, A., Akin, F. i Gelecek, N. (2005). *Physical fitness in rural children compared with urban children in Turkey.* Pediatrics International; (47): 26-31.

Peña Reyes M.E, Tan S.K., Malina R.M. (2003) Urban-rural contrasts in the physical fitness of school children in Oaxaca, Mexico. *Am J Hum Biol,* 15(6), 800-13.

Petrić,, V., Novak, D., (2007). *Razlike u antropološkim obilježjima učenika urbanih i ruralnih naselja.* Zbornik radova: Sport za sve u funkciji unapređenja kvalitete života, Zagreb, 277-284.

Pfister, G., & Reeg, A. (2006). Fitness as 'social heritage': a study of elementary school pupils in Berlin. *European Physical Education Review,* 12(1), 5-29.

Ruiz, J.R., Ortega, F.B., Gutierrez, A., Meusel, D., Sjostrom, M., & Castillo J.M. (2006). *Health-related fitness assessment in childhood and adolescence:* A Europen approach based on the AVENA, EYHS and HELENA studies. Journal of Public Health*,* 14, 269-277.

Sandhu Surjit Singh (1983). *Physical Fitness of Rural and Urban Middle School Students of Amritsar* District. M.P. Ed Thesis, Unpublished. Amritsar: G.N.D.U.

Tanner, J.M., (1981). *A History of the Study of Human Growth. Cambridge* University Press, Cambridge .

Tanner JM. (1989). *Physical growth from conception to maturity.*2nd edition. London: Castlemead Publications.

Tinazci C, Emiroğlu O. (2010). Assessment of Physical Fitness Levels, Gender and Age Differences of Rural and Urban Elementary School Children. Turkiye Klinikleri *J Med Sci,* 30, 1-7.

Villermé, I.R., (1828). *Mémoire sur la mortalité en France dans laclasse aisée et dans la classe indigente. – Mémoire Acad. Méd.* (Paris), (1), 51-98.

РАЗЛИКИ ПОМЕЃУ ПРОФИЛОТ НА ФИЗИЧКИОТ ФИТНЕС НА МАКЕДОНСКИТЕ АДОЛЕСЦЕНТИ ВО УРБАНАТА И РУРАЛНАТА СРЕДИНА ВО ОПШТИНА КИСЕЛА ВОДА

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САЖЕТАК

Степенот на развивање на моторните и морфолошките способности кај училишната популација зависи од повеќе фактори, меѓу кои најзначајни се: социјално економскит статус, културните влијанија, животниот стил, здравствениот статус, средината во која детето учи и се развива, реализацијата на наставните содржини по физичко воспитание и образование во основните и средни училишта, и посебно дали сето ова се реализира во градска или рурална средина. Истражувањето е спроведено на примерок од 490 испитаници поделени во два субпримерока од градската и руралната средина. Како во повеќето досегашни истражувања, така и во ова истражување се потврдува фактот дека децата од руралната средина покажуваат подобри резултати во некои моторни, морфолошки и функционални способности.

Клучни зборови: моторни тестови, антопометриски мерки, функционални способности, ученички.

THE DIFFERENCES IN HEIGHT TO WEIGHT RATIO, NOURISHMENT AND POSTURAL STATUS IN PRIMARY SCHOOL PUPILS MEASURED BETWEEN 1988 AND 2012

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SUMMARY

Introduction: The decreased level of physical activity in free time is present not only in children but also in their parents all over the world and Serbia as well. The consequence of hypokinesis together with the calorie intake is an increased level of obesity and postural dysfunction in primary school pupils. The aim of this research was to establish the height to weight ratio, nourishment and postural status of primary school pupils in Aleksinac and Paraćin measured during the period between 1987/88 and 2012.

Methods: The sample comprised 327 pupils, of which 141 were measured in the period between 1987/88, and 186 in 2012.

Results: The results have shown that body mass, body mass index, skin folds, and % of body fat of the pupils measured in 2012 is significantly greater than that of the pupils measured during the period between 1987 and 1988. As far as the postural status and the deformities are concerned, the large percentage of pupils measured in 1987/88 had flat feet, while scoliotic bad body posture was observed in the pupils measured in 2012.

Conclusion: We may conclude that the body weight of the pupils measured in 2012 is significantly greater than the one of the pupils measured in 1987/88. This is the result of the low level of physical activity, while the scoliotic posture is the result of bad posture.

Key Words: pupils, nourishment, postural status.

INTRODUCTION

The decreased level of physical activity in free time is present not only in children but also in their parents all over the world and Serbia as well. The consequence of hypokinesis together with the calorie intake is the increased level of obesity and postural dysfunction in primary school pupils. The problem of obesity is more and more present in the world and Serbia as well (Mulina,2004.; Zdravković et al. 2009). There are several definitions of obesity, (Salazer et al .2006, 37) say that obesity is a state in which the excess adipose tissue can be harmful to health. Antić gave a definition more suitable for this research in 2009. He defines obesity in children and adolescents as an increase in body weight above the referential values that are related to gender, age and height and as a result there is an increased amount of fat in the body.

In a contemporary society obesity is one of the most important problems of health care. It is also estimated that obesity is the second- leading cause of

death which can be prevented and treated. The development of obesity in adulthood is under the influence of obese parents (Bukara-Radujković et al. 2008). Various factors are responsible for an increase of obesity in children and adults. One of these factors is an increased amount of food intake, especially fast food. During the past 20 years an average portion of food has become bigger, partially as a result of TV commercials and other means of communication. During this period the amount of time that people spend watching TV and eating snacks has been increased (Buenen et al. 1992; Troiano et al. 2002). Apart from this, one of the main causes of obesity is an insufficient level of physical activity. The participation of school children and adults in the organized forms of physical activity has been reduced, hence the involvement in the spontaneous forms of physical activity.

Apart from obesity, postural disorders are more and more present in primary and high school pupils (Trajković & Nikolić, 2008). A certain amount of daily activity represents a decisive factor in the development and maintenance of functional abilities, as well as bone density (Twomey, 1992). A physical activity program that consists of the exercises for postural antagonist muscles stretching is important for the prevention of bad posture. Good posture is very important in everyday life. However, bad posture does not necessarily imply poor health. It should also be noted that good posture provides excellent functioning in everyday life. God posture means that the body segments are well balanced; furthermore this means that the body reaches maximal efficiency with the least effort (Garrison & Read, 1980). Human body functions at its best when the body parts are in balance during sitting, walking, standing or any other every day activity. Contemporary lifestyles together with the immediate environment have a negative influence on the development of children; these especially reflect on the bad posture and feet deformities (Rao et al., 1992). A great number of factors influences the development of physiological arches of the feet some of them being: genetic determinism, physical activity, obesity (Madić et al. 2009) and a disbalance of feet muscles (Lee at al. 2008). More than 70% of school children have more or less severe posture deformities that are a result of the lack of physical activity, both spontaneous and organized (Velitčenko 1993).

METHODS

THE SAMPLE is comprised of 327 first grade pupils of primary schools in Aleksinac and Paraćin. The sample consists of two subsamples: 141 pupils measured in Aleksinac between 1987 and 1988 and 186 pupils measured in Paracin in 2012.

MEASURING INSTRUMENTS We used the Martin anthropometer, a plastic meter ruler and the GPM caliper Swiss made. The anthropometric variables were measured according to the methodology suggested by the International Biology Program (Weiner & Lourie, 1969).

In order to determine the level of nourishment we used the Body mass index (BMI), the sum of skin folds and the percentage of body fat. The body mass index was calculated by means of the following formula:

BMI=body weight kg/height m^2 (WHO, 1997).

The level of nourishment was determined based on the Body mass index values according to the standard criteria (Cole et al. 2000).

TABLE 1 The level of nourishment in pupils based on the Body mass index

The category of nourishment	Pupils
Well-nourished	< 17,91
Increased body weight	17,92-20,63
obese	>20,64

The percentage of body fat (BF %) was calculated according to the following equation (Slaughter et al. 1998). For the pupils:

%fat =1.21 x (ΣKNND+KNLE)- 0.008

Their postural status was determined by the somatoscopy method and a modified Volansky's method which includes seven body segments: head, shoulders, chests, blade bone, spine, stomach, legs and feet

(according to Jovović, 2008).

STATISTICAL DATA PROCESSING was conducted by means of the statistical package Statistics 6.0, and the level of statistical significance was 0.05.

We calculated the basic parameters of descriptive statistics for every measured or calculated variable: mean value (MV), minimum (MIN) and maximum (MAX) values and standard deviation (SD). In order to determine the differences between the groups we used the t-test.

RESULTS

The tables 1 and 2 show the basic parameters of the descriptive statistics, the anthropometric variables, the BMI, the sum of skinfolds, the percentage of fat in pupils measured in the period between 1987 and 1988, and in 2012.

TABLE 2 Basic descriptive parameters of the anthropometric variables, the Body mass index and % of fat in the pupils of primary schools in Aleksinac measured in the period between 1987 and 1988.

VARIABLES	N	MV	MIN	MAX	SD
A (age)	141	7.1	6.10	8.0	0.49
BW (body weight expressed in kg)	141	24.9	18.0	43.0	4.51
H(height expressed in cms)	141	125.7	110.0	139.2	5.90
BMI (Body mass index expressed in kg/m^2)	141	15.65	11.81	22.64	1.86
ACHC (average chest circumference expressed in cms)	141	59.9	52.5	76.0	4.10
SFUAT (skinfold of the upper arm triceps expressed in mms)	141	7.5	3.2	44.4	3.96
BSF(back skinfold expressed in mms)	141	5.1	2.8	19.0	2.40
ASF(abdominal skinfold expressed in mms)	141	5.3	2.8	44.4	4.65
SSF (the sum of skinfolds expressed in mms)	141	18.1	10.6	58.0	8.62
THE PERCENTAGE OF FAT	141	15.3	7.7	59.5	6.68

Table 3 The basic descriptive parameters of the anthropological variables, the body mass index and the % of fat of the primary school pupils in Paraćin measured in 2012.

VARIABLES	N	MV	MIN	MAX	SD
A (age)	186	6.7	6.05	7.09	0.44
BW	186	26.5	17.0	53.7	6.25
H in cm	186	125.0	106.2	140.3	6.42
BMI in kg/m^2	186	16.79	12.94	27.63	2.79
ACHC in cms	186	59.0	50.5	84.2	5.25
SFUAT in mms	186	10.2	4.6	36.0	4.51
BSF in mms	186	8.8	2.6	36.4	5.53
ASF in mms	186	9.6	2.8	38.0	6.74
SSF in mms	186	28.7	12.4	110.0	16.00
% FAT	186	23.0	10.8	87.1	11.69

The average values of the examined variables that have been shown in the tables 2 and 3 indicate that the body weight, the BMI, the skinfold thickness, the sum of skinfolds and the % of fat have lower values in pupils measured in the period between 1987 and 1988 in comparison to those measured in 2012.

Statistically significant difference of the examined variables shown in Table 4 indicates that the pupils measured in 2012 have higher values at the level 01 (p=.00), with the exception of height and average chest circumference. This shows that the first grade pupils measured in Paracin in 2012 have higher body weight and the examined indicators of nourishment in comparison to the pupils of the same age from Aleksinac measured in the period between 1987 and 1988.

TABLE 4 Statistically significant difference of the arithmetic mean of the anthropometrical variables, the body mass index and the % of fat in primary school pupils in Paraćin measured in the period between 1987 and 1988

VARIABLES	Pupils measured in2012		Pupils measured in 1977		t	P
	MV	SD	SV	SD		
BW in kg	26.5	6.25	24.8	4.51	2.61	**0.00**
H in cm	125.0	6.42	125.7	5.90	-0.96	0.33
BMI in kg/m^2	16.79	2.79	15.65	1.86	4.18	**0.00**
ACHC in cms	59.0	5.25	59.93	4.10	-1.55	0.12
SFUAT in mms	10.2	4.51	7.5	3.96	5.60	**0.00**
BSF in mms	8.8	5.53	5.1	2.40	7.41	**0.00**
ASF in mms	9.6	6.74	5.3	4.65	6.39	**0.00**
SSF in mms	28.7	16.00	18.0	8.62	7.12	**0.00**
% FAT	23.0	11.69	15.3	6.68	7.01	**0.00**

TABLE 5 The number and percentage of the pupils measured in 1987/88 and their level of nourishment based on the body mass index

Category	1987/88		2012	
	Number	%	Number	%
Well-nourished	130	92,20	137	73,65
Increased body weight	7	4,96	26	13,98
Obese	4	2,84	23	12,37

The results shown in Table 5 indicate that the number of well-nourished pupils measured in the period between 1987 and 1988 is 130, or 92, 20 %. The number of pupils measured in 2012 that are well-nourished is 137 or 73, 65%. An increased body weight has been noticed in 7 pupils measured in 1987/88 or 4, 96%, whereas in the pupils measured in 2012 it is 26 or 13, 98%. There are 4 obese children or 2, 84% measured in 1987/88 in Aleksinac, while the number of obese children measured in 2012 in Paraćin is 23 or 12, 37%.

TABLE 6 The number and percent of the postural disorders and deformities in pupils measured in the period between 1987 and 1988 in Aleksinac and those measured in 2012 in Paraćin

Disorder	1987/88		2012	
	Number	%	Number	%
Postural kyphosis	23	16,31	36	19,35
Postural scoliosis	12	8,51	78	41,93
Postural lordosis	1	0,71	1	0,54
Flat feet (fallen arches)	24	17.02	17	9,14
O-legs	-	-	3	1,61
X-legs	2	1,42	1	0,54
The total	62	43,97	136	73,12

The postural status and the deformity of the lower extremities are shown in Table 6. They indicate that the number and percentage of pupils with postural disorders and feet deformity measured in 1987/88 in Aleksinac is lower (62 ili 43, 97%) than the number of pupils measured in 2012 in Paraćin (136 ili 73, 12%).

DISCUSSION

We expected the difference in growth and development of the pupils of the same age measured in 1987/88 and the ones measured in 2012 to be different. The gathered data show that there is no difference in height and chest circumference. However, there is an evident difference in body weight, skinfold thickness, the percentage of fat and the sum of skinfolds. The values of the measured variables in pupils measured in the period between 1987 and 1988 are lower than the values of the pupils measured in 2012. Obesity, which is more and more present in contemporary society, starting from the early youth until the old age is a negative factor that may cause various noninfectious diseases (Mulina, 2004; Zdravković et al. 2009). The great deal of research shows the difference in the anthropometric parameters such as height and body weight, between the generations that have been measured 10 to 20 years ago and the present generations (Malina, 1990; Krawezanski et al. 2003; Hes et al. 2003; Marques-Vidal et al. 2008; Đurašković et al. 2012). The data gathered in this research do not show the difference in height and the average chest circumference. The results have shown a greater percentage of obese pupils measured in 2012 in comparison to those measured in 1987/88. The results indicate that the pupils measured in 2012 are not as physically active as the pupils measured in 1987/88. The low level of physical activity of preschool and school children is the result of a great deal of time spent watching TV, playing on the computer, or on the internet. Some studies show that the level of physical activity has been reduced for 50% within the period of 10 years (Buenen et al., 1992; Troiano et al., 2002; Salbe et al. 2002).

The results of this research on the postural disorders and deformities of the lower extremities conducted on the primary school pupils in Aleksinac in 1987/88 and Paraćin in 2012 show that there has been the greatest increase in the percentage of children with postural scoliosis. The gathered data are in accordance with other results (Protić-Gava & Krneta, 2010; Krsmanović, 2007). The great number of postural disorders in the present generations is a result of the lack of parents' interest in encouraging their children to participate in various forms of organized and spontaneous physical activity (Radisavljević, 2001). Various forms of physical activity such as sports and recreation have a great impact on the proper growth and development.

CONCLUSION

The gathered data indicate that the first grade primary school pupils measured in Paraćin in 2012 have a higher body weight, a greater BMI, thicker skinfolds, a greater sum of skinfolds and a higher

percentage of fat in comparison to the pupils measured in Aleksinac in 1987/88.

The analysis of the postural status indicates that the number of children with bad posture and fallen arches is greater in Paraćin.

The cause of the received results is the decreased level of physical activity in contemporary generations, the changed nutrition and the genetic basis.

REFERENCES

Antić AP. (2009). Arterijska hipertenzija gojazne dece i adolescenata. *Srpski Arhiv za Celokupno lekarstvo*. 137: 91-97.

Bukara-Radujković G., Zdravković D.(2008). Determinante gojaznosti dece i adolescenata. *Srpski Arhiv za Celokupno zdravstvo*. 136: 22-27.

Buenen G., Malina R., Renson R., Simons J., Ostyn M., Lefevre J.(1992). Physical activity and growth, maturation and performance: a longitudinaln study. *Medicine and Science in Sport and Exercise*. 24: 576-585.

Hesse V., Voigt M., Salzler A., Steinberg S., Friese K., Keller E.(2003). Alteration in height, weight and body mass index of newborns, children, and adults in eastern Germany after Germani reunification. *Journal of Pediatrics*.142:259-262.

Velitčenko, KV.(1993). *Fizkultura bez traumi*. Biblioteka učitelja fizičeskoj kulturi, Moskva.

Garrison L., Read AK.(1980). *Fitness for every body*. Palo Alto, Calif. Mayfield Publishing.

Zdravković D., Banićević M., Petrović O.(2009). Novi standardi rasta i uhranjenosti dece i adolescenata. Udruženje pedijatara Srbije. 5-7.

Jovović V.(2008). *Korektivna gimnastika sa kineziterapijom*. Filozofki fakultet-Nikšić, "Pobjeda" AD-Podgorica.

Cole TJ., Ballizzi MC., Flegal KM., Dietz WH.(2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal*. 320:1240-1243.

Krawezanski M., Walkowiak J., Krzyzaniak A.(2003) Secular changes in body height and weight in children and adolescents in Poznan. Poland, between 1880 and 2000. *Acta Pediatrica*. 92:277-282.

Krsmanović T.(2007). Posturalni poremećaji i kako ih sprečiti. *Glasnik Antropološkog društva Srbije* 42:345-351.

Lee MC., Sucato DJ.(2008). Pediatric Is sues with Cavovarus Foot Deformities. *Foot Ankle Clinics*. 13(2):199-219.

Malina RM.(2004). Secular trends in growth maturation and physical performance: A review *Anthropological Review* 67: 3-31.

Malina RM.(2008). Research on secular trends in auxology. *Antropologischer.Anzeiger*. 48: 209-227.

Marques-Vidal P., Madeleine G., Romain S., Gabriel A., Bovet P. Secular trends in height and weight among children and adolescents of the Seychelles. 1956-2006. BMC Public Health. 2008;8:166-174.

Madić D., Popović B., Kaličanin N. Total body fat – impor tant component of life health status.How to eval uate?. 1st International Scientific Conference-Excercise and Quality of life. Proceed ings book. Novi Sad: Faculty of Sport and Physical Education. 2009; 399-403.

Protić-Gava B., Krneta Ž.Posturalni status dece mlađeg školskog uzrasta četiri okruga vojvodine. Glasnik Antropološkog društva Srbije, 2010;45:375-383.

Rao UB., Jo seph B. The in flu ence of foot wear on the prev a lence of flat foot: a sur vey of 2300 chil - dren. J Bone Joint Surg. Br. 1992;74:525-527.

Radisavljević M.Korektivna gimnastika sa osnovama kineziterapije. Fakultet za sport i fizičko vaspitanje. Beograd. 2001.

Salbe AD., Weyer C., Harper I., Lindsay RS., Ravussin E., Tataranni PA. Assessing risk factors for obesity between childhood and adolescence. Energy metabolism and physical activity. Pediatrics. 2002; 110: 307-314.

Salazer B., Trnka Z., Sušica M. Pretilost, lipoproteini i telesna aktivnost. Biochenija medica. 2006; 16: 37-42.

Slaughter MH., Lohman TG., boileau RA., Horswill CA., Stillman RJ., Van Loan MD., Bomben DA. Skinfold

equations for estimation of body fatness in children and youth. Human Biology. 1998; 60: 709-723.

Twomey LT. A rationale for the treatment of back pain and joint pain by manual therapy. Phys Ther 72: 885-891.

Troiano RP. Physical inactivity among young people. New England Journal of medicine. 2002; 347:706-707.

Trajković S., Nikolić M. Kanoničke relacije ankih mera i posturalnih poremećaja školske dece. Glasnik Antropološkog društva Srbije, 2008;vol.43: 379-385.

Weiner S., Lourie A. practical Human Biology. 1981.

]WHO (World Heart Organization). Physical Status: the use and interpretation of antropometry. 1997.

Who Tehnical Raport Series no.854. Geneva:WHO.

RAZLIKE U TEŽINSKO VISINSKIM ODNOSIMA, UHRANJENOSTI I POSTURALNOM STATUSU UČENIKA OSNOVNIH ŠKOLA MERENIH 1988. I 2012. GODINE

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SAŽETAK

Uvod: Smanjena fizička aktivnost u slobodnom vremenu je evidentna, kako kod dece, tako i kod odraslih, u svetu i u Srbiji. Posledica hipokinezije uz unos kalorija dovodi do povećane gojaznosti, poremećaja posturalnog statusa kod učenika osnovnih i srednjih škola. Cilj ovog istraživanja je utvrđivanje razlika u težinsko visinskim odnosima, uhranjenosti i posturalnom statusu učenika I razreda osnovnih škola Aleksinca i Paraćina merenih 1987/88 i 2012. godine.

Metode: Ukupan broj ispitanika iznosio je 327, od toga 141 učenik meren 1987/88 i 186 učenika merenih 2012. godine.

Rezultati: Rezultati istraživanja ukazuju da su učenici mereni 2012. godine statistički značajno veće mase tela, body mass index-a, debljine kožnih nabora u svim merenim tačkama i % masti u odnosu na učenike merene 1987/88. godine. Poremećaji u posturalnom statusu i deformitetima su pokazali da je najveći broj i procenat učenika mereih 1987/88. godine sa spuštenim svodom stopala, a kod učenika merenih 2012. godine sa skoliotički lošim držanjem tela.

Zaključak: U zaključku se može konstatovati da je značajno povećana telesna masa kod učenika merenih 2012. godine u odnosu na učenike merene 1987/88. godinu.Ovo je rezultat smanjene fizičke aktivnosti, a skoliotički loše držanje tela je posledica nepravilnog sedenja.

Ključne reči: učenici, uhranjenost,posturalni satus.

THE EFFECT OF NEUROMUSCULAR ADAPTATION AND PSYCHOLOGICAL FACTORS ON THE EXPRESSION OF MUSCLE FORCE AND STRENGHT

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SUMMARY

The neurological adaptation during strength training is probably the result of the following factors: an increased activity of CNS, increased efficacy in nerve conduction, improvement in the synchronization of motor units, inhibition of the Golgi tendon organs and a decrease in the inhibitory neuroreflexes. More complex activities and exercises during strength training, which involve more joints and muscles, require more time for neuromuscular adaptation. However, the mechanisms of the changes in neuromuscular control during strength training still remain unclear. The cognitive factors are related to sport by the influence on the physiological adaptation process (primarily neuromuscular) during training and the expression of functional performances at a competition. The changes in motor cortex and other regions in cerebral cortex, spinal nerves, reflex pathways and motor neurons, are potentially ways of morphological adaptation of nerve structures by strength and force training. Further studies should explain the compensatory effects of strength training on structure and the function of neuromuscular connections, as well as the causes of fatigue during specific forms of training for increasing muscle force and strength.

Key Words: muscle strength, adaptation, psychological factors, training.

INTRODUCTION

The expression of muscle strength is mostly determined by morphological and physiological factors of musculoskeletal tissue and joints of every individual. The effects of training with resistance are mostly referred to adaptation of contractile structures, which results in an increased muscle the force and strength (Kraemer, Fleck & Evans, 1996). Also, a relationship was observed between force and speed of muscle contraction (Carroll, Riek & Carson, 2001). The increase of the muscle force and strength positively influences the speed of movement. The ability of muscles to overcome great loads, as well as the ability to overcome resistance in shortest period of time (explosive muscle strength), are important for success in different sports. Therefore, strength training has become an integral part of a training program. One of the main goals of strength training is improvement of successfulness in performing wanted movements (high jump, sprint etc.), respectively the greatest possible transfer of effects of strength and force training to success in performing motoric tasks (Radovanovic & Ignjatovic, 2009).

The Transfer of the effects of training to success in motoric movements is based on the principle of specific adaptation, which depends on the nature and character of the training load. Because of that, during choosing exercises the influence of different factors should be considered: the amplitude of joint movement, caused metabolic stress, the number and sequence of activated motor units, muscle coordination and the speed of movement (Radovanovic & Ignjatovic, 2009).

Acting based on the principle of specific adaptation the best training for strength increase would be that which mimics and has movements similar to those which are performed during the wanted motoric task. This approach could result, in short period of time, even in experienced athletes, in improved successfulness in performing movements. However, it should be expected that in the long term this kind of training would lead to unwanted effects such as: overtraining, uneven ability of different muscle groups and increased chance of injury, monotony over a long period of training. Of course, if only this kind of approach to training should be used, a lot of other popular methods for improvement force and strength would never exist.

Weight training represents the basic and the most used way of training for increasing muscle force and strength. However, success in traditional exercises with weights (bench press, squat) is only a partial indicator in dynamic sport movements (jumps, throwing). The reason for that is that the success in weight lifting represents the ability of muscles to overcome a certain load without time limit, while in performing dynamic movements during a sport activity it is necessary to achieve high values of muscle force in a very short period of time. Also, certain activities such as kicking or jumping involves elastic energy gained through the cycles of elongation and contraction (Radovanovic & Ignjatovic, 2009).

For increasing the success in performing certain motoric tasks, it is necessary to train all muscle groups, especially the weakest muscle groups which are involved in a motoric task, because they could limit the useful effect of larger muscle groups. For the optimal increase of success in performing certain motoric tasks the recommendation is that during the training for the increase of force and strength, the training of proper performing of a wanted motoric task should be included (Radovanovic & Ignjatovic, 2009).

As early as the middle of the previous century a lot of trainers realized the importance of a general or nonspecific training for creating a “muscle base”. Uniformly strengthening the whole body has become important because it creates a balanced function of neuromuscular system as basis for later specific adaptation. It is very important that the muscle force and strength improvement training affect prevention and reduction of a sport injury. Due to that fact the considerable part of the training process should be devoted to achieving that goal. Creating quality “muscle base” has become an aim of many training programs, especially in younger athletes (Radovanovic & Ignjatovic, 2009).

NEUROLOGIC ADAPTATION ON FORCE AND STRENGHT TRAINING

Fast adaptation of the nervous system explains fast and important progress in muscle strength during the early stages of training. Adaptive changes in muscles during early stages of training are not important, because there is no substantial increase in volume or the cross section area of skeletal muscles (Semmler & Enoka, 2000). It is believed that neurological adaptation is responsible for the increase in muscle force and strength in older persons involved in training. Neurological adaptation during strength training is probably the result of several factors (Carroll, Riek & Carson, 2002; Aagaard, 2003): increased activity of CNS, increased efficacy in nerve conduction, improvement in synchronization of the motor units, inhibition of the Golgi tendon organs and a decrease in the inhibitory neuroreflexes.

In studies where the effects of training on structural changes in neuromuscular connections were measured there were important findings. In experiments with rats, that had a load systematically put on them, by the model of strength training, there has been a change in the ratio between nerve endings and muscle fibers, because the diameter of fibers was reduced without change in nerve endings size (Sale, 1998).

In humans, different intensity of strength training lead to different body responses. The Training of lower intensity, longer duration and biggera

workload resulted in the widening of neuromuscular connections (Aagaard, Simonsen, Andersen, Magnusson, Halkjaer-Kristensen & Dyhre-Poulsen, 2000). More intensive training resulted in a bigger spreading of neuromuscular connections (Aagaard, Simonsen, Andersen, Magnusson & Dyhre-Poulsen, 2002).

NEUROLOGIC ADAPTATION ON FORCE AND STRENGHT TRAINING

The complexity of training significantly determines direction of neuromuscular adaptation. Relatively simple activities (e.g. biceps bench curl) in comparison to the more complex movements (e.g. leg press), show a very fast neuromuscular adaptation in an early stage of training followed by an increase in strength and muscle hypertrophy in a later stage. More complex activities with more joints involved demand more time for neuromuscular adaptation (Behm, 1995). However, the mechanisms of changes in neuromuscular control during strength training still remain unclear. The researches about effects of the strength training on neuromuscular activity were performed on trainings including exercises of different speed. Using appropriate tests the effect on the amplitude and elasticity of muscle response (M) and patellar ligament (T) was determined. The T response was measured by using superficial electromyography on *m. vastus medialis,* while the M response was measured by stimulation of *n. femoralis* with 1 ms and frequency of 0,2 Hz. The subjects performed exercise with angular speed of 90 degrees per second, in two series of 15 concentric contractions of the extensor muscles in the knee joint, 5 days per week during 10 weeks. The improvement was 48-54% in males and 67-70% in females, while the results didn't change in the untrained control group. However, the M response elasticity was significantly different in subjects, while the amplitude of M response was significantly increased (almost double). The authors attributed the increased maximal response to neuromuscular adaptation expressed through increased activity of α-motoneuron (which facilitated the activity of motor unit) and increased elasticity of muscles included in training (Garfinkel & Cafarelli, 1992; Higbie, Cureton & Warren, 1996).

EFFECT OF PSYCHOLOGICAL FACTORS ON FORCE AND STRENGHT MANIFESTATION

It is believed that the most people are normally functioning under certain neurological limits which prevent complete expression of their muscle strength (e.g. self-protecting reflex and other inhibitory mechanisms). The neuromuscular inhibition can be a consequence of various unpleasant experiences with training, over protective environment, fear of injury, etc. (Wescott & Baechle, 1998; Jensen, Marstrand & Nielsen, 2005). Whatever the reason, the person cannot express its full potential. Excitement and tension during a competition, the effect of relaxants or hypnotic suggestion often lead athletes to "supramaximal" performance, because of the decreased neuromuscular inhibition and an optimal function of motor neurons.

Top athletes are often capable of inducing some sort of self-hypnotic state, by intensely concentrating or using some of the psychological preparation methods, immediately before competition. Sometimes years of training are needed to perfectly block outer stimulators (e.g. noise, distraction by crowd), so that the muscle activity is directly focusing on performing within the given sport discipline. This state is typical for weight lifters, who have to precisely perform coordinated movements with maximal muscle tension (Wescott & Baechle, 1998). High level of physical ability and the accompanying "releases" from neuromuscular limits result in a complete activation of the muscles and achieving competitive success. Changes in nervous system functioning can be q trigger and only a scientifically proven foundation for the unexplained expressions of muscle force and strength during tense and extraordinary situations (e.g. world record

jump of American athlete Bob Beamon at Olympic games in Mexico City 1968.).

By a series of standard experiments the importance of the psychological factors in expressing muscle strength in humans was illustrated. The authors measured arm strength in male students in different conditions (in normal conditions; just after a big noise; while someone shouted loudly during the measurement; under the influence of alcohol and amphetamine; under hypnosis while suggested that they have substantial strength and not to be afraid of injury). Every of this variations increased strength above normal level, and the most effective one was hypnosis, because of hte greatest influence on CNS (Ranganathan, Siemionow, Liu, Sahgal & Yue, 2004). The assumption of the authors was that the increase in strength during different conditions of experiment is a result of the temporariy modifications of the CNS functions

Cognitive factors are connected with sport, by influencing the physiological adaptation process (neuromuscular) during training and expressing functional performance at the competition. It is believed that during a strength training a specific model should be organized in which the mental effort, attention and intention are combined in a program aimed at achieving maximal sport-specific physiological adaptation and later maximal sport performance (Ives & Shelley, 2003). Earlier it was considered that the unconscious part of the brain named "central governor" regulates output force so called "tempo strategy" modulating recruitment of the motor unit so to keep the whole body in homeostasis and prevent catastrophic decline of the physiological regulatory mechanisms (Noakes, Clair-Gibson & Lambert, 2005). However, according to the modern theory of fatigue, the mechanisms of fatigue varie depending o the specific exercise as a stressor (Weir, Beck,Cramer & Housh, 2006). During strength training, according to that model, fatigue includes changes at the central level and also the peripheral causes, and relative importance of these factors depends on type of exercise and specificity of its performing (specific position, number of repetitions, etc.).

CONCLUSION

The changes in the motor cortex and other regions in cerebral cortex, spinal nerves, reflex pathways and motor neurons, are potential instances of morphological adaptation of nerve structures by strength and force training. Further research should clarify the compensatory effects of strength training on the structure and function of the neuromuscular connection and the causes of the fatigue under specific forms of training to increase muscle force and power.

REFERENCES

Aagaard, P., Simonsen, E.B., Andersen, J.L., Magnusson, S.P., Halkjaer-Kristensen, J. & Dyhre-Poulsen, P. (2000). Neural inhibition during maximal eccentric and concentric quadriceps contraction: effects of resistance training. *Journal of Applied* Physiology, 89, 2249–2257.

Aagaard, P., Simonsen, E.B., Andersen, J.L., Magnusson, S.P. & Dyhre-Poulsen, P. (2002). Increased rate of force development and neural drive of human skeletal muscle following resistance training. *Journal of Applied* Physiology, 93, 1318–1326.

Aagaard, P. (2003). Training-induced changes in neural function. *Exercise Sport Science Review*, 31, 61–67.

Behm, D. (1995). Neuromuscular implications and applications of resistance training. *Journal of Strength and Conditioning Research*, 9, 264–274.

Carroll, T.J., Riek, S. & Carson, R.G. (2001). Neural adaptations to resistance training: implications for movement control. *Sports Medicine*, 31, 829–840.

Carroll, T.J., Riek, S. & Carson, R.G. (2002). The sites of neural adaptation induced by resistance training in humans. Journal of Physiology, 544, 641–652.

Ives, J.C. & Shelley, G.A. (2003). Psychophysics in functional strength and power training: review and

implementation framework. *Journal of Strength and Conditioning Research*, 17(1), 177–186.

Garfinkel, S. & Cafarelli, E. (1992). Relative changes in maximal force, EMG, and muscle cross-sectional area after isometric training. *Medicine and Science in Sports and Exercise*, 24, 1220–1227.

Higbie, E.J., Cureton, K.J. & Warren, G.L. (1996). Effects of concentric and eccentric training on muscle strength, cross-sectional area, and neural activation. *Journal of Applied* Physiology, 81, 2173–2181.

Jensen, J.L., Marstrand, P.C. & Nielsen, J.B. (2005). Motor skill training and strength training are associated with different plastic changes in the central nervous system. *Journal of Applied* Physiology, 99, 1558–1568.

Kraemer, W.J., Fleck, S.J. & Evans, W.J. (1996). Strength and power training: physiological mechanisms of adaptation. *Exercise Sport Science Review,* 24, 363–397.

Noakes, T.D., Clair-Gibson, A. & Lambert, E.V. (2005). From catastrophe to complexity: a novel model of integrative central neural regulation of effort and fatigue during exercise in humans: summary and conclusions. *British Journal of Sports Medicine*, 39, 120–124

Radovanović, D. & Ignjatović, A. (2009). *Fiziološke osnove treninga sile i snage*. Niš: Fakultet sporta i fizičkog vaspitanja.

Ranganathan, V.K., Siemionow, V., Liu, J.Z., Sahgal, V. & Yue, G.H. (2004). From mental power to muscle power–gaining strength by using the mind. *Neuropsychologia*, 42, 944–956.

Sale, D.G. (1998). Neural adaptation to resistance training. *Medicine and Science in Sports and Exercise*, 20(Suppl 1), 135–145.

Semmler, J.G. & Enoka, R.M. (2000). Neural contributions to changes in muscle strength. In: Zatsiorsky, V.M. (Ed.). *Biomechanics in sport: performance enhancement and injury prevention* (p. 3–20). Oxford: Blackwell Science.

Weir, J.P., Beck, T.W., Cramer, J.T. & Housh, T.J. (2006). Is fatigue all in your head? A critical review of the central governor model. *British Journal of Sports Medicine,* 40(7), 573–586.

Wescott, W.L. & Baechle, T.R. (1998). *Strength training past 50 years*. Champaign, IL: Human Kinetics.

UTICAJ NEUROMIŠIĆNIH ADAPTACIJA I PSIHOLOŠKIH FAKTORA NA ISPOLJAVANJE MIŠIĆNE SILE I SNAGE

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SAŽETAK

Neurološka adaptacija tokom treninga snage verovatno je rezultat uticaja sledećih faktora: veće aktivnosti CNS-a, veće efikasnosti u nervnom sprovođenju, poboljšanja u sinhronizaciji motornih jedinica, inhibicije Goldžijevih tetivnih organa i smanjenja inhibitornih neurorefleksa. Složenije aktivnosti i vežbe tokom treninga snage, sa više uključenih zglobova i mišića, zahtevaju više vremena za neuromišićnu adaptaciju. Međutim, mehanizmi promena u neuromišićnoj kontroli tokom treninga snage i dalje ostaju nejasni. Kognitivni faktori su povezani sa sportom, preko uticaja na procese fizioloških adaptacija (pre svega neuromišićnih) tokom treninga i ispoljavanje funkcionalnih performansi na samom takmičenju. Promene u motornoj zoni kore velikog mozga i ostalih područja koja pripadaju kori velikog mozga, spinalnih nerava, refleksnih puteva i samih motornih neurona, potencijalni su vidovi morfološke adaptacije nervnih struktura pod uticajem treninga sile i snage. Dalja

istraživanja bi trebalo da razjasne kompenzatorne efekte treninga snage na strukturu i funkciju neuromišićnih veza, kao i uzroke zamora pri specifičnim oblicima treninga za povećanje mišićne sile i snage.

Ključne reči: mišićna snaga, adaptacije, psihološki faktori, trening.

BODY TYPE AND COMPOSITION OF THE PE STUDENTS

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SUMMARY

Introduction: Body build, as a framework of reference for interpreting physical fitness and athletic performance, is one of the very important items for success in PE studies. Many previous researches obtained significant relationship between the physique of PE students and their performance in motor activities. The purpose of this study therefore, was to examine the somatotype and body composition of a group of 36 PE students (F=12, M=24), aged 20.4±1.58.

Methods: The anthropometric variables included body height, the selected diameters, girths and skinfolds, selected body composition parameters (body weight, BMI, relative body fat, visceral fat and relative skeletal muscles), and the Heath-Carter anthropometric somatotype (endomorphic, mesomorphic, and ectomorphic components). All of the anthropometric data were collected according to IBP and then processed in the Somatotype 1.2. The body composition was assessed by bioimpedance device (Omron BF511), and the data were analyzed using the IBM SPSS 21.0 (descriptive statistics, t-test).

Results: The obtained ANOVA results show that the male and female PE students differ in the endomorphic component ($F=4.1$, $p=0.048$), and the t-test indicated the presence of statistically significant differences ($p<0.05$) in all of the selected body composition parameters, except BMI. The prevalence of the endomorphic over mesomorphic component in PE female students (meso-endomorphic somatotype), unlike the PE male students (endo-mesomorphic somatotype), is confirmed by bioimpedance results (higher percent of body fat was found in females, but visceral fat level is higher in males). This indicates that in female students fat is stored subcutaneously, and in males is stored mostly around internal organs (visceral fat).

Conclusion: All of the results indicate that body fat values are higher than those favorable for PE studies, which can be due to malnutrition (they are studying outside hometown), lower physical activity level (non-active athletes, or even non-athletes), and even the reason may lie in insufficiently high criteria for the enrollment in PE studies.

Key Words: PE studies, somatotype, bioimpedance

INTRODUCTION

Body size and composition, which are largely predetermined by genetic inheritance, can be altered slightly when speaking about body size, and even substantially with diet and exercise in the case of body composition. Body size refers to the the physical magnitude of the body in terms of its volume, mass, length, and surface area, and visual appraisal is often used to describe individuals as thin (ectomorphy), muscular (mesomorphy), or fat (endomorphy) (Komiya et al., 1996).

A great number of studies testifies that body built or constitutional type is the foundation for the framework of reference in attempts to interpret health, types of physical fitness, athletic performance, and the personality characteristics of human beings. Within the general framework of

constitutional types are many detailed aspects to be tested and studied for separate interpretation. The need for selecting persons fit for physical education (PE) studies includes every valid method of selecting and adapting persons to the tasks requiring above average physical and athletic characteristics. It may be postulated that the somatotyping of PE students is a fundamental procedure. This approach is necessary because almost every type of physical fitness test ultimately must be normed or interpreted in terms of constitutional type.

Body composition refers to the relative amounts of body constituents such as adipose tissue, skeletal muscles, bones, blood, and residuals (water, internal organs, etc.) (WHO, 1995, 5). The evaluation of body composition provides an excellent opportunity for partitioning a person's gross size in two major structural components – body fat (BF) and lean body mass (LBM), i.e. relative body fat and muscles are of paramount importance in practice (Cvetković, Obradović & Kalajdžić, 2008). Somatotype and body composition have been examined by a number of researchers (Bolonchuk et al., 1989; Krsmanović et al., 1997; Srdić, Dimitrić & Obradović, 2009; Jović et al., 2010; Krick & Raschka, 2012).

Although large quantities of BF are undesirable from a health perspective, precise optimal levels of BF or body weight for a particular individual cannot be made. The assessment of body built and composition in both individuals and groups is important for both clinical investigation and medical practice. Individuals, engaged in sports activities, significantly differ in many somatic traits from those leading a more sedentary life. Besides, many previous researches obtained results showing an important relationship between the physique of PE students and their performance in motor activities (Bale, 1978, 1979, 1980), which clearly indicates the necessity of establishing their body physique status. The purpose of this study was to determine body type and composition in the PE students population, and according to that draw some conclusions about the curriculum and „selection process“ for PE studies.

METHODS

Sample of examinees

The sample was comprised of 36 PE students [students of Faculty of Sport and Physical Education (FSPE), University of Niš, Serbia], aged 20.4±1.58. The baseline characteristics of the sample in total, and sub-samples (F=12, M=24) are presented in Tab. 1.

TABLE 1 The baseline characteristics of FSPE students

Gender categories	Variable	Mean±SD	Median	Range
Females N=12	*Age*	20.36±1.29	19.91	19.12 – 22.9
	Height	164.16±7.83	163.4	155.5 – 179
	Weight	60.86±8.81	58.05	49.2 – 75.8
Males N=24	*Age*	20.43±1.73	19.9	19.26 – 26.09
	Height	178.11±5.39*	178.3	165.1 – 191
	Weight	74.41±9.59*	74.95	58.5 – 89.3
Total N=36	*Age*	20.4±1.58	19.9	19.12 – 26.09
	Height	173.46±9.1	176.2	155.5 – 191
	Weight	69.89±11.26	69.4	49.2 – 89.3

Legend: N – number, **SD** – standard deviation.
Note: Age is presented in years, height in cm, and weight in kg.
* $p<0.05$

Sample of measuring instruments

The measures were taken in February 2013, at FSPE in Niš, and the testing was conducted in agreement with the principles stated in the Helsinki Declaration (WMA, 2002). An anthropometric method was used for obtaining the FSPE students' somatic type and it included 10 following variables: body height (in cm), body weight (in kg), four skinfolds (over triceps, subscapular, suprailiac, and medialcalf; in mm), and biceps girth (flexed 90° and tensed; in cm), calf girth (in cm), bi-condylar humerus (in cm) and femur breadth (in cm). All of the measurements were taken by both authors in the optimal climatic conditions, with the participants in underwear, and according to the methods proposed by the International Biological Programme (Weiner & Lourie, 1969). Body composition parameters [body weight (in kg), body mass index- BMI (in kg/m^2), body fat- BF (in %), visceral fat (level) and skeletal muscles (in %)] were assessed with a tetrapolar bioimpedance device, Omron BF511 (Kyoto, Japan).

Statistical procedures

The FSPE students' somatotype was determined according to the methodology of Heath-Carter (Carter & Heath, 1990), applying the statistical data analysis [Descriptive statistics and one-way analysis of variance (ANOVA)] using the computer program *Somatotype 1.2*. Body composition data were analyzed using the Statistical Package for the Social Sciences, version 21.0 (IBM SPSS 21.0, SPSS Inc, Chicago, USA). Descriptive statistics [average value (Mean), standard deviation (SD), Range] were summarized for all variables. The test of normality (Shapiro-Wilk test) and the t-test were performed to determine gender differences. The level of significance was set at $p<0.05$.

RESULTS

The obtained data are presented in the tables and graphs (by somatoplots). The sample of 36 PE students showed that the mean somatotype was: 4.71–4.97–2.37 (values for the endomorphy, mesomorphy and ectomorphy, respectively; Tab. 3). The descriptive statistics of all the measurements are presented in Tab. 2, and all thirty-six profiles (squares) with the mean somatotype (circle) are presented in Fig. 2.

TABLE 2 The anthropometric parameters of the sample in total (N=36)

Variable	Mean±SD	Median	Range
Triceps SF	13.68±7.16	11.6	3.6 – 29.8
Subscapular SF	16.95±3.69	17.1	10.4 – 25.8
Suprailiac SF	17.69±6.62	17.2	2.9 – 34.8
Calf SF	11.66±4.65	10.6	3.6 – 22.4
Flexed Arm G	32.45±4.2	32.45	25.3 – 40
Calf G	37.2±2.53	37.15	32.2 – 41.5
Humerus B	6.63±0.57	6.6	5.6 – 7.9
Femur B	9.76±0.43	9.7	9 – 10.9

Legend: SF – skinfold, **G** – girth, **B** – breadth, **SD –** standard deviation.

TABLE 3 The values of somatotype components of FSPE students

Gender categories	Variable	Mean±SD	Median	Range
Females N=12	*Endo*	5.55±0.88 #	5.55	3.9 – 6.8
	Meso	4.7±1.04	4.7	2.1 – 6
	Ecto	2.08±1.15	2.0	1 – 4.8
Males N=24	*Endo*	4.29±1.31	4.1	2.3 – 7.8
	Meso	5.1±1.03	5.15	3 – 6.6
	Ecto	2.52±1.14	1.95	0.9 – 4.6
Total N=36	*Endo*	4.71±1.32	4.6	2.3 – 7.8
	Meso	4.97±1.04	5.1	2.1 – 6.6
	Ecto	2.37±1.15	1.95	0.9 – 4.8

Legend: N – number, **SD** – standard deviation**, Endo –** endomorphy, **Meso –** mesomorphy, **Ecto –** ectomorphy.

p=0.005 compared to males

Analyzing the somatoplots presented in Fig. 1, the superiority of two somatotype components-endomorphic and mesomorphic may be noted, while the ectomorphic component has low value. The prevalence of endomorphic over mesomorphic component in FSPE female students (meso-endomorphic somatotype), unlike in male students (endo-mesomorphic somatotype) (F=9.02, p=0.005, endomorphic component), is confirmed by the bioimpedance results (higher percent of body fat was found in females, but visceral fat level is higher in males) (Tab. 4). This indicates that in FSPE female students fat is stored subcutaneously, and in males it is stored mostly around internal organs (visceral fat). Also, the t-test indicated a presence of statistically significant differences in favor of male students, for following variables: body height and body weight (Tab. 1), and skeletal muscles (Tab. 4) (p=0.000).

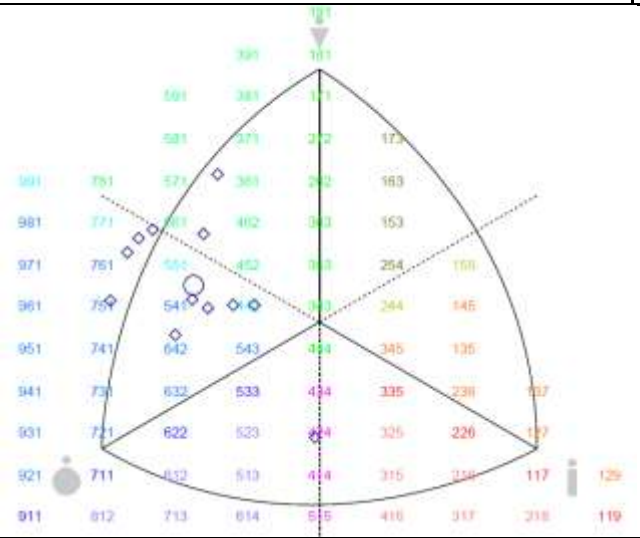
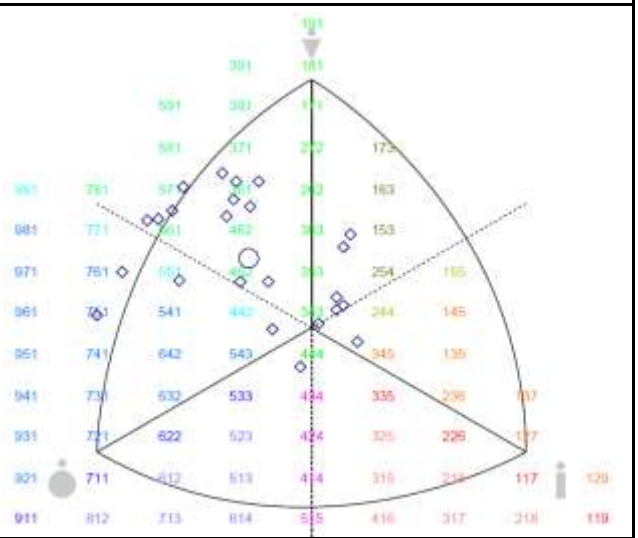
1. Females (N=12)	2. Males (N=24)
	
5.55 – 4.7 – 2.08 (meso-endomorph)	4.29 – 5.1 – 2.52 (endo-mesomorph)

Figure 1. Somatoplots of FSPE students, according to two gender categories. The squares are the individual somatotypes, and the circle is the mean profile.

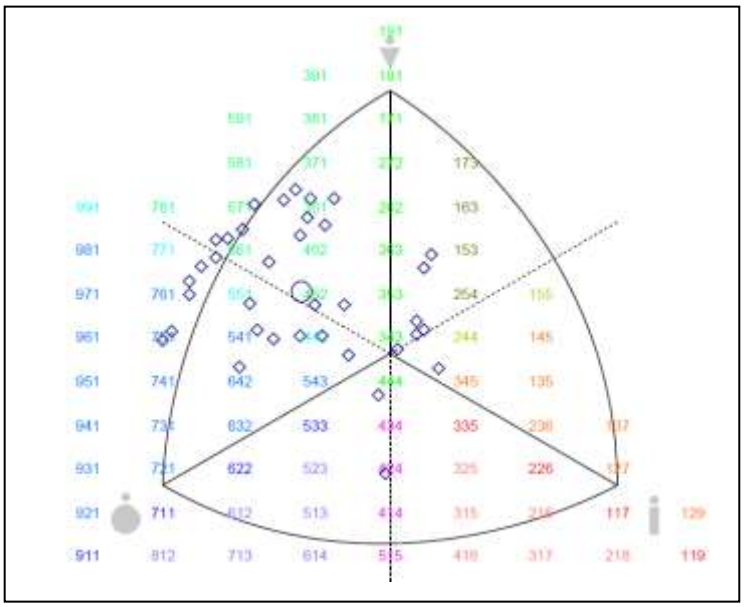


Figure 2. Somatotype distribution of FSPE students (N=36). The squares are the individual somatotypes, and the circle is the mean profile (4.71–4.97–2.37; endomorph – mesomorph).

TABLE 4 The body composition parameters of FSPE students

Gender categories	Variable	Mean±SD	Range
Females N=12	*BMI (kg/m²)*	22.59±2.41	18.6 – 26.5
	BF (%) †	30.69±5.65	24.2 – 41.7
	Visc fat (level)	3.67±0.98	2 – 5
	Muscle (%)	29.58±3.6	24.4 – 37.5
Males N=24	*BMI (kg/m²)*	23.5±2.59	18.9 – 27.7
	BF (%)	17.24±5.3	9.9 – 27.5
	Visc fat (level) ‡	5.21±2.43	1 – 9
	Muscle (%) ‡	41.94±2.98	36 – 46.2
Total N=36	*BMI (kg/m²)*	23.2±2.53	18.6 – 27.7
	BF (%)	21.73±8.35	9.9 – 41.7
	Visc fat (level)	4.69±2.18	1 – 9
	Muscle (%)	37.82±6.69	24.4 – 46.2

Legend: SD – standard deviation, **N –** number, **BMI –** body mass index, **BF –** body fat**, Visc fat –** visceral fat, **Muscle –** skeletal muscles.

† $p<0.05$ compared to males

‡ $p<0.05$ compared to females

DISCUSSION

Apart from talent, the adequate body built is a prerequisite for achieving success in sports, and thus PE studies. Body built is, to a large extent, determined by the human genotype, but within the defined limits it is also subject to environmental influences (the extent of sensitivity to the external environment is also hereditary conditioned).

The studied anthropometric parameters in the observed students clearly indicate a presence of gender differences, which is expected. According to Martin's referent body height values, distributed in seven categories (Simić, Vasić & Jakonić, 2010), 50%

of FSPE female students are tall, 33.33% are of average body height, 8.3% are above average, and 8.3% are very tall. When speaking about FSPE male students, 75% are tall, 16.67% are very tall, 4.17% are average, and 4.17% are above average. In average, both FSPE female and male students are tall.

The type of body constitution in the observed FSPE students was characterized by the prevalence of the endomorphic and mesomorphic components, with low value of the ectomorphic component (4.71–4.97–2.37, mesomorph-endomorph). This body constitution (4.1-4.6-2.5) is seen in the study of Jović et al. (2010) who did their research on the sample comprised of 117 FSPE students from Niš, aged 22±1.27. Srdić, Dimitrić, and Obradović (2009) did their study on the sample of 122 PE students from Novi Sad, and the endomorphic mesomorph somatotype was found.

According to the reference values (WHO, 2000, 9), more than 50% of the participants (F- 83.33%, M- 62.5%) have normal BMI values, and the rest of them are overweight (F- 16.67%, M- 37.5%). The BF% situation is as follows: in FSPE female students the majority (83.33%) has normal values of relative BF, and only 16.67% has very high values of BF%. In FSPE male students is almost similar situation: the majority (62.5%) has normal values of relative BF, 29.17% has high values, and only 8.33% has very high values of BF% (Omron, 2002, 11). When it comes to relative muscle mass, the situation is different: in FSPE female students the majority (58.33%) has normal values of relative skeletal muscles mass, 33.33% has high values, and only 8.33% has very high values of Muscle%. In FSPE male students the majority (45.83%) has high values of Muscle%, 29.17% has normal values, and even 25% has very high values of Muscle% (Omron, 2002, 12). When speaking about visceral fat level, all participants are in the range of normal values (Omron, 2002, 11).

CONCLUSION

FSPE students from Niš are tall, have strong endomorph-mesomorph built with fat stored subcutaneously, and even around internal organs. The obtained results show the expected gender differences in those body traits that are non-hereditary conditioned: the endomorphic component, and all of the selected body composition parameters (except BMI). Although the majority of the values are within the recommended ones, that small percent of high BF and BMI, and relative skeletal muscle mass values indicate the heterogeneity of the students population, their sports orientation, and their physical activity level. The reasons should be sought in the (mal)nutrition (they are studying outside hometowns), and even in the insufficiently high criteria for the enrollment in PE studies (besides active athletes and former athletes, non-athletes are admitted).

One of the requirements arising directly from this study is the adaptation of the curriculum at the FSPE in Niš. This research has shown that the population of FSPE students is of various morphological types, and therefore it is expected that they adapt differently to the unique curriculum. Although, from this point of view, it is very difficult to expect that something like this will actually be implemented, it is a widespread opinion that the formation of homogenous groups based on morphological types, with the modification of the curriculum requests, has to lead to better and more efficient studies at the Faculty of Sport and Physical Education.

Acknowledgments

The authors would like to thank Nenad Stojiljković for the statistical data processing.

REFERENCES

Bale, P. (1978). The physiques of physical education students and their relationships to performance. *Research Papers in Physical Education*, *3*(4), 30-33.

Bale, P. (1979). The relationship between physique and basic motor performance in a group of female physical education students. *Research Papers in Physical Education*, *1*, 26-32.

Bale, P. (1980). The relationship of physique and body composition to strength in a group of physical education students. *Brit J Sports Med*, *14*(4), 193-198.

Bolonchuk, W. W., Hall, C. B., Lukaski, H. C. & Siders, W. A. (1989). Relationship between body composition and the components of somatotype. *American Journal of Human Biology*, *1*, 239-248.

Carter, J. E. L. & Heath, B. H. (1990). *Somatotyping. Development and applications*. Cambridge: Cambridge University Press.

Cvetković, M., Obradović, J. & Kalajdžić, J. (2008). Effects of pilates on morphological characteristics of female students of the Faculty of Physical Education (Efekti pilatesa na morfološke karakteristike studentkinja Fakulteta fizičke kulture). *Glasnik Antropološkog društva Srbije*, *43*, 605-613.

Jović, D., Đurašković, R., Pantelić, S. & Čokorilo, N. (2010). Constitutional differences in student from Faculty of Sports and Physical Education (Konstitucionalne razlike studenata sporta i fizičkog vaspitanja u Nišu). *Glasnik Antropološkog društva Srbije*, *45*, 335-342.

Komiya, S., Masuda, T., Ube, M. & Mitsuzono, R. (1996). Body size and composition in different somatotypes of Japanese college-aged women. *Appl Hum Sci*, *15*(1), 5-11.

Krick, C. & Raschka, C. (2012). Sports anthropological comparison between male martial arts fighters and the students majoring in physical education. *Papers on Anthropology*, *21*, 155-162.

Krsmanović, B., Jakonić, D., Krsmanović, R. & Krsmanović, C. (1997).The somatotype of the Faculty of Physical Culture students (Somatotip studenata Fakulteta fizičke culture). *Glasnik Antropološkog društva Srbije*, *33*, 177-183.

Omron (2002). *BF511, Body Composition Monitor. Instruction Manual*. Retrieved September, 09, 2013, from http://filehost.fonq.nl/Gebruikshandleidingen/Omron/HBF511.pdf

Simić, S., Vasić, G. & Jakonić, D. (2010). Body height, body mass and nutrition status of students of the University of Novi Sad (Telesna visina, telesna masa i uhranjenost studenata Univerziteta u Novom Sadu). *Medicina danas*, *9*(4-6), 141-146.

Srdić, B., Dimitrić, G. & Obradović, B. (2009). Anthropological characteristics of students of Faculty of Sports and Physical Education (Antropološke karakteristike studenata Fakulteta sporta i fizičkog vaspitanja). *Glasnik Antropološkog društva Srbije*, *44*, 463-470.

Weiner, J.S. & Lourie, J.A. (1969). *Human Biology, A guide to Field methods. International Biological Programme*. Edinburgh: Blackwell Scientific Publications.

World Health Organization (1995). *Physical status: the use and interpretation of anthropometry*. *Report of a WHO Expert Committee*. Geneva: WHO. Retrieved September, 09, 2013, from http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf

World Health Organization (2000). *Obesity, preventing and managing the global epidemic*. *Report of a WHO consultation on obesity*. Geneva: WHO. Retrieved September, 09, 2013, from http://whqlibdoc.who.int/trs/WHO_TRS_894_(part1).pdf

World Medical Association (2002). *World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects*. Retrieved May, 01, 2013, from http://www.fda.gov/ohrms/dockets/dockets/06d0331/06D-0331-EC20-Attach-1.pdf

TELESNA GRAĐA STUDENATA FSFV

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SAŽETAK

Uvod: Telesna građa, kao okvirna preporuka za tumačenje fizičke spreme i sportskog dostignuća, je jedna od važnih stavki za uspešno studiranje na FSFV. Mnoga ranija istraživanja su potvrdila postojanje značajnih relacija između fizičkih odlika studenata FSFV i njihovih motoričkih sposobnosti. Stoga, svrha ove studije je da ispita somatotip i telesni sastav kod 36 studenata FSFV (M=24, Ž=12), starosti 20.4±1.58 godina.

Metode: Istraživanjem su obuhvaćene antropometrijske varijable, kao što su telesna visina, određeni dijametri, obimi i kožni nabori, odabrani parametri telesnog sastava (telesna težina, ITM, procenat telesne masti, visceralna mast i procenat skeletnih mišića), kao i Heath-Carter antropometrijski somatotip (endomorfna, mezomorfna i ektomorfna komponenta). Svi antropometrijski podaci su prikupljeni u skladu sa IBP, a potom obrađeni u program Somatotype 1.2. Telesni sastav je procenjen pomoću uređaja za bioimpedancu (Omron BF511), a prikupljeni podaci su analizirani pomoću IBM SPSS 21.0 (deskriptivna statistika, t-test).

Rezultati: Rezultati ANOVA-e pokazuju da endomorfna komponenta diskriminiše studente od studentkinja ($F=4.1$, $p=0.048$), a t-test ukazuje na prisustvo statistički značajnih razlika ($p<0.05$) kod svih selektovanih parametara telesnog sastava, izuzev BMI. Nadmoć endomorfne nad mezomorfnom komponentom kod studentkinja (mezo-endomorfni somatotip), za razliku od studenata (endo-mezomorfni somatotip), je potvrđena i rezultatima bioimpedanse (veći procenat telesne masti je utvrđen kod studentkinja, ali je kod studenata veći nivo visceralne masti). Ovo ukazuje na potkožno skladištenje masti kod žena, a kod muškaraca se masne ćelije više skladište oko unutrašnjih organa (visceralne masti).

Zaključak: Svi rezultati ukazuju na nepovoljne vrednosti telesne masti za studije FSFV, što se može pripisati lošoj ishrani (studiraju van rodnog grada), nižem niovou fizičke aktivnosti (neaktivni sportisti, pa čak i nesportisti), ali razlog mogu biti i nedovoljno visoki kriterijumi prilikom upisa FSFV.

Ključne reči: FSFV studije, somatotip, bioimpedanca

SOME PHYSIOLOGICAL CHARACTERISTICS OF ALPINE SKIING WITH DIFFERENTLY SHAPED SKIS

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UDC 796.926:612

SUMMARY

More than 100.000 people in Serbia and 100 million around the world participate in alpine skiing. The carving skis have a diversified geometry in comparison to the conventional skis. This development has also changed the ski technique and might affect the risk of injures. The purpose of this research was to investigate the influence of the use of differently shaped skis concerning the heart rate in skiers. Three healthy, male students of the Faculty of sport and physical education were the subjects (22.2±1.7 years) of this research. They were asked to ski 10 runs on a ski track „Krst", 5 runs using the carving skis – CARG and 5 runs using the conventional skis – CONG. The statistical comparison showed no differences regarding the heart rate responses between the tested skis types. Therefore, the risk of a physical strain does not appear to depend on the ski type (carving or conventional), but rather the technique, the style of skiing and the speed when using new carving skis

Key Words: differently shaped skis, heart rate, alpine skiing

INTRODUCTION

The non-competitive leisure/recreational alpine skiing is often described as a social and pleasurable form of physical activity in an attractive outdoor scenery. More than 100.000 people in Serbia and 100 million around the world participate in alpine skiing. This activitiy involve both dynamic and static muscle contractions (Berg & Eiken, 1999) and is comprised of intermittent bouts of moderate intensity, using aeribic as well as anaeribic energy pathways (Tesch, 1995) and may confer significant health benefits. Kahn et al, 1996; for instance, suggested cardiovascular health enhancing changes after one week of recreational skiing. However, despite the popularity and the health enhancing potential, little is known about the physiological workload during recreational alpine skiing from a public health perspective.

Heart rate (HR), Blood lactate (LA), myoglobin and cortizol have also been used to assess the acute stress levels of the activity. Krautgasser et al, 2007, and Scheiber et al, 2007, reported the blood lactate of about 2 mmol/L and the skiing heart rate of about 80% maximal of heart rate (HRmax) during skiing in recreational skiers. In contrast, race training significantly increases the skiing heart rate over the recreational skiing. The heart rate during the giant slalom training has been reported to be between 87% and 97% of the maximal heart rate (Burtscher, 2001; Seifert, 2005).

On a typical ski day, skiers will ski for about 3 hours in the morning, take a break and then ski for 2 more hours in the afternoon. With thousands of repeated contractions occurring during a day of skiing, some level of fatigue is inevitable. However, the risk of injury increases with fatique and reduces the pleasure of the activity (Andersen & Montgomery, 1988; Hunter, 1999; Langran & Selvaraj, 2002; Langran & Selvaraj, 2004; Meyers et al, 2007). It is important to understand how a specific activity can change the various physiological

indices associated with fatigue. For example, in the activities such as cycling and running, the heart rate and blood lactate levels are positively correlated to and good predictors of an acute training load and the resulting fatique. As the training load increases, the heart rate and blood lactate also increases (McArdle et al, 1996; Wilmore et al, 1999, Sirotic et al, 2007). As a result, the common fatique indices and the muscular stress increases with the increasing training loads. It is known if the heart rate and blood lactate change in a similar manner when skiing due to the influence of the external factors (snow conditions, a changing terrain and a changing ski edge pressure application), all of which increase the muscular stress. Little is known about how the heart rate and the blood lactate levels interact with the indices of the muscle stress during the recreational skiing.

The carving skis have forever changed the way people ski. The carving skis need a significant side-cut (SC) in order to be able to perform carved turns (Federolf et al, 2010). The carving skis have a diversified geometry in comparison to the conventional skis. This development has also changed the ski technique and might affect the risk of injures (Roder et al, 2005).

Thus, the purpose of this research was to investigate the influence of the use of differently shaped skis concenrning the heart rate in skiers.

METHODS

Three healthy, male students of the Faculty of sport and physical education were the subjects (22.2±1.7 years) of this research. They were asked to ski 10 runs on the ski track „Krst“, 5 runs using the carving skis – CARG and 5 runs using the conventional skis – CONG. Each run took about 90-120 sec to complete. Ski time was about 30 min out of the 2 hours total time. The subjects performed an average of 50 turns per run. The total elevation change for the run was 200 meters vertical elevation. This run is classified as an intermediate level run. The subjects skied through a standardized corridor on a groomed ski terrain. Although they could ski as they preferred, they were instructed to maintain similar finishing times and the heart rate for their individual runs to ensure a standardized load. All subjects were of the intermediate level based on the grades they earned during the first part of the practical skiing lessons. Intermediate level skiers are able to perform short and long radius turns on the prepared terrains. On a flat terrain, intermediate skiers are able to execute carved turns, but perform mostly skid turns (skidding) on a steep terrain. Verbal feedback on the heart rate and the finishing time was provided to each skier at the end of each run. Data collection occured during the practical skiing classes on mountain Kopaonik, Serbia. The skis for CARG were the carving skis (Atomic Race SL – 165 cm), and the skis for CONG were the conventional skis (the skies were standardized according to the body size). The heart rate was collected at the end of each run (Polar, Finland).

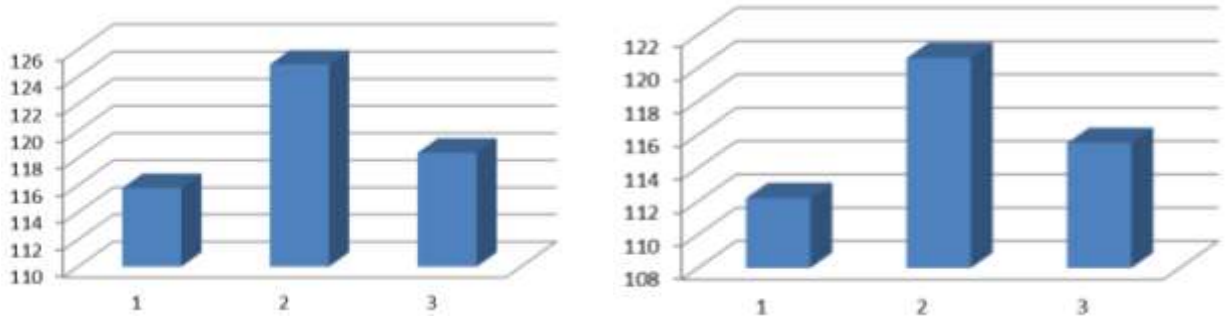
RESULTS AND DISCUSION

The examinees heart rate responses from the two ski runs cycles can be found in figure 2. This cycle includes skiing the run for about 120 seconds, then a short pause on the slope for the researchers to record the data and then going to the top of the slope in a ski lift, for about 6 minutes, and the preparation for another go down the slope.

The average time for the skiers using the carving skis was 116.1±8.4 seconds, whereas with the conventional skis it was 119.7±9.1 seconds. The maximum heart rate for the skiers with the carning skis was 143±13 compared to the conventional skis 146±11 (Table 1). The comparison shows that there were no significant differences for the different ski types.

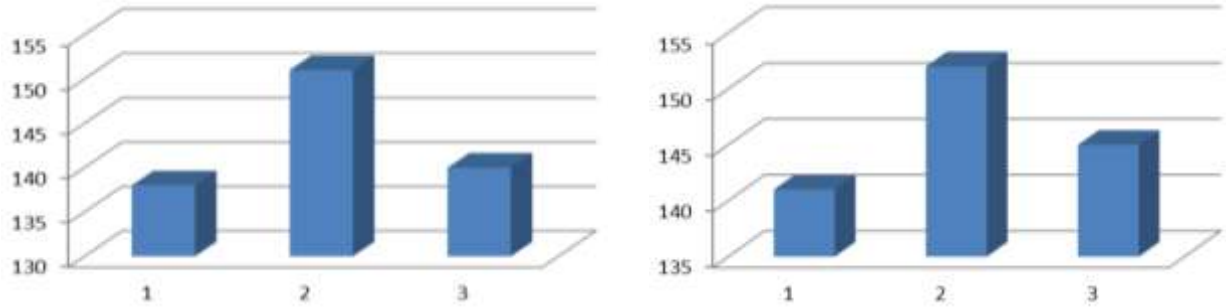
	Running time (s)	Heart rate (bpm)
carving skis	116.1±8.4	143±13
conventional skis	119.7±9.1	146±11

Table 1. Mean±SD from two runs with differently shaped skis



a B

Figure 1. Running time during alpine skiing: a) carving skis, b) conventional skis



a B

Figure 2. Heart rate during alpine skiing: a) carving skis, b) conventional skis

This research did not employ an extreme exercise, but a two hours of skiing at an intensity which is indicative of recreational skiing.

The pre-seasonal aerobic and strenght training, in which the ski enthusiasts are often engaged, might provide additional health benefits. At a higher altitude, the heart rate is elevated during a given work load (Mazzeo et al, 2008). When compared to the aerobic exercises like walking or cycling, the heart rate in alpine skiing may be further increased by the spatio temporal and cognitive demands, the intermittent activity pattern and different muscle recruitment and motor strategies (Achten & Jeukendrup, 2003). Thus, the relative work intensity may be slightly overestimated when expressed as %HRR. However, when expressed as %VO2R, it is likely that the relative intensity will be underestimated since at a height of 2000 meters, acute hypoxia may reduce VO2 max by 5-10% (Weineck, 2004).

Burtscher et al, (2001), compared the conventional skis to the carving skis and also found no significant differences concerning the heart rate of the skiers on a standardizer slope.

Skiing is an atypical sport were many external and internal variables act upon the skier. The individual compensation mechanisms and the skiing style contributed to highly variable responses during skiing. It is important for the practitioner to be able to discern the acute from chronic stress in terms of physiological responses, especially in sports such as alpine skiing. Measuring only one parameter of

stress may not be indicative of the true stress of the activity. While the heart rate is an indicator of the acute stress within a given run, it was not a good indicator of the chronic stress and fatique. This information can help the ski instructor and give direction to the skier regarding the skiing intensity in order to minimize the chronic stress. This may be particulary heplful during multi-day skiing.

The running times on the specific course under excellent snow condiditions tend to be faster when using the carving skis in comparison to the conventional skis. The statistical comparison showed no differences regarding the heart rate responses between the tested skis types. Therefore, the risk of physical strain does not appear to depend on the ski type (carving or conventional), but rather the technique, the style of skiing and the speed when using new carving skis (Roder et al, 2005).

REFERENCE

Achten, J. & Jeukendrup, A. E. (2003). Heart rate monitoring: applications and limitations. *Sports Medicine*, 33(7), 517-538.

Andersen, R. E. & Montgomery, D. L. (1988). Physiology of alpine skiing. *Sports Medicine*, 6, 210-221.

Berg, H. E. & Eiken, O. (1999). Muscle control in elite alpine skiing. *Medicine & Science in Sports & Exercise*, 31, 1065-1067.

Burtscher, M. (2001). Comparison of cardiorespiratory and metabolic responses during conventional and carving skiing. In: Muller, E., Schwameder, H., Raschner, C., Lindiger, S. & Kornexl, E. (eds.), *Science and skiing II*. Oxford: Meyer & Meyer Sport (UK) Ltd, 552-565.

Hunter, R. E. (1999). Skiing injuries. *American Journal of Sports Medicine*, 27, 381-389.

Federolf, P., Lüthi, A., Roos, M. & Dual, J. (2010). Parameter study using a finite element simulation of a carving Alpine ski to investigate the turn radius and its dependence on edging angle, load, and snow properties. *Sports engineering*, 12, 135-141.

Joksimović, A. (2010). Specifične karakteristike alpskih skijaša. In: Stanković, R. (Ed.), *XIV International Scientific Conference FIS communications*. Niš. Faculty of Physical Education. 672-677.

Joksimović, D., Joksimović, A. & Stanković, D. (2010). Uloga psiholoških faktora u procesu obuke skijaških zavoja kod početnika. In: Stanković, R. (Ed.), *XIV International Scientific Conference FIS communications*. Niš. Faculty of Physical Education. 678-685.

Kahn, J. F., Jouanin, J. C., Bruckert, E., Guezennec, C. Y. & Monod, H. (1996). Physiological effects of downhill skiing at moderate altitude in untrained middle-aged men. *Wilderness & Environmental Medicine*, 3(1), 199-207.

Langran, M. & Selvaraj, S. (2002). Snow sports injuries in Scotland: a case-control study. *British Journal of Sports Medicine*, 36, 135-140.

Langran, M. & Selvaraj, S. (2004). Incresed injury risk among first-day skiers, snowboareds and skiboarders. *American Journal of Sports Medicine*, 32, 96-103.

McArdle, W. D., Katch, F. I. & Katch, V. L. (1996). *Exercise Physiology: Energy, Nutrition and Human Performance*. Williams & Wilkins, Publ. Baltimore, Maryland.

Meyers, M. C., Laurent, C. M. Higgins, R. W. & Skelly, W. A. (2007). Downhill ski injuries in children and adolescents. *Sports Medicine*, 37, 485-499.

Raschner, C., Schiefermuller, C., Zallinger, G., Hofer, E., Brunner, F, & Muller, E. (2001). Carving turns versus traditional parallel turns – a comparative biomehanical analysis. In: Muller, E., Schwameder, H., Raschner, C., Lindiger, S. & Kornexl, E. (eds.), *Science and skiing II*. Oxford: Meyer & Meyer Sport (UK) Ltd, 203-217.

Roder, Y., Vater, H., Vater, K., Riehle, H. & Haag, H. (2005). Physiological aspects of alpine skiing with differently shaped skis. In: Muller, E., Bacharach, D., Klika, R., Lindiger, S. & Schwameder, H. (eds.), *Science and skiing III*. Oxford: Meyer & Meyer Sport (UK) Ltd, 166-171.

Seifert, J. G., Kipp, R. W., Amann, M. & Gazal, O. (2005). Muscle damage, fluid ingestion and energy supllemetation during recreational alpine skiing.

International Journal of Sports Nutrition and Exercise Metabolism, 15, 528-536.

Sirotic, A. C. & Coutts, A. J. (2007). Physiological and performance test correlates of prolonged, high intesity, intermittent running performance in moderately trained women team sport athletes. *Journal of Strength & Conditioning Research*, 21, 138-144.

Tesch, P. A. (1995). Aspects on muscle properties and use in competitive alpine skiing. *Medicine & Science in Sports & Exercise*, 27(3), 310-314.

Wilmore, J. H. & Costill, D. W. (1999). *Physiology of sport and exercise*, 2nd Edition. Human Kinetics, Publ. Champaign, IL.

POJEDINE FIZIOLOŠKE KARAKTERISTIKE ALPSKOG SKIJANJA SA SKIJAMA RAZLIČITIH OBLIKA

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SAŽETAK

Više od 100.000 ljudi u Srbiji i 100 miliona širom sveta učestvuje u alpskom skijanju. Karving skije imaju različitu geometriju u odnusu na konvecionalne skije. Ovaj razvoj (tehnologije) takođe je promenio i skijašku tehniku i može da utiče na rizik od povreda. Cilj ovog istraživanja bio je da se ispita uticaj upotrebe različito oblikovanih skija i njihova povezanost sa nivoom pulsa kod skijaša. Tri zdrava studenta fakulteta sporta i fizičkog vaspitanja (22,2 ± 1,7 godina), učestvovala su u ovom istraživanju. Oni su skijali na stazi „Krst" i iskijali tu stazu 10 puta, 5 puta koristeći karving skije – CARG i 5 puta koristeći konvecionalne skije – CONG. Poređenje dve grupe nije pokazalo statistički značajne razlike u nivou pula kod skijaša. Dakle, rizik od fizičkog opterećenja na zavisi od tipova skija (karving ili konvecionalne), već od tehnike, stilu skijanja i brzini kada koristimo karving sije.

Ključne reči: skije različitog oblika, puls, alpsko skijanje

THE NUTRITION OF ROCK CLIMBERS

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SUMMARY

The aim of this work was to recommend the efficient model of the rock climbers' nutrition that will meet all the energy demands during one active climbing day. Like all the athletes, rock climbers should follow a good diet and sound nutritional practices in order to cultivate a top climbing performance. In order to succeed in this there is a need for an adequate dieting pre-, during and after climbing. In this respect, it is necessary to determine for each meal, liquids, carbohydrates, proteins and other macro and micro nutrients, and the time of their intake.

Key Words: nutrition, sport climbing

INTRODUCTION

Sports climbing today is a complex sport, complete with its own vocabulary and equipment that have come out of decades of experimenttation. It has, for many years, been one of the fastest growing leisure activities, involving millions of people worldwide (Creasy & al., 1999).

Many words can describe the wonderful activity of rock climbing – elegant, powerful, rewarding, and, sometimes, frustrating. While there may be nothing more natural and intuitive than climbing (just watch how children climb around on everything in sight!), rock climbing is indeed a complex activity with demands unique and different from those of living and playing in the everyday, horizontal world. Performing in the vertical plane requires physical capabilities such as strength, power, and endurance. (Horst, 2003). A good strength and conditioning program can help improve these aspects, but the body needs the correct fuel to help the body perform these activities.

According to the sports classification, sports climbing belongs to a group of combined (complex) sports (Stanković, 2009; Stanković & al., 2011). They are characterized by high variety of movements in the conditions of compensated fatigue and changing intensity of work (Verhosanski, & al., 1992). The immanent characteristic of these sports is a changeable competition situation and a need to preserve a high level of working capacity in the compensated fatigue conditions. Acyclic and cyclic types of sports include features of organization of movement activities and energy provision. Having in mind the changing intensity of the competitions' activity, the alteration of high movement activities and total rest, the energy work of muscles has an aerobic-anaerobic feature and the specific weight of glycolitic reaction (Verhosanski & al., 1992).

The aim of this work is to recommend the efficient model of the rock climbers nutrition that will meet all the energy demands during one active climbing day.

METHOD

It's impossible to say exactly how big a part diet plays in climbing performance, but it is estimated that average climbers can realize a 10 to 20 percent improvement in their training, recovery, concentration, energy, and overall climbing performance if they dedicate themselves to an improved dietary surveillance (Horst, 2003).

Like all athletes, rock climbers should follow a good diet and sound nutritional practices in order to

cultivate top climbing performance. Proper rock climbing nutrition starts with eating a balanced and activity-appropriate diet based on the healthy nutritional principles. Intelligent pre-, during, and post-training/climbing meals come next (Rainey, 2009).

In sports climbing, the interval activities of high and low intensity call for the intake of energy substances that will be processed by means of the aerobic and anaerobic metabolic reactions. The anaerobic metabolic processes rely on the existing depots of ATP, phosphocreatine (PCr) and muscle glycogen, whereas the aerobic process derives energy from the muscle glycogen, glucoses in blood, fat and, to a lesser extent, proteins. During climbing body is mainly relying on muscle glycogen for the production of the majority of energy, using secondary fat and glucoses from the blood circulation as the source of the needed energy. The depots of fat almost never deplete. However, the energy generated by glucoses in blood is scarce, which forces an athlete to be on alert as far as the provision of a continuous source of glucoses during one climbing day is concerned.

Relying on muscle glycogen and glucoses from blood, to provide for the energy needs of the active muscles, means that a greater quantity of the carbohydrates prior to the onset of the physical activities is to be consumed, and the carbohydrate rich drinks in the course of the physical activity. (Benardot, 2010). These studies claim that the sporting excellence in performances was accomplished by means of an increased intake of carbohydrates (65% of the total calories) in contrast to the performances realized by a moderate intake of carbohydrates (39% of the total calories), and these are larger in the interval activities (Bangsbo, 2000).Also, a combination of the intake of water and carbohydrates induces improvements in the performances by 12% when compared to the intake of the electrolytes and by 5-6% in the case of the sole intake of just water, or just carbohydrates (Below & al., 1995). These findings validate the claim that carbohydrates enhance the absorption of liquids, and that the decreased reserves of the carbohydrates ask for the intake of additional carbohydrates during physical activities. The increased need for the carbohydrates during physical activities of the high intensity asks for the continuous intake of additional carbohydrates. This claim is corroborated by the study showing that the performances during exercises are significantly improved if the intake of carbohydrates is continuous (Murray, & al., 1991). Also, it was determined that the optimal level of concentration of carbohydrates is 6-7% , in the drinks that are taken during physical activity. This concentration is the most optimal for the absorption of liquids, and also helps out carbohydrates to be efficiently transported to the active muscles. (Gisolfi & al., 1992).

The climbers may feel some pressure to achieve the high power-weight ratio useful in climbing, some may try to minimize their food intake in order to reduce body weight. However, the loss of body weight does not necessarily improve power-weight ratio. Climbers should focus on the loss of body fat while maintaining as much muscle mass as possible. An inadequate dietary intake can cause the loss of muscle mass which causes power to decrease. Consequently, the power-weight ratio ends up unchanged or lower despite a lower body weight. Consuming a diet too low in energy can also place climbers at risk of inadequate intakes of nutrients such as carbohydrate, protein, calcium and iron. It can also cause fatigue and a weakened immune system. Smart climbers avoid severe dieting and instead find the weight and body fat level that allows them to perform optimally while maintaining good health (Certified HyperStrike Trainers, 2005).

Here are some recommendations for sports climbing nutrition pre-, during and post climbing.

The purpose of pre-climbing meal is to provide fluid and energy to the climber during the activity. Pre nutrition will start around 3 hours before climbing. The pre-climbing meal should consist of a mix of very low glycemic carbohydrates. A good source of protein is also added to this meal. This will supply the body with the fuel to get through the

session. Water is also very important and the studies indicate 0.5 liter of water should be taken 2 hours before the activity. It is necessary to maximize the carbohydrate storagess by eating something about 30 minutes before the session. It is also recommended to drink another 0.5 liter of water.

During rock climbing, the main thing to consume is an adequate fluid. The purpose of this is to keep the body hydrated and at peak performance. For longer climbs and training sessions, it's important to refuel regularly with carbs during the activity in order to extend endurance and prevent fatigue. As climbing is focused on the muscular strength, power and endurance, it is recommended to have a branched chain of amino acids during climbing sessions and adding these to a carb/electrolyte drink.

As soon as the session has finished, it is recommended to take a mix of carbohydrates and proteins. A mix of whey protein and glucose will help replenish the depleted carbohydrate storages. This should be done in the first 30 minutes after finishing the session. Water is also needed to help re-hydrate the body. 1-2 hours after completing a climb, a substantial meal can be consumed, which can consist of carbohydrates, protein and fat.

CONCLUSION

Like all athletes, rock climbers should follow a good diet and sound nutritional practices in order to cultivate top climbing performance. In order to succeed in this there is a need for an adequate dieting pre-, during and after climbing. In this respect, it is necessary to determine for each meal, liquids, carbohydrates, proteins and other macro and micro nutrients, and the time of their intake.

REFERENCES

Bangsboo, J. (2000). Team sports. In *nutrition in sport* (Ed. Maughan, R.). London: Blackwell Science, 574-587.

Below, P.R., Mora-Rodrigues, R., Gonzalez-Alonso, J., & Coyle, E.F. (1995). Fluid and carbohydrate ingestion independently improve performance during one hour of intense exercise. *Med. Sci. Sports Exer.,* 27(2), 200-210.

Benardot, D. (2010). *Advanced sports nutrition*. Beograd: Data Status.

Certified HyperStrike Trainers (2005). Nutrition for Rock Climbing. Taken 17.08.2011. from http://www.workout-x.com/fitness-articles/65/Nutrition-for-Rock-Climbing-Part-2.

Creasey, M., Shepherd, N., Banks, N., Gresham, N., & Wood, R. (1999). *The Complete Rock Climber.* London: Lorenz Books.

Gisolfi, C.V., Summers, R.W., Schedl, H.P. & Bleiler, T.L. (1992). Intestinal water absorption from select carbohydrate solutions in humans. *J.Appl. Sports Sci. Res.*, 5, 129-197.

Horst, E. J. (2003). *Training for Climbing: The Definitive Guide for Improving Your Climbing Performance*. Guilford: Falcon Press.

Murray, R., Paul, G.L., Seifert, J.G., & Bleiler, T.L. (1991). Responses to varying rates of carbohydrate ingestion during exercise. *Med. Sci. Sports Exer.,* 23(6), 713-718.

Rainey, A. (2009). Basic Nutrition & Diet Advice for Rock Climbers. Taken from http://allirainey.suite101.com/basic-nutrition-diet-advice-for-rock-climbers-a178386 15.08.2011.

Stanković, D. (2009). *Strength as a factor of success in free climbing.* Unpublished doctoral dissertation, Niš: Faculty of Sport and Physical Education.

Stanković, D., Joksimović, A., & Aleksandrović, M. (2011). Relation and influences of sports climbers' specific strength on the success in sports climbing. *South African Journal for Research in Sport, Physical Education and Recreation*, 33 (1), 121-131.

Verhosanski, V.J.,Šestakov, M.P., Novikov, P.S., & Nićin, D.A. (1992). *Specific power in sport.* Novi Sad: Prometej & Faculty of physical education.

ISHRANA SPORTSKIH PENJAČA

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SAŽETAK

Cilj ovog rada bio je da se preporuči efikasan model ishrane sportskih penjača, koji će zadovoljiti sve energetske potrebe za vreme jednog aktivnog penjačkog dana. Kao i svi sportisti, sportski penjači bi trebalo da prate dobar program ishrane kako bi postigli vrhunsku penjačku formu. Da bi u tome uspeli neophodan je pravilan režim ishrane pre, za vreme i posle penjanja. U tom smislu, neophodno je za svaki obrok odrediti količinu unete tečnosti, ugljenih hidrata, proteina i drugih makro i mikronutritijenata, kao i vreme njihovog konzumiranja.

Ključne reči: ishrana, sportsko penjanje

SOMATOTYPE OF THE ELITE JUDOKAS OF JUDO CLUB KINEZIS

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UDC 159.9:796.853.23

SUMMARY

The aim of this study is to determine the somatotype of the best judokas of the judo club "Kinezis." In judo, a martial art, somatotypization is a useful procedure in the selection of the athletes who will successfully practice judo and achieve superior results. In this study the somatotype of 5 top judokas was investigated. Anthropometry involves the following parameters: height, weight, selected diameters, circumferences and skin folds, which are necessary to determine the somatotype by the Heath-Carter method. All anthropometric data were collected by the International Biological Program, and then processed in software Somatotype 1.2. The obtained result of the contestants from the judo club "Kinezis" indicates the endomezomorphe type with the values 3.22-6.16-1.64. By comparing the results with other similar studies it can be concluded that there are no differences in the somatotype between the top judokas of the judo club Kinezis and the top judo players from other countries.

INTRODUCTION

Competitive Judo is a dynamic and demanding combat sport. The agonistic character of judo as a sport contributes, in addition to developing the physical skills, also to the development of the individual's psychic abilities (endurance, concentration, communication, control of aggression, etc.) (Bratić, 2003). It is characterized by the high intensity activities of the following duration: 15-30 seconds, with ten seconds breaks (Casterlanas & Planas, 1997). Modern judo is very dynamic, high efforts are expected from the judokas in training and competition, which requires a high psychological and physical preparedness. The body composition and anthropometric characteristics play an important role in this sport (Claessens et al, 1987). The classification of the fighters into categories based on their body weight, was aimed at in order to equalize the fighter force (Sterkowicz et al. 2000), i.e. favouring the technical and tactical preparation. Due to this division, it is desirable that the body composition is dominated by the muscle mass with less body fat percentage. Constitution, i.e. somatotype, is a specific set of structural-morphological, physiological and psychological functioning and cognitive-conative characteristics of an individual, which is influenced by heredity, but also under the influence of a number of exogenous factors (Tucker & Lessa, 1940), such as nutrition, socio-economic conditions, physical activity and sport. In judo, somatotypization is also used in the selection of athletes. Furthermore, it was found that a certain somatotype has a major role in selecting the most efficient or a favourite technique of a fighter (Carratala et al, 2010). Most authors (Gualdo Russo & Graziani, 1993, Romero et al., 1996 a; Romero et al., 1996 b; Benavent et al., 2004; Lewandowska et al., 2011; Sterkowicz-Przybycień et al., 2012) came to one, usually present "model" of the judokas somatotype -endomezomorphia (dominantly expressed mezomorphia and less expressed endomorphia).

METHODS

The sample of examinees

Five male judo athletes (ages 23:40 ± 3:58 years, body height 179.82 ± 2:40 cm, weight 83.24 ± 7.05kg) voluntarily participated in the study. These are the five best competitors of judo club "Kinezis" (Nis, Serbia), the national and international level competitors, the participants of the World and European Championships, and the medal winners from the Universiade, European Cups and Balkan Championships.

TABLE 1 Basic characteristics of elite judo athletes University Judo Club Kinezis (N = 5)

Variables	AS±SD	Median	Range
Age	23.40±3.58	25.15	17.95– 26.51
Height	179.82±2.40	180.00	177.2 – 183.4
Weight	83.24±7.05	80.80	75.2 - 91.6

Legend: AS–Mean value, SD - Standard deviation.

A sample of measuring instruments

The measurement was carried out immediately before a national championship, so all the contestants were in the competition cycle. All subjects were exposed to an identical testing protocol, with which they were introduced earlier and which they voluntary accessed. The anthropometric method was applied to determine the somatotype of the judokas, and it included the following 10 variables: body height (in centimetres), weight (in kg), four skin folds (triceps, back, abdomen and lower leg, in mm), the volume of flexed upper arm (in cm), volume of lower leg (in cm) diameter of elbow and knee (in cm).

The testing was performed in the morning, in the room with optimum microclimate conditions (temperature 21-23 ° C, humidity 55-60%) where the examinees were minimally dressed, by the same researchers, with the method of IBP (Weiner and Lourie, 1969). The examinees' body weight was measured using electronic scales Omron BF 511.

Statistical analysis of data

Somatotype was determined by the Heath-Carter method (Carter & Heath, 1990) and using the software Somatotype 1.2.

RESULTS

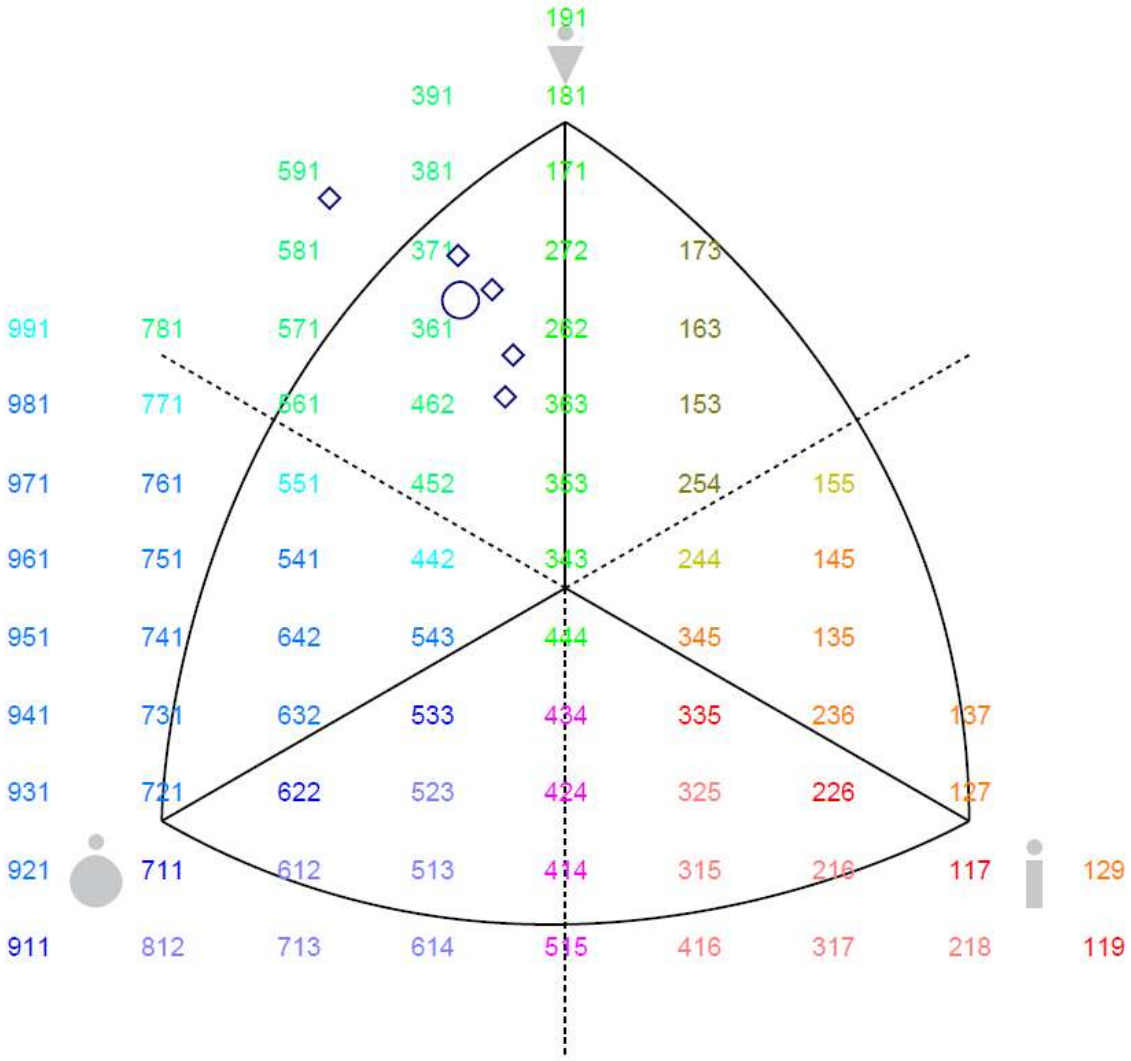
In the sample of the top 5 judokas average somatotype is: 3.22-6.16-1.64 (values endo-, meso- and ecto components; Graph 1). Descriptive statistics of all the measures are shown in Table 2.

TABLE 2 Descriptive statistics of the measured anthropometric parameters

Variables	AS±SD	Median	Range
SF upper arm	11.96±3.59	11.20	7.6 – 17.2
SF back	13.76±3.55	13.20	9.6 – 19.4
SF abdomen	7.68±1.92	7.80	4.8 – 9.6
SF lower leg	7.24±2.07	6.5	5 – 10.4
C flexed upper arm	38.16±2.72	38.20	34.8 – 42.1
C lower leg	38.80±1.01	37.3	37.6 – 40.4
Dia elbow	7.12±0.54	7.00	6.5 – 7.9
Dia knee	10.06±0.61	9.74	9.5 – 11.1
HWR	41.23±0.81	41.20	40.02 – 41.98
SAD	1.04±0.66	0.82	0.47 – 2.08
Endo	3.22±0.67	3.00	2.7 – 4.4

Meso	6.16±1.02	6.00	5 – 7.7
Ecto	1.64±0.53	1.60	0.9 – 2.2

Legend: SF–skin fold, **C**–circumference, **Dia** –diameter, **HWR**–height-weight-ratio, **SAD**– somatotype attitudinal distance, **AS** –arithmetic mean, **SD** –standard deviation.



Graph 1 Somatoplot of Serbian judo athletes (N = 5). The squares are individual profiles; the circle is the profile of the entire sample.

DISCUSSION

The analysis of the somatotype of the judokas of the judo club "Kinezis" proved the dominance of the endomezomorphic type (3.22-6.16-1.64), as it is the case with the results of judo athletes from other countries. Very similar results were found in the study conducted on the Hungarian national team (3.61-6.97-1.56) (Farmosi, 1980), characterized by extremely high values of the mesomorphe component and low values ektomorphe components, as well as the studies conducted on senior members of the Polish national team (2.6-6.4-1.8) (Sterkowicz-Przybycień et al., 2012). The same study showed that the Polish junior national team haa lower values of mezomorphe (3.0-5.5-2.1). While the sample of the thirteen Polish judokas age 18.4 ± 3.1 years, (cadets and juniors), the mean value of somatotype was 3.5-

5.9-1.8 (Lewandowska et al., 2011). The higher values of our mesomorphic component can be justified by an older age sample. In contrast to these studies, we in our sample have only one junior. The biggest difference in the results compared to our sample was found in a survey conducted on the national team of Nigeria (3.6-5.1-2.6) (Mathur et al., 1985). This study included 18 junior and senior, average body weight of 67.4 ± 3.8kg, which means that there were no examinees from the larger weight classes. The body weight of our sample was 83.24 ± 7.05kg, so our quite heavier sample justifies more mesomorphic values, and lower values of the ektomorphic components.

CONCLUSION

The judokas of the judo club "Kinezis" can be characterized as the athletes of endomezomorphic structure, which is very consistent to the somatotype of judo athletes from other countries. The results of this study may be useful in selecting the individuals for this martial art. However, as the result out on the sports fields does not necessarily depend only on the anthropometric characteristics of athletes, it is essential to consider other skills as well (motor status, psychological status, functional abilities, etc.) that affect the sport success. Very small sample size, given that it was consisted of the top judokas from one club, prevents the generalization of the results, so it is recommended that further research on this topic is implemented with a larger sample.

REFERENCES

Benavent, J., Carqués, L. & Carratalá, E.(2004). Valoración de los componentes cineantropométricos de los judokas infantiles y cadetes del equipo nacional español. Retrieved on 30th March, 2013, from http://www.judoinfo.com/pdf/research1.pdf

Bratić, M. (2003). Džudo. Niš: SIA.

Carratela, V., Garcia, J.M., Monterio, F., & Diaz, A.D. (2010). Effective ways of struggles applied by teenage female judoka during Spanish Judo Cadets Championship. *Archives of Budo,* 6(1), 39-44.

Carter, J.E.L. & Heath, B.H. (1990). *Somatotyping: Development and Applications*. Cambridge: Cambridge University Press.

Castarlenas, J.L., Planas, A. (1997). Estudio de la estructura temporal del combate de judo. Apunts: Educación Física y Deportes 47: 32–39.

Claessens, A.L.M., Beunen, G.P., Welles, R. & Geldof, G. (1987). Somatotype and body structure of world top judoists. *Journal of Sports Medicine*, 27 (1), 105-113.

Farmosi, I. (1980). Body-composition, somatotype and some motor performance of judoists. J *Sports Med Phys Fitness*, 20 **(**4), 431-434.

Gualdi-Russo, E. & Graziani, I. (1993). Antropometric somatotype of Italian sport participants. *J Sports Med Phys Fitness*, 33 (3), 282-291.

Lewandowska, J., Buśko, K., Pastuszak, A. & Boguszewska, K. (2011). Somatotype variables related to muscle torque and power in judoists. *Journal of Human Kinetics*, 30, 21-28.

Mathur, D.N., Toriola, A.L. & Igbokwe, N.U. (1985). Somatotypes of Nigerian athletes of several sports. *Br J Sports Med*, 19 (4), 219-220.

Romero, J.F., Gutiérrez, E. & Marrodán, M.D. (1996). Cineantropometría de los judokas: campeonato de España absolute. *Antropología física*, 33, 29-38.

Romero, J.F., Marrodán, M.D. & Gutiérrez, E. (1996). Cineanthropometric study in Spanish judoists. *International Journal of Anthropology*, 11 (1), 11-19.

Sterkowicz, S., Blecharz, J. & Lech, G. (2000). Differentiation between high class judoists in terms of indices of experience, physical development, psychomotor fitness and their activities during competitions. *Journal of Human Kinetics,* 4, 93-110.

Sterkowicz-Przybycień, K., Błach, W. & Żarów, R. (2012). Somatotype components in judoists. *Journal of Combat Sports and Martial Arts*, 3, 73-78.

Tucker, W.B. & Lessa, W.A. (1940). Man: A constitutional investigation. *The Quarterly Review of Biology*, 15, 411-455.

Weiner, J.S. & Lourie, J.A. (1969). *Human Biology, A guide to Field methods. International Biological Programme*. Edinburgh: Blackwell Scientific Publications.

ACKNOWLEDGMENT

The authors also like to thank Tijana Purenović-Ivanović for the help with data processing and for supplying many articles used in this text

SOMATOTIP ELITNIH DŽUDISTA DŽUDO KLUBA KINEZIS

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SAŽETAK

Cilj ove studije je da utvrdi somatotip najboljih džudista džudo kluba „Kinezis“. U džudou, kao borilačkom sportu, somatotipizacija je koristan postupak u selekciji sportista koji će se uspešno baviti džudoom i postizati vrhunske rezultate. U ovom istraživanju ispitivan je somatotip 5 vrhunskih džudista. Antropometrija podrazumeva sledeće parametre: visinu, težinu, odabranu dijametre, obime i kožne nabore, neophodne za utvrđivanje somatotipa po Heath-Carter metodi. Svi antropometrijski podaci su prikupljeni po Internacionalnom Biološkom Programu, a potom obrađenu u programu Somatotype 1.2. Dobijeni rezultat takmičara džudo kluba „Kinezis“ ukazuje na endomezomorfni tip sa vrednostima 3.22-6.16-1.64. Upoređivnjem rezultata sa rezultatima sličnih istraživanja dolazi se do zaključka da se vrhunski džudisti Kinezisa ne razlikuju po somatotipu od vrhunskih džudista iz drugih zemalja.

PARENTS' ATTIUTES ON THEIR PRE-SCHOOL AGE CHILDREN'S NUTRITION

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UDC 796.08-053.4

SUMMARY

Introduction: The research was done in the pre-school institutions in which, through monitoring and insight into attitudes of parents on habits in nutrition of their children attending Montenegrin pre-school institutions, it has been tried to get directions to take measures for education of parents regarding knowledge improvement on regular nutrition. Problem of this research is consisted in an attempt to use the parents' attitudes in evaluation of how regular nutrition habits of the pre-school children really are. The aim of this research is to establish what the nutrition habits among the pre-school children in Montenegro are and whether their parents wish to be better informed on importance of the regular nutrition.

Methods: The research was done through poll in Montenegrin pre-school institutions with anonymous questionnaire filled by parents of the children attending that pre-school institution. Sample of the examinees consisted of 1365 parents of the pre-school children attending the pre-school institutions in all Montenegrin municipalities. There was a special questionnaire made for this purpose only, which contains 25 questions answered by the examinees by circling only one answer.

Results: Comparing given results with directions in the relevant literature, it can be concluded that over a half of the children of examined parents have no healthy nutrition habits. The interesting thing is that most of the parents consider that their pre-school children mostly have a healthy way of nutrition, although the given results refer to an opposite conclusion. Descriptive statistics was used in the statistic processing of the data, which expresses frequency of some answers of the examinees, and the answers are given in charts and graphics.

Conclusion: This research refers to some aspects of irregular nutrition of the pre-school children that might be corrected by additional education of their parents in the field of regular nutrition. For that purpose an adequate brochure has been prepared, with texts on basic principles of healthy nutrition, which will be available to interested parents.

Key Words: poll, nutrition habits, importance, overweight.

INTRODUCTION

One of the main conditions for the maintenance of health, work ability and good mood is certainly a proper nutrition. It is particularly important in the pre-school period, which is the most sensitive period of mental and physical development of man. In order to ensure proper growth and development at this age we need to take the daily nutrients in quantitative and qualitative terms. Yet in this period of development we often meet with inadequate nutrition, which can affect the overall mental and physical development of preschool children.

Knowledge on nutrition, according to research by: Rosenbloom, Jonnalagadda and Skinner (2002), in all likelihood influence the attitudes and nutritional habits. There are many reasons why we do not adhere to nutritional advice. When it comes to these reasons, that despite awareness of the importance of proper nutrition hinder its acceptance and implementation of it, in the American College of Sports Medicine, (2000), a number of barriers that

may be hindering factors are cited, those are: lack of time to prepare quality meals, insufficient financial resources, limited ability to plan meals, lack of cooking skills and the busy schedule of daily duties.

Contemporary style and pace of life has greatly contributed to such habits to become permanent and to take on a broader view, and it is known that eating habits acquired in childhood remain in the following stages of development and in adulthood.

Problem of this research is consisted in an attempt to use the parents' attitudes in evaluation of how regular nutrition habits of the pre-school children really are. The aim of this research is to establish what the nutrition habits among the pre-school children in Montenegro are and whether their parents wish to be better informed on importance of the regular nutrition. When it comes to the importance of nutrition of preschool children in their growth and development, it should be noted that the main goals of modern pre-school education are creation of the preconditions for the formation of healthy, physically well and harmoniously developed children as well as maintaining of normal state of apparatus for movements, which depends on the proper nutrition and optimal physical activity.

METODS

A sample of respondents

The research was done through poll in Montenegrin pre-school institutions with anonymous questionnaire filled by parents of the children attending that pre-school institution. Sample of the examinees consisted of 1365 parents of the pre-school children attending the pre-school institutions in all Montenegrin municipalities.

A sample of measuring instruments

There was a special questionnaire made for this purpose only, which contains 25 questions about daily nutritional habits, attitude towards food, the existence of a desire to learn more about proper nutrition, answered by the examinees by circling only one answer.

Statistical analysis of data

The survey was administered using descriptive statistics, and all the results in this paper are presented numerically and in percentage through the tabulation.

RESULTS

In the following tables the complete results are displayed numerically and in percentage for each question from the questionnaire for the assessment of daily nutritional habits, attitude towards nutrition, the existence of a desire to learn more about proper nutrition of children from preschools of Montenegro. Due to limitations on the maximum length of papers, only some of the results are discussed separately below.

1. Does your child, in your opinion, eats healthy food?		YES	NO	Total
	Number of respondents	1182	174	1356
	Udio %	87,17	12,83	

2. How many main meals does your child consumes per day?	Number of respondents	Share %
One	2	0,15
Two	214	16,00
Three	1137	83,85
TOTAL	1356	

3. How many times a week your child regularly eats breakfast, lunch and dinner?	Number of respondents	Share %
Every day	854	62,98
Two-three times a week	177	13,05
Once a week	92	6,79
Not once	233	17,18
TOTAL	1356	

4. How many times a week does your child consumes a snack?	Number of respondents	Share %
Every day	951	70,13
Two-three times a week	215	18,51
Once a week	151	11,14
Not once	39	0,22
TOTAL	1356	

5. If your child consumes a snack what kind of food does he/she usually get?	Number of respondents	Share %
Fruit	341	26,62
Vegetables	56	2,66
Pastry	189	13,94
Sweets "snacks"	623	45,94

Some other food	147	10,84
TOTAL	1356	

6. How often does your child drink Coca Cola and other carbonated drinks?	Number of respondents	Share %
Every day	174	12,83
Two-three times a week	339	25,00
Once a week	638	47,05
Not once	205	15,12
TOTAL	1356	

7. How many times a week your child drinks sour or sweet milk?	Number of respondents	Share %
Every day	689	50,18
Two-three times a week	524	38,64
Once a week	125	9,22
Not once	18	1,96
TOTAL	1356	

8. How many times a week your child consumes fried meals?	Number of respondents	Share %
Every day	193	14,23
Two-three times a week	508	37,46
Once a week	619	45,65
ni jednom	36	2,66
TOTAL	1356	

9. How many times a week your child eats fried potato-chips?	Number of respondents	Share %
Every day	197	14,53
Two-three times a week	794	58,55
Once a week	353	26,03
Not once	12	0,89
TOTAL	1356	

10. Do you use animal fat or vegetable oil for frying these meals?	Number of respondents	Share %
Animal fat	357	26,33
Vegetable oils	815	60,10
Both	184	13,57
TOTAL	1356	

11. How many times a week your child eats sweet or salty snacks?	Number of respondents	Share %
Every day	479	35,32
Two-three times a week	681	50,22
Once a week	177	13,05
Not once	19	1,41
TOTAL	1356	

12. How many times a week your child consumes cooked or baked meals?	Number of respondents	Share %
Every day	583	42,99
Two-three times a week	719	53,02
Once a week	53	3,91
Not once	1	0,08
TOTAL	1356	

13. How many times a week your child consumes fish?	Number of respondents	Share %
Every day	49	3,61
Two-three times a week	289	21,31
Once a week	917	67,63
Not once	101	7,45
TOTAL	1356	

14. How many times a week your child consumes cheese, cream butter and other dairy products?	Number of respondents	Share %
Every day	889	65,56

Two-three times a week	358	26,40
Once a week	84	6,19
Not once	25	1,85
TOTAL	1356	

15. Do you give your child nutritional supplements, such as vitamins, minerals, etc.?		YES	NO	Total
	Number of respondents	279	1077	1356
	Share %	20,58	79,42	

16. What kind of food your child prefers?	Number of respondents	Share %
White meat	199	14,68
Fast food	127	9,37
Red meat	178	13,13
Potato	92	6,78
Fruit	207	15,26
Dairy products	81	5,97
Fish	79	5,83
Vegetables	97	7,15
Sweets	192	14,16
Pastry	74	5,46
Other	30	2,21
TOTAL	1356	

17. What kind of food your child does not like at all?	Number of respondents	Share %
White meat	215	15,85
Fast food	75	5,53
Red meat	157	11,58
Potato	95	7,01
Fruit	143	10,54
Dairy products	169	12,46

Fish	56	4,13
Vegetables	45	3,32
Sweets	181	13,35
Pastry	189	13,94
Other	31	2,29
TOTAL	1356	

18. What, in your opinion, the most popular type of food among preschool children?	Number of respondents	Share %
White meat	142	10,47
Fast food	184	13,57
Red meat	118	8,70
Potato	127	9,37
Fruit	178	13,13
Dairy products	107	7,89
Fish	85	6,27
Vegetables	105	7,74
Sweets	189	13,94
Pastry	89	6,56
Other	32	2,36
TOTAL	1356	

19.Do you know what your child eats while he/she is in kindergarten?		YES	NO	Total
	Number of respondents	1195	161	1356
	Share %	88,13	11,87	

20. What do you think about the way in which your child is fed?	Number of respondents	Share %
I think he/she eats healty food	827	60,99
I think he/she does not eat healty food	452	33,33
I have no opinion on that matter	77	5,68
TOTAL	1356	

21. What do you think about the way in which you, as a parent feed yourself?	Number of respondents	Share %
I think I eat healty food	516	38,05
I think I do not eat healty food	491	36,21
I have no opinion on that matter	349	25,74
TOTAL	1356	

22. Do you think that eating habits affect the growth and development of your child and to what extent?	Number of respondents	Share %
They affect to a large extent	618	45,58
They partially affect	292	21,53
They affect to a small extent	199	14,68
They do not affect at all	247	18,21
TOTAL	1356	

23. How much do you know, as a parent, about proper nutrition?	Number of respondents	Share %
Much	614	45,28
Enough	341	25,15
Not enough	225	16,59
I am not interested about that	176	12,98
TOTAL	1356	

24. Do you think that the food quality would be improved in your family if you got a brochure about healthy food?		YES	NO	Total
	Number of respondents	653	703	1356
	Share %	48,16	51,84	

25. Do you think that your child has a basic knowledge about healthy nutrition?		YES	NO	Total
	Number of respondents	795	561	1356
	Share %	58,63	41,37	

If your child has basic information on healthy nutrition, where it has been acquired?	Number of respondents	Share %
In family	673	49,63
In kindergarten	487	35,91

Through the mass media	179	13,20
From the doctor	17	1,26
	1356	

DISCUSSION

Having in mind the objective of this research, through which we attempted to determine how much the proper nutrition among children of preschool age is present and what their nutritional habits look like; how much parents of pre-school children know about the importance of proper and consequences of improper nutrition, adverse effects of improper nutrition on organism, and whether there is a need and desire for more knowledge and better information about the importance of proper and consequences of improper nutrition, we will present the results of some similar surveys:

Studies by Read and Schlenker, (1993) show that individuals who have the appropriate knowledge about nutrition and nutritional habits apply these principles when choosing food. Frederick and Hawkins (1992); Lissner and Heitmann (1995) show in their studies that the improvement of knowledge and attitudes about nutrition through nutritional education can help in the prevention or mitigation of disease. This suggests that if we determine area of nutritional knowledge that lacks, choice feeding grounds will be open for nutritional education, despite the lack of sufficient information on the skills and habits of nutrition.

Several studies have shown that the respondents often have misconceptions about nutrition; they fail to make a priority from nutritional values in the selection of food and, in general, are poorly informed about the dietary guidelines (Abood, Black and Birnbaum, 2004; Jacobson, Sobonya and Ransone, 2001; Mitchell 1990).

Healthynutritional habits include various, hygienic food, prepared especially by cooking and baking, while cured meat products should be avoided, as well as fried foods, fatty meats, excessive use of salt, sweets and carbonated drinks. It is preferably to use skim milk and milk products and to use grains, fruit and vegetables every day.

It is important that the food is taken at home, along with other family members, properly distributed in more than one meal, which for the school children involves three main meals and two snacks. It is not good to skip meals because a regular nutrition gives a feeling of fullness which stimulates metabolism to consume calories not to store them in the form of fat tissue. "Snacking" between meals by the TV or computer should be avoided. An additional problem, other than malnutrition, is physical inactivity and spending too much time on watching TV or playing computer games. As a result, there are eating disorders and obesity.

One of the main consequences of malnutrition is obesity that occurs when we store in the body for long time greater amount of nutrients than the body manages to consume, and lack of physical activity. At the same time, the media "lure" children to consume high-fat foods, while on the other hand, an obsession for thinness is promoted, which is certainly confusing for children.

Therefore it is necessary to take as much time as possible in dynamic activities which are inherent in pre-school children.

CONCLUSION

This study represents the first step in identifying current knowledge of the children's parents on nutritional habits and quality of the nutrition of their children, who are attending pre-school institutions of Montenegro. By comparing the results of our research with the principles of proper nutrition, we believe that knowledge of parents about proper nutrition should be improved.

Parents and educators should realize in time the danger of malnutrition and its consequences, to pay more attention to nutrition of children, to inform where to find help, so that nutrition would be harmonized with the needs of children, to make children learn and be accustomed to healthy nutrition and physical activity from an early age. This is supported by research on the effects of education in nutrition, in which we came to similar conclusions on improving individual skills, habits, and developing of awareness of nutrition, supporting the need for benefit of nutritional education in increasing of knowledge about nutrition, self-efficacy and positive changes in the perception of knowledge and nutritional habits among respondents.

The obtained results suggest that some aspects of malnutrition of preschool children which might be adjusted by further education of their parents in the field of healthy nutrition. For this purpose, adequate booklet is prepared with texts on the basic principles of healthynutrition, which will, when itcomes out from printing, be available to interested parents.

REFERENCES

1. Abood, D. A., Black, D. R., & Birnbaum, R. D. (2004). Nutrition education intervention for college female athletes. Journal of Nutrition Education Behavior, 36, 135–139.

2. American College of Sports Medicine, American Dietetic Association, & Dietitians of Canada. (2000). Nutrition and athletic performance. Medicine and Sport Science, 32(12)

3. Barr, S. I. (1987). Nutrition knowledge of female varsity athletes and university students. Journal of American Dietetic Association, 87.

4. Chang, S. L. (1987). Survey on health knowledge of college students in the middle area of Taiwan. Public Health, 14, 250–273.

5. Frederick, L., & Hawkins, S. T. (1992). A comparison of nutrition knowledge and attitudes, dietary practices, and bone densities of post-menopausal women, female college athletes and nonathletic college women. Journal of American Dietetic Association, 92, 199–205.

6. Lissner, L., & Heitmann, B. L. (1995). Dietary fat and obesity: evidence from epidemiology. European Journal of Clinical Nutrition, 49, 79–90.

7. Nancy, C., Connie, E., Vickery, R. D., & Mcbee, S. (2005). Sports Nutrition for Young Athletes. Journal of School Nurses, 21, 323–328.

8. Read, M., & Schlenker, E. D. (1993). Food selection patterns among the aged. In J. M. Smith (Ed.),

9. Ruka, S., Toyama, K., Amamoto, R., Liu, C. H., & Shinfuku, N. (2005). Nutritional knowledge, food habits and health attitude of Chinese university students cross sectional study. Journal of Nutrition, 4.

10.Yueching, W., & Yi-Chia, H. (1999). Is the College environment adequate for accessing to nutrition education: A study in Taiwan, Nutrition Research, 19, 32–37.

STAVOVI RODITELJA O ISHRANI NJIHOVE DJECE PREDŠKOLSKOG UZRASTA

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SAŽETAK

Uvod: U crnogorskim predškolskim ustanovama sprovedeno je istraživanje s ciljem da se kroz praćenje i uvid u stavove roditelja o navikama u ishrani njihove djece koja pohađaju crnogorske predškolske ustanove dobiju smjernice za preduzimanje mjera kojima bi se roditelji edukovali u smislu unapređenja znanja o pravilnoj ishrani.

Problem ovog istraživanja je sastoji se u pokušaju da se na osnovu stavova roditelja procijeni u kojoj mjeri djeca predškolskog uzrasta imaju pravilne prehrambene navike. Cilj ovog istraživanja je da se utvrdi kakve su prehrambene navike među djecom predškolskog uzrasta u Crnoj Gori i da li kod njihovih roditelja postoji želja za saznanjima i boljim informisanjem o značaju pravilne ishrane.

Metode:

Istraživanje je sprovedeno anketiranjem u crnogorskim predškolskim ustanovama anonimnim upitnikom, koju su popunjavali roditelji djece koja su upisana u tu predškolsku ustanovu. Uzorak ispitanika činio je 1356 roditelja djece predškolskog uzrasta koja pohađaju predškolske ustanove u svim crnogorskim gradovima. Za anketiranje je korišten upitnik posebno konstruisan za ovu namjenu, koji sadrži 25 pitanja na koja su ispitanici odgovarali zaokruživanjem samo jednog odgovora.

Rezultati: Upoređujući dobijene rezultate sa smjernicama u referentnoj literaturi može se zaključiti da više od polovine djece anketiranih roditelja nema zdrave prehrambene navike. Zanimljivo je da većina roditelja smatra da se njihova djeca predškolskog uzrasta uglavnom hrane na zdrav način, iako dobijeni rezultati upućuju na suprotan zaključak. Pri statističkoj obradi korišćena je deskriptivna statistika, kojim je izražena učestalost pojedinih odgovora ispitanika, a odgovori su prikazani tabelarno i grafički.

Zaključak: Ovo istraživanje ukazuje na neke aspekte nepravilne ishrane djece predškolskog uzrasta koji bi možda mogli biti korigovani dodatnom edukacijom njihovih roditelja iz oblasti pravilne ishrane. U tu svrhu je pripremljena odgovarajuća brošura, sa tekstovima o osnovnim principima zdrave ishrane, koja će biti dostupna zainteresovanim roditeljima.

Ključne riječi: anketa, prehrambene navike, značaj, gojaznost.

Multidisciplinary Topics

THE CONNECTION BETWEEN THE MANIFESTATION OF EMOTIONAL INTELLIGENCE AND DIFFERENT TYPES OF SPORT

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UDC 159.9 :796

SUMMARY

Numerous studies of the influence of emotional intelligence on human functioning and success have been carried out in the past several years. Regardless of the model that is used in the analysis, whether the combined or ability model, the influence of emotional intelligence is proven to be significant in the realm of sport. This study is aimed at determining whether the prominent emotional intelligence and its aspects vary depending on a specific sport of the students of the Faculty of Sport and Physical Education decide to, or would like to, chose. The Emotional Competence Questionnaire(Taksic, 2002), comprised of three subscales (the ability to perceive and understand emotions, the ability to express and name emotions and the ability to govern emotions). Furthermore, a questionnaire which serves to examine preferences for certain sports has been created and used for this research. The results show that the highest level of emotional intelligence is present among the students who do martial arts and gymnastics and that the differences are statistically significant compared to certain team sports. The limitation of this research is the lack of data on the period and intensity of practicing sports specified as primary and especially the lack of the outer criteria of their performance.

Key Words: emotional intelligence, sport, students

INTRODUCTION

There are different definitions of emotional intelligence. One of the broader and more encompassing ones defines emotional intelligence based on four psychological skills: 1) the ability to adequately perceive, evaluate and express emotions, 2) the ability to see and generate emotions that facilitate thinking, 3) the ability to understand and recognize emotions, and 4) the ability to regulate (govern) emotions (Mayer & Salovey, 1999).

It is often rightly said that the conceptualization of a psychological construct largely depends on the method of measurement. There are several methods of measuring emotional intelligence as a psychological construct, and thus several approaches to this notion. The first method of measuring is through the examinee's self-evaluation of the abilities related to emotional intelligence. The second method is measuring emotional intelligence as an ability, i.e. it is measured by the same principle as classic intelligence, whereas the third method is the mixed one because it combines the principles of the first two (Takšić, Rukavina & Linardić, 2005). Some authors (Lane et al., 2009) checked the validity of certain ranges of emotional intelligence self-evaluation on a test group of athletes, insisting that further work on validation needs to be conducted, and concluded that it may be used in sports practice.

Regardless of the operationalization of the emotional intelligence construct, there are numerous studies dealing with the connection between emotional intelligence and the events and features that occur primarily in the work environment.

However, there are certain aspects of the work environment that are very similar to those in sports and the sports environment (stressfulness, competitiveness, insecurity, cooperation), and it is therefore considered that the findings obtained in these studies may be of importance for the proper and effective functioning in sport (Meyer & Fletcher, 2007). The most significant findings relate to the correlation of the level of emotional intelligence and the use of appropriate and purposeful strategies of dealing with stress in the work environment (Jordan, Ashkanasy & Hartel), and resolving conflicts (Jordan & Troth, 2002). Caruso et al. (2002) argue that emotional intelligence is an extremely important factor for successful leadership and management.

By studying the differences in the level of emotional intelligence and its subscales among high school students attending a 'regular' and a sports high school, Takšić et al. (2005) obtained results indicating that the students of sports high schools better name and express emotions when compared to their peers from 'regular' high schools. The authors attribute this difference to the participation in organized sports activities. Mitić et al. (2011) found that emotional intelligence in general, and in the domain of emotional government in particular, is higher in judo players as opposed to the general population.

RESEARCH QUESTION

The research question was to determine whether there were any differences in the level of emotional competence and aspects of emotional competence: understanding emotions, naming emotions, and governing emotions, in relation to the sport that the students of sport and physical education were participating in at that time, as well as in relation to which sport they would prefer.

Research aims

To examine the differences in the level of the overall emotional competence of the sport and physical education students in relation to the sport they are currently engaged in and the sport they would prefer;

To examine the differences in the level of the aspects of emotional competence and the understanding of emotions among the sport and physical education students in relation to the sport they are currently engaged in and the sport they would prefer;

To examine the differences in the level of the aspects of the emotional competence of naming emotions among the students of sport and physical education in relation to the sport they are currently engaged in and the sport they would prefer;

To examine the differences in the level of prominence of the emotion-governing aspect of the emotional competence among students of sport and physical education in relation to the sport they are currently engaged in and the sport they would prefer;

Research instrument

The emotional competence questionnaire (Takšić, 2002) was used as an instrument for measuring emotional competence, which assesses three aspects of emotional intelligence - competence: 1. the ability to perceive and understand emotions, 2. the ability to express and name emotions, and 3. the ability to govern emotions.

A questionnaire was developed just for the purpose of studying the preferences for a particular sport among the students of sport and physical education, on which the participants state the sport they are currently engaged in and the sport they would prefer to participate in.

The sample of participants

The study included a sample consisting of 143 students of the Faculty of Sport and Physical Education in Niš, of both sexes.

THE RESULTS

Differences in the level of emotional competence (and its subscales) in relation to the sport the participants were engaged in at the time

TABLE 1 The level of emotional competence (and its subscales) in relation to the sport the participants were engaged in at the time

Sport 1	Emotional competence	Understanding emotions	Naming emotions	Governing emotions
Football	164,2093	53,0233	51,2791	59,9070
Basketball	168,9688	53,4545	52,8750	62,6667
Volleyball	172,8125	54,1875	54,2500	64,3750
Handball	170,5833	51,8333	53,8333	64,9167
Swimming	169,1429	52,5714	52,1429	64,4286
Athletics	171,0000	55,1429	54,1429	63,8000
Gymnastics	**182,3333**	**55,3333**	**58,0000**	**69,0000**
Martial arts	**186,0000**	**58,2500**	**58,7500**	**69,0000**
Dance	155,2500	48,5000	50,5000	56,2500
Other sports	172,6000	55,1000	54,0000	63,5000
Total	168,7842	53,3732	52,9930	62,5674

By examining the data shown in Table 1, it is evident that the total emotional competence is highest among the students engaged in martial arts. In addition, the overall emotional competence showed high values among the students engaged in gymnastics. The situation is similar with the subscales of emotional competence. The highest scores on the subscales of understanding emotions, naming emotions and governing emotions were determined for students currently engaged in martial arts; however, students engaged in gymnastics also had high values for the aforementioned aspects of emotional competence.

To verify that the previously given differences in the level of total emotional competence and its aspects are statistically significant, we carried out an analysis of variance, and the results are presented in Tables 2, 3, 4 and 5.

TABLE 2
The analysis of the variance of the emotion competence levelin relation to the sport the participants were engaged in at the time

	F	p
Emotion competence	1,565	,117
Understanding emotions	,835	,605
Naming emotions	1,276	,245
Governing emotions	2,123*	**,023**

The results obtained by the analysis of variance indicate that, although there are differences in the level of all the aspects of emotional competence (Table 1), they are statistically significant only at the subscale that measures aspects of emotional intelligence, which refers to governing emotions (Table 2).

Given that the differences are statistically significant only in the aspect of the emotional competence of governing emotion, further analyses refer to this aspect.

TABLE 3
The analysis of variance, post hoc tests – the significance of the obtained differences in the level of governing emotions in relation to the sport that the participant was engaged in

		Difference in AS	p
Martial arts	Football	7,47093*	**,011**
	Basketball	5,87500*	**,047**
	Volleyball	4,50000	,148
	Handball	4,91667	,126
	Swimming	6,60714	,059
	Athletics	4,60714	,187
	Martial arts	,75000	,859
	Dance	8,25000*	**,037**
	Other sports	4,75000	,149

The results obtained by the analysis of variance indicated that the students engaged in martial arts scored higher values on the subscale of emotional competence of governing emotions compared to the students currently engaged in sports such as football, basketball and dancing, also indicate that these differences are statistically significant at the p <0.05 level (Table 3).

TABLE 4
The analysis of variance, post hoc test - the significance of the obtained differences at the level of the governing emotions in relation to the sport that the participants were engaged in

		Difference in AS	p
Gymnastics	Football	**9,09302***	**,020**
	Basketball	6,33333	,106
	Volleyball	4,62500	,256
	Handball	4,08333	,328
	Swimming	4,57143	,306
	Athletics	5,20000	,271
	Martial arts	,00000	1,000
	Dance	**12,75000***	**,011**
	Other sports	5,50000	,197

It was found that the students currently involved in gymnastics have a more pronounced aspect of emotional competence of governing emotions in relation to students who were primarily engaged in football and dance. The differences were statistically significant at the p <0.05 level (Table 4).

Differences in the level of the emotional competence (and its subscales) in relation to the sport that the students would prefer to participate in

When it comes to differences in the level of the emotional competence and its aspects in relation to the sport that the students would prefer to participate in, the following results were obtained.

TABLE 5
The level of emotional competence (and its subscales) in relation to the sport that the participants prefer

Sport 2	Emotional competence	Understanding emotions	Naming emotions	Governing emotions
Football	164,6944	52,8108	51,6389	60,3514
Basketball	170,7143	53,8571	53,1905	63,6667
Volleyball	170,7333	54,4118	53,2941	63,9333
Handball	169,5385	52,9231	52,9231	63,6923
Swimming	159,4000	51,2667	49,6667	58,4667
Athletics	169,5000	52,6667	53,1667	63,6667
Gymnastics	**184,0000**	**56,3333**	**57,3333**	**70,3333**
Martial arts	**186,0000**	**58,2500**	**58,7500**	**69,0000**
Dance	164,1667	50,1667	53,8333	60,1667
Other sports	173,2000	55,5000	55,0000	62,7000
Total	168,7842	53,3732	52,9930	62,5674

It was evident (Table 5) that the students, who would prefer martial arts or gymnastics, achieved the highest scores on the scale of overall emotional competence.

When it comes to the differences in the level of prominence of the aspects of emotional competence, it was evident that the aspects of understanding emotions, naming emotions and governing emotions were the most pronounced among the students who preferred martial arts or gymnastics.

We examined whether these differences were statistically significant by means of the method of the analysis of variance, and the results are presented in Tables 6, 7, 8, 9 and 10.

TABLE 6
The analysis of variance of the level of emotional competence in relation to the sport that the participants prefer

	F	p
Emotional competence	2,092	**,025**
Understanding emotions	,830	,610
Naming emotions	1,677	,086
Governing emotions	2,409	**,009**

The results obtained by the analysis of the variance indicate that, although there are some differences in the level of all the aspects of emotional competence (Table 6), they are statistically significant only in the subscale that measures the aspect of emotional intelligence, which refers to governing emotions, and on the scale that measures the level of total emotional competence.

Given that the differences are statistically significant only in terms of the overall emotional competence and in the aspect of governing emotions; further analyses refer to these aspects only.

TABLE 7
The analysis of the variance, post hoc test – the significance of the obtained differences in the level of the total emotional competence in relation to the sport that the participants prefer

		Difference in AS	p
Martial arts	Football	**21,30556***	**,007**
	Basketball	15,28571	,060
	Volleyball	15,26667	,068
	Handball	16,46154	,053
	Swimming	**26,60000***	**,002**
	Athletics	16,50000	,085
	Gymnastics	2,00000	,859
	Dance	**21,83333***	**,023**
	Other sports	12,80000	,145

The results shown in Table 7 present that the students who prefer martial arts have a more pronounced overall emotional competence in relation to the students who prefer swimming, dancing or football, and these differences are statistically significant at the $p < 0.05$ level.

TABLE 8
The analysis of the variance, post hoc test – the significance of the obtained differences at the level of the total emotional competence in relation to the sport that the participants prefer

		Difference in AS	p
Gymnastics	Football	**19,30556***	**,031**
	Basketball	13,28571	,147
	Volleyball	13,26667	,157
	Handball	14,46154	,128
	Swimming	**24,60000***	**,009**
	Athletics	14,50000	,167
	Martial arts	-2,00000	,859
	Dance	**19,83333***	,059
	Other sports	10,80000	,268

It was found that the students who would like to practice gymnastics have a more pronounced total emotional competence in relation to the students who would prefer swimming, dancing or football. The differences were statistically significant at the $p < 0.05$ level (Table 8).

The results given in Table 9, show that the students who prefer martial arts, have a more pronounced aspect of emotional competence of governing emotions in relation to the students who would prefer swimming, dancing or football, and these differences were statistically significant at the $p < 0.05$ level.

TABLE 9
The analysis of the variance, post hoc test – the significance of the obtained differences in the level of governing emotions in relation to the sport that the participants prefer

		Difference in AS	P
Martial arts	Football	**8,64865***	**,011**
	Basketball	5,33333	,128
	Volleyball	5,06667	,161
	Handball	5,30769	,148
	Swimming	**10,53333***	**,004**
	Athletics	5,33333	,198
	Gymnastics	-1,33333	,785
	Dance	**8,83333***	**,034**
	Other sports	6,30000	,097

TABLE 10
The analysis of the variance, post hoc test – the significance of the obtained differences in the level of governing emotions in relation to the sport that the participants prefer

		Difference in AS	p
Gymnastics	Football	**9,98198***	**,010**
	Basketball	6,66667	,093
	Volleyball	6,40000	,115
	Handball	6,64103	,107
	Swimming	**11,86667***	**,004**
	Athletics	6,66667	,142
	Martial arts	1,33333	,785
	Dance	**10,16667***	**,026**
	Other sports	7,63333	,071

It turned out that the students who prefer gymnastics have a more pronounced aspect of emotional competence of emotion governing in relation to the students who would prefer swimming, dancing or football, and that these differences were statistically significant at the $p < 0.05$ level (Table 10).

DISCUSSION AND CONCLUSION

The aim of this study was to determine whether a difference exists between students, in the level of emotional intelligence and its individual factors: the ability to perceive and understand emotions, the ability to express and name emotions, and the ability to govern emotions, depending on their preference of certain sports and their practice of certain sports. When it comes to sports, which the tested students participated in, a statistically significant difference was revealed only in the domain of governing emotions, especially among the students who are predominantly engaged in martial arts on the one hand, and the students engaged in football, basketball and dancing on the other hand, as well as among the students engaged in gymnastics, as opposed to those engaged in football and dance. The level of this domain of emotional intelligence of those engaged in martial arts is consistent with the previous findings (Mitić et al., 2011). The differences in comparison to the students engaged in other sports can be explained in two ways: as the result of the demands the athletes have to meet when practicing certain sports and as the result of the success in sports of the students tested in the selected subcategories.

When speaking about the demands that the students have to meet, there is a clear difference between martial arts and gymnastics on one hand,

and basketball and football on the other. The first two are individual sports and during their performance the athletes cannot afford a moment of emotion to overcome them, since that would affect their performance badly. On the other hand, in team sports there are times (time-outs, half-time, moments after the action) when the athletes can allow themselves some outlets, without it having a drastic effect on the overall result. Simply put, individual athletes need to have a better control of their emotions while performing. In addition to these differences, there was a statistically significant difference between the students engaged in martial arts and gymnastics, and those engaged in dance. One of the possible explanations is that the dance performance, which is a combination of sport and art, is incomplete without the proper emotions of the dancers, and therefore they do not have to control their emotions much (even the opposite is desired). The second possible explanation of the given differences in terms of the extent of ability to govern emotions can be the difference in the success and the results the participants achieved in a certain discipline. However, this variable was not controlled in the study, and the basis for this highly speculative explanation is found in the achievements of the students of the Faculty of Sport and Physical Education in Niš on national and international competitions where the judo players and gymnasts were the most successful. We may therefore explain this difference by the better selection of students, who make successful athletes in the categories of martial arts and gymnastics.

As for the results obtained when the students were asked which sport they would prefer, there are no particularly interesting data. Students generally prefer sports that they are already involved in, except for a few that would switch to swimming instead of team sports.

These research results indicated that constructs such as emotional intelligence and its subscales have their place in the interpretation of sports affinities and that they may be used for selective and diagnostic purposes, in addition to their being characteristic of certain types of sports. However, the conducted research has its flaws and limitations. This primarily relates to uncontrolled length and intensity, and especially sports success of the participants. The consequence of this is that the students opted for the sport which they do most, but very often recreationally or as a part of their regular exams. The results therefore relate with certainty only to the affinities of certain sports. It is necessary to carry out a study on a sample of athletes while controlling for their level of success in order to fully reveal the relationship between the level of emotional intelligence, success of athletes and the type of sport.

REFERENCES

Caruso, D., R., Mayer, J., D., Salovey, P. (2002) Emotional intelligence and emotional leadership, In M. Riggio (Ed), Multiple intelligences and leadership: LEA's organization and management series, pp. 55-74, Mahawah, NJ: Lawrence Earlbaum.

Jordan, P.,J., Ashkanasy, M.,M., Hartel, C., E., J. (2002) Emotional intelligence as a moderator of emotional and behavioral reactions to job insecurity, Academy of Management Review, vol. 3 pp. 361-372.

Jordan, P.,J., Troth, A., C. (2002) Emotional intelligence and conflict resolution: Implications for human resource development, Advances in Developing Human Resources, vol. 1, pp. 62-79.

Lane, A., M., Meyer, B., B., Devonport, T., J., Davies, K., A., Thelwell, R., Gill, G., S., Diehl, C., D., P., Wilson, M., Weston, N. (2009) Validity of the emotional intelligence scale for use in sport, Journal of Sports Science and Medicine, vol. 8, pp. 289-295.

Mayer, J., D., Salovey, P. (1999) Što je emocionalna inteligencija? U: P. Salovey i D. Sluyter (ured.). Emocionalni razvoj i emocionalna inteligencija: Pedagoške implikacije. EDUCA, Zagreb.

Meyer, B., B., Fletcher, T., B. (2007) Emotional Intelligence: A Theoretical Overview and Implications for Research and Professionl Practice in Sport Psychology, Journal of Applied Sport Psychology vol. 19, pp. 1-15.

Mitic, P., Mitrovic, M., Bratic, M., Nurkic, M. (2011) Emotional intelligence, styles of coping with stressful situacions, anxiety and personality traits in judokas, Serbian Journal of Sports Sciences, vol.5, pp. 163-169.

Takšić, V., Rukavina, T., Linardić, M. (2005) Emotionl intelligence in high school students in normal and sport gymnasium, Proceedings of 4-th International Scentific Conference on Kinesiology „Science and Profession-Chalenge for the Future“, Opatija, Croatia, 7-11 September.

ODNOS IZRAŽENOSTI EMOCIONALNE INTELIGENCIJE I VRSTE SPORTA

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SAŽETAK

Poslednjih godina često je izučavan uticaj emocionalne inteligencije na ljudsko funkcionisanje i uspešnost. Bez obzira da li se posmatra kroz kroz kombinovani model ili kroz model sposobnosti, uticaj emocionalne inteligencije se pokazao značajnim i u oblastimi sporta. Istraživanjem smo želeli da utvrdimo da li se izraženost emocionalne inteligencije i njenih aspekata razlikuje u zavisnosti od izbora sporta kojim se studenti Fakulteta sporta i fizičkog vaspitanja bave, odnosno kojim bi voleli da se bave. Od instrumenata su korišćeni Upitnik emocionalne kompetencije (Takšić, 2002) koji sadrži tri subskale (sposobnost uočavanja i razumevanja emocija, izražavanja i imenovanja emocija i upravljanja emocijama) i upitnik za ispitivanje preferencija prema pojedinim sportovima, koji je napravljen za ovu priliku. Rezultati pokazuju da najizraženiju emocionalnu inteligenciju imaju studenti koji se bave borilačkim sportovima i gimnastikom i razlike su statistički značajne u odnosu na pojedine kolektivne sportove. Ograničenje ovog istraživanja je što nema podataka o dužini i intenzitetu bavljenja sportom koji je naveden kao primarni, a naročito nedostaju spoljašnji kriterijumi njihove uspešnosti.

Ključne reči: emocionalna inteligencija, sport, studenti

DIFFERENCE IN MANIFESTED EXPLOSIVE STRENGTH DETERMINED BY THE USE OF VERTICAL JUMP

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UDC 796.012.11

SUMMARY

The aim of the research was to quantify the explosive strength of the lower extremities and to observe/examine if there exists a difference in the manifested explosive strength of the lower extremities between examinees, in terms of vertical i.e., counter movement jump (CMJ) implementation with and without sports shoes on. Nine male examinees participated in the research. All of them were students of the Faculty of Sport and Physical Education, University of Niš, age 22.78±1.394 years, body height 185.167±5.579 cm, body weight 81.711±7.700 kg, Body Mass Index (BMI) 23.9111±2.57072, body fat 18.5667±4.16953 in % (Mean±St. Dev.). On each, initial and final measurement, each examinee performed five CMJ. By using the wireless accelerometer Myotest (Sion, Switzerland) the values of the following variables of the explosive strength were determined: 1) Height expressed in cm; 2) Power expressed in W/kg; 3) Force expressed in N/kg; 4) Velocity expressed in cm/s). For/In data processing Kolomogorov-Smirnov test and T-test were used. Based on the significance of the T-test for the two dependant samples, it can be concluded that the results of the examinees, achieved by jumping without sports shoes on, are not statistically-significantly different from the results achieved by jumping with sports shoes on. Further researches of this topic are necessary, and the results of the tests performed on the examinees with determined flat feet deformity will be especially interesting.

Key Words: CMJ, student population, explosive strength, difference.

INTRODUCTION

The decisive factor for the success in many sports activities represents exertion of the maximal muscle strength in as short period as it is possible (Newton & Kreamer, 1994), i.e., success directly correlates with the lower extremities activity, and the vertical jumps are often used for increasing lower extremities strength and its explosiveness (Ebben, 2005).

High intensity vertical force, to which the body of an athlete is exposed during the vertical jump's landing, if repeated in a long time period may cause injury in an/the athlete. Guided by this knowledge, as well as the experience and intuition, athletes often do their trainings with no shoes on, with the aim of making the feet muscles stronger and avoiding injury (Goldmann, Sanno, Willwacher, Heinrich, & Bruggemann, 2011).

In the last few years, the production of sports shoes with flexible soles increased significantly, with an/the aim of simulating the conditions in which athletes do their exercises with no shoes on. However, the impact of sports shoes with flexible sole on the walking pattern and athletes' performance is insufficiently studied. According to

Goldmann at al. (2011), the previously mentioned shoes enable bigger amplitude of dorsiflexion in metatarsophalangeal joint, compared to the conventional shoes.

Bruggemann, Potthast, Braunstein, & Niehoff (2005) determined significant increment in the strength of the big toe flexor after five-month utilization of sports shoes with a flexible sole.

According to Squadrone & Gallozi (2009), by running without sports shoes, 5% less energy is used than with running by wearing them.

Robbins & Waked (1958) stated that the people with no shoes on can sense the foot position in space correctly. However, that sense is disturbed by wearing conventional sports shoes, and as a result, wearing sports shoes may cause luxation in ankle joint. Authors, as the solution for avoiding ankle luxation, emphasize with joy the invention and designing of the contemporary sports shoes which can preserve the maximal feet touch sensitivity and keep consciousness of the feet position, as it is the case when the athletes have no shoes on.

In the last few years a contemporary five- toe rubber sock appeared, have the properties to increase postural control by separating toes, by increasing the number of proprioreceptive and skin impulses towards the central nerve system. Also, it has been claimed that previously mentioned rubber socks improve the perception of the ground and enable better feet-ground contact.

In that context, Shinohara & Gribble (2009) have been studying the stability of balancing position on one foot, accomplished by the use of the contemporary five-toe rubber sock, compared to the conventional sports shoe and such exercise with no shoe on. They determined that the static balance is questioned during the testing with contemporary rubber sock and conventional sports shoe, but not when examinees kept balancing position with no shoes on.

The aim of the research was to quantify the explosive strength of the lower extremities and to verify if there exists the difference in manifested explosive strength of the lower extremities between examinees, in terms of vertical i.e., counter movement jump (CMJ) implementation with and without sports shoes on.

METHODS

Examinees' sample

Nine male examinees participated in the research. All of them were the students of the Faculty of Sport and Physical Education, University of Niš, age 22.78±1.394 years, body height 185.167±5.579 cm, body weight 81.711±7.700 kg, Body Mass Index (BMI) 23.9111±2.57072, body fat 18.5667±4.16953 in % (Mean±St. Dev.), without any injury or illness which could affect, in a negative way, their health status and the results of the research.

Variable's sample

1. Height (expressed in cm),
2. Power (expressed in W/kg),
3. Force (expressed in N/kg),
4. Velocity (expressed in cm/s).

Procedures of measurement

Foremost, on the initial measurement, by using the Martin's anthropometer and electronic weight balance, the body height and body weight were determined. With the aim of evaluating body composition, i.e., body fat measurement, the bio-impedance analyzer Omron BF500 was used.

During each measurement, including the initial and final, examinees performed five CMJ, which can be divided in three phases: 1) lowering the body by flexion in knee-joints up to 100 deg.; 2) action of concomitant stretching of all the joints of the lower extremities (by concentric muscles' contraction, which performs extension and plantar flexion in these joints), and consequent jump, 3) controlled landing which is followed by legs' muscle eccentric contraction. Hands are on hips during the jump

(Bartlett, 2007). By using the wireless accelerometer Myotest (Sion, Switzerland) positioned on the belt around the examinee's waist, the values of the previously mentioned variables have been determined. The examinees performed two-foot jumps after the device sound signals. The examination of the explosive strength was preceded by the static stretching protocol, so that it could reduce the possibility of eventual injury of examinees.

At the initial measurement, the examinees performed CMJ by wearing the conventional sports shoes, which are mainly produced with a positive sole inclination, i.e., with higher heel position compared to the front part of a foot, by which a better absorption of the force of the foot collision with the ground is achieved and which maintains foot comfort.

According to Snab & Larkins (1993), positive sole inclination raises the foot and protects the foot's arch from injuries in case of sudden stopping.

At the final measurement, one day after the initial one, the examinees performed CMJ without sports shoes on, i.e. foot inclination was 0 deg.

Data processing

A tabular account of the results is shown: the Kolomogorov-Smirnov test, by which is determined if the results have normal distribution; and the T-test, by which is determined if there exists a statistically significant difference between values of the examined variables between the two measurements (Pallant, 2007).

RESULTS WITH DISCUSSION

Results of BMI (23.9111±2.57072, Mean±St. Dev.) and body fat (18.5667±4.16953 in %, Mean±St. Dev.) show normal values for both variables.

TABLE 1 The descriptive statistics of CMJ.

	N	Minimum	Maximum	Mean	Std. Deviation
Height1	9	29.00	45.00	36.3333	5.14223
Power1	9	30.40	56.00	41.2000	9.41594
Force1	9	20.30	34.40	26.5778	5.23946
Velocity1	9	188.00	276.00	229.5556	26.71662
Height2	9	30.70	44.10	37.2222	4.68369
Power2	9	27.40	60.00	43.1333	10.22497
Force2	9	19.00	35.40	26.6444	4.98877
Velocity2	9	181.00	296.00	233.7778	34.18252

1-with sports shoes on; 2- with-out sports shoes on

TABLE 2 Testing the results' normality.

	Height	Power	Force	Velocity	Height_A	Power_A	Force_A	Velocity_A
Asymp. Sig. (2-tailed)	.996	.906	.891	.984	.975	.924	.973	.972

Based on the results of the Kolomogrov-Smirnov's test, a conclusion was made that the two measurement results are normally distributed, and the T-test was used for that purpose.

TABLE 3 Examination of the differences.

	Mean	N	Std. Deviation	sig.
Height1	36.3333	9	5.14223	0.096
Height2	37.2222	9	4.68369	
Power1	41.2000	9	9.41594	0.147
Power2	43.1333	9	10.22497	
Force1	26.5778	9	5.23946	0.909
Force2	26.6444	9	4.98877	
Velocity1	229.5556	9	26.71662	0.371
Velocity2	233.7778	9	34.18252	

1-with sports shoes on; 2- with-out sports shoes on

Based on the significance of the T-test for the two dependant samples, it is concluded that the results of the examinees, gathered from testing the jumping without sports shoes on, are not statistically-significantly different from the results of jumping with sports shoes on.

The current research results may be compared to those of Brizuel, Lian, Ferradins & Garcia- Belenguer (2010), which determined, using ultra fast camera, dynamometer and accelerometer, the influence of different sports shoes prototypes on vertical jump height and the speed of running with obstacles in basketball players. The difference between shoes was reflected in heel height: the first shoes prototype was with high heel, while the other one was with flat sole. Otherwise, in case of both prototypes the sole was made of the same material. Testing with high heel shoes resulted in smaller CMJ height, smaller range of the eversion and the bigger range of the inversion in ankle joint during the landing, as well as with the increased time duration, necessary for the accomplishment of the running on/across given polygon with obstacles, compared to the testing with the shoes with flat sole.

Kreamer, Ratamess, Volek, Mazetti, & Gomez (2000) determined that wearing the shoes with flexible sole, which puts the users heel in position lower than the front part of the foot, increases the final height reached during the vertical jump performance.

Snab & Larkins (1993) created their sports shoes by positioning the heel in a significantly lower position compared to the front part of the foot, which is not the case in conventional shoes which always have positive sole inclination. With negative inclination they improved three performances within the explosive movement area: a) vertical jump's height is increased; b) foot acceleration and speed are increased; c) possibility of injuries is lowered. Also, research results aren't in accordance to the current research results, which indicates that there is no statistically significant difference in jump height and velocity.

CONCLUSION

In both cases, by activating the leg's muscles, i.e., by the contraction of mm. Quadriceps, as well as by flexing the knee-joints, examinees have successfully absorbed vertical force of high intensity during the landing. Additionally, proper landing has been made possible by a plantar flexion in ankle joints and by the activation of mm. Triceps surae, i.e., by the collision of the front parts of the foot with the ground, which is especially characteristic in the instances when the examinees were performing CMJ with no shoes on. However, greater stretching of the Achilles tendon in the case when the examinees were

performing CMJ without shoes on, didn't generate greater muscle strength, i.e., it didn't result with statistically significantly greater jump height in relation to the jump with sports shoes on. There is a lack of available researches by which differences between the manifested explosive strength are interrogated, by using the/ doing the vertical jump with conventional sports shoes on and without them. Further researches on this topic are necessary, and the results will be especially interesting in the examinees with known flat feet deformity.

REFERENCES

Bartlett, R. (2007). *Introduction to sports biomechanics-Analysing human movemet patterns*. Second edition. Routledge: London and New York.

Brizuela, G., Liana, S., Ferrandis, R., & Garcia-Belenguer, A.C. (2010). The influence of basketball shoes with increased ankle support on shock attenuation and performance in running and jumping. *Journal of Sports Sciences*, 15 (5), 505-515.

Bruggemann, G.P., Potthast, W., Braunstein, B., Niehoff, A. (2005). Effect of increased mechanical stimuli on foot muscles functional capacity. Proceedings of the ISB XXth Congress - ASB 29th Annual Meeting, July 31 - August 5, held in Cleveland, Ohio, USA, p.553.

Ebben, W. P. (2005). Practical guidelines for plyometric intensity. *NSCA's Performance Training Journal*, 6 (5), 12-16.

Goldmann, J.P., Sanno, M., Willwacher, S., Heinrich, K., & Bruggemann, P. (2011). Effects of increased toe flexor muscle strength to foot and ankle function in walking, running and jumping. *Footwear Science*, 3 (Suppl. 1), S59.

Kraemer, W.J., Ratamess, N.A. , Volek, J.S., Mazzetti, S.A., & Gomez, A.L. (2000). The effect of the Meridian shoe on vertical jump and sprint performances following short-term combined plyometric/sprint and resistance training. *Journal of Strength and Conditioning Research*, 14 (2), 228-238.

Newton, R.U., & Kreamer, W.J. (1994). Developing explosive muscular power: Implications for a mixed methods training strategy. Strength and Conditionig Research.

Pallant, J. (2007). *SPSS Survival Manual*. Third Edition, Allen & Unwin.

Robbins, S., & Waked, E. (1998). Factors associated with ankle injuries: Preventive measures. *Sports Medicine*, 25 (1), 63-72.

Shinohara, J, & Gribble, P. (2009). Five-toed socks decrease static postural control among

healthy individuals as measured with time-toboundary analysis. Available on: http://runsnrc.org/RUNSNRC/Clinic_-_Supporting_Research_files/Shinowara.pdf

Snab, J.C., & Larkins, C. (1993). Athletic shoes with reverse slope construction. Available at: http://www.google.com/patents?hl=en&lr=&vid=USPAT5491912&id=NcgbAAAAEBAJ&oi=fnd&dq=vertical+jump+barefoot+and+in+sport+shoes&printsec=abstract#v=onepage&q&f=false Date of patent: Feb. 20, 1996.

Squadrone, R., & Gallozzi, C. (2009). Biomechanical and physiological comparison of barefoot and two shod conditions in experienced barefoot runners. *The Journal of Sports Medicine and Physical Fitness*, 49 (1), 6-13.

RAZLIKA U ISPOLJENOJ EKSPLOZIVNOJ SNAZI UTVRĐENA PRIMENOM VERTIKALNOG SKOKA

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SAŽETAK

Cilj istraživanja bio je da se kvantifikuje eksplozivna snaga donjih ekstremiteta i da se utvrdi da li postoji razlika u ispoljenoj eksplozivnoj snazi donjih ekstremiteta ispitanika u uslovima sprovođenja skoka sa počučnjem (CMJ) sa i bez sportske obuće. U istraživanju je učestvovalo 9 ispitanika muškog pola, studenata Fakulteta sporta i fizičkog vaspitanja Univerziteta u Nišu, starosti 22.78±1.394 godina, telesne visine 185.167±5.579 cm, telesne težine 81.711±7.700 kg, indeks telesne mase (BMI) 23.9111±2.57072, masnog tkiva 18.5667±4.16953 u procentima (Mean±St.Dev.). Ispitanici su na inicijalnom i finalnom merenju izveli po pet CMJ. Bežičnim akcelerometrom Myotest (Sion, Švajcarska) utvrđena je vrednost sledećih varijabli: 1) Height (visina izražena u cm); 2) Power (snaga izražena u W/kg); 3) Force (sila izražena u N/kg); 4) Velocity (brzina izražena u cm/s). U obradi podataka korišćeni su Kolmogorov-Smirnov test i T-test. Na osnovu značajnosti T-testa za dva zavisna uzorka zaključuje se da se rezultati grupe ispitanika postignuti prilikom skoka bez patika ne razlikuju statistički značajno od rezultata postihnutih prilikom skoka u patikama. Neophodna su dalja istraživanja na ovu temu, a rezultati će naročito biti interesantni kod ispitanika sa utvrđenim deformitetom ravnih stopala.

Ključne reči: Skok sa počučnjem, studentska populacija, eksplozivna snaga, razlika.

PROFESSIONAL COMMUNICATION IN ACTIVITY OF SPA SPECIALISTS

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UDC 796.015.132

SUMMARY

Introduction: Intensive development of the contemporary SPA industry requires the creation of a specialized professional preparation and a specific kind of communication of specialists in this area. The aim of the study is to outline the role of professional communication in the activity of SPA specialists.

Methods: The study was conducted on a sample of 50 clients of SPA center in Regensburg, Germany. The method of survey used is a special questionnaire with fixed and open questions. The data was measured with alternative and content analysis.

Results: Positive attitudes and the satisfaction of clients in the SPA center with activity and communication of SPA specialists is established. The atmosphere in the SPA centre is defined as positive, vital and emotional. The clients do not mention any conflicts between them and the SPA specialists. At the same time recommendations for future activities were given.

Conclusion: Communication is an important part of the professional preparation and competency of the contemporary SPA specialists. Special standards of professional behaviour of SPA specialists in the process of interaction with the clients must be created. Future qualification of the SPA professionals requires participation in specialized communicative trainings and the application of specific interactive teaching methods.

Key Words: Clients, SPA centre, preparation, satisfaction

INTRODUCTION

Wellness and SPA industry has been developing intensively since the end of the 70-80s of the XX century with the changes in the modern lifestyles (Димитрова, 2009, 2010; Йорданов, 2007). In their spare time people start looking for more opportunities for physical and spiritual unloading of everyday life, strive for perfection and positive emotional experiences (Милева, 1995, 2005; Динев, Томова, 2006). Modern people want to feel happy in a new way.

The statistic that has been discussed in the European Commission (2010) shows that annually over the next decade, on average, 40 million Europeans will retire and thus they become members of social and health services within the European Union. Citizens of the European countries in their working age with daily stressful situations are millions and they become victims of socially significant diseases of various kinds. Prevention will become a focus on health and social policy of the community in the coming years.

A significant part of the European citizens that has needed health prevention in the recent years has visited centers which offer Wellness and SPA services. These centers are directed at clinically healthy people - physically and creatively active clients. The contemporary SPA centers, studios and hotels are visited by the people of different ages. Made in a modern style, these places use therapeutic properties of the water.

METHODS

Intensive development of the contemporary SPA industry requires a creation of specialized professional preparation and specific kind of communication of specialists in these area.

The following hypothesis of the study is defined: the satisfaction of the customers' activities in SPA centers is associated with the implementation of specific methods of communication between the therapist and clients. In this context the aim of the research is to determine the customers' satisfaction with the services in SPA centers and to outline the role of professional communication in the activity of SPA specialists.

The sample of this study consists of 50 clients of the SPA center in Regensburg, Germany – 29 male (58%) and 21 female (42%).

The method of survey used is a special questionnaire with fixed questions. It also includes questions that required free expression of opinion on the part of the respondents.

For the processing of the results the following statistical methods are applied:

- Alternative analysis (establishing share) - for processing the responses to the closed questions of the survey.
- Content analysis – for processing the responses to the open questions in the questionnaire. For this purpose key semantic units, to which the answers of the respondents were referenced, were identified.

RESULTS

It is clear that the SPA center in Regensburg is visited mainly by those people who work with their own funds - 66%. At the same time the students have an interest in the SPA center, who make up about one-third of the visitors or 34%. The age of the customers ranges from 15 to 73 years which represents a wide age range. Contrary to the well established notion that SPA centers are mainly visited by young people the proportion of clients aged between 26 and 73 is 64%. The relative share of the customers from the youngest age group between 15 and 25 is 36%.

Positive attitudes and the satisfaction of the clients with the activity and communication of the SPA specialists is established. The atmosphere in the studied SPA center in Germany is defined as positive, vital and emotional by all the examinees (100%). Nobody evaluates the atmosphere in the center as negative.

The answers to the next question outline the reasons for the clients' participation in SPA services.

The main reason for using the services of the SPA center is "better health" - 76% (fig.1). Secondly, relatively equal percent has the "improving the appearance" of the customers - 74%. A high percentage have the reasons such as "fun and relaxation" - 58% and "improving efficiency" - 52%. Another important motive is the "creation of new social contacts" – 38%.

Comparatively low relative share have reasons such as "recovery from trauma" - 18% and visiting the SPA center "under the influence of relatives and friends" - 6% (answering the question exceeds 100% because of the possibility of giving more than one answer).

The question of whether customers are satisfied with the way of communication with the therapist during the procedures examinees answered that they feel good with the experienced therapists. They are satisfied with the way of communication with them – 98%.

Very high is the proportion of customers who responded that the methods and approaches of communication by the therapist in the SPA center are appropriate "to a great extent" and "to a very great extent" - 98%.

Some of the customers specify particular difficulties in communication at the SPA center in Regensburg. As such, most common difficulties mentioned are a lack of availability, non-stipulated office hours and delayed procedures.

In regard to the occurrence of conflicts in communication with the therapist the clients do not

mention any conflicts between them and the SPA specialists.

It is clear that the therapists generally manage to satisfy the wishes and the interests of the clients in terms of SPA treatments. In this way customers leave the SPA center satisfied and happy.

At the same time some recommendations for the future activity by the customers were given.

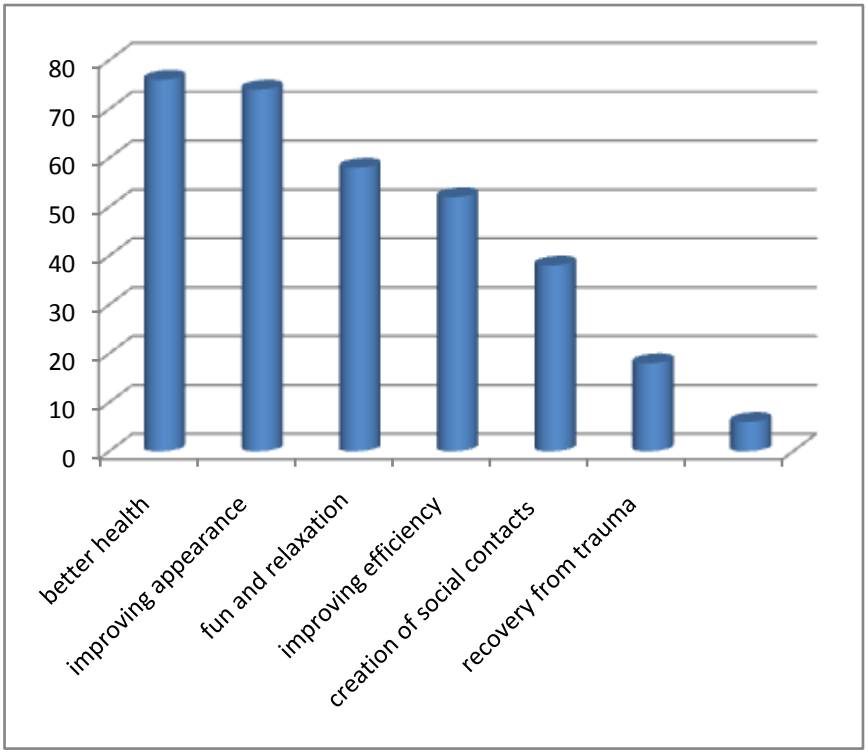

Figure 1. Reasons for visiting the SPA center in Regensburg

DISCUSSION

Results of the customers' satisfaction with the services and methods of communication in the SPA center in Regensburg confirm the data from our previous studies in Bulgaria (Е. Милева, М. Ацева, 2011, 2012). There are no significant differences in the perceptions and attitudes of the customers to communication with the therapists in Bulgaria and Germany. This points out the established practices in the SPA industry, which require professional standards of communication in this area.

CONCLUSION

Communication is an important part of the professional preparation and competencies of the contemporary SPA specialists. Special European standards for the professional behaviour of SPA specialists in the process of interaction with the clients must be worked out.

Future qualification of the SPA professionals requires participation in specialized communicative trainings and the application of specific interactive teaching methods.

REFERENCES

Димитрова, Б. (2009). *SPA култура и аква практики.* София: Авангард.

Димитрова, Б. (2010). *Аква практики. Ръководство за ОКС "Магистър"*. София: Авангард Прима.

Динев, П., Сн. Томова. (2006). *Спорт и рекреация*. Варна: ИУ.

Йорданов, Й. (2007). *СПА и Уелнес туризъм*. София.

Милева, Е. (1995). Феноменът фитнес – естетика и бизнес, - *Спорт и наука*, *2, 35-40*.

Милева, Е. (2005). *Алтернативна педагогика в спорта.* София: Авангард Прима.

Милева, Е., М. Ацева. (2011). Методи на общуване в условията на СПА дейности. *Личност. Мотивация. Спорт, том 16,* София: НСА ПРЕС, 145-152.

Милева, Е., М. Ацева. (2012). Удовлетвореност на клиенти от услугите и общуването в SPA център, - *Спорт и наука*, *извънреден брой 1,* 58-65.

THE STRUCTURE OF MOTOR COORDINATION IN THE PE STUDENTS OF BOTH GENDER

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SUMMARY

Introduction: While male and female characteristics are traditionally attributed to some sports, or preferred physical activities, contemporary trends are going toward changing the gender inequality in sport and physical education. In this research emphasis is placed on identifying the factor structure of motor coordination, because it determines the fundamental base of some segments of motor dimensions. This research aims to determine gender specific factor structure of coordination skills in PE students, and possible gender differences.

Methods: The sample involves the first year students (N=36, M=24, F=12) of the Faculty of Sport and Physical Education (FSPE) at the University of Niš, aged 19 to 26. Students' motor coordination abilities were made operational by the scores from ten tests. All the analyses (descriptive statistics, factor analysis) were carried out by the statistical package for data processing SPSS 10.0.

Results: The applied factor analysis produced two factors, and showed some gender differences in the set of tests for the motor coordination assessment.

Conclusion: The results indicate that male and female FSPE students differ in the structure of coordination skills, which is expected, due to their different anthropometrical status.

Key words: PE studies, coordination abilities, factor structure, gender differences

INTRODUCTION

The processes of selection, direction, and monitoring, in the field of sports and in other activities, are unthinkable without the information on the structure of the anthropological dimensions of an individual. In the field of sports, first of all we need information on the motor dimensions of athletes, similar to the evaluation of the study on the efficiency of the specific selected examinees (e.g. Students of the Faculty of Sport and Physical Education) in relation to the motor status. Motor competence can be conceptualized as a person's ability to execute different motor tasks, including the coordination of both fine (e.g. manual dexterity), and gross motor skills (e.g. static and dynamic balance) (Henderson & Sugden, 1992), and it is also important because it can serve as an indicator of different aspects of development in children and adolescents (Piek et al., 2006).

The ability to perform complex movements, known as the motor coordination, is one of the substantial determinants of the development of the body as a whole. Although this capability is largely innate (80-85%) (Stojiljković, 2003), its development is being reproduced over a longer period of life. The reason for the prolonged development of coordination, which ends later than the development of most other motor abilities, lies in the fact that coordination is the most complex motor ability that is being saturated through its relations to all other abilities (Katić, Srhoj & Pažanin, 2005).

Due to the exceptional potential importance of the coordination skills for the process of orientation,

selection and monitoring in the field of sports and physical education, to this issue is given special attention, since research in the field of coordination never gets old, and its structure defining has started far back as the 70s (Hošek, 1976; after Cvenić, 2007). Therefore, this research aims to determine the factor structure of the coordination abilities of both male and female students of the Faculty of Sport and Physical Education (FSPE), and any differences.

METHODS

Sample of examinees

The sample consisted of 36 (M=24, F=12) FSPE students in Niš, aged 19-26. Baseline characteristics of the sample are presented in Tab. 1.

TABLE 1 Baseline characteristics of FSPE students

Groups	Variable	Mean±SD	Median	Range
M students N=24	*Age*	20.43±1.73	19.9	19.26 – 26.09
	Height	178.11±5.39*	178.3	165.1 – 191
	Weight	74.41±9.59*	74.95	58.5 – 89.3
F students N=12	*Age*	20.36±1.29	19.91	19.12 – 22.9
	Height	164.16±7.83	163.4	155.5 – 179
	Weight	60.86±8.81	58.05	49.2 – 75.8
Total N=36	*Age*	20.4±1.58	19.9	19.12 – 26.09
	Height	173.46±9.1	176.2	155.5 – 191
	Weight	69.89±11.26	69.4	49.2 – 89.3

Legend: N – number, **M –** male, **F –** female, **Mean –** average value, **SD** – standard deviation.
Note: Age is presented in years, height in cm, and weight in kg.

Sample of measuring instruments

This study analyzes the structure of two isolated factors (by principal components method), based on a set of 10 motor coordination variables (Metikoš et al., 1989): 1. MKAVLR - Handball dribbling with one hand (0.1 sec), 2. MKAAML - Basketball amortization with one hand (points), 3. MKLSNL - Legs slalom with two footballs (0.1 sec), 4. MBKPOP - Crawling and jumping through and over Swedish box frames (0.1 sec), 5. MBKPIS - Climbing over Swedish bench and pooling down the wall bars (0.1 sec), 6. MAGOSS - "Eight" with bending (0.1 sec), 7. MREPOL - Backward polygon (0.1 sec), 8. MAGKUS - Side steps (0.1 sec), 9. MAGONT - Floor agility (0.1 sec), 10. MKTOZ - Air agility (0.1 sec). All of the measured variables (except MKAAML) have inverse values (i.e. less is better). The measures were taken in February 2013, at FSPE in Niš, and the testing was conducted in agreement with the principles stated in the Helsinki Declaration (WMA, 2002).

Statistical procedures

All analyses (descriptive statistics, factor analysis) were carried out using the Statistical Package for Social Sciences, version 10.0 (SPSS 10.0, SPSS Inc, Chicago, USA).

Principal component analysis (PCA) was carried out in three main steps:

Step 1: Review the appropriateness of the factor analysis steps. When determining the appropriateness of the given set of data for factor analysis, above all two main issues need to be considered: sample size and the strength of connections between variables. In the case of small samples, as in our study, the correlation coefficients between the variables are less reliable and often change from one to another sample. It is because the factors obtained from small data sets, when used at all, give worse results than those obtained from large

samples (Tabachnick & Fidell, 2007; after Pallant, 2011, 183).

Step 2: Factors extraction. The extraction of the factors includes determining the minimum number of factors that are representative of the interconnections in the set of variables. Usually PCA is used. Researchers themselves should determine the number of factors that, in their opinion, best describe the relationship between the variables. That means finding a balance between two contradictory demands: to find a simple solution with the smallest possible number of factors, and the need to explain as much of the variance of the manifest data set.

Step 3: Rotation and interpretation of factors. When the number of factors is determined, the next step is to try their interpretation. To facilitate this process, the resort to the factors "rotation" is the solution. Rotated factors can be orthogonal (uncorrelated), or oblique (correlated). These two broad categories of rotation involve several different techniques of SPSS. The *Varimax method* is the most used orthogonal rotation, which attempts to minimize the number of variables with high absolute values of factor weights (mass). The most used oblique rotation is *Direct Oblimin*. After the rotation, the researchers are hoping to get a "simple structure" (Thurstone, 1947; after Pallant, 2011, 187).

RESULTS AND DISCUSSION

A factor analysis was conducted and it showed that there is a difference in the association of individual characteristics of male (N=24), and female students (N=12), which is shown graphically.

The structure of two extracted factors in the set of variables for the motor coordination assessment

TABLE 2 Correlation matrix

Variables	MKAVLR	MKAAML	MKLSNL	MBKPOP	MBKPIS	MAGOSS	MREPOL	MAGKUS	MAGONT	MKTOZ
MKAVLR	1.000									
MKAAML	-.244	1.000								
MKLSNL	**.546**	-.236	1.000							
MBKPOP	.174	**.300**	.149	1.000						
MBKPIS	.238	.157	.82	**.684**	1.000					
MAGOSS	**.604**	**-.366**	**.431**	.261	**.456**	1.000				
MREPOL	.45	.128	.37	**.552**	**.495**	.253	1.000			
MAGKUS	**.643**	-.238	**.382**	.189	**.369**	**.725**	.285	1.000		
MAGONT	**.469**	-.16	.287	**.653**	**.808**	**.596**	**.429**	**.479**	1.000	
MKTOZ	.297	.123	.00	**.576**	**.611**	.190	.213	.172	**.519**	1.000

Legend: MKAVLR - handball dribbling with one hand (0.1sec), **MKAAML** - Basketball amortization with one hand (points), **MKLSNL** - Legs slalom with two footballs (0.1sec), **MBKPOP** - Crawling and jumping through and over Swedish box frames (0.1sec), **MBKPIS** - Climbing over Swedish bench and pooling down the wall bars (0.1sec), **MAGOSS** – "Eight" with bending (0.1sec); **MREPOL** - Backward polygon (0.1sec), **MAGKUS** – side steps (0.1sec), **MAGONT** – floor agility (0.1sec), **MKTOZ** – air agility (0.1sec).

After examining the Tab. 2, it can be seen that the highest positive correlation (.808) is between the variables MAGONT, and MBKPIS, while the highest negative correlation (-.366) was found between the variables MAGOSS, and MKAAML.

TABLE 3 Characteristic roots and its percentage

Variables	Root	%	Sum
MKAVLR	4.227	42.267	42.267
MKAAML	2.203	22.032	64.299
MKLSNL	.880	8.802	73.101
MBKPOP	.793	7.928	81.029
MBKPIS	.606	6.063	87.092
MAGOSS	.451	4.509	91.601
MREPOL	.263	2.633	94.234
MAGKUS	.251	2.506	96.740
MAGONT	.203	2.026	98.766
MKTOZ	.123	1.234	100.000

The percentage of the characteristic roots (Tab. 3) ranges from 1.234% to 42,.67%. The newly obtained structure consists of two separate factors, which include 64.299% of the information of the entire sections of the examined motor coordination.

The structures of the extracted factors of motor coordination

The whole of 10 motor coordination variables was reduced in two separate factors/components (Tab. 4). A significant contribution of the selected factors (**qlt**), for the various parameters of motor coordination, was found in all 10 of the applied variables. *Higher values of communality* are in: MBKPIS (813), MAGONT (803), MBKPOP (775), MAGOSS (769), MKAVLR (686), and MAGKUS (683). *Moderate communality values* indicate that the structure of the two separate factors include a moderate amount of information on the four variables in motor coordination, such as: MKTOZ (512), MKAAML (493), MKLSNL (473), and MREPOL (424).

TABLE 4 Characteristics of two extracted factors of motor coordination

		1. factor			2. factor		
Variables	**qlt**	**krd**	**cor**	**ctr**	**krd**	**cor**	**ctr**
MKAVLR	686	-648	420	99	516	266	121
MKAAML	493	75	6	1	-698	487	221
MKLSNL	473	-436	190	45	531	282	128
MBKPOP	775	-697	485	115	-538	290	131
MBKPIS	813	-805	648	153	-406	165	75
MAGOSS	769	-755	571	135	445	198	90
MREPOL	424	-532	283	67	-376	141	64
MAGKUS	683	-699	489	116	440	194	88
MAGONT	803	-885	784	185	-139	19	9
MKTOZ	512	-593	351	83	-401	161	73
				1.000			

Legend: MKAVLR - handball dribbling with one hand (0.1sec), **MKAAML** - Basketball amortization with one hand (points), **MKLSNL** - Legs slalom with two footballs (0.1sec), **MBKPOP** - Crawling and jumping through and over Swedish box frames (0.1sec), **MBKPIS** - Climbing over Swedish bench and pooling down the wall bars (0.1sec), **MAGOSS** – "Eight" with bending (0.1sec); **MREPOL** - Backward polygon (0.1sec), **MAGKUS** – side steps (0.1sec), **MAGONT** – floor agility (0.1sec), **MKTOZ** – air agility (0.1sec), **qlt –** value of communality, **cor –** amount of contribution.

In forming the structure of the each extracted factor, all of the motor coordination variables contribute. There are no variables that do not affect the formation of the factors' structure, indicating their simple structure. *The structure of the first extracted factor* is composed of six motor coordination variables, and indicated by the amount of contributions (**cor**): MAGONT (784), MBKPIS

(648), MAGOSS (571), MAGKUS (489), MBKPOP (486), MKAVLR (420). The latent contribution to the structure gave variables MKAVLR (352), and MREPOL (283). *The structure of the second extracted factor* is defined with one motor coordination variable: MKAAML, with factor contribution of 487. The latent contribution to the structure gave variables MBKPOP (290), and MKLSNL (283). *The contribution of the several factors* to the segment can be seen in MBKPOP: factor-1 (485), factor-2 (290). It can be said that to the formation of the two factors structure the first group of subjects (male students, N=24) contributes the most. That is, to the formation of the extracted factors structure contribute all of the 10 variables (100%) of the battery of the tests for the motor coordination assessment.

The unity of eigenvalues of the participants' motor coordination, and the structure of the extracted factors

The analysis of the sample of 36 participants reveals that, in forming the structure of the two extracted factors, high contribution included 13 examinees (36.11%), moderate contribution included nine examinees (25%), and low contribution, without significance- 14 examinees (38.89%).

In 14 examinees (38.89%) the motor coordination variables are highly compatible with the structure of the first extracted factor. Latent consent with the structure was found in four examinees (11.11%). In seven examinees the proportional relationship is noted, and in 11 examinees the correlation is inversely proportional.

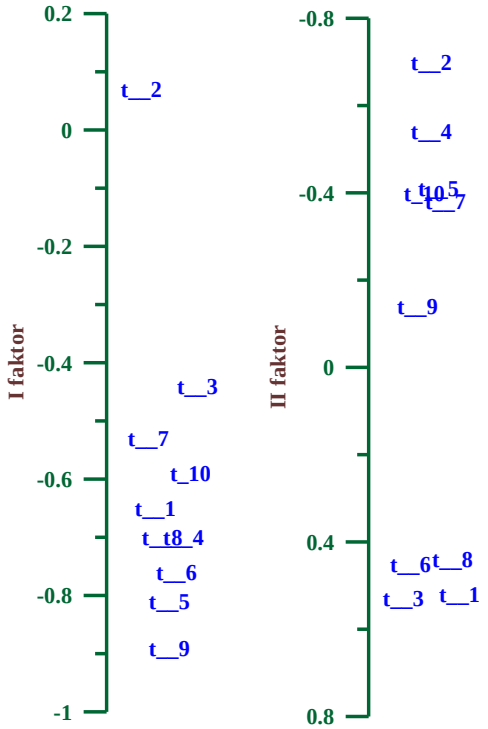
In four examinees (11.11%) the motor coordination variables are highly compatible with the structure of the second extracted factor. Latent consent of the structure was found in six examinees (16.67%). In the same number of the examinees (N=6) the proportional relationship is noted, and in four examinees the correlation is inversely proportional.

TABLE 5 The mutual contributions between-groups divisions and separated structures of factor analysis of the motor coordination variables

			1-factor			2-factor		
	mass	**inr**	**krd**	**cor**	**ctr**	**krd**	**cor**	**ctr**
Group 1 (M)	641	52	904	1.000	124	18	0	0
Group 2 (F)	359	93	-1614	1.000	221	-33	0	0

Legend: M – males, **F –** females, **mass –** weight coefficient, **inr** - inertia, **cor** – amount of contribution.

The observation of the Tab. 5 shows that the largest weight coefficient (**mass**) (641) is found in male students' class (Group 1), which means that most of the sample belonging to a class is in that class, which corresponds to the weight coefficient. The following weight coefficient (359) is found in female students' class (Group 2). Inertia (**inr**) of the female students' class is 93, which means that it stands out from the most of other classes, and the next inertia, found in the male students' class, is 52. The relative contribution (**cor**) of the first factor to the male students' class, as well as to the female students' class, is high (1.000). The relative contribution of the second factor to the classes of students, both male and female, is of no importance (0).



Graph 1. The ilustration of the motor coordination variables in separated factors structures

CONCLUSION

The total of 10 motor variables, which concern the segment of the whole body coordination, have undergone the principal component analysis (PCA). Prior to the implementation of the PCA, the data suitability for factor analysis was estimated. The inspection of the correlation matrix revealed many coefficients' values of 0.3, and above.

PCA revealed the presence of two components with characteristic values above 1 (4.227; 2.203), which explained 42.27%, and 22.03% of the common variance. Based on Catel criteria it was decided to retain two components for further exploration. This two-component solution explained the total of 64.299% of the variance, with following contributions of the first and second factor: 42.27%, and 22.03%, respectively.

To help the interpretation of these two components, Oblimin rotation was performed. Rotated solution revealed the presence of the "simple structure", in which both components have sufficient factor weight, and the most of the variables give considerable weight only by one of the components. The interpretation of the two components was conditioned by the manner of motor tasks' performance, which is also consistent with previous studies, in which the variables with inverse values (MKAVLR) gave great weight to the 1st factor, whereas the 2nd factor was marked with the variable of repeated number attempts (MKAML).

REFERENCES

Cvenić, J. (2007). Neke metrijske karakteristike testa za procjenu koordinacije (Some metric characteristics of motor coordination assesment tests). *16. ljetna škola kineziologa republike Hrvatske* (str. 415-419). Zagreb: Hrvatski kineziološki savez.

Henderson, S. E. & Sugden, D. (1992). *The Movement Assessment Battery for Children*. London: The Psychological Corporation.

Katić, R., Srhoj, Lj. & Pažanin, R. (2005). Integration of coordination into the morphological-motor system in male children aged 7–11 years. *Coll Antropol*, *29*(2), 711-716.

Metikoš, D., Hofman, E., Prot, F., Pintar, Ž. & Oreb, G. (1989). *Mjerenje bazičnih motoričkih dimenzija*

sportaša (Measuring of basic motor dimensions in athletes). Zagreb: Fakultet za fizičku kulturu.

Pallant, J. (2011). *SPSS Priručnik za preživljavanje (SPSS Survival Manual).* Beograd: Mikro knjiga.

Piek, J. P., Baynam, G. B. & Barrett, N. C. (2006). The relationship between fine and gross motor ability, self-perceptions and self-worth in children and adolescents. *Human Movement Science*, *25*, 65-75.

Stojiljković, S. (2003). *Osnove opšte antropomotorike (Fundamentals of general anthropomotorics)*. Niš: Studentski kulturni centar.

STRUKTURA MOTORIČKE KOORDINACIJE CELOG TELA KOD STUDENATA FSFV OBA POLA

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SAŽETAK

Uvod: Dok se muške i ženske karakteristike tradicionalno pripisuju nekim sportovima ili fizičkim aktivnostima, savremeni trendovi idu u pravcu promene neravnopravnosti polova u sportu i fizičkom vaspitanju. U ovom istraživanju akcenat se stavlja na strukturu faktora motoričke koordinacije, jer ista određuje osnovnu bazu nekih segmenata motoričkog prostora. Cilj ovog istraživanja je da se utvrdi specifična struktura faktora koordinativnih sposobnosti studenata i studentkinja, kao i uporede eventualne razlike po polovima.

Metode: Uzorak obuhvata grupu od 36 studenata (M=24, Ž=12) Fakulteta sporta i fizičkog vaspitanja (FSFV) Univerziteta u Nišu, starosti 19 do 26 godina. Koordinativne sposobnosti studenata operacionalizovane su rezultatima merenja kod deset varijabli. Statistička obrada podataka (deskriptivna statistika, faktorska analiza) je realizovana pomoću SPSS 10.0.

Rezultati: Primenjena analiza faktora proizvela je dve komponente, a ukazala i na polno specifične razlike u skupu testova za procenu motoričke koordinacije celog tela.

Zaključak: Rezultati ukazuju da se studenti i studentkinje FSFV razlikuju u strukturi koordinativnih sposobnosti, što je i očekivano, zbog njihovih različitih antropometrijskih karakteristika.

Ključne reči: FSFV studije, koordinativne sposobnosti, faktorska struktura, polne razlike

AN EXCERPT FROM THE HISTORY OF THE SCIENCE OF SPORT AND PHYSICAL EDUCATION

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UDC 93/99 : 796

SUMMARY

The aim of this paper is to represent the beginnings of the study of human kinetics and human physical abilities which reach back to the age of great ancient civilizations, Ancient Greece, Rome and India. The leading thinkers of the time explained man's motor skills as the soul'smysterious control over the body. In their work they presented practical advice on how and why one should exercise, but with insufficiently developed methods of research they were not able to fully explain the nature of human kinetics or the physiological processes which are the response to increased physical activity. However, in addition to that, through very significant basic research and discoveries in the fields of anatomy, physiology and medicine, they laid the foundation for the further development of the science of motion, that is, the science of sport and physical education, as as it is called today. Finally, at the end of the 19th and the beginning of the 20th century, a scientific discipline was formed which would unite the biomedical and social-humanistic approach to the study of movement. This paper will also present the most prominent scientists who as individuals contributed to the development of this field of science with their research.

Key words:science, history, kinesiology, sport and physical education

INTRODUCTION

For the science of sport and physical education we could say that it is as old as man's longing to achieve some kind of sports result. Athletes and their coaches were always ready to adopt the behavior of other athletes and coaches who achieved their desired results, believing that the applied program will also guarantee them success. These examples date as far back as ancient times. As sport gained ever increasing popularity over time, and the risk for the health of the athlete with the increase in load became even greater, a group of scientists, primarily physicians and physiologists got more and more interested in the research in the field of sport by creating a new field of science with the aim of pushing the limits of top sport results, but also with the aim of improving the health of the entire population. Over time several sub-disciplines would form within the science of sport and physical education, each of which would have a different target group and final aims and tasks (physical education science, sports science, recreational physical exercise which is primarily focused on the activities of adults and the elderly, the science of the physical activity of individuals with special needs and so on).

The origin of human kinetics and the relations between movement and the systems which control it have fascinated scientists from the time of the great Ancient Greek philosophers. At the time, the connection between movement and the central nervous system (CNS) was generally described through the connection of the body, which is in constant movement, and the soul which controls that movement. As an example we could use Plato, who saw movement as the reflection of the immortal soul, which according to him was a characteristic and

unbreakable unity found in all animals able to perform voluntary movement. Aristotlewas probably the first to start separating a specific characteristic of human kinetics as a separate ability. That was coordination. In the second century A.D. the famous Roman physician Galen, who was rightfully considered the founder of sports medicine, pointed out that the voluntary movement of certain segments of the human body is controlled by the soul which sends signals through the nervous system through the 'animal soul'. The classic Greco-Roman understanding of the relationship between the soul and body was succinctly put by St. Augustine: 'The way the soul fits with the body is completely wondrous and cannot be understood by man; it is man himself.' (De Monteign, 2003:489).

The complexity of the research of human kinetics is reflected in the fact that man is a very complex being and that a great number of completely different scientific disciplines have as the subject matter of their research human kinetics, that is, motor skills, viewed through the various aspects of its manifestation. For example, biomechanics as a scientific discipline is primarily focused on the research of the humanlocomotor apparatus viewed through the kinematic or dynamic model, while the structure and anatomic build of the muscles is pushed to the background and is the subject of interest only in the function of movement. Unlike biomechanics, in surgery as a branch of medicine, the situation is quite opposite, as in this case the anatomic part is the essence and basis of any further improvement(Klette& Tee, 2008).

We cannot neglect the fact that man's movement was often throughout history the subject matter of the study of artists who viewed motor skills primarily through their esthetic dimension, and found inspiration for their exceptional works of art in it. Art has definitely for centuries been the main force of behind the study of human movement (Leonardo da Vinci). Sculptures, reliefs, and other works of art from ancient times demonstrate and confirm an advanced level of knowledge of the movement of people and animals. At that time mathematics was to a great extent used for the description of various positions and movement of both people and animals, which is visible in the artwork from ancient times. The artist was faced with no easy task of using the static impression of a work of art represent the various models of movement. The dynamic representation of movement was made possible only two thousand years later when, at the end of the 19th century, the first movies were made.

RESEARCH OF MOVEMENT IN THE ANCIENT TIME

The beginnings of the study of human motor skills can be found in the words of ancient philosophers and scientists. The ancient philosopher Aristotle among his numerous published works published a short text entitled 'On the motion of animals' (Stojiljković, 2003) in which he wrote about the walking skills of animals. He defined locomotion as the 'part which animals use to relocate themselves in space'. In this text Aristotle wrote about very interesting questions related to the issues of human motor skills such as the question 'Why do people and birds walk on two legs, and fish have no legs?' and the question 'Why are there great differences in the curvature of the legs and bend of the knees among humans and birds, even though they both walk on two legs?' In his work he also connectedhuman movement with the basics of geometry wherehe says 'when one leg is put forward it becomes the hypotenuse of a right-angled triangle. This means that its square is equal to the sum of the squares of the length of theleg and the square of the length of the step. Since thelength of both legs is equal that means that the leg which is at rest must be bent at the knee.' Aristotlealso described the first experiments which as the subject matter of their research hadhuman kinetics. One of these examples was the experiment in which he asked the question why in the case when man moves parallel to a wall the shadow his head makes on the wall is not a straight line but a broken,zig-zag line. This one of

Aristotle's texts was the first known written document which in a way represented biomechanical research. In addition to the aforementioned examples he made very detailed observations of the models of movement of man during his involvement in various activities.

The greatest contribution to the development of the scientific approach to physical exercise in ancient times came from three doctors: Herodicus(480 - ? B.C.), Hippocrates (460 - 370. B.C.)andGalen (129 – 210. A.D.) (Berryman, 1992). The first to study 'therapeutic gymnastics' or 'gymnastics medicine' as it was often called was the ancient Greek doctor and former paidotribe, Herodicus. Herodicuswas a boxing instructor and wrestling coach who believed that even his weakest student could become strong withthe help of exercise(Olivova, 1984). He also believed that it was also important to work on the prevention of disease through physical exercise as well as treatment when the disease has already set in. Herodicusalso considered physical exercise to be one of the duties of the doctor which had to be realized within the wider field which will be known as conservative medicine or hygiene (Blundell, 1864). In a biographical text on Herodicuspublished in 1819, in the work *Encyclopedia* (Rees et al., 1819), it was written that Herodicuswas a high school teacher and that he dedicated his career to 'gymnastic medicine', defining the rules for the most suitable form of exercise, taking into consideration the age, body type, and health status of the patient, but also the climate, season and so on.

The second big name in ancient Greece is Hippocrates whose opinions on physical exercise and diet, which accompanied physical exercise, many historians believed to have been developed under the strong influence of Herodicus. Hippocrates is accepted the world over as 'the father of medical science' and doctors all over the world still take the Hippocratic oath before taking on their duties (Precope, 1952). Hippocrates wrote two very significant works in which he paid special attention to physical exercise. The first volume is entitled *Regimen in Health* (Hippocrates, approximately 400. B.C., pg. 45-59) and consists of nine short chapters. The first seven chapters of this book offer advice on healthprotection. These texts were written in such as way so as the information could be available and understandable even to a layman. The advice consist of what to eat and drink in various seasons. Hippocratesalso recommended speed walking during the winter and slow walking during the summer, and dedicated a special chapter to athletic training (Ibid.,pg. 229). The second volume is entitled *Regimen*and consists of four longer fields (Ibid.,pg. 1). It is believed that this work was written around 400. B.C.In this work Hippocratespointed out that a proper diet needs to be accompanied by a suitable physical exercise program so that the final outcome could be good health. He pointed out that physical exercise contributes to the consumption of physical 'material' but that through proper dieting this consumption could be compensated. In his advice he includes information that running is good for ridding the body of excess 'moisture' (Hippocratesopted for this term even though today it is not appropriate) and that a walk should be taken after dinner (Ibid.,pg. 283). Hippocratesclassified all types of exercise as belonging to two large groups. The first he called *natural exercise* and included observation, listening, speech, thinking and walking in it. The second group he referred to as *strenuous exercise* and included running, wrestling, sparing and games involving balls in it. He also wrote about how one could run with a cape in order to increase the temperature of the body, and spoke of the running technique and the importance of hand movements during running, how to avoid pain caused by fatigue among individuals who were not previously involved in the training process (Ibid., pg. 353-359).

The third ancient doctor who gave a significant contribution to the development of physical education as a science was the physician of ancient roman gladiators, Claudius Galenusor just Galen (Ackernecht, 1962: 389-419). He lived in the second century A.D. and wrote a large number of texts in which he outlined his approach to physical exercise and sports training. Just like Hippocrateswas under

the strong influence of the work of Herodicus, so Galen was under the influence of Hippocrates(Brock, 1929: 230). For Galena we could freely say that he continued Hippocrates' work borrowing from him most of the postulates which he himself used during his career. Galen, as a doctor who paid special attention to hygiene, supported the idea that work should be done on preserving the equilibrium with the help of therapy and preventive measures (Green, 1951). Galen in his work classified physical exercise as belonging to the field of hygiene, and classified hygiene as a medical science. One of the more significant works which Galen wrote bears the title *On Hygiene* (Green, 1951:1). In the chapter entitled 'The use and value of physical exercise' Galen pointed out that the need for movement is present in all age categories. Whether it was a case of sailing, horseback riding, riding in a chariot or rocking a cradle, everyone, even children, have the need to exercise (Green, 1951:25). He was the first to offer a definition of physical exercise. In the definition he stated that not every type of movement can be considered physical exercise. In order to consider some kind of movement physical exercise, it must be energetic, but seeing how energy is relative, the same movement can be exercise for someone, but not for someone else. The criterion for the energy of a movement is reflected in the changes in the function of breathing. Galen believed that movement which does not lead to changes in breathing cannot be characterized as physical exercise. But if a person is forced through movement to more or less speed up their breathing, then that becomes physical exercise for him(Green, 1951:53-54). Galen in his work also offered an extensive discussion which refers tothe time when an individual should be involved in physical exercise, as well as the factors which should be considered before the start of any exercise, the various types of exercise, their quality and place where the person will exercise (Green, 1951:54). The benefit of physical exercise that Galen indicated is in agreement with the achievements of modern science in the field of sport and physical education.

Another prominent ancient physician, of whom today not much is known, and who in part is still in the shadow of the famous ancient Greek physicians, is the ancient Indian doctor, MaharshiSushruta. In the work of Tipton (2008) we find for the first time data on the contribution of the Indian physician and surgeon, MaharshiSushruta, to the field of the development of the physiology of physical exercise prior to the well-known ancient doctors such as Hippocrates and Galena. Sushrutalived in the sixth century B.C. and even then prescribed physical exercise in the treatment and prevention of illness. The exercises he recommended did not solely have the purpose of maintaining an equilibrium of the body fluids which forSushrutawas a basic precondition for good health, but was also used to mediate the effects of obesity and diabetes. He also spoke of the dosing of physical exercise, which he considered should be a part of daily life,at moderate intensity, which should not exceed half of the maximum intensity, which would otherwise lead to exhaustion and even illness or death. Tipton pointed out that the contribution of MaharshiSushrutais well known in scientific circles of physicians but that his contribution to the development of physical exercise has so far not been written about, and that his name is virtuallyunknown in the field of sport and physical education specialists.

Involvement in the field of sport at the beginning of our era became more complex and required the thorough, professional work of the coaches and doctors so as to create a successful athlete. This contributed to the publication of the first manuals which dealt with sports training at the time (Robinson, 1955). Unfortunately, only one of these handbooks remains to this day. That is the 'Gimnasticus'written by Lucius Flavius Philostratus (170-244. A.D.). On the pages of this book, which is believed to have been compiled in 220 A.D., Philostratusgave a very detailed account of the various topics which refer to sports competitions and training which should be carried out. Philostratusalso wrote about the origin of various Olympic disciplines, the degenerative nature of

modern sport, and the proper realization of the training process, of the physical signs of a weak condition, the system which was dominant in ancient training periodization, training equipment, competitions and so on (Sweet, 1987).Philostratusat the very beginning of his work discussed the 'science of gymnastics' which he believedrepresented a science which by no means lags behind the other scientific disciplines. We might even say that this is the first text which in this way represents what is today known as the scienceof sport and physical education. Philostratuscompares a coach to a physician indicating that he should possess the necessary knowledge of the proper diet, various types of diets and the influence of certain products on the body. A coach is also required to possess basic knowledge of the field of anatomy and the influence of various types of exercise on the body. When designing an exercise program, as Philostratuspoints out, we should include the recommendations on the various types of exercise, their number and the order of their performance, the way in which muscle mass can be increased, the rhythm and intensity of the exercise, continuedand sporadic training as well as the positive effects of training in the open (Yallouris, 1979). Philostratuswrote about the ideal physical proportions for specific sports disciplines and the rudimentary understanding of the influence of hereditary factors such as the transfer of physical characteristics fromthe parents onto the children and further offspring and the likelihood of the inheritance of certain illnesses. (Yallouris, 1979). Coaches were required to evaluate whether the state of the athlete, making a distinction between physical exhaustion caused by training and psychological or mental exhaustion caused by factors such as depression or a bad mood (Yallouris, 1979).

Writing about physical exercise and the role of ancient coaches,who referred to themselves as *gymnasts,*Philostratuspointed out that they were constantly trying to determine how thebody would react to a certain exercise, byevaluating progress during training. Gymnasts also used certain signs such as the color of the skin for the evaluation of load and the possible excessive laod. They diagnosed extreme cooling or heating of the body during training, estimated optimal muscle tone, the disturbance of the structure of muscle fiber, removing pain from the muscles or local fatigue through massage or other similar therapies, and all with the aim of increasing the level of physical fitness (Yallouris, 1979). In addition to Philostratusnot being either a coach or a scientist, his reports offer the most precise evaluation of training in ancient times.

RESEARCH OF MOVEMENT IN THE MIDDLE AGES

Hieronymus Mercurialis(1530-1606) was an Italian doctor who made a significant contribution to the development of intellectual thought during the renaissance (McIntosh, 1984: 73-84). His book was publishedin 1569, originally entitled'De Arte GymnasticaAputAncientes', and is considered one of the oldest books devoted to physical education. With this work he created a good basis for the further development of physical education and other related fields. This work consists of texts which include the works of ancient physicians and thinkers such as Galen, Hippocrates, PhilostratusandVegetius,who wrote about the training of military formations in the 6th century A.D., as well as the work of other authors, ancient philosophers, historians, educators and politicians. Mercurialisin his work strengthened the validity of ancient works, but also gave his own, improved recommendations. One of the more significant contributions of Mercurialiswas the improvement of Galen'sdefinition of physical exercise and the connection of physical exercise and health. Mercurialisstated the following: 'The physical activity which medicine should focus on consists of energetic voluntary movements of the human body accompanied by a change in respiratory speed in order to protect health or develop physical fitness' (McIntosh, 1984:77). Mercurialismade the classification of gymnastics dividing it into two groups. The first was preventive gymnastics, and the

second therapeutic gymnastics. In both cases he believed that physical exercise should be adapted to every individual, depending on his body type and fitness level. Writing and working at a time when there was no kind of organized sport, Mercurialiswarned readers that training performed only for the sake of training had no purpose. He considered that sports training for fun was not effective and could have a detrimental effect on health. Such training in his opinion created boredom, laziness and athletes would begin to resemble the wide pillars of the schools. On the other hand, gymnastics used for military purposes was used in preparations for war, theprotection and promotion of health, which was considered a legitimate aim of physical education. Hieronymus Mercurialiswas one of the first reformers of physical education who supported the idea that physical education could improve one's health status, but also ruin it depending on its use, duration and intensity. On the basis of the aforementioned we could conclude that Mercurialiswas one of the leading authors inthe field of physical education after nearly ten centuries of the dark middle ages and oppression, and even the public prohibition of physical exercise.

In the renaissance, a huge contribution was made to the study of human kinetics by the Italian renaissance artist and scientist, Leonardo da Vinci, who believed that it was invaluable for an artist to possess knowledge of the anatomy of muscles, bones, nerves, tendons and thus understand their activities and role in the performance in a variety of movements and motions. In his drawings it is possible to find very detailed studies of the kinematics of human movement. It is very impressive to see the level of detailed modelling of human build or humanmovement which da Vinci did a few centuries ago. By analyzing human movementwhen climbing stairs, Da Vinci carried out a very serious biomechanical analysis in which he described the effect of force, thecenter of the body mass and function of body levers.

RESEARCH OF MOVEMENT IN THE MODERN ERA

Giovanni Alfonso Borelli,a scientist from the 17th century made his contribution to the development of various disciplines. In his work 'De motuanimalium' which was printed posthumously as a set of two volumes, in 1680 and 1681, he applied the same analytical and geometrical method in biology as the one developed by Galileo Galilei (1564-1642) in mechanics. For that reason he is often referred to as the 'father of biomechanics' (a nickname also borne by Aristotle). He studied the circulatory system and compared it to the hydraulic system. Some ofBorelli'spostulates on human kinetics are current even today. He was the first to understand levers of the muscle-skeletal system increase movement rather than force, so that the muscles need to produce a much greater force than those which oppose movement. Borelli determined that bones have the role of levers, and that muscles act producing force so that the entire system functions in accordance with mathematical principles, which today is one of the basic principles of analyzing human movement. Borelli based his study, which includes the analysis of muscle function and a mathematical analysis of movement such as running and jumping, on firm mechanical principles. The shift fromthe visual (qualitative) observation to quantitative measurement was of crucial importance for the development of biomechanics and its differentiation as a field of science. Borelli also attempted to explain the reason for the occurrence of the first signs of muscle fatigue, to explain organic secretion and the concept of the onset of pain (Borelli, 1680/1681).

We could say that from the time when Borelli worked intensely on the qualitative and quantitative analysis of human kinetics, allthe way to the second half of the 19th century there were no significant changes in the field. A certain number of scientists dealing in basic scientific fields (mathematics, geometry, mechanics, physics) carried out experiments in which they studied human kinetics

and made a breakthrough in the science of movement which would later be used as a basis for the development of the science of sport and physical education.

The scientist who made a special contribution to the formation of modern mathematics, analytical geometry and the definition of the coordinate system was René Descartes, the French philosopher, physicist and mathematician. In the analysis of human motor skills, Descartes' right-angled coordinate system holds special significance, since it placed human movement in such a coordinate system and allowed it to be represented through suitable mathematical models. The two-dimensional Descartescoordinatesystem(two axes - x-axis or the abscissa and the y-axis or the ordinate) is used to uniformly determine every spot in the field with the help of two numbers, which are usually marked as *x*and *y*. In it we can represent geometric figures, such as curves, which can also be presented through algebraic equations. Descartes' contribution to the development of the scienceof human movement does not end with the discovery of the coordinate system. This great renaissance thinker also dealt with the specific issues of the connection between human motor skills and his intellectual or spiritual side. René Descartesbelieved every man to be built of two independent entities, the soul and the body. The first was responsible for thought and other cognitive aspects of action, while the body obeyed the soul and the laws of nature. Certain movements were visibly independent of the soul, such as the human heartbeat. Other movements were induced by the senses and guided by the soul.

The famous Sir Isaac Newton also took part in the debate giving his view on how to produce biological movement. Newton was a religious man and his territory of motor control was also based on the idea that the soul controlled the body. To a great extent he was aware of the problems which exist in the communication between the soul and body and as a true physicist he explained this through the introductionof a medium which representsether and is unfortunately unobservable.

Another important scientistwas Luigi Galvani (1737-1798) who discovered 'animal electricity' in 1780, as he called it, and who twenty years later introduced Alessandro Volta who determined that the muscle contracts under the influence of electrical impulses. Half a century later, in 1852 the German physician and physicist Hermann von Helmholtz discovered the miograph which he used to help monitor the transfer of electrical signals along the nerves, measuring at the same timethe speed at which the electrical signal travels to the referent tissue (Turner, 1972). Between 1820and 1860 a certain number of scientists intensely worked on the study of the concepts of energy and thermodynamics, constantly looking forthe applicability of the laws of thermodynamics in the functions of living bodies. Members of this group of researchers include Nicolas Leonard SadiCarnottfrom France (1796 – 1832), Rudolf Julius Emanuel Clausiusfrom Germany (1822 - 1888), WilliamThomsonfrom Great Britain (later known as Baron Kelvin, 1824 – 1907), JamesClerkMaxwellfrom Scotland (1831 – 1879) and the aforementionedHermanhFonHelmholtzfrom Germany (1821 – 1894).

In the 19th century, the role of electrical phenomena in neuro-muscular processes was studied most extensively, and this type of research was very highly regarded, while the studies on movement were helped along by the discovery and development of photography. However, the philosophical question of whether movement is the product of the soul (it could be referred to as both the will or intent if we consider such terms to be more appropriate) or represent the responses of the body to external stimuli remains unsolved.

Two exceptional scientists has a great role to play in the field of movement control and so rightfully earned the name 'the fathers of motor control'. One of them is the great British neurophysiologist Sir Charles Sherrington, and the otheris the Russian physiologist, Nikolai Bernstein. Sherrington'scontribution to the neurophysiology of movement was very fertile and diverse (Stuart,

Pierce, Brichta&McDonagh, 2001). He introduced the especially important idea of reciprocal inhibition as amethod of coordinatingpairs ofagonist andantagonist muscles, described the tonic reflex of stretching and developed the theory of movement based on thecoordinated changes in muscle reflexes. Bernstein'sname is closely related to the famous Bernsteinproblem of the elimination of the redundant degree of freedom (Turvey, 1990), with the idea of the hierarchical control of movement and the development of activity physiology (Bongaardt, 2001).

The beginnings of the kinematic analysis of human movement also date back to the 19th century and the brothersWeber, Ernst Heinrich Weber, Wilhelm Eduardand Eduard Friedrich who carriedout an entire sequence of experiments in the fields of physics, human anatomy and human locomotion. Wilhelm Eduard Weberand Eduard FriedrichWeberpublished a volume in 1836 entitled 'Mechanics of walking in humans'(Weber & Weber, 1836) in which they analyzed the human walk by representing it withthe first kinograms and models which represent the human body as a system of levers in a sequence of successive phases. In addition tothe graphic representation, the three brothers Weberalso presented human movement mathematically with the help of differential equations.

A special period in the development of science, which as its subject matter had human movement, was the discovery of chronophotography(Rosenhahn, Klette, & Metaxas, 2008). Chronophotography represents the photographic representation of a kind of movement through a series of still pictures taken in short but equally spaced intervals; this is done with the help of chronophotographicapparatuses (stroboscope, kinetoscope, cinematographand a mutoscope – an apparatus used to show pictures taken with a mutograph). TheFrench astronomer Pierre Jansen was especially successful in the application of this method. His experiments, in which he used chronophotography as a method of monitoring astral bodies, had a great impact on another French scientists, Etienne Jules Mareywho was interested in the monitoring of the locomotion of animals andhumans through the use of various measuring instrument's which he specifically made reference to in his book'The animal machine, locomotion on land and in the air' (Marey, 1873). In the final decade of the 19th century, Etienne Jules Marey published the work Le Mouvement (1895-1972) in which he described the application of various devices such as cameras and instruments which were sensitive to pressure and which could measure and record force and human movement in various activities. His well-equipped laboratory for biomechanics was the predecessor of modern laboratories in which the measuring of biomechanical and physiological characteristics of movement take place. Inspired by Marey's work, the British photographer, EdwardMuybridge, after emigrating to the USA began recording the locomotion of humans and animals. He recorded horses during a race trying to prove the claim that it was possible for a horse to achieve flight during a race, which would mean that all four of his hooves would have no contact with the ground for a moment. In order to monitor their movement he used 12 cameras (later he started using 24). He also started using this technique on people, analyzing the different categories of locomotion, where the participants were often times not clothed (Muybridge, 1957). Muybridge recorded children who were walking, adults who were climbing stairs, people carrying boxes and so on. Certain authors consider his work to be a pioneer venture in the steps of biomechanical research (Rosenhahn, Klette, & Metaxas, 2008). Another scientist who gave a special contribution to the application of chronophotography in the monitoring of movement was the German, OttomarAnschütz,who recorded using a camera with an exposition of 1/1000 seconds, which was his original invention.

During the second half of the 19th century, ChristianWilhelm BraunandOtto Fisherstarted their experimental studies of the human walk,

determining at the time the body center of mass, that is, the body's center of gravity. Their work had a huge contribution to the development and improvement of prosthetics for individuals with special needs.

Archibald Vivian Hill also carried out research in which he studied the mechanics and energetics of the sprint in athletics (Braun, 1941). On the basis of his good knowledge of mathematics, Hilldeveloped a mathematical model which he used to describe the production of heat in muscles. He also applied a kinetic analysis for the explanation of oxygen uptake at rest and during physical activity. Hillwas very devoted to working on the relationship with force and speed in muscle contractions, giving thebasic equation of muscle dynamics which actually represents a mathematical equation of the famous Hill curve. His research initiated the development of biophysics and its introduction into the physiology of sport and physical education. The crown of Hill's work was the Nobel Prize for medicine that he was awarded in 1922 and which he shared with the German chemist Otto Meyerhof. Hillwas awarded for his discoveries in the field of chemical and mechanical processes during a single muscle contraction.

The work done by A. V. Hill was continued by Wallace Fenn (Fenn, 1931; 1929) during the 1930s, which is corroborated by the texts written by ThomasCureton (Cureton, 1939). He himself analyzed the mechanics of swimming (1930) and athletic disciplines (1939). He also described the use of the camera and motion pictures with the aim of analyzing movement(Cureton, 1939). At the same time, Arthur Steindler published one of the first books on biomechanics (1935).

One of the first books which discusses the mechanics of movement, and not only the anatomic aspects of movement, is the book by John Bunn, published under the title 'Scientific Principles of Coaching' in 1955. Until the 1960s the term biomechanics became commonplace and mostly used in the studies of sport and physical activities.

By studying the historical development of the scientific discipline which as the subject matter of its research had movement, and which today we refer to as the science of sport and physical education or kinesiology, we clearly come to the conclusion that this scientific discipline, as we know it today, evolved from two completely separate fields of scientific inquiry. The first field is the branch of neurophysiology which was primarily aimed at the study of neural processes which were connected to (or were the cause of) movement with a slight study of the manifest dimension of movement which is manifested in the in the human ability to walk, run, jump, swim and so on. The second field represents a branch of psychology which primarily dealt with the study of motor learning and skills with very slight or almost no mention on neurological mechanisms which are involved in the process. It would almost seemthat these two fields developed separately for almost an entire century, at different levels of research and with very small overlap. It was only at the end of the 1970s that these two fields were brought closer together. (Schmidt & Lee, 2005, 6)

It is very difficult to pinpoint the moment when the science of sport and physical education was born as an independent scientific discipline. Before this discipline started to develop in the way we are familiar with today and was given one of the names by which we recognize it today (physicaleducation, sport and physical education or the science of movement, kinesiology, kinanthropology...) some other scientific disciplines were involved in the study of human activities and movement, creating a basis for the formation ofa new scientific discipline. This range of various scientific disciplines which studied man and his movement included work done in the field of anatomy, physiology, pedagogy, psychology, physical education but also included the work of engineers, statisticians, sociologists. The science of sport and physical education begins to appear and intensely develop during World War II, along with the development of physical education. It is a case of a multidisciplinary scientific field which includes various scientific approaches stemming

from physiology, psychology, sociology, pedagogy and othersciences. As a result of the multidisciplinary nature of the field, we have a wide variety of scientific research which could all be included under the heading of anthropological research in sport and physical education. This all-encompassing concept carries in its name the adjective anthropological, which refers to the complex study and research of man as a whole and as a unique being. It includes not only the human body, but also the soul and spirit, that is, both human natures, the biological and cultural-spiritual one (Čupić, 2002:8).

CONCLUSION

The science of sport and physical education evolved over the last two centuries along with the experimental tradition of basic scientific disciplines, both in the west and in the east. The development of scientific research in the field of physiology during the 19th century coincided with the development of sport and physical education throughout Europe and the USA. It was quite a natural sequence of events where the scientific approach gained increasing application in the study of changes in the body of an athlete and the students involved in physical education classes. We could say that the conceptualization of physical exercise in the physiological sense preceded the application of scientific analyses in the study of the workings of the human body or 'human machine' as certain scientists of the time referred to it. The German pedagogue who made a great contribution to the development of physical education, JohannChristophFriedrich GutsMuths, wrote in hiswork 'Sportgymnasiumjena'(1793): 'I am aware that an authentic theory of gymnastics should be built on physiological bases. But this kind of perfection will not be found in my work.' (Langenfeld, 1988: 125-148). The physiology of physical exercise actually began to develop successfully only at the end of the 19th century when scientists mainly studied isolated movements of certain muscles in order to discover the chemical processes which took place during muscle contractions, as well as a way of obtaining energy necessary for muscle work. This is by far not even close to the sophisticated physiology of physical exercise which will much later andmore systematically view the entire human body on more sound scientific facts.

Through this historical overview of the science of sport andphysical education, we can conclude that its formation as a new scientific discipline was linked to the increasingly frequent study of human motion and the influenceof physical exercise on other, already established scientific disciplines, such as physiology, psychology and sports medicine. These scientific disciplines will later be incorporated into the newly-formed field of science of sport and physical education and gain the epithet sports (sports physiology, sports medicine, sports psychology, sports pedagogy and so on). Soon after, following World War II, sports science began to develop in most European countries as a special field of science, leading to the formation of professional and academic organizations, initiating the publication of scientific papers which will be the first carriers of scientific and research ideas in sport and physical education.

REFERENCES

Ackernecht, E.H. (1962). Aspects of the History of Therapeutics. *Bulletin of the History of Medicine*. 36. 389-419

Berryman, J. W. (1992). *Exercise and the medical tradition from Hippocrates through antebellum America: a review essay*. In: Berryman, J.W., Park, R. J., editors. *Sport and exercise science: essays in the history of sports medicine*. Urbana, IL: University of Illinois Press. 1–56.

Blundell, J.W.F. (1864). *The Muscles and Their Story, from the Earliest Times; Including the Whole Text of Mercurialis, and the Opinions of Other Writers Ancient and Modern, on Mental and Bodily Development.* London: Chapman & Hall. 32

Bongaardt, R. (2001). *How Bernstein conquered movement*. In: Latash, M. L., Zatsiorsky, V., editors.

(2001). *Classical Papers in Movement Science*. Champaign, IL: Human Kinetics

Borelli, G. A. (1680/1681). *De MotuAnimalium*. Rome (On the Movement ofAnimals, translated from Latin to English by P. Maquet, Springer, Berlin, 1989).

Brock, A.J. (1929). *Greek Medicine: Being Extracts Illustrative of Medical Writers from Hippocrates to Galen*. London: J.M. Dent & Sons.

De Montaigne, M. (2003). *The Complete Works*. New York: Everyman's Library

Fenn, W. O. (1929). Mechanical energy expenditure in sprint running as measured in moving pictures. *American Journal of Physiology*, 90, 343–344.

Fenn, W. O. (1931). A cinematographical study of sprinters. *Popular Science Monthly.* 32, 346–354.

Green, R.M. (1951). *A Translation of Galen's Hygiene (De sanitatetuenda).* Springfield, Mo.: Charles C. Thomas.

Hippocrates (1959). Regimen. Translation: Jones, W.H.S. Cambridge, Mass: Harvard University Press. 45-59

Klette, R. and Tee, G. (2008). Understanding Human Motion: A Historic Review. У*Human Motion: Understanding, Modelling, Capture, and Animation*. Rosenhahn, B., Klette, R., Metaxas, D. (Eds). Dodrecht: Springer

Langenfeld, H.(1988). Auf demWegezurSportwissenschaft: Mediziner und Leibesübungenim 19. Jahrhundert [On the Way to Sports Science: Physicians and Physical Culture in the Nineteenth Century].*Stadion*. 125-148.

Marey, E. J. (1873). *La Machine Animale, Locomotion TerrestreetAerienne*. Paris: GermerBailliere.

McIntosh, P.C. (1984). Hieronymus Mercurialis "De Arte Gymnastica": Classification andDogma in Physical Education in the Sixteenth Century. *British Journal of SportsHistory* 1(1), 73-84.

Muybridge, E. (1957).*Animals in Motion*. Edited by L. S. Brown. New York: Dover

Olivova, V. (1984). *Scientific and Professional Gymnastics*. In Olivova, V. ed., Sports and Games in the Ancient World. New York: St. Martin's Press, 135-144

Precope, J. (1952). *Hippocrates on Diet and Hygiene*. London: Williams, Lea & Co.

Rees, A. et al. (1819). *The Encyclopaedia; Or, Universal Dictionary of Arts, Sciences, and Literature*. Vol. 17. London: Longman, Hurst, Rees, Orme& Brown.

Robinson, Rachel Sargent (1955). *Sources for the History of Greek Athletics*. Ohio: The Author.

Rosenhahn, B., Klette, R., Metaxas, D. (2008). *Human Motion: Understanding, Modelling, Capture, and Animation*.Dodrecht: Springer

Schmidt, R.A. & Lee, D. T. (2005). *Motor Control and Learning – A Behavioral Emphasis*. Champaign, IL: Human Kinetics

Steindler, A. (1935). Mechanics of normal and pathological locomotion in man. Springfield, IL: C.C. Thomas

Stuart, D. G., Pierce, P. A., Callister, R. J., Brichta, A., McDonagh, J. C. (2001). Sir Charles Sherrington: Humanist, Mentor, and Movement Neuroscientist. У: Latash, M. L., Zatsiorsky, V., editors. (2001). Classical Papers in Movement Science. Champaign, IL: Human Kinetics

Sweet, Waldo E. (1987). *Sport and Recreation in Ancient Greece: A Sourcebook withTranslations*. New York: Oxford University Press.

Tipton, C.M. (2008). Sucruta of India, an Unrecognized contributor to the history of exercise physiology. *Journal of Applied Physiology*, 104, 1553-1556

Turner, R. S. (1972).*Herman von Helmholtz, in Dictionary of Scientific Biography*(edited by C. C. Gillispie), 6,241–253, New York: Charles Scribners Sons

Turvey, M. T. (1990). Coordination. *American Psychologist.* 45(8), 938-953.

Weber, E. F., and W. E. Weber (1836).*Uber die Mechanik der menschlichenGehwerkzeuge: Eineanatomisch-physiologischeUntersuchung*. Gottingen:Dieterich(Translation by P. Maquet and R. Furlong (1992).*Mechanics of the Human WalkingApparatus*. Berlin: Springer).

Yallouris, Nicolas, ed. (1979). *The Eternal Olympics: The Art and History of Sport*. Athens:Caratzas Brothers.

Стојиљковић, С. (2003). *Општа антропомоторика*. Ниш: Студентски културни центар

Чупић, Ч. (2002). *Политичка антропологија: хрестоматија*. Београд: Чигоја штампа

IZ ISTORIJE NAUKE O SPORTU I FIZIČKOM VASPITANJU

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SAŽETAK

Ovaj rad ima za cilj da predstavi početke istraživanja čovekovog kretanja i njegovih fizičkih sposobnosti koji sežu u period velikih antičkih civilizacija, Stare Grčke, Rima i Indije. Vodeći mislioci toga doba objašnjavali su čovekovu motoriku misterioznim upravljanjem duše nad telom. Oni su u svojim radovima iznosili čitav niz praktičnih saveta o tome kako i zašto treba vežbati, ali nedovoljno razvijenim metodama istraživanja nisu bili u prilici da u potpunosti objasne prirodu čovekovog kretanja kao ni fiziološke procese koji su odgovor na povećanu fizičku aktivnost. Međutim, oni su i pored toga, vrlo važnim bazičnim istraživanjima i otkrićima u oblasti anatomije, fiziologije i medicine postavili osnove za kasniji razvoj nauke o kretanju, odnosno nauke u sportu i fizičkom vaspitanju kako se danas ova naučna disciplina naziva. Konačno, krajem XIX i početkom XX veka formirala se naučna disciplina koja će objediniti biomedicinski i društveno-humanistički pristup u izučavanju kretanja. U radu su predstavljeni i istaknuti naučnici koji su kao pojedinci svojim istraživanjima doprinelu razvoju ove multidisciplinarne naučne oblasti.

Ključne reči: nauka, istorija, kineziologija, sport i fizičko vaspitanje

BASKETBALL PROGRAM APPLICATION DEVELOPMENT OF SITUATIONAL MOTOR CONTROL IN CHILDREN WITH MENTAL RETARDATION

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UDC 796.323:056.24

SUMMARY

In a sample of 27 subjects, pupils attending special schools "14 October "in Nis, divided into two groups performed a longitudinal study aimed to determine the effect of elements of basketball in the development of situational motor abilities in children with mental retardation. For that purpose a battery of six tests for the assessment of situational motor abilities. The experimental group of 13 students worked on corrected and specially adapted basketball program, while the control group of 14 students worked on a steady program proposed by the Ministry of Education of the Republic of Serbia. Two measurements were made initially at the beginning of the experiment, and finally at the end of the experiment. All results were statistically analyzed and presented in two tables. Conclusions are partly confirmed the assumption that elements of basketball statistically significant influence on the development of specific situational motor abilities.

Key Words: basketball, mental retardation, physical activities, training

INTRODUCTION

During adolescence, daily physical activity becomes essential for the improvement of health, proper growth and development in children with disabilities, and also the reduction of risk factors which influence the formation of cardio-vascular and metabolic disorders later in adulthood. Existing guidelines recommend to adolescents at least 60 minutes of moderate to intense physical activity several days per week (Strong, Malina & Bimkie, 2005). Regular physical activity can promote an active way of living, and increase physical and work capacities in this part of the population (Carmeli, Barchad, Lenger, & Coleman, 2002).

Disabilities such as mental retardation can ruin the capability of learning and being active in some kind of educational environment, including also physical education. Since childhood, children with mental retardation progress more slowly than children with the normal intelligence when it comes to motor skills (Shapiro & Dummer, 1998).

Regular fhysical activity during life is recommended for the increasing of emotional stability (Fernhall,1993). Usefulness of doing sports for the people with special needs is very similar to the one for the perfectly capable person. Those useful effects are not only concentrated on physical health, but also on the psychological health, including cognitive, social, affective and moral development of the children (Franciosi, 2007).

The close connection between the physical activity and durability of an individual, who is mentally retarded, causes the need of increasing muscle strength through the preparation of training programs, which are especially important because of the positive effect on everyday activities (Franciosi, 2007). Therefore it is necessary to create needed prerequisite for physical activity of adolescents with

intellectual disability. It can be accomplished through various physical activities (physical education, inclusive activities, class activities, etc), under the leadership of qualified professor of physical education (Kenneth, Beets, & Combs, 2009).

The close connection between the physical activity and durability of an individual, who is mentally retarded, causes the need of increasing muscle strength through the preparation of training programs, which are especially important because of the positive effect on everyday activities (Franciosi, 2007). Therefore it is necessary to create needed prerequisite for physical activity of adolescents with intellectual disability. It can be accomplished through various physical activities (physical education, inclusive activities, class activities, etc), under the leadership of qualified professor of physical education (Kenneth, Beets, & Combs, 2009).

A team sport is a popular way of including perosons with intellesctual disability in physical activity (Gencoz, 1997). Sport can help the athletes with mental retardation to begin appreciating themselves more, to improve the quality of life, and it can ce fundamental for socialization and cooperation. Team sports, like basketball, are a popular way for the individuals with mental retardation to become a part of some kind of physical activity (Baldari et al., 2009). Basket ball is not only used as a part of planned physical activities for intellectually disabled individuals, but also as an independant soprt activity for these individuals, because it means the development of their motor skills (running, jumping, shooting, etc.) throuhg the team work and cooperation among individuals with the same level of disability (Gencoz, 1997). The muscle strength, that is, fundamental capacity of persons without the disability and with the disability to perform effective and coordinated movements is considered to be inefficient when it comes to chronic cases of mental retardation (Tsimaras et al., 2009). It is known that muscle strength and balance recede in adulthood in persons with mental retardation, and that is the time when other health risks appear, such as overweight problem and obesity (Lahtiner, Rintala, & Malin, 2007). Muscle strength of lower extremities is very important for general health, for performance of daily activities, and for the performance of some skills which are connected to work when it comes to the persons with mental retardation (Tsimaras et al., 2009). Basketball is very popular because it involves motor skills such as running, jumping, shooting, and it involves mutual cooperation among players. Training can be led to psychophysical improvement when we talk about persons with mental retardation by satisfying theis primary needs and by increasing their need for living.

During the developmental period, mental retardation was defined as a significant intellectual function below average which exists as a deficiency in the adopted behaviour. Retardation begins before the 18th year of a person's life, and it doen't always last his/her whole life. Mental retardation is more present in men than in women (Baldari et al., 2009).

Educational system of the children with disabilities in Serbia is organized in three basic ways:

- Special education in special schools for the children with disabilities;
- Special education in special classes in regular schools which are made out of the students with the same type of disability;
- Regular education in the same class with the rest of the students, but without systematic support and adjustment to the special needs of these students. Therefore, their achievements are minimal, and a big number of those children repeat the grade or leave the school.

Children with disabilities go to special schools which are divided by the committee for the classification of the mentally retarded children. The committee estimates the level and the type of disability. Teachers who work in classes with the large number of children are not prepared nor motivated for working with this type of children. Special schools function as an independent and parallel system along the regular system without

mutual connection. A child who once enters this special system of education hardly ever goes out of it.

It is a fact that a special school is more adapted to the needs of children with disabilities than the regular schools - in terms of teachers' education, in terms of equipment, and also in terms of applying special methods in working with students.

The aim of actual research is to establish the level of influence of the basketball elements on the motor development (speed, coordinations and accuracy) of children with disabilities, and also to perform adaptation of particular segments of basketball and to adjust them to children.

Characteristics of children with mental retardation

Children with disabilities learn in different ways, therefore it is not easy to find the best methods. Some children learn the best when they are alone, through the activities that are done on their own tempo, others, on the other hand, feel the best when they cooperate with other children of their own age. To some children, movement and touch are very important, and others rely on visualization, while some of them use language and speaking as a primary instrument of learning. Some children are very skilled to find connections between objects and events, and others are prone to observing. No matter the way of learning, children will be successful when the teacher creates conditions which respond to their way of learning (Lazor, 2009).

Developmental disabilities associated with slow or irregular development of intellectual abilities. The difficulties of these children come to the fore in the cognitive area (such difficulty in the learning process) and in the area of adaptive behavior (such as difficulties in applying the lessons sadržajaTeškoće in learning are due to the slower memory, unstable and fluctuating attention, poor speech development, reduced powers of deduction and generalization.

METHOD

The subject of this study is the use of elements of basketball in the development of certain motor skills in children with mental reatardacijom in order to determine the level of impact elements of basketball on the motor development of children with developmental difficulties, and to zvrši adaptation of certain segments of basketball and to the needs of children. The task of the research was to determine the levels of certain motor skills at the initial and final measurement and use the results in making its findings. Based on the objectives, goals and tasks of the research is a general hypothesis which states: "The elements of basketball significantly affect the development of certain motor skills (speed, coordination and precision) of pupils mental retardation." The research was longitudinal and lasted four weeks. On the basis of studies was in the pedagogical methodology of scientific research method of application of elements of basketball in the development of certain motor skills in children with mental retardation.

The sample of participants

The sample of participants (N=27) was made out of the population of students from the school for the children with disabilities "14. Oktobar" in Niš, of both sexes, chronological age of 16-19 years, and covered with regular classes of physical education. Their IQ was between 70 and 85. The sample was divided into two sub-samples: experimental (N=13) and control sub-sample (N=14).

The students of the experimental sub-sample were doing a modified program of basketball elements adjusted to the intellectual abilities of the children, while the students of the control sub-sample were doing the program made for special schools that was written by the Ministry of Education of the Republic of Serbia.

The sample of variables

1.	Dribbling better hand 2 "circle" around adjacent two rounds of basketball	(SVDB)
2.	Jump shot from the use of table different directions and distances	(JSRP)
3.	Jump shot from different distances and of the same direction perpendicular to the board (without table)	(JSIP)
4.	Behind-the-back over his head with both hands	(DO2R)
5.	Dribbling around a central circle of the basketball	(SVKR)
6.	Circling the ball around the body	(KRTE)

Measuring instruments for evaluation of motor skills characteristics are taken from the text book "Anthropological basics of basketball" (Jovanović-Golubović, & Jovanović, 2003).

RESULTS

The differences between the control and experimental groups at the initial and final measurement of situational motor abilities

TABLE 1 Univariate analysis of variance between the control and experimental groups in situational motor behavior at the initial and final measurement.

	GROUP	N	Mean	Std. Dev.	F	Sig.	Mean	Std. Dev.	F	Sig.
			INITIAL MEASUREMENT				FINAL MEASUREMENT			
SVDB	KO	14	44,61	21,49608	,374	,546	35,24	15,25685	3,949	,048*
	EK	13	32,31	15,95996			24,86	7,35562		
JSRP	KO	14	10,50	4,911	,835	,370	9,07	4,859	2,548	,123
	EK	13	11,77	5,688			13,31	6,369		
JSIP	KO	14	11,00	7,696	,002	,969	11,21	8,097	,053	,820
	EK	13	13,62	7,240			16,85	8,305		
DO2R	KO	14	2,21	4,061	5,119	,033*	2,43	4,292	4,552	,043*
	EK	13	5,77	6,112			6,31	6,921		
SVKR	KO	14	26,61	15,43906	,715	,406	24,93	15,16704	6,892	,015*
	EK	13	18,59	11,77359			15,88	3,66867		
KRTE	KO	14	11,57	8,178	,426	,520	35,24	15,25685	3,949	,058
	EK	13	16,69	8,750			24,86	7,35562		

* represents statistical significance at $p \leq 0.05$

TABLE 2 Analysis of differences between the control and experimental groups inicijlanom and final measurement of situational motor abilities.

	t	df	Sig.	Mean Diff.	t	df	Sig.	Mean Diff.
	INITIAL MEASUREMENT				FINAL MEASUREMENT			
SVDB	1,678	25	,106	12,30253	2,223	25	,035*	10,38275
JSRP	-,622	25	,540	-1,269	-1,952	25	,052*	-4,236
JSIP	-,908	25	,373	-2,615	-1,784	25	,087	-5,632
DO2R	-1,793	25	,085	-3,555	-1,765	25	,090	-3,879
SVKR	1,509	25	,144	8,02357	2,092	25	,047*	9,04687
KRTE	-1,572	25	,129	-5,121	-1,690	25	,103	-5,879

* represents statistical significance at $p \leq 0.05$

DISCUSSION

Table 1 lists the results of univariate analysis of variance tests situational motor by comparing the arithmetic means of the control and experimental groups at the initial measurement. Based on the coefficients F - relationships and their significance (sig.) is konstantovati that statistically significant only in the test pass behind his back over his head with both hands (DO2R). In the other were not statistically significant. Children are mainly interested in basketball as a sport and they are proud joined situational tests of motor skills in an effort to achieve better results. In test after adding back over his head with both hands (DO2R) regardless of their mental incapacity were all trying to achieve good results. Since it is quite complex and difficult test for them though students of the experimental group were more successful. Table 1 also contains the results between the control and experimental groups at the final measure. Based on the coefficients F - relationships and their significance (sig.) is konstantovati the statistically significant results of the tests pass behind his back over his head with both hands (DO2RF), dribble better hand 2 "circle" around susenda two rounds of basketball (SVDB) and keeping the ball around the center circle of the basketball (SVKRF). In this case, there can be observed that for some variables there was a statistical significant change under the influence of the experimental program was conducted with students in the experimental group for 8 hours. Is applied to the corrected basketball program tailored to children with mental retardation who certainly influenced the statistically significant results in some variables.

Table 2 contains the results of the t - test situational motor ability between the control and experimental groups at the initial measurement. After analyzing the results it can be seen that statistical significance does not exist for the sole test. However, the t - test situational motor ability between the control and experimental groups at the final measure indicates that there is statistical significance for test dribble better hand 2 "kurga" over two consecutive rounds of basketball (SVDBF), at the test dribble around the center circle of the pitch basketball (SVKRF) and we can mention the

test jump shot from the use of table of different directions and distances (JSRP) where the statistical significance of slightly less than 95%. Here we can see that the corrected basketball program tailored to children with mental retardation significantly influenced the three variables that are quite complex. In any case, such a small number of hours of basketball gave statistically significant results in some tests indicating that basketball can be used as a specific method of working with mentally retarded children. Results would have been far better if it came with a number of hours and over a longer period.

Since 2000. in our country are intensively working to promote and develop inclusive education. Some cities in Serbia (Subotica, Kula, Pancevo, Belgrade, Nis, Novi Pazar, Novi Sad) have largely developed inclusive practices in local kindergartens and schools. In the absence of appropriate legislation, develop alternative forms of support to children, parents and teachers are removed or overcome architectural barriers ... (Lazor, 2009)

CONCLUSION

Based on the objectives, goals, tasks and appointments hypotheses derived forth the following conclusions:

1. The t - test and analysis of variance on the final measurement compared to the initial state indicated that elements of basketball significantly influenced the development of the ball leading better hand 2 "kurga" around two adjacent rounds of basketball (SVDBF), at the test dribble around the central circle of the basketball (SVKRF) and a jump shot from the use of different directions and table spacing (JSRP) where the statistical significance of slightly less than 95% of students in the experimental group thus partially confirmed the hypothesis. Thus, we can conclude that the corrected basketball program tailored to children with disabilities still significantly influenced the development of coordination of movement with the ball and accuracy as well as realized with only eight (8) hours of basketball , which indicates that the elements of basketball can be used as special method of working with children with special needs.
2. Results would have been far better if it came with a number of hours and over a longer period. Working with children with special needs requires patience, perseverance, love of children, motivation and continuous contact with the children. Program content must be adapted to their mental and morphological characteristics as well as the battery of tests used for the evaluation of certain motor and situational motor abilities.
3. This work can be used as a pilot project for a larger and more comprehensive study with a larger sample and over a longer period to make the results more valid and useful for pedagogical theory and practice. Also, this study is skorman contribution to the development of new methodological procedures in working with children with special needs, where they used elements of basketball as are methods of working with children with disabilities as a means to develop basic and complex motor skills.

REFERENCES

Baldari, C., Franciosi, E., Gallotta, M.C., Emerenziani, G.P., Reis, V.M., & Guidetti, L. (2009). Using basketball test battery to monitor players with mental retardation across 2 sports seasons. *Journal of Strength and Conditioning Research,* 23 (8), 2345-2350.

Carmeli, E., Barchad, S., Lenger, R., & Coleman, R. (2002). Muscle power, locomotor performance and flexibility in aging mentally-retarded adults with and without Down's syndrome. *Journal of Musculoskeletal and Neuronal Interactions,* 2 (5), 457–462.

Fernhall, B. (1993). Physical fitness and exercise training of individuals with mental retardation. *Medicine & Science in Sports & Exercise*, 25, 442–450.

Franciosi, E. (2007). *Effects of a 6-months training period on basketball abilities and psychological dispositions of players with mental retardation across two sports seasons*. Published Master Thesis, Portugal: University of Physical and Sports Activities of Vila Real. Available at World Wide Web: http://hdl.handle.net/10348/95

Gencoz, F. (1997). The effects of basketball training on the maladaptive behaviors of trainable mentally retarded children. *Research in Developmental Disabilities*, 18, 1-10.

Jovanović–Golubović, D., & Jovanović, I. (2003).*Antropološkeosnovekošarke (Anthropological basis of basketball).* Niš:GrafikaGaleb. In Serbian

Kenneth, P.H., Beets, M.W., & Combs, C. (2009).Activity levels of children with intellectual disabilities during school. *Medicine and Science in Sports andExercise*, 41 (8), 1580-1586.

Lahtiner, U., Rintala, P., & Malin, A. (2007). Physical performance of individuals with intellectual disability: A 30 year follow up. *Adapted Physical Activity Quarterly*, 24 (2), 125–143.

Lazor, M. (2009). *Priručnik za rad sa decom sa smetnjama u razvoju (Text book for the working with children who have developmental disabilities).* Novi Sad: LitoStudio. In Serbian

Shapiro D.R., &Dummer, G.M. (1998). Perceive and actual basketball competence of adolescent males with mild mental retardation. *Adapted Physical Activity Quarterly*, 15, 179 – 190.

Strong, W., Malina R.M., & Blimkie, C. J. R. (2005). Evidence based physical activity for school-age youth. *Journal of Pediatrics*, 146, 732-737.

Tsimaras, V.K., Samara, C.A., Kotzamanidou, M.C., Bassa, E.I., Fotiadou, E.G., & Kotzamanidis, C.M. (2009). The effect of basketball training on the muscle strength of adults with mental retardation. *Journal of Strength and Conditioning Research,* 23 (9), 2638-2644.

Van de Vliet, P., Rintala, P., Fröjd, K., Verellen, J., Van Houtte, S., Daly, D.J., et al. (2006). Physical fitness profile of elite athletes with intellectual disability.*Scandinavian Journal of Medicine & Science in Sports*, 16 (6), 417-425.

PRIMENA KOŠARKAŠKOG PROGRAMA NA RAZVOJ SITUACIONO MOTORIČKIH SPOSOBNOSTI KOD DECE SA MENTALNOM RETARDACIJOM

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SAŽETAK

Na uzorku od 27 ispitanika, učenika specijalne škole "14. Oktobar" u Nišu, podeljenih u dve grupe izvršeno je longitudinalno istraživanje sa ciljem da se utvrdi uticaj elemenata košarkaške tehnike na razvoj situaciono motoričkih sposobnosti kod dece sa mentalnom retardacijom. U tu svrhu primenjene je baterija od šest testova za procenu situaciono motoričkih sposobnosti. Eksperimentalna grupa od 13 učenika radila je po korigovanom i specijalno prilagođenom program košarke dok je kontrolna grupa od 14 učenika radila po ustaljenom programu koga je predložilo Ministarstvo prosvete Republike Srbije. Izvršena su dva merenja inicijalno na početku eksperimenta i finalno na kraju eksperimenta. Svi rezultati statistički su obrađeni i prezentirani kroz dve tabele. Izvedeni zaključci delimično su potvrdili predpostavku da će elementi košarkaške tehnike statistički značajno uticati na razvoj određenih situaciono motoričkih sposobnosti.

Ključne reči: košarka, mentalna retardacija, fizička aktivnost, trening.

THE ROLE OF SPORT FACILITIES ARCHITECTURE ON THE NORMAL FUNCTIONING OF SPORT ACTIVITIES

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UDC 796.02

SUMMARY

Introduction: Designign sports facilities is a major challenge for the architects because it is necessary to make a multi-purpose facility that will meet the needs of many people. There is a number of rules that should be respected and the most important one is to plan the functional communication and make a compact facility that will meet the needs of all the users and that will be visually attractive. When designing, the architects have encountered numerous problems because it is necessary to organize a large number of activities within a building, to use proper construction that allows wide variations, it is necessary to maximize natural ventilation and lightning and, of course, the complete form of the object should be integrated into the environment and should be connected with it. This paper is about the role of architecture in the organization and the smooth functioning of sport activities in gyms.

Methods: The methods that will be used are the analysis and synthesis of the completed sports facilities around the world, and the analysis and description of the role of architecture in the smooth running of sporting activities. A comparative analysis of some of the examples will highlight the advantages and the disadvantages of the design of the sports facilities.

Results: The analysis ofthe completed sports facilities around the world, will give the basic guidelines for the design of buildings and their forms so that sport and physical activities in a sports hall can function smoothly. The synthesis of the data from an analysis of different examples of sport halls from different countries and with different purposes, will be reviewing the impact of architecture and its importance for the functioning of communication in the sport and physical education.

Conclusion: The aim of this paper is to analyze and to approach the successfully completed objects using the examples from international practice and to highlight the inter-relationship between sport, physical education and architecture.

Key Words: sports, communication in sports halls, the connection between architecture and sports activities

INTRODUCTION

Sport and architecture were through history always linked. Even in Ancient times there were built stadions for sport games and these objects represented architecture masterpieces. Many of them remained until today and even today people admire their architecture and functionality. Even hundreds years ago, architects were considering funcionality and good comunications during planning process. Through history, sport facilities were always built on important locations in the cities and they represented symbol of one region. Many sport objects built for Olympic Games are symbols of countries in which Olympics were held. Because of that, architecture play key role in planning sport facilities and it represents link between functionality, sport rules and form of one object. For sport facilities the most important is to make possible that all activities can be done without

barriers both functional and physical. Because of that, architecture planning must connect needs of the future users, must respect regulations that are given for future purpose and must provide visually attractive shape that will be kind of sculpture in space.

This paper is about role of architecture in sport facilities planning and main goal is to show role of architecture in organizing and performing sport activities. Main and most important is to make good communications and to make sport facility accessible for all users. There are many successfully built objects which are good examples of connection of sport and architecture and their interaction. In this paper, good examples from foreign countries will be analyzed and good strategies for organizing future spot facilities will be highlighted. Depending on type of sport for which sport center is planned, there are different regulations that must be respected. Even so, good practices from built objects can be base for planning new object anywhere in the world and considering examples of already built objects will make minor chances for making same mistakes twice.

In many countries, local community is involved in planning process and many funds for financial and expert help are formed. Because of that, there are many eminent examples around the world, even in countries of former Yugoslavia. In this paper examples of Zamet Sport Center by 3LHD Architects, Medellin Sport center by Plan B architects, Žatice sport hall by Sonja Jurković and Oriental sport center by GMP Architects will be analyzed. Using descriptive-analytical method, main strategies for successful and regular organizing of sport centers will be shown.

METHODS

Architecture planning of sport objects is a complex process that has origins in Ancient times. Sport and architecture have always been connected and architecture was a medium to express how much sport was important for one nation. In Ancient times- Egypt, Syria, people where doing sport activities for religious reasons. In Ancient Greece the expansion of sport activities occured and people started playing sports to stay in good shape and to be healthy. Even than, there were sport competitions – the Olympic games that are the forerunner of today's biggest sport competition. These games were held on sport terrains that were outside, in the open and that were specially arranged for the needs of the sport discipline in which people were competing. In Ancient Rome, situation was a little different. Roman empire conquered the Mediterranean region and the Middle east and it was known as an Empire with imperial and monumental architecture. Games were every day activity for all the residents and because of that sport became part of the Romans' identity. At the beginning, sport was an individual activity, and just a few times per year the tournaments were organized. Games were popular in all parts of the Roman Empire and among all the nations that they conquered. Because of their popularity, the Romans started to build Coloseums and stadiums and their idea was to organize games and to make poor people happy. Also, to show their power, the Romans built monumental stadions – colosseums which were used for games in which there were animals also. Very famous were the gladiator games that were held in amphitheaters from whose structures, stadiums are developed today . The Roman Colosseum in Rome, the first building made for sport activities and gladiator games, was constructed for 50.000 visitors and had eighty entrances so that the arena could be empty in less than 10 minutes. Also, ancient architects were thinking about accessibility and they made the model that is still in use. (Crowther N.,“Sport in Ancient times“,87-140)

Depending on the time when they were built, objects for sport activities were different shaped. In Ancient Greece, typical stadiums were for Olympic games and they were U shaped. (Fig 1.) These stadiums could host 45.000 visitors and they were of giant dimensions. This stadions were adjusted to the needs of sportsmen and they weren’t adjusted to the terrain, unlike the Ancient city centers that had to follow the landscape. For Ancient architects it was

important to make a stadium that will satisfy the need for a sport activity and even if it was necessary they did excavations on the terrain and adjusted the landscape for the future stadiums. Beside the stadiums, in Greece they built amphitheaters that were later reconstructed and improved in the Roman empire. The Roman architects are still famous for their coloseum constructions. Even today, the model of the Colosseum in Rome is one of the ideal models of stadium planning (Fig 2.). After the Romans, in the Middle Ages, the accent was on the religious and art objects and sport facilities were no longer built for more than ten centuries. The built coloseums and amphitheatars were studied and described in books of famous artists and scientists but they weren't used. Many of the built hipodroms or circuses were frequently used for games but they were very often neglected. In many countries these sports objects were converted and made for residential use. The sport revival started at the end of the XIX century , or better said, during the Industrial revolution, when the „sports revolution" also occured. In 1894 a meeting where was it was decided that the next Olympic games would be in Athens in 1896 was held. From this period the sport architecture expansion started again and sports, again, had an important place role in the society. Thanks to the revolution in engineering, there were new possibilities for constructing and designing sport objects. Thanks to that, the architects could satisfy more technical needs for sport activities and accessibility was on a higher level. Many materials and construction methods made possible better comunications and organisation of all the functions. After the industrial revolution, sport architecture was still present and especially after the WW2 in Serbia a huge number of sport facilities were built. Architecture knowledge and sport requirements were combined and the results are monumental buildings that thousands of visitors every day. (Geraint J.,Sheard R.,Vickery B.,(2007) „Stadia: A Design andDevelopment Guide"fourth edition,Oxford, Great Britain, page 1-7)

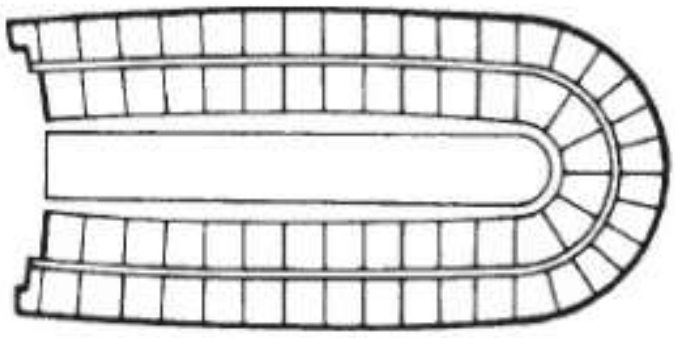

Fig. 1- The U-shaped sunken stadium at Athens, Geraint J.,Sheard R.,Vickery B.,(2007) „Stadia: A Design and Development Guide" fourth edition,Oxford, Great Britain (page 3)

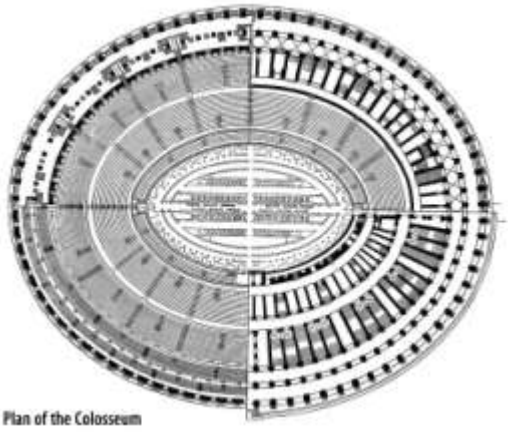

Fig. 2- Colosseum in Rome from I century after Christ
http://wanderstories.com/wp-content/samples/book/Rome/Colosseum.html

Today, the architectural planning of sport facilities is a really complex activity. Beside, technical requirements for sport activity (dimensions) and many other conditions must be satisfied so that everything can function without obstacles. First of all, because of the dimensions of sport courts (sometimes over 100 m) and the necessary height, the construction system must be with a huge span so that columns are not needed. Because of the big surface there is a big load and also it is a big covered surface without openings and sport facilities beside artificial lightning need to have natural lightning. Because of that, many objects have roof lightning and that is achieved with dynamic roof constructions.

(Fig. 3) For the halls that are used for multifunctional activities and that are multifunctional city sport halls and where there is a small auditorium it is easy to use natural lightning from the façade openings. In big sport halls behind the auditorium there are organized locker rooms, bathrooms, utility rooms and their corridors are attached to the facades. There are also many objects that are covered with polycarbonate panels which transmit light and reduce the use of artificial lightning. Another problem in sport halls is heating and cooling of these objects when there is a big number of visitors. In those objects that are purposed for swimming pools where there is high air humidity and for ice arenas where there is low temperature, there are different requirements for lightning and heating. (Headquarters Departments of the army and air force (1988.), "Planning and design of outdoor sports facilities", TM 5-803-10/AFR 88-33, Washington DC, page 5)

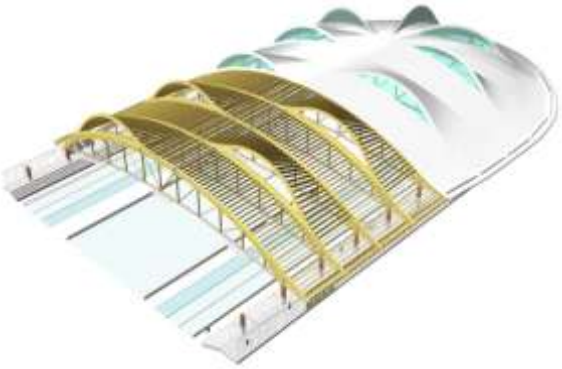

Fig. 3- Construction model for sport hall in Inzel in Germany by Behnisch and Pohl Architects
http://behnisch.com/projects/492

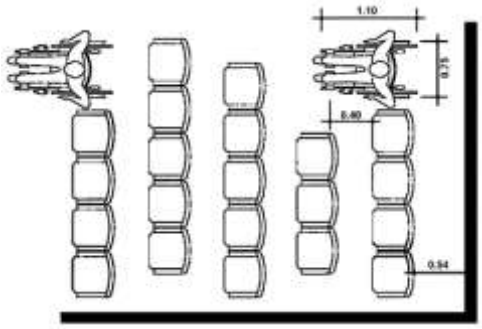

Fig. 4- Ministry of Social Affairs
National Committee for the Disabled, "Accessibility for the Disabled
A Design Manual for a Barrier Free Environment",

One of the main requirements is to make access to all visitors. That means that all parts of a sport hall must be accessible for handicapped visitors. There are many guides that are published by National Committee for Disabled of United Nations and they provide strategies for accessibility without barriers. (Fig 4.) Beside seating places for the disabled people, there must be enough elevators so that the visitors of al ages can access all the rows in sport forums. Also there must be enough entrances, stairs, and entrances for sportsmen, VIP persons and the visitors must be separated. There must be enough parking lots and a distinction between the pedestrian and motor traffic must be achieved. Entrances must be well connected and the corridors must be clear and not too long. There must also be the corridors that are connecting sportsmen entrances, locker rooms, toilets and courts. These corridors should separate male and female locker rooms and their toilets. In many cases, the utility rooms, lockers and bathrooms are placed bellow the auditorium because they don't need natural light. (Ministry of Social Affairs,National Committee for the Disabled, "Accessibility for the Disabled A Design Manual for a Barrier Free Environment", United Nation 2003-2004 from website http://www.un.org/esa/socdev/enable/designm/AD3-01.htm)

Since sport halls are a long term investment, during the planning process sustainability aspects must be considered so that the building can be eco-friendly and that can reduce the maintenance costs. Because of its purpose – a sports multifunctional hall – the carrying construction, façades and auditorium must be flexible and their transformation for different types of sport activities must be easy. Often, partitions are planned and when there are two games at the same time the partitions are pulled. The

floor in sport halls is always designed for one sport and when other sport tournaments or other events are organized, the floor is covered with other material.

Zamet sport center in Rijeka designed by the 3LHD Architects is one of the good examples of a successfully built sport centers. This multifunctional building beside sport activities has also a commercial function. This facility is chiefly planned for handball courts. This facility is adjusted to the terrain and part of the courts are an the underground level and on the roof, there are strips that are optimal for walking and thanks to that there are no barriers for the handicapped people. These strips are also a part of the construction and they are following the shape of the main construction. These strips are a kind of detail that symbolizes this object. The sport hall is planned as a multifunctional hall and it is completely flexible. Sport forums are telescopic and they can be adjusted to the number of visitors and to the type of sport. The object construction is from a still grid that is with the span of 55 m and they are of variable shape with different heights. Height over court goes from 13,20 – 15,30 m. Usable area is 46 * 44, which is enough to make two handball courts (Fig. 5 and 6).

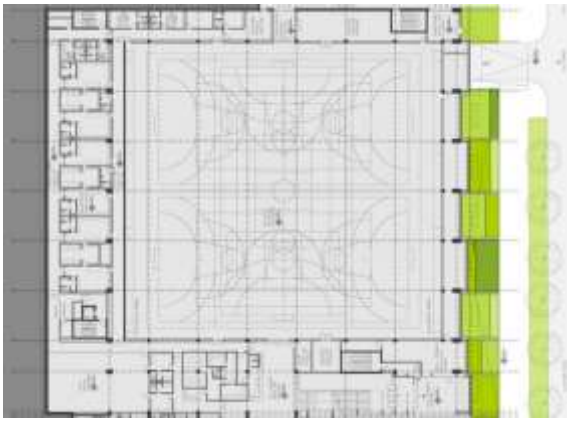

Fig. 5- Floor plan of Zamet sport center
http://www.archdaily.com/425/3lhd-wins-the-zamet-centre-competition/3lhd-centre-zamet-groundfloor-1209030682/

Fig. 6- Handball hall interior look
http://www.archdaily.com/38538/zamet-centre-3lhd/3lhd_zamet_centre_photo_by_3lhd_30/

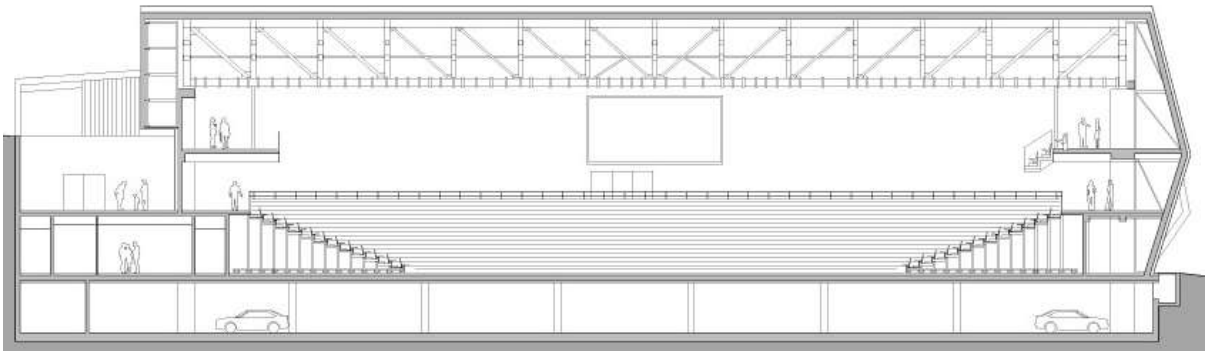

Fig. 7- Section through Zamet sport hall handball court
http://www.archdaily.com/38538/zamet-centre-3lhd/3lhd_zamet_centre_drawings_section_b/

In this project, the architects had an idea to make the sport hall better for sportsmen and they used wood in the interior so that they can feel at home. All around the courts are placed VIP auditoriums with

restaurants and coffee shops and this VIP sections is organized like a corridor which is closed with glass and they have a view of the entire sport hall. To get to the VIP stage and auditorium there are many elevators, stairs and at the entrance, there are ramps for the handicapped (Fig. 7). The main lightning is artificial but there is also the roof light and openings that are planned on the joints of the grid because every grid is shaped differently. The entrances and parking lots for the sportsmen and visitors are separated as well as the parking lots. Around the court there are corridors that are connecting lockers, bathrooms, utility rooms and lockers for the referees. The northern side of the hall is dug in the ground because of the terrain and that side of the roof is used for a pedestrian strip. The southern side is free and thanks to the dynamic shape of stripes there are openings that are from glass and a part of the corridors behind the auditorium has natural light. Entering the auditorium is from the 1st floor and to the VIP auditorium from the 2nd floor, but thanks to the good connectivity every row is accessible for the handicapped persons also. (N.B. (2009) Centar Zamet u Rijeci, Građevinar, vol 61)

The sport center in Medellin, Columbia designed by the Plan B Architects is also one of the good examples of sport center planning. This sport complex was design for the 2010 South American games and it was built in 2008. This complex is built on the place where the earlier sport objects-stadium, basketball hall for 1978 games and aquatic center that were neglected stood. There are four main buildings that were separated and the idea was to connect them all and to create a unique space for all the courts. This was done by using the same roof for all and the roof is made from strips – bands that are parallel and that are following the carrying grid. The grid has a dynamic shape and there are six repeating types of the grid. Thanks to the shape of the grid, natural light is used and also natural ventilation is achieved (Fig. 8 and 9). Also with the variable height all technical requirements were satisfied and enough air for all the visitors is provided. The idea behind using the stripes was to connect all the courts together but also to make it possible to remove and change the facilities depending on the requirements of a sport activity.

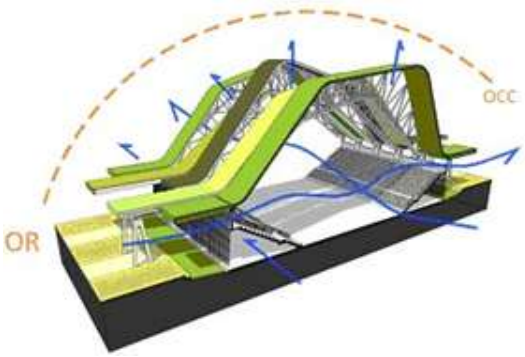

Fig. 8- 3D model of sport hall

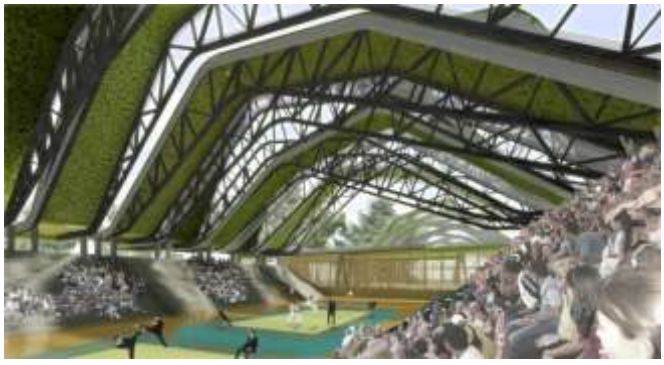

Fig. 9 – Interior of sport hall

http://www.archdaily.com/141675/four-sport-scenarios-giancarlo-mazzanti-felipe-mesa-planb/

Even though this complex has huge dimensions, every court functions as a separated hall and has its own entrances and locker rooms, bathrooms and other required areas. The bands are in the north – south direction so they protect from sun and make possible ventilation east-west. This object also has stairs and elevators so that all visitors can reach all the rows in the auditorium. Every court has its own entrance and it is completely independent of the other courts. All the halls have an underground level which is purposed for preparation before the games and for practicing during different events. Also in the

underground level there are locker rooms, bathrooms and utility rooms and under the auditorium sport stores and restaurants. (Fig 10.) Entrances for the visitors and sportsmen are separated and they are planned that in a case of fire or other disaster the objects can be empty in just a few minutes. Communication: the corridors in the object are very clear and there is no interfering when the events are ongoing. Also, the auditorium has stairs to the middle of the rows and the last rows are attached to the façade. Beside the natural lightning and heating, there is a complete system of ventilation tubes so that enough fresh air is always in the object. This sport center is a good example of the flexibility between sport and architecture. (http://archrecord.construction.com/projects/portfolio/2011/01/coliseums.asp)

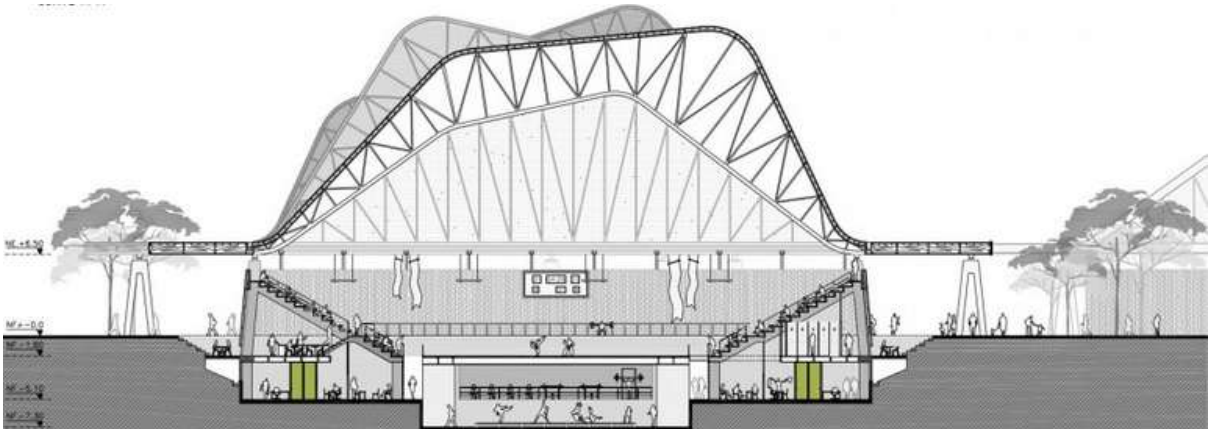

Fig. 10- Section through gymnasium hall in Sport center in Medellin
http://www.archdaily.com/141675/four-sport-scenarios-giancarlo-mazzanti-felipe-mesa-planb/

Sport hall Žatice in town Poreč, Croatia designed by professor Jurković Sonja is another good example of a successfully completed sport hall. This hall was built in 2008. and it represents one of the most important facilities in town. This hall was designed as multifunctional hall and till now it hosted many events mainly handball and tennis games. The building has an unusual shape (Fig. 11) and thanks to its form natural light is used. The building is orientated east – west and the south and the north façades are left free and covered with glass because of natural light. The entrances are on a different elevation because of the terrain slap. With this object structure it is possible to use natural ventilation mainly. Of course, there are tubes for ventilation and they are not hidden they are visible and placed next to the construction elements.

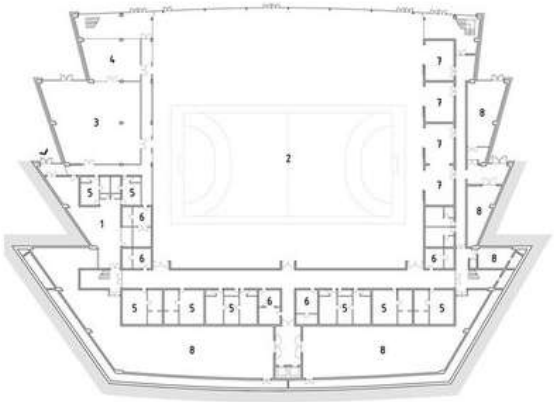

Fig. 11- -2Ground plan of sport hall Žatice
http://www.worldbuildingsdirectory.com/project.cfm?id=1693

Fig.12 – Interior of sport hall Žatice

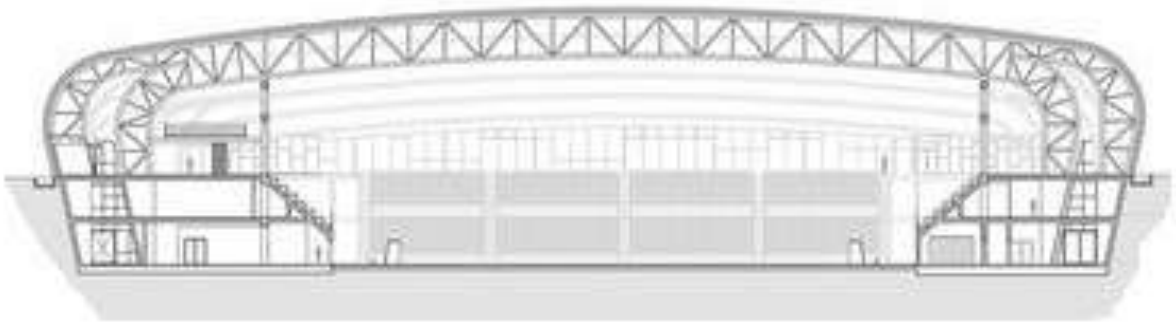

Fig. 13- Section through sport hall in Žatice
http://www.worldbuildingsdirectory.com/project.cfm?id=1693

The entire object has a surface of 80*100 m but the area used for games is 45*45m and consists of two parallel courts (Fig. 12). The entire object has 4 stores. In the -2 level there are locker rooms, bathrooms, practicing rooms, utility rooms for sportsmen and other technical rooms. On the -1 level there are locker rooms and bathrooms for visitors. Also, club quarters and meeting and press rooms are underground. On the ground level there are the main entrances. On the 1st floor is the auditorium and there are elevators and stairs to the auditorium rows. Above the auditorium there are balconies. The capacity of the hall is 4.000 visitors. There are 3 auditoriums on the east, south and west side and above the auditorium are balconies that are sort of the 5th level.(Fig. 13) This sport hall represents the biggest hall in this town which is known for sport activities. Around the building is parking on the ground level and there are few entrances from it. The entrances for the visitors and sportsmen are separated and the main courts are detached from the entrance lobby with a glass partition.

In this project the accessibility for the disabled visitors is also taken into account. Apart from the entering ramps there are elevators which can transport people in wheelchairs to all levels in the sport hall. The corridors in the hall are clear and they are separated for the visitors and the sportsmen. Directions for the auditorium are clearly defined and it is easy to reach all rows. Also in case of an

emergency it is planned to empty the building in just a few minutes. This is important because there are many visitors during the sport events and because of a possible panic situation there must be enough exits so that the visitors don't risk their lives. (http://www.worldbuildingsdirectory.com/project.cfm?id=1693)

The Oriental sport center in Shanghai designed by the GMP Architects is a sport hall projected for swimming championship. It was opened in 2011 for the 14th Fina championship. The Oriental sport center consists of 3 separated buildings – one where there is the main swimming pool for championship, the second where there are a few swimming pools of different dimensions and the third with an open air swimming pool which is used during the summer. This complex is built on the former industrial land and because the ground was devastated, and since this complex is purposed for swimming, all the land around it was turned into an artificial lake and the objects are connected by bridges. Everything is on the same level and there are no physical barriers for the handicapped visitors. The construction of these two closed objects is from the grid that has a shape which allows intrusion of natural light and makes natural ventilation possible. In the main hall around the auditoriums are the corridors that are attached to the facades so that natural light doesn't reach swimming pool. In the natatorium – a hall with smaller pools, the auditoriums are only on the two sides and the other two are opened (covered with glass) towards the artificial lake.

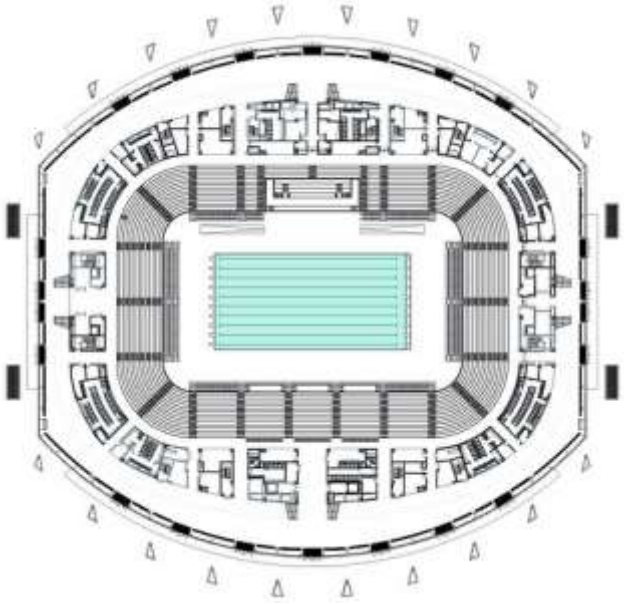

Fig. 14- Ground plan of sport hall with swimming pool

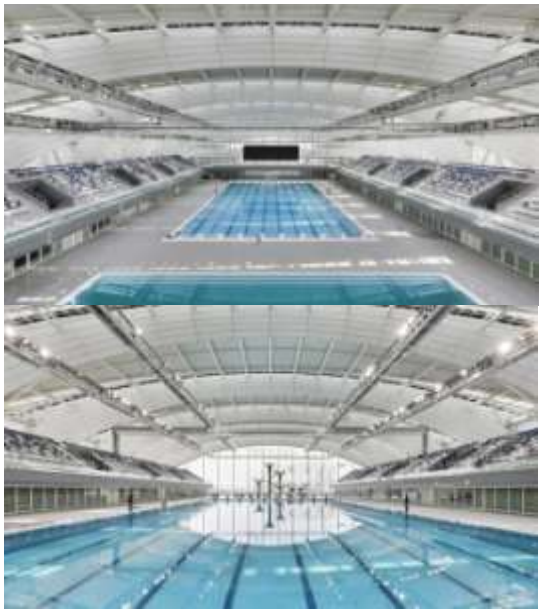

Fig.15 – Interior of sport hall Oriental

http://www.archdaily.com/151303/shanghai-oriental-sports-center-gmp-architekten/

The capacity of the main hall (Fig. 14) is 17.000 - 18.000 visitors and capacity of natatorium (with smaller swimming pools) is 4.000 – 5.000 visitors (Fig. 15). The main hall has 20 entrances and they are placed on every 5-8 m as well as the carrying construction. The entrance portals are completely made of glass and they allow the natural light to enter. From each entrance there is a direct corridor to the auditoriums and on the way to the seats on the sides are bathrooms. The entrances for the sportsmen are not on the same sides as for the visitors. There are four entrances for sportsmen and from the entrance lobby there are direct lobbies to the locker rooms. The locker rooms, bathrooms for sportsmen, utility and technical rooms are placed under the auditoriums. The swimming pools are dug

in the ground and in that underground level are pumps for water, rooms for props and other necessary materials. Around the pools there is enough space for the benches and the players' seats. Also, because there was a need to construct a diving board, there had to be a sufficient height for jumping. From the swimming pools there are direct exits in case of injury of swimmers so that they can get out of the object easily.

The Oriental sport hall is accessible from all sides. Even though there is an artificial lake around all the objects, there are pedestrian bridges that are connecting all objects. These bridges have no barriers that could make impossible moving to the people in wheelchairs. All the entrances for sportsmen are connected to the parking space for them and there is the movement of the visitors does not interrupt that of the sportsmen. Thanks to the large number of entrances, there is a possibility to empty the sport hall in less than 10 minutes in case of an emergency. (http://www.gmp-architekten.com/projects/shanghai-oriental-sports-center.html)

RESULTS

Analyzing the above mentioned objects we found many similitaries and many rules that must be respected. First of all, the most important is to have open communication and to plan the corridors that are not crossing so that there is no confronting between the visitors and the sportsmen. There must also be an access for all people – also for the people with handiceps and because of that, there are often many elevators so that they can reach all the rows in the auditorium and also to reach all the levels in the sport hall. Often, the toilets are placed on the underground levels and they must be avaliable to all the visitors. On the other hand, the corridors are also important in case of an emergency. When there is a fire or any other emergency situation, it is important that the hall could be empty in just a few minutes so that the visitors don't risk their lives. As well as inside, good connection is importamt outside the hall. Parking lots must be near the entrances, and the entrances must be adequately positioned and there must be enough entrances for all the visitors.

To make everything according to the technical requirments, it is necessary to chose the adequate construction type that has a huge span ao as to avoid pillars inside the construction. Also, depending on the sport type, there must be a sufficient height so that a ball cannot hit the roof. For all the sport events, the best is to use as much natural and not artificial light as possible and that can be easily achieved with the roof openings and façade glass. Also, it is important to preserve enough fresh air during the summer and to obtain an average temperature during the winter. Because of that, it is important to have good ventilations and to make constant cycling of the air. This can also be done using the openings on the construction and this way artificial ventilation is reduced. All this technical details are a part of the sustainability plan which should be implemented in all the objects. Because of the fewer and fewer sport funds, the architects must consider that the building must use as many natural resources as possible and to save energy and reduce the costs. Because of that, it is important to combine the technical needs and the bioclimatic architecture so that the lightning, ventilation and heating uses as much natural energy as possible.

DISCUSION

No matter where a sport hall is located, the guidelines are always the same. The plan and the form of the hall depends of the technical requirements and the visual effects depend of the architecture plan. The objects that were analysed are from South America, China and Croatia, and all four have many similitaries that are the result of the technical requirements. It is not enough only to respect all the technical propositions; it is necessary to connect everything and to get a unique form inside but also on the outside so that the object itself can attract visitors. Also, because many sport halls are used not only for sport events but also for culture and music festivals, this space must be flexible. All halls must be adjustable to many types of

sport and by using partitions it is possible to play two games at the same time.

The emphasis in all sport objects is on communication and corridor organization. This is the main factor for a successful function of one sport hall. When we have a few halls in one complex, a good corridor organization is crucial for the normal and uninterrupted sport events. No matter what is surrounding the sport facility (water, park, street) it is important to make functional parkings, to clearly mark the entrances and to connect them with the parkings. In the interior, it is important to connect the entrance lobby with the auditorium and toiletes. Also it is important to separate entrances for visitors, sportsmen and vip visitors. Sportsmen entrances are directly connected with the parking which is right in front of the entrance door. Inside, the sportsmen entrance lobby is connected with the locker rooms and bathrooms which are connected to the courts by corridors. Sometimes, where there is a possibility, the entrances for the handicapped persons are also separated so that they don't have to go through the crowd.

In the center of all the halls are playgrounds – courts and around them are the auditoriums that can be from all the sides or only on two sides and the other two can be attached to the façade. Often, below the auditoriums are the locker rooms and bathrooms for sportsmen and in that way the place below the rows is which is directly linked to the playgrounds. Depending on the capacity of the auditoriums, there are corridors at the precisely defined distance so that a large number of people can enter and exit in short time. In many cases, also in the given examples, the locker rooms, utility rooms, bathrooms club quarters are placed on the underground levels. To provide good connections, the sport halls must have elevators to all the levels and also the regular and firesafety stairs. When these requirmenets are satisfied, the facility gets a unique form which can be refined with the outside façade details that can at the same time provide natural light or natural ventilation. Also, many sport halls have a green roof that is for pedestrians and sometimes there are even sport grounds for the outside games.

CONCLUSION

The results obtained by the analysis show that many of the requirements can be satisfied only by using an adequate architecture structure. This paper shows that there is an unbreakable link between architecture and sport and that many conditions can be satisfied only with a good architectural proposal. Because of that, sport and architecture have been connected from Ancient times and still are. Thanks to the architectural planning and shaping, the technical requirements and the form of the object together can make monumental and very attractive halls that are often symbols of towns and whole regions. No matter in which part of the world a sport center is located, it is important to analyze all the successfully completed objects and to learn from them and avoid making mistakes.

This paper analyzes and submits the examples of the successfully completed sport centers. It is important to take all the technical needs into account but also to try to enrich sport architecture and to prove that sport objects can be completely functional and at the same time look monumental and grand as public and cultural buildings. Also, during the planning process sport objects can be connected with the surrounding in order to provide a better accessibility and to make an interesting architectural structure. This is achieved in Zamet sport center where the roof is a pedestrian band and in the Oriental sport center where water is connecting all the buildings in the complex.

REFERENCES:

1. Crowther N.(2007),"Sport in Ancient times",Westport, United States, page 87-140

2. Geraint J.,Sheard R.,Vickery B.,(2007) „Stadia: A Design andDevelopment Guide"fourth edition,Oxford, Great Britain, page 1-7

3. Headquarters Departments of the army and air force (1988.), "Planning and design of outdoor sports

facilities", TM 5-803-10/AFR 88-33, Washington DC, page 5, http://www.wbdg.org/ccb/ARMYCOE/COETM/tm_5_803_10.pdf found on 20.08.2013

4. Ministry of Social Affairs,National Committee for the Disabled, "Accessibility for the Disabled A Design Manual for a Barrier Free Environment", United Nation 2003-2004 from website http://www.un.org/esa/socdev/enable/designm/AD3-01.htm found on 20.08.2013

5. Nadilo B. (2009) Centar Zamet u Rijeci, Građevinar, vol 61, page 563-573

6.http://archrecord.construction.com/projects/portfolio/2011/01/coliseums.asp found on 21.08.2013.

7.http://www.worldbuildingsdirectory.com/project.cfm?id=1693 found on 21.08.2013.

8. http://www.gmp-architekten.com/projects/shanghai-oriental-sports-center.html found on 22.08.2013

ULOGA ARHITEKTURE SPORTSKIH OBJEKATA NA PRAVILNO ODVIJANJE SPORTSKIH AKTIVNOSTI

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SAŽETAK

Uvod: Projektovanje sportskih objekata predstavlja veliki izazov za arhitekte jer je potrebno napraviti multifunkcionalan objekat koji će zadovoljiti potrebe velikog broja ljudi. Postoji veliki broj pravila koja treba ispoštovati a najbitnije je isprojektovati funkcionalne komunikacije i napraviti kompaktan objekat koji će zadovoljiti potrebe svih korisnika i koji će biti vizuelno atraktivan. Prilikom projektovanja arhitekte se sreću sa mnogobrojnim problemima jer je potrebno organizovati veliki broj sadržaja unutar jednog objekta, treba upotrebiti adekvatnu konstrukciju kojom se omogućavaju veliki rasponi, treba voditi računa da se maksimalno koristi prirodno osvetljenje i ventilacija i naravno kompletnu formu objekta treba uklopiti u okruženje i povezati je sa njim. Predmet rada jeste uloga arhitekture u organizovanju nesmetanog i funkcionalnog odvijanja sportskih aktivnosti u sportskim dvoranama.

Metode: Metode koje će biti korišćene jesu analiza i sinteza izvedenih sportskih objekata širom sveta i analiza i deskripcija uloge arhitekture u nesmetanom odvijanju sportskih aktivnosti. Komparativnom analizom nekih od primera biće ukazano na prednosti i mane projektovanja sportskih objekata.

Rezultati: Na osnovu analize izvedenog stanja sportskih objekata širom sveta, biće dat prikaz osnovnih smernica za projektovanje objekata i njihove forme kako bi se nesmetano odvijale sportske i fizičke aktivnosti u jednoj sportskoj dvorani. Sintezom podataka dobijenih analizom različitih primera sportskih dvorana iz razliitih zemalja i sa različitom funkcijom, biće dat pregled uticaja arhitekture i njen značaj na funkcionisanje komunikacija u sportu i fizičkom vaspitanju.

Zaključak: Cilj rada jeste da približi i analizira uspešno izvedene primere iz svetske prakse i da ukaže na međusobnu vezu između sporta, fizičkog vaspitanja i arhitekture.

Ključne reči: sport, komunikacije u sportskim dvoranama, veza između arhitekture i sportskih aktivnosti

THE ANALYSIS OF THE SPORTS LEXIS IN THE DAILY NEWSPAPER BLIC DURING THE OLYMPIC GAMES IN LONDON IN 2012

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SUMMARY

Introduction: The problem of investigating the frequency and the stability of the use of some terms and phrases is one of the most important in any domain of expertise. The value and actuality of such a body of research lies in the fact that new data on collocations, elaboration of new research methods should contribute to the development of lexicography, syntax and semantics.

Methods: The research methods used in this paper include context comparatve and other types of analysis. Also a statistical analysis was applied on corpuses of Serbian language texts by using statistical measures of corpus linguistics used in similar studies. As a basic material newspaper „Blic "articles were used published during the OG in London and immediately after this event from 27.06 – 16.08.2010.

Results: For the data generation the software for corpus data analysis was used. The basic part of the analysis was performed by AntConc corpus tool but other tools were also used in order to obtain more complete information on the analyzed corpus.

The analysis procedure meant using the abovementioned concordancer which selected all the words that, at first sight, showed any connection to sports or the more general words which had a logically possible connection to sports paired with other words. More than 50 of those words that have had the frequency of appearance in basic and other grammar formswere selected..

Conclusion: The Internet offers wide possibilities for a more sophisticated research of language on the basis of the available information that can be very efficiently analyzed and processed by the means of adequate softwares and thus improve insights into any area of knowledge. In this research we have gained significant information on a small sample of available information but, nevertheless, one that can be very important for further similar research.

INTRODUCTION

Nowadays, a growing body of research is aimed at studying the possibility to identify formal properties that are necessary for the determination of the subject area of the texts and keywords that describe the considered corpus. The corpus of scientific and journalistic styles are analyzed (Agun, Pivovarova, 2010; Aguno, 2010). The problem of studying the frequency and stability of an individual use of terms and phrases is one of the most important problems in the terminology of each profession. Actuality of such research is conditioned by obtaining new information on collocations, development of new methods of research which is to contribute to the development of lexicography, syntax, semantics. Existing literature and dictionaries do not always reflect fully the information about interconnections of lexemes, of stable phrases. This is even more pronounced in the area of sport and physical education as a profession that has a large lexical fund which has been increasing over the recent years but from the point of language it is still very scarcely understood.

The statistical methods reveal new perspectives for this kind of research. The statistical methods may be current particularly when studying the processes of the emergence of a new subject area and the terminology changes (especially in the coexistence of different scientific paradigms, each of which can use its own terminological apparatus. The application of such methods to obtain information about the lexical and syntactic connectivity based on the large corpora even today serves as the basis for the creation of vocabulary and grammar of a new type.

Lately, more and more frequently the papers appear to address the ways and solutions of the automatic extraction of terminological collocations, usually to index documents in information search tasks or to complete the vocabulary of the intellectual systems (Braslavskij, Sokolov 2006).

This paper focuses on the description and the experimental verification of linguistic and statistical methods for presenting vocabulary and terminology in the journal texts in Serbian language.

Today, the corpora in linguistic research has become an indispensable tool and at the same time, the material for research and the solution of the practical problems. However, for users of the corpuses it has become very difficult to cope with the huge volume of diverse information, its processing and classification. There is a problem of the enormous quantity of data. We need a system of "filters" that will help to extract important linguistic facts that are partly related to the theoretical and practical aspects of the connectivity of the words. The statistical device used in the text corpuses allows the users to rank the search results according to several different parameters and set limits, which leads to obtaining very important information.

This research aims to automatically extract and classify the information from the newspaper articles. The realization of this idea is inseparable from the task of allocating the terms and collocations that are most characteristic according to certain parameters of the investigated corpus. When separating collocations in these texts using statistical measures, we can limit the research task of collocations' separation in general, and focus on the study of terminological collocations, primarily on bigrams. Under **collocations** we mean a non-random combination of the two or more lexical items which are specific to the language as a whole (texts of any type), and for certain types of texts (or even the sub-selection of texts). Various statistical measures were used to automatically extract collocations from the texts which are then ranked according to their degree of stability in accordance with the meanings of the selected measures.

MATERIAL AND METHODS

The object of this study was to determine the frequency of the use of individual words and their syntagmatic connectivity in the journalistic texts related to sport in Serbian.

The subject of research is the data, the most frequently used words and stable syntagmas (collocations), which correspond to certain lexical and syntactic models.

The aim of the research is to investigate and solve complex theoretical issues related to the frequency of individual words, collocations of threefold nature (lexical, syntactic and statistical), development of a general model of lexical and syntactic compounds in Serbian language and the study of their extraction methods.

To reach the aim of this research several tasks were performed:

- The term "frequency of words" and "collocation" in both foreign and domestic literature were analyzed.

- A study of the statistical measures to determine the frequency and strength of syntagmatic relationship was also conducted.

- We also analyzed the software package that captures these measures in a text corpus.

The choice of materials was determined by the desire to examine a selected sample and analyze the structure of the used vocabulary in order to establish the basic terminology of parameters that can be used for later comparison with other similar corpuses.

The research methods used in this paper include contextual, comparative and other types of analyses. Also, there was applied a statistical analysis of the texts in Serbian language by using the statistical measures of corpus linguistics used in the studies of a similar nature. The text corpora allow for the review of the text simultaneously from several perspectives and getting various information about them (e.g., morphological , statistical characteristics of the contexts of word usage, etc.).

Definitions of used terms

Corpus linguistics in the broadest sense means the study of the language of the text corpus, which today includes the texts in electronic form and computer made corpora.

Corpus is a collection of texts that are selected and assembled according to certain criteria in order to make the pattern language and the language that provide the data on which the study of language is to be conducted.

Under collocations we mean the non-random combination of two or more lexical items which are specific to a language as a whole (texts of any type), and for certain types of texts (or even the (sub) selection of texts). Collocations are combinations of main words and those tokens that occur in its vicinity.

Token is any single occurrence of the word in the corpus, so that the term means a corpus set of texts with a million tokens.

Type is, unlike a token, a unique form of token in the corpus.

N -grams are sequences of n words separated by spaces or punctuation marks. There are n-grams that in the text appear together more often and not by chance. Such a series of words in the corpus linguistics is called a collocation, ie. an expression made up of two or more words that have some meaning.

Concordancer is a special computer program that allows different kinds of searching the corpus, from a simple frequency analysis, to the study of the kinds of words, collocations and research even of the phonological text search. (Dobric, 2009)

Lexical density is the ratio of the number of individual words in the text to the total number of words. It is used in the analysis of discourse as a descriptive parameter that depends on the style and genre. Spoken texts tend to have a lower density than written texts.

The frequency of the linguistic units (phonemes, morphemes, lexemes, semems) taken as a content analysis is a basic requirement of legality within a corpus. The frequency indicates how many times a linguistic unit occurs in the context of a specific corpus, which allows to later reach certain conclusions. The numerical values of frequency are used as the basis for what makes the core of the corpus linguistics - statistical analysis.

RESULTS

To obtain the results, a software for corpus processing and text analysis was used. The main part of the analysis is done with the help of AntConc corpus tools but other tools were used in order to obtain the most complete information about the analyzed corpus .

As the maincorpus the articles of the daily newspaper "Blic" in the period when the Olympic Games were held in London and just before that, from 27.06 - 16.08.2010 were used.

A total of 754 articles from the the daily newspaper "Blic " was collected, including the following sports - athletics (12.6%) , badminton (0.27 %) , cycling (1.33 %) , boxing (0.8 %), water polo (4.24%) , rowing (2.55 %) , gymnastics (0.27 %) , weight lifting (0.27 %) , kayaking (2.39 %) , basketball (4.38 %) , fencing (0.27 %) , volleyball (5.97 %), swimming (7.69 %), wrestling (0.27 %), handball (4.51 %), diving (0.13%), table tennis (0.53 %), archery (0.13%), shooting (3.58%), taekwondo (2.92%), tennis (9.28 %), soccer (6.50%), judo (1,19%) and articles of general character (27.85 %).

The size of the collection incorporated 209 693 "tokens" and 25055 different words - thus their relationship and lexical density was found to be 0.12.

The analysis was performed by using the above mentioned concordancer to select all the words that

are obvious at the first glance to have a connection with the sport, or that connection was logically possible in the connection with other words, although the word was more of the general character. There were selected those words that had the frequency in the primary and other grammatical forms more than 50. Thus the first 100 words were set aside. The list of words is presented in the Table below (the first half of the Table is presented to save space).

	Lexeme	Frequency - basic form	Frequency - all grammar forms
1.	medal	305	1300
2.	finals	350	845
3.	match	269	632
4.	race	57	543
5.	game	431	518
6.	national team	203	472
7.	result	190	441
8.	sportsman	180	426
9.	semifinal	156	388
10.	gold	288	386
11.	set	127	379
12.	tournament	65	363
13.	competition	93	321
14.	victory	63	317
15.	point	51	269
16.	game	65	268
17.	quarter	135	242
18.	qualifications	33	234
19.	record	172	227
20.	defeat	90	227
21.	discipline	22	222
22.	sport	60	221
23.	team	90	219
24.	team	211	216
25.	sport	60	211
26.	bronze	69	202
27.	placement	134	195
28.	selector	138	187
29.	player	32	178
30.	net	59	175
31.	game	64	165
32.	tennis player	97	162
33.	selection	33	162
34.	break	116	157
35.	water polo	30	152
36.	terrain	41	152

37.	Olympian	35	150
38.	chance	16	149
39.	champion	74	148
40.	service	103	147
41.	handball	8	136
42.	rival	31	129
43.	athlete	74	123
44.	silver	99	122
45.	ball	15	120
46.	swimmer	66	116
47.	target	75	115
48.	duel	61	114

After that, using the same program, N-grams (connections of more words) that had the highest frequency and probability of occurrence in the text were selected. The N-grams that were made up of two words that have had the frequency of occurrence in the studied corpus of more than 15 were selected. Then, for each of these collocations a certain measure of interconnections (MI) (on this measure more in Stubbs 1995; Khokhlova 2008) between the words in collocations showing the probability of the compound words that make and indicate the degree of the stability of a collocation. The higher values of this measure indicate greater stability of collocation and its more probable use in similar texts. This procedure has gained 48 collocations shown in the Table below.

	Syntagma /collocation	Total frequency - all forms	Frequency - infinitive	MI
1.	World Cup	34	5	14,999
2.	European Championship	37	3	14,667
3.	Greco Roman	15	12	13,677
4.	qualifying group	18	1	13,528
5.	final race	28	4	13,063
6.	small-caliber rifle	23	11	12,977
7.	free hit	27	0	12,923
8.	world record	80	49	12,704
9.	small-caliber gun	24	11	12,548
10.	opening ceremony	37	7	12,408
11.	qualification race	30	0	12,063
12.	Olympic champion	36	19	11,311
13.	Olympic Village	71	18	11,289
14.	Olympic finals	20	12	11,289
15.	Olympic Committee	144	58	11,219
16.	basketball Team	30	21	11,118
17.	handball team	58	31	11,095
18.	Serbian tennis player	20	19	10,655
19.	quarter final	51	0	10,602
20.	water polo team	54	33	10,569

21.	butterfly	39	0	10,449
22.	gold Medal	280	24	10,349
23.	state record	20	19	10,186
24.	volleyball team	62	35	10,177
25.	Olympic champion	43	28	10,145
26.	football team	32	17	10,048
27.	Serbian tennis player	76	60	9,578
28.	silver medal	109	37	9,538
29.	Olympics	894	247	9,329
30.	Serbian Olympic	30	13	9,258
31.	Olympic Tournament	164	14	9,214
32.	national Record	18	14	9,113
33.	Serbian swimmer	47	30	9,086
34.	Serbian national team	42	29	8,863
35.	Serbian foursome	20	18	8,757
36.	Olympic gold	39	27	8,492
37.	Serbian national team	26	22	8,482
38.	Olympic record	29	23	8,443
39.	Serbian athlete	32	17	8,312
40.	Olympic team	73	25	8,295
41.	Serbian volleyball	25	17	7,645
42.	match point	18	1	7,382
43.	Olympic medal	108	10	7,165
44.	Serbian athletes	40	9	6,832
45.	Serbian team	149	59	6,669
46.	final race	34	17	6,183
47.	Committee of Serbia	38	6	5,245
48.	Serbian team	31	11	4,188

DISCUSSION

The first table gives appropriate information from which one can draw some conclusions in regard to the individual words used in the journalism texts studied. Most articles, when it comes to sports, were on track and field, tennis and swimming and it is expected that the most frequent words should be in these sports, and of course those that are more typical (the categories related to these sports with little or no degree of generality with other sports). However, from the Table it can be concluded that the most frequent words are with a higher level of generality, ie . the words used in many different sports, which is understandable, since the number of words related solely to one sport is less than the multi area words as the result of common features and elements inherent to many sports, as well as certain linguistic principles (such as polysemy) to economize lexical resources in the representation of many concepts. Also, to this contributes a great number of articles that have the content of a general nature and do not represent an individual sport or a greater number of sports together.

The analysis of the same corpus can also be used to draw some conclusions regarding the use of proper nouns (they are not presented here to save

space). Out of all the local athletes Novak Djokovic is, by far, the most mentioned one (total of 394 times), followed by Milorad Cavic (a total of 205 times). Of the foreign athletes the most mentioned one is Usain Bolt (305) and behind him is Michael Phelps (176).

The second Table that represents the syntagmas (collocations) points to the two-component expressions which can have terminological meaning and that are relatively stable compounds in which these words appear most often. The table sorts collocations by their degree of statistical correlation (MI) . But their order, if one looks at the overall frequency in which they appear (in all inflected forms), is significantly different. It is so because, in addition to the observed frequency of the collocation, the individual frequency of each word that is a part of the collocation affects the number of times they are mentioned. The Table shows that of the two compound words the most stable are “World Cup” and “European Championship”, which means that the two collocations of all two-member words appear most frequently in these mutual connections.

Corpus linguistics uses extensively statistical methods to obtain information on the structure and composition of the corpus of facts. These methods are associated with the nature of language. There are various measures that are based on the calculation of the degree of connection between the words in the text. The most commonly used are MI, t -score and log -likelihood. The closeness of the words in the text assumes their relationship, so the obtained values of the measures for each pair of elements contain information about their connectivity.

The results of the research in the field of corpus linguistics are applied parallel to the number of commercial releases of the vocabulary and grammar of English, of the publishing house HarperCollins and a further research in theautomation process of dictionary and thesaurus is needed (Samardzic, 2004).

The internet offers great opportunities for meaningful language investigation based on a large amount of information available that can be successfully analyzed and processed using the appropriate software tools, thus improving the knowledge scope of the relevant fields of knowledge. In this study we have obtained important information on a small sample of the information available, but that may be very important for further studies of a similar nature.

REFERENCES

Dobrić, N. (2009). Corpus linguistics as the basic paradigm of language investigation. Philologia , pp. 47-58.

Samardžić, T. N. (2004). Basic theoretical-methodological characteristics of corpus linguistics. Philologia, no. 2 , pp. 15-18.

Stubbs, M. (1995). Collocations and semantic profiles: on the case of the trouble with quantitative studies . Functions of language 2(1) , 23-55.

Браславский, П., & Соколов, Е. (2006). Сравнение четырех методов автоматического извлечения двухсловных терминов из текста. Компьютерная лингвистика и интеллектуальные технологии:Труды международной конференции «Диалог 2006», (pp. 88-94). Бекасово.

Хохлова, М. В. (2008). Экспериментальная проверка методов выделения коллокаций. Slavica Helsingiensia 34. Инструментарий русистики: Корпусные подходы., (pp. 343 – 357). Хельсинки.

Ягунова, Е. В. (2010). Формальные и неформальные критерии вычленения ключевых слов из научных и новостных текстов. Материалы IV Международного конгресса исследователей русско-го языка «Русский язык: исторические судьбы и современность», (pp. 533-534). Москва.

Ягунова, Е. В., & Пивоварова, Л. М. (2010). Природа коллокаций в русском языке. Опыт автоматического извлечения и классификации на материале новостных текстов. Научно-техническая информация . Сер.2. Информационные процессы и системы. № 6, 30 – 40.

ANALIZA SPORTSKE LEKSIKE U DNEVNOM LISTU BLIC TOKOM OLIMPIJSKIH IGARA U LONDONU 2012

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SAŽETAK

Uvod: Problem izučavanja frekventnosti i stabilnosti upotrebe pojedinačnih termina i sintagmi je jedan od najvažnijih u terminologiji svake struke. Aktuelnost ovakvih istraživanja je uslovljena time što dobijanje novih podataka o kolokacijama, razrada novih metoda njihovog izučavanja treba da doprinesu razvoju leksikografije, sintakse, semantike.

Metode: Metode istraživanja korišćene u radu uključuju kontekstnu, poredbenu i druge vrste analize. Primenjena je takođe statistička analiza na korpusima tekstova srpskog jezika uz korišćenje statističkih mera korpusne lingvistike koje se koriste u istraživanjima sličnog karaktera.

Rezultati: Za dobijanje rezultata korišćen je softver za korpusnu obradu i analizu teksta. Osnovni deo analize je urađen uz pomoć AntConc korpusnog alata ali su korišćeni i drugi alati sa ciljem dobijanja što kompletnijih informacija o analiziranom korpusu.

Postupak analize je izveden tako što su pomoću napred navedenog konkordansera selektovane sve one reči koje su očigledno na prvi pogled imale vezu sa sportom ili je ta veza logički bila moguća u okviru spoja sa drugim rečima, iako je sama reč više opšteupotrebnog karaktera. Odabrane su one reči koje su imale frekvencu pojavljivanja u osnovnom i drugim gramatičkim oblicima više od 50.

Zaključak: Internet pruža velike mogućnosti za sadržajnije izučavanje jezika na osnovu velike količine dostupnih informacija koje se mogu vrlo uspešno analizirati i obrađivati pomoću odgovarajućih programskih sredstava i na taj način unapređivanje saznanja odgovarajućih oblasti znanja. U okviru ovog istraživanja dobili smo značajne informacije na jednom manjem uzorku dostupnih informacija, ali koje mogu da budu vrlo značajne za dalja istraživanja sličnog karaktera..

Ključne reči: Olimpijske igre, sport, Blic, sportska leksika

“POLL” METHODS IN A SPORTS PEDAGOGICAL STUDY

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UDC 37.012

SUMMARY

Introduction: It is well known that any serious research is based on a particular method. This is the central problem of the research, which largely determines the scientific results and achievements in one or another area in this figure and in teaching. It's first and foremost a system of requirements that the researcher must comply. The aim is to obtain new knowledge about the rich and diverse pedagogical reality at some stage of her development. Approved is the understanding that the methods are ways, devices, procedures for touring sports - pedagogical reality the way it is. And, also for expanding and deepening its closest relationship and dependencies of contemporary realities and trends in the development of scientific knowledge. Namely, it is possible through the acquisition of new knowledge and incorporating it into a modern theoretical and practical schemes and patterns. That is its strength - to consider the peculiarities of the practice and its theoretical understanding.

Methods: Report has highlighted the theoretical and applied aspects of research training and sports activities.

Conclusion: The main emphasis, the subject of this development, mostly focused on the following: clarifying the nature and specificity of the above methods of survey research, the procedures to be implemented for their use; variants of their application in sports teaching practice, their advantages, disadvantages and perspectivesKeywords:

Key Words: method for testing, investigation, interview, experts' assessment

Each serious scientific study is based on a certain method. Word goes about a c e n t r a l p r o b l e m, c o n d i t i o n and m e a n s for each science, including the sports-pedagogical one. It is namely it that, to a greater degree, predetermines the scientific results and achievements in one or another scientific field. Word goes about a s y s t e m o f requirements which the sports pedagogue as a researcher should follow. The objective is to receive some new knowledge about the exceptionally rich and varied pedagogical reality at a certain stage of its manifestation.

Method is the w a y, m e a n s, p r o c e d u r e of knowing the pedagogical reality, such as it is as an essence, law, development, tendencies, perspectives. This is a prerequisite for its enrichment and perfection. It is what makes it possible to reach new and authoritative knowledge and its immersion in the modern theoretical and practically applicable schemes and models; it contributes to a deeper “insight” in the sports-pedagogical reality as well as the continuous approach of theory towards practice. Some researchers offer the following classification of the sport research methods: (Г. Бижков)

- from historical point of view : spiritual – scientific, empirical and ethnographic;
- from the point of view of the knowledge about science : theoretical and empirical;

- according to the frequency of their use and application : observation, experiment, inquiry method, interview, socio metry, etc. It is accepted that this method is the most suitable from the practical point of view.

Attention in this paper shall be directed mainly to the inquiry me- thod and the interview, known as well as the "poll" methods. They are most often used in the sports-pedagogical theory and practice.

It is known that by the inquiry method (written poll) it is possible to collect information via a preliminary defined system of questions on the problems of interest, presented in a written form in an inquiry card or a questionary, specially designed for the purpose. The objective is to study the standing point of the persons under study (pupils, athletes, teachers, coaches, managers, experts in information provision, experts in medical-biological sphere, etc) on the problems of particular importance for the sports-pedagogical theory and practice. For instance, the attitude towards the physical education and sport lessons; to the training and competitive process; the influence of some internal and external factors on the effectiveness of the sports competition; the motivations and attitudes towards the success in the sports competitions; the effect of the "formal" and informal" communication in the school and sports activity; the "stress providing" factors leading to unwanted sports successes and results; etc.

Various variants of constructing the questions are possible. We reduce them mainly to the following: "opened" questions – provide the possibility of a "free" formulation of the answers; "closed" questions – offer pre- formulated possible answers; "questions – dilemma" – offer two opposite or mutually excluding answers – "yes" or "no"; "alternative" questions – give two or more mutually excluding answers; "semiclosed" questions – offer a possibility for entering answers which do not exist in the offered ones; "direct" or "indirect" questions; "personel" and "nonpersonel" questions; "control" questions, etc.

The so-called inquiries – scales were widely used during the last years. When filling in them the persons under study should not simply choose the most correct of the offered answers but they should put them in order, "arrange" or gradually organize them according to their importance, in a certain "ranking order" by giving a mark to each of them (most often from 1 to 5 or 1 to 10). This is particularly useful when it is necessary to collect information related to defining the ranking, hierarchic place, for instance: of the basic factors helping the pupils or the athletes to study and train better; the nature and contents of the sports motivation as primary psychological-pedagogical prerequisite for achieving better results – European, World, Olympic; leading professional-personal qualities which the up-to-date pedagogue should have; the "optimal" style of interaction within the "teacher-pupil" and "coach-athlete" system; the pedagogical competence and overcoming stress states particularly prior to and during the important sports competitions, etc.

A serious alternative of the traditional "poll" is the so-called "Internet – inquiries". These studies are more and more applied in the Internet - the net as a mass, reliable and modern media. That is in close relation to and conditioning by the advantages and possibilities of the internet communication; we are reducing them basically to:

- the validation of the Internet as a mass and reliable modern media;
- the possibility of comparatively swift, express, not so expensive and not difficult to implement studies related mainly to collecting and processing the gathered data;

- a high effectiveness of the Internet studies because of the possibilities for conducting a well-timed and swift contact within the "inquirer – inquired" system;
- the possibilities for receiving sufficiently objective information particularly on more delicate problems in comparison to the possibilities of other traditional "techniques of studies" inquiries;
- a minimum cost of time as organization,the number of people engaged and a relatively low cost for distributing the inquiries;
- a maximally quick contraction of the time for the procedure of filling in the inquiry or the questionnaire,the introduction of the information into the data base, procession and analysis,a timely presentation and the interpretation of the results.

The limitations of the method are mainly related to the "barriers" of the language, thoughts, feelings, experiences, frame of mind, relationships, which are more fully and more exactly expressed through the word or the speech; and the word, as it is known, is the most complicated, most exact, most fine and most effective means of communication and intercourse. The fact that should not also be undermined is that via this method the casual dependences and laws determining the processes and the events are difficult and not always possible to be determined. As far as the Internet studies are concerned, the main difficulties are reduced to finding the electronic addresses of the people listed in the extract; the relatively low degree of the "return" of the inquiry cards; the contents of the "audience" as age, education, profession, addresses, income, etc.

As far as the interview, as another basic method of a "poll" (verbal poll") is concerned, we reduce it mainly to the i n t e r a c t i o n a n d c o n t a c t between two subjects – "interviewer", who wants to receive the information from another person or group of people (pupils, athletes, coaches, managers, experts in information provision, etc), called the interviewed of a specially researched nature. This method allows entering more deeply into the "inner world" of the pupils, athletes, to provide valuable information related to the personal views, relations, understanding, motives, feelings, experiences. The latter are of primary importance for the success of the unified school, training and competitive activities.

Known are various variations of the i n t e r v i e w as a research method of wide application in the sports-pedagogical theory and practice. They are most often reduced to the following: "s t a n d a r d i z e d" i n t e r v i e w where by a preliminary prepared scenario, the questions and the sequence of their asking, as well as the expected answers have been defined; "n o n s t a n d a r d i z e d" i n t e r v i e w where the questions are defined most generally, without "strict" formulation and order of asking; "s e m i s t a n d a r d i z e d" i n t e r v i e w where the central questions are pre- formulated, followed by a "series" of additional questions. The interview can also be "v o l u n t a r y" or "o b l i g a t o r y", "f i r s t h a n d", i.e. "f a c e" to "f a c e" or "c i r c u m s t a n t i a l" by using modern technical means or registrators of information.

Within the context of the written so far, it is obvious how difficult and responsible the mission of a sports pedagogue and a researcher is. We think the problem is particularly current and important and more often it enters the "agenda". That is why, according to us, it should be studied in detail, as it depends on its successful solution, to a great degree, the effectiveness of the sports-pedagogical activity within the modern conditions and reality. Today, the sports pedagogue is "forced" to be a r e s e a r c h e

r and c r e a t o r. That is a primary prerequisite and condition for his/her activity to be maximum effective.

If the pedagogue-researcher does not know in detail the concrete dimensions of the sports pedagogy theory and practice as needs, state and perspectives, he/she would not direct his/her scientific studies to the right direction. Furthermore, that would not allow him/her to make the necessary actual conclusions which would be a prerequisite for the nonrealistic concepts which would seriously hinder his/her activity as a teacher or coach.

LITERATURE

Бижков, Г., В. Краевски. Методология и методи на педагогическите изследвания, С., 1995.

Ценева, Ев., П. Захариев Спортният педагог като изследовател. В: Личност, мотивация, спорт. Т. 17, НСА, С., 2012.

Tzeneva, Ev. Sports Pedagogy, Sofia. 2002

SPORTS PEDAGOGY AND ITS PLACE WITHIN THE SYSTEM OF SCIENCE

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UDC 37.015:796

SUMMARY

Introduction: Established understanding that pedagogy is one of the oldest sciences. Emergence and development as a learning process and accompany the overall historical development of society and the conscious activity of man from "prenatal" communities to this day. The aim is to detect scientific truth, ie knowledge that is constantly evolving and improving. At the same time, it seems a sufficiently significant degree trends in educational reality and prospects, particularly favorable to civilization process.

Methods: Theoretical and historical methods to explore the pedagogical reality.

Conclusion: Integrative links between pedagogy and sports science determine the occurrence of sports pedagogy. It contains a component that defines its specificity. Therefore, this report will focus our attention mainly to certain indisputable facts and evidence affirming her right to independent existence.

Key Words: pedagogical knowledge, civilizing process, evolution, sport pedagogy

Approved is the understanding that pedagogy is one of the most ancient sciences. Its origin and development as cognition and as a process is accompanying the whole historical development of the society and the conscious activity of man since the “pre-generic” communities till today. The objective is to find the scientific truth, i.e. the knowledge which is continuously developing and perfecting. At the same time it outlines to a sufficiently important degree the tendencies in the development of the pedagogical reality as well as its perspectives particularly favorable for the civilization process.

Pedagogy has got its evolution, i.e., it has been developing, enriching and perfecting according to the changes having occurred in the historical development of society. They have inevitably left their imprint on the pedagogical processes and events too, which are as well the subject of the sports-pedagogical science. In the context of the above said we think that there are sufficient reasons to state that pedagogical science is an “opened” system which is continuously developing, new knowledge is added and the existing one is reconstructed.

That the real, including pedagogical actuality, is radically changed is without doubt. That takes to the front not only new problems but a range of requirements related to the wholesome development of the pedagogical science as contents, new spheres, new structure, enlargement of the subject and its fields of research, as well.

It is a fact that within the conditions of the incessantly increasing variety of life, the necessity for a specialized pedagogical knowledge is more and more increased; while it is well known that knowledge is an exceptionally dynamic and quickly changing process. That reasons as well the need for the appearance of a range of private pedagogical disciplines on the bases of a certain specificity or “sign” of the object and subject of the pedagogical science.

The development of sport, as well as of the pedagogical science, takes to the front the problem

of the whole establishment and approval of the sports pedagogy as a relatively independent pedagogical discipline. It is known that the "sports pedagogy" concept is already in circulation, i.e., it is more and more convincingly imposed on the scientific terminology; but for the time being it has not yet being sufficiently exactly and completely defined as a concept. According to us, its contents aspect and status have not yet being specified to the end.

It is known that the "sports pedagogy" concept is most often used in two basic meanings: first, in the quality of a concept which "indicates" the activity of the pedagogue in his/her immediate sports-pedagogical practice, i.e. the activity of the coach; second, in the quality of a specific privately pedagogical discipline within the system of the pedagogical science as a theoretical discipline.

These two basic meanings of the "sports pedagogy" concept, as well as the fact that it is found in between two sciences – pedagogy and the physical education and sport theory, as well as the fact that modern sport contains an enormous and more and more enlarging "multitude" of sports disciplines, present the specificity of the sports pedagogy as exceptionally difficult to be analyzed, "multi layer" in contents and rather difficult to be defined. That, to a greater degree, stems as well from the influence of the more and more imposing at the end of the XXth and the beginning of the XXIst century tendency related to the appearance and the quick development of the interdisciplinary studies and their respective scientific fields of knowledge.

We think that there are sufficient reasons to state that the right for the existence of the sports pedagogy is determined by two indisputable facts in the social and scientific life. The first one is related to the social practice. Indisputably, each human activity which has been approved as such has the right to exist but obligatory suggests as well its "theoretization" which allows entering into its essence, laws and regularities. That applies in full force for the phenomenon sports too, whose appearance may and should be looked for in the whole of history, since the most ancient times. The second fact is related to the pedagogy as a science which is directly related to all fields of the human activity – scientific-theoretical, esthetic-artistic, moral-ethic, practice-applied, etc. According to us, practically any human activity, which is specified as such and has established its relatively "independent status" has got its relation to the pedagogical science. Namely, it is the "transmission" through which knowledge and experience, having been piled up during the historical development of the society, from generation to generation are conveyed. In that sense, pedagogy is directly related to sports and that, to a greater degree, defines the right of the existence of the sports pedagogy as well.

The reasons for the existence of one or another scientific discipline do not yet provide the status of an actually existing one. In science there exist exceptionally strict rules, the following of which is an obligatory condition or requirement for the establishment of one or another scientific discipline within the system of science. These rules are concentrated in the structure of science. Word goes about a strictly defined structure in which several basic components exist.

Inside science contains a component which puts in its specificity. Within its frames the object and the subject of science take the first place, followed by the aims, the problems and the tasks of the respective science or scientific discipline.

As far as sports pedagogy is concerned, it has its object of research and its specific and unrepeated subject which makes it unique, unrepeated and relatively independent scientific discipline. The study and the analysis of the problem related to the object of the sports pedagogy shows that in the wide meaning of the word, that is man and his formation, development and successful life realization. In the narrow sense of the word, these are the students, athletes and other people practicing sport who are actively influenced by the specially organized school, sport-educative, competitive and restoring process.

Indisputably, more complicated is the issue related to the s u b j e c t of the sports pedagogy. That complexity arises mainly from the fact that sports pedagogy contains in it both the specificity of the sport as theory and type of human activity and the one of pedagogy as science and practice. It is expressed in the requirement for "harmonization" both of the general in sport and pedagogy and the specific, unique in the sports pedagogy itself. More concretely, that means sports pedagogy does not duplicate the subject of pedagogy but contains elements from it.

In the context of the above said it is obvious that the subject of the sports pedagogy has to be looked for both in the system of the pedagogical science and the sports science. That is why, according to some pedagogues, the subject of the sports pedagogy may be treated both in a narrower and a wider sense. In that respect it can be accepted that it "studies and researches the particularities and the regularities, the structure and mechanisms of formation of the personality within the sports media conditions, in the interaction between the coach and the athlete as well as between the athletes themselves … it is one of the lot of more or less well built pedagogical systems of the school-education activity, for sports preparation and specialization both of young and grown up people with the purpose of their multi side development, formation and achievement of high sports results".(2, pg. 393). Reporting the general characteristics of each separate scientific discipline and the particularities of the sports pedagogy, we think that its subject can be expressed in the following way: s u b j e c t o f t h e s p o r t s p e d a g o g y is the general qualities, relations, structures and regularities of the functioning and development of the teaching, schooling and education in the field of sport as a kind of human activity.

It can be seen from the s u b j e c t formulated so, that sports pedagogy is close but does not coincide completely with pedagogy. It takes the conception apparatus from pedagogy, the knowledge confirmed in it about the regularities, the methods, forms and means of organization, realization and management of the pedagogical process. At the same time, sports pedagogy takes from the theory of the physical education and the private sports scientific disciplines the knowledge about sport as a whole and the separate concrete kinds of sports; but it does not coincide with them as its main objective is not the study about sport as such but the teaching, schooling and education in the field of sport in general. In that sense, sports pedagogy owns all characteristic features of an interdisciplinary, borderline scientific discipline, as it started to appear avalanche-like in the middle of the XXth century.

The particularities of the object and subject of the sports pedagogy pointed out here do not appear to be the final solution of the problem related to the independent existence of this scientific discipline, but its beginning only. In the further analysis, it is necessary to render an account that science contains in its structure a s e c o n d obligatory component too which establishes the system of knowledge in it. The most important element in this structure is the t h e o r e t i c a l t y p e of scientific knowledge. Word goes mainly about terms and concepts, i.e., words with strictly fixed contents. Within the structure of each science, the next obligatory component related to the scientific methods used in it is of primary importance too.

In c o n c l u s i o n we think it necessary to underline that "sports pedagogy" is within the process of establishing itself as an independent scientific field of cognition. More efforts are yet needed to precisely specify both its subject and the establishment of its scientific theories and the approval of its specific scientific methods.

LITERATURE

Попов, Н. Треньорът. Психология, образование, адаптация. С., 2007

Тодоров, Ат. За предмета на спортната педагогика. ВФК. С., 1984 – 6 .

Ценева, Ев., Спортна педагогика. С. 1998.

ATHLETES' PERFORMANCE SUCCESS PRIDE WHEN COMPETING INTERNATIONALLY- REVIEW

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UDC 796.41.062

SUMMARY

Introduction: Grounded in the social-identity and self-categorization theories and drawing on the data gathered in the US General Social Survey (N = 2528), this research examines how the demographics and the media use the measures associated with national pride, as experienced through the success of the US athletes competing internationally.

Methods: The US General Social Survey (N = 2528) was used initially. The bivariate tests and the analysis of covariance models indicated greater levels of national pride among black males, older respondents, those who classified themselves as republicans and those with lower levels of formal education.

Results: Exposure to newspapers and television did not prove statistically significant in the multivariate analyses, although the bivariate tests revealed that those exposed most frequently to television tended to agree in significantly higher numbers with the statement 'When my country does well in international sports, it makes me proud to be an American".

Conclusion: A review of and some comparisons to domestic athletes' pride taking based on the research results as well as the limitations and recommendations for future research are offered.

Keywords: social identity, national pride, success, athletes, domestic athletes

INTRODUCTION

Like many other countries, the Dutch government increased investments in elite sports in the last decennium, partly driven by the ambition to organize the Olympic Games in 2028 in the Netherlands. One of the most important legitimating for this ambition is that the elite sports events and national achievements should foster national pride, social cohesion and international prestige. In the article by Agnes Elling, Ivo Van Hilvoorde, Remko Van Den Dool there were presented and discussed the results of a study on the relationship between the Dutch international sport achievements and the development of national pride. The outcome is based on 27 longitudinal measurements among the adult Dutch population in the years 2008–2010 in which European and world Championships men's soccer and a summer and winter Olympic Games took place. The results support the common belief that the international sporting success of Dutch athletes contributes to the testimony and expression of national pride and belonging. However, the extent to which national pride can be increased by national sporting success seems to be rather limited. The data show that national performances in international sport events may lead to small, short-term eruptions in feelings of national sporting pride and well-being, especially among the athletes, men and non-immigrants. However, the results indicate that national pride is a rather stable characteristic of national identification that cannot easily be

increased by improving national sporting success and winning more Olympic medals.

As well as being a growing academic literature, subjective well-being - SWB is now firmly on the public policy agenda. Likewise, the sports industry is viewed as being of growing economic significance, reflected in its promotion in public policy. The paper we compare with the Dutch experience fostering national pride, explores the impact of engagement with sports on the individual subjective well-being (SWB) for a sample of 34 countries. Engagement in sports is defined to include formal and informal participation, as well as attendance at sports events. It is hypothesized that one dimension of SWB associated with sports by individuals in a country is the pride felt by them as a result of international sports success. To provide a robust account of the determinants of these dimensions of SWB, a variety of estimators are employed that also account for any feedback between them. Account is also taken of different country level effects on the impacts. Controlling for standard covariates associated with SWB the results suggest that all forms of sports engagement enhance SWB. However, it is suggested that there is also an indirect impact of pride felt from international sporting success on SWB. Crucially, these effects are, in part, determined by formal participation in sport, or attendance at sport events but not informal participation. Further, there is some evidence that pride has a strong country-level dimension. A further interesting policy dilemma raised by the research is that passive engagement in sports is more likely to raise SWB (Pawlowski, T., Downward, P and Rasciute, S. Sport Management Review, 08/2013).

More specifically the following pattern of results can be established. For the socioeconomic covariates a quadratic effect of age is identified on happiness, as noted in the literature. A similar effect is identified for pride. In contrast, the results suggest that generally females are happier, yet males experience greater pride from international sporting success. This is perhaps not surprising since it is recognized that males participate more in sport, and make up more of its audience (Downward et al. 2009). As also indicated in the literature, greater household size and being a couple, rather than being widowed, divorced or separated contributes to happiness.

In contrast and perhaps not surprisingly given the comments just made, being single or separated is more likely to contribute to pride because of international sporting success. Further, in general, work status other than being unemployed or ill and unable to work contributes to happiness as does education and income. The opposite is the case for pride from international sporting success. This would seem to suggest that the pride from sporting success can help to offset economic and social disadvantage. As far as the key sporting covariates are concerned the main results are robust to specification and suggest that all forms of sporting engagement contribute to SWB, suggesting that this impact is greater the more frequent the sporting activity.

Social-identity theory (Tajfel and Turner, 1986) suggests that a human tendency to categorize with a need to maintain positive self-esteem leads individuals to perceive themselves as members of certain social groups. The model claims members of in-groups will stress their similarities relative to out-groups, belongingness helping to neutralize insecurity and bolster esteem. Thus, when a nation sends its best athletes to compete in the Olympics, the Tour de France or the World Cup, individuals within a given country will generally support those who represent the ‘in-group’ internationally. When an athlete or a team excels, the entire nation may share in the victory, with mass media engaging in nationalistic news coverage (Bairner, 2001; Butterworth, 2010; Hargreaves, 1992; Lee and Maguire, 2009; Tomlinson, 1996; Tomlinson and Whannel, 1986).

Consistent with social-identity theory, news organizations may become especially nationalistic, or overtly biased, when a country, through elite sports competition, comes under attack. As an example, Denham (2004) studied how US and international news organizations reported

revelations in 2003 that famed Olympian Carl Lewis had failed a drug test prior to the 1988 US Olympic trials. While US news organizations largely ignored the story, international outlets offered intense criticism not only of Lewis, but of the United States Olympic Committee (USOC). Linking the news with the US invasion of Iraq in March 2003, international observers charged that the United States had played by its own set of rules for too long, and that Lewis deserved to lose the medals he had won in 1988. Similarly, Denham and Duke (2010) studied US and international press coverage of cyclist Lance Armstrong and US media outlets, in general, did not criticize Armstrong to the extent that international news organizations did (Billings and Tambosi, 2004; Delgado, 2003; Denham and Desormeaux, 2008).

The current study shifts the conversation from *between* groups to *within* them. Drawing on US survey data, the study examines determinants of pride in the performance success of US athletes competing internationally, exploring the extent to which measures such as sex, race, age, education level and political leanings predict nationalistic sentiment. The study also examines the respective roles of newspaper and television exposure in the formation of attitudes, anticipating that media users will tend to express more nationalistic sentiment than those not exposed to mass media, given the aforementioned research on nationalistic news coverage.

That observation identifies the importance of studying the subordinate, or interpersonal, level of self-categorization, as it pertains to variation *within* an in-group, as opposed to variation *between* in-groups and out-groups. Writing about global sport, Maguire (1999) posited that individuals who live in complex nation-states may structure identities at the local, regional, national and international levels, with individuals self-classifying based on factors such as status and prestige. When advantageous, individuals may stress their membership in a certain group, just as they may discount that membership in a different context.

For purposes of the current study, in-group variation might be understood along demographic lines. Because American males, for instance, have traditionally been more involved as both participants and sport spectators, they might express more nationalistic pride in the performances of US athletes than American females will. Televised sports, in particular, focus largely on male athletic competition, and Whannel (2002: 67) posited that 'For many men, sport provides a bounded universe, part real, part fantasy, in which fantasies of the perfection of performance can be realized.'

Regarding education level, those with higher levels of formal education might be comparably reluctant to agree with a categorical statement about pride in athletic performance success, perhaps being more willing to scrutinize the efforts of US athletes in relation to those from other nations. Additionally, those who indicate greater levels of political conservatism might be expected to score higher on measures that relate to patriotism. In the United States, those with conservative political beliefs often consider themselves republicans, while those with more liberal, or progressive, beliefs tend to identify with the democrats.

Older Americans might express greater levels of national pride in the performance success of US athletes, as much of their political socialization will have occurred during the Cold War, when athletic competition symbolized East/West political rivalries. Finally, the study anticipates that individuals who report higher levels of media exposure will tend to express more pride in the performance success of US athletes competing internationally. Seminal research conducted by sociologists Gans (1979) and Tuchman (1978) identified ethnocentric patterns in the construction and dissemination of news, and in the context of sport, media outlets in the United States seek to construct rivalries in order to develop compelling news narratives. Television, which packages sporting competitions for mass audiences, adds to the drama through visual symbols (e.g., Olympic medal winners singing their respective

national anthems or taking victory laps while waving a national flag).

METHODS

Sample

This study drew on the data gathered in the US General Social Survey (GSS), an ongoing research initiative administered by the National Opinion Research Center at the University of Chicago. In the cumulative GSS data file (1972–2008), items measuring pride in the performance success of US athletes appeared twice, in the Olympic years 1996 and 2004. The 1996 data included 2904 total cases and the 2004 dataset included 2812. While all respondents were not asked about pride in athletic performance success, the number of 1996 respondents (N = 1331) combined with those from 2004 (N = 1197) resulted in a representative sample of 2528 individuals.

Dependent measure

In the current study, the following Likert measure served as a dependent variable: 'When my country does well in international sports, it makes me proud to be an American.' Response options included 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. This step allowed bivariate relationships to be tested with chi-square analysis. Figure 1 illustrates data dispersions for 1996 and 2004 – public opinion appeared consistent across the two periods, with approximately three in four respondents agreeing or strongly agreeing with the statement. Given its centrality as the dependent measure, the national pride variable served as a filter for all other variables.

Independent measures

Personal characteristics

This study included five demographic items, including sex, race, education level, age and political party identification. Age formed a continuous measure, beginning at 18 and concluding with 89 or older (M = 44.96, SD = 16.48). In addition to the male/female sex variable, race included three categories – white, black and other race – as coded by the GSS. Education level indicated the highest degree earned, including no high-school diploma, high-school diploma, degree from a junior college, undergraduate degree, or a graduate degree. Lastly, an item asked respondents to place their political affiliations on a continuum, including the following seven categories: 'Strong democrat', 'not very strong democrat', 'independent, close to democrat', 'independent', 'independent, close to republican', 'not very strong republican', and 'strong republican'. As indicated, individuals with conservative beliefs often identify themselves as republicans, while those with more liberal, or progressive, beliefs tend to align themselves with the democrats.

Media exposure

In the current study, two variables measured the extent to which respondents were exposed to newspapers and television, respectively. The GSS asked respondents to indicate whether they read the newspaper 'every day', 'a few times a week', 'once a week', 'less than once a week', or 'never'. Television exposure formed a continuous measure, asking respondents to indicate the number of hours per day they watched TV, beginning at zero and ending with 24.

Analytic strategy

Bivariate analyses.

After examining initial frequencies for all variables, the present study explored relationships between nominal and ordinal explanatory measures and the four-level ordered dependent measure through cross-tabulation and chi-square analysis, reporting coefficients of correlation for significant bivariate tests. For cross-tabulations that contained nominal explanatory measures, the study reports the value of Cramer's V. Cross-tabulations containing two ordered variables used Kendall's tau as a measure of association, in addition to chi-square

analysis. All bivariate tests contained original frequencies.

Multivariate analyses

In addition to bivariate tests, the study also used analysis of covariance (ANCOVA) procedures to investigate statistical relationships. ANCOVA procedures test the effects of both categorical factors and continuous-level covariates on one continuous-level – in this case, quasi-interval – response variable.2 To keep modeling procedures systematic, an initial ANCOVA procedure included two categorical factors, year and sex, and one continuous covariate, age. Measures were then added incrementally, with ascending models displayed in table form. In addition to examining the entire dataset with ANCOVA procedures, the study also examined male and female data subsets independently, based on sex differences identified in the initial ANCOVA models. Full factorial models were examined prior to those indicating main effects, and equality of variance assumptions were tested and met in every case except one.

RESULTS

Bivariate analyses

The two nominal explanatory measures, sex and race, did not show statistical significance in chi-square tests. While a higher percentage of male respondents agreed with the statement regarding pride in athletic performance success, the relationship did not exceed chance ($\chi 2 = 5.624$; d.f. = 3; $n = 2528$; p = ns). Similarly, while black respondents agreed in higher numbers than did white respondents and members of other races, the cross-tabulation did not show significance ($\chi 2 = 6.233$; d.f. = 6; $n = 2{,}528$; p = ns).

Moving to education, the cross-tabulation of education level by pride in sporting success proved statistically significant ($\chi 2 = 34.461$; d.f. = 12; $n = 2527$; $p < .01$), yielding a Kendall's tau value of .088 ($p < .001$). While 44 percent of those who had not obtained a high-school diploma strongly agreed with the statement about sporting success, 29.4 percent of undergraduate degree holders and 29.7 percent of those with graduate degrees offered the same response. When the dataset was split by sex, 47.6 percent of male respondents without a high-school diploma strongly agreed, compared to 30.3 percent of those with an undergraduate degree and 27.5 percent of those who had completed graduate school ($\chi 2 = 34.245$; d.f. = 12; $n = 1114$; $p < .001$). The Kendall's tau value for males, at .111, showed significance at $p < .001$. For female respondents, patterns were less pronounced and not statistically significant ($\chi 2 = 15.476$; d.f. = 12; $n = 1413$; p = ns).

The overall cross-tabulation of political party affiliation by pride in sporting success showed significance ($\chi 2 = 76.352$; d.f. = 18; $n = 2490$; $p < .001$) and yielded a Kendall's tau value of –.042 ($p < .001$). Here, 45.3 percent of those who identified themselves as strong republicans strongly agreed with the sporting success dependent measure, compared to 36.4 percent of strong democrats and 31.1 percent of independents. These differences proved significant among males ($\chi 2 = 35.707$; d.f. = 18; $n = 1101$; $p < .01$) and females ($\chi 2 = 55.613$; d.f. = 18; $n = 1389$; $p < .001$), although Kendall's tau showed significance only among female respondents (Kendall's tau = –.051; $n = 1{,}389$; $p < .05$). Thus, while education level appeared significant among males; political affiliation appeared more important, statistically, among females.

Finally, regarding demographic measures, a significant inverse correlation appeared between age and the four-level dependent measure (Kendall's tau = –.088; $n = 2523$; $p < .01$), indicating that older respondents expressed greater pride in the athletic performance success of US athletes. This pattern held for both males (Kendall's tau = –.069; $n = 1113$; $p < .01$) and females (Kendall's tau = –.100; $n = 1410$; $p < .01$).

Regarding mass media, for reasons indicated earlier, bivariate tests included data from 1996 only. First, a cross-tabulation of newspaper exposure by pride in athletic performance success did not show significance ($\chi 2 = 15.894$; d.f. = 12; $n = 906$; p = ns).

Notably, those not exposed to newspaper content and those exposed everyday agreed in higher numbers with the statement about athletic success than did those who indicated more sporadic exposure. While similar patterns held for male and female respondents when the dataset was split by sex, neither males ($\chi 2$ = 19.335; d.f. = 12; n = 390; p = ns) nor females ($\chi 2$ = 17.946; d.f. = 12; n = 516; p = ns) differed significantly. Concerning television, a cross-tabulation of television exposure and athletic performance success contained a series of zero-count cells, and thus chi-square statistics were not interpreted. Nevertheless, the table revealed a clear pattern of exposure to television and pride in athletic performance success, with those who viewed more television expressing greater levels of pride (Kendall's tau = –.147; n = 902; p < .01). These patterns held for males (Kendall's tau = –.158; n = 389; p < .01) and females (Kendall's tau = –.142; n = 513; p < .01). Overall, then, bivariate analyses indicated that older respondents, those with lower levels of formal education, those who identified with the more conservative republican political party, and those who watched more television tended to express greater levels of pride in the performance success of US athletes competing internationally.

Multivariate analyses

Table 2 displays the results of six ANCOVA models, the first of which tested the effects of survey-year, sex and age on the dependent measure addressing national pride. As the model indicates, while no differences were observed across 1996 and 2004, males experienced significantly higher levels of national pride through the sporting accomplishments of American athletes, as did older respondents more generally. Because the Likert item incorporated as the dependent measure began with 'strongly agree' and 'agree', which were scored '1' and '2', respectively, negative parameter estimates for males and older respondents appear in the table (e.g. the older the respondent, the lower the attitudinal score).

The second model included race in addition to year, sex and age. As indicated, black respondents appeared to experience greater levels of national pride through the performance success of American athletes, with gender and age remaining significant as well. In the third model, political affiliation served as a second covariate, and it revealed greater levels of national pride among those who identified themselves as republicans along the seven-point continuum. Race and age remained significant, with sex moving to p <.06.

Model 4 included education level in addition to the explanatory measures from the first three models. As indicated, level of education showed significance as a predictor, with college and graduate education associating with (relatively) lower levels of national pride in athletic-performance success. Sex, race, age and political leanings remained significant as well. The final two ANCOVA models which included newspaper and television exposure, respectively, did not show significance, although the inclusion of television resulted in a loss of statistical difference across the two sexes and among black respondents.

CONCLUSION

In demonstrating how self-categorization applies to identity dynamics in the context of sport, one might consider how the quantitative results in the current study differ from intuitive, or casual, assumptions in identity politics. In the United States, for instance, President Barack Obama, an African American democrat, captured 95 percent of the black vote in the 2008 Presidential Election. In fact, black voters have consistently supported democrats since 1932 (Caraley, 2009), considering the democrats more progressive on both social and economic issues. Yet, in the present study, black males, in particular, expressed attitudes similar to those expressed by the most conservative GSS respondents – those who considered themselves strong republicans. One proceeding from intuition alone might have expected white males – not black males – to express higher levels of national pride; however, if

one considers a fundamental premise of the self-categorization model – that individuals accentuate intragroup memberships when doing so enhances status or prestige – then the statistical findings appear plausible, if not probable. African American athletes have long excelled internationally, and while admiration of athletic accomplishment is by no means limited to one race, African Americans might experience a heightened sense of national pride in an athletic context. More specifically, African American males might experience a heightened sense of pride in the accomplishments of black male athletes.

Overall, the female respondents expressed less agreement with the statement about pride in athletic performance success, conceivably because, in the aggregate, females do not follow sports as closely nor become as personally involved in athletics and sport spectatorship as males do. As statistical analyses revealed, female respondents did not differ attitudinally across race, and while education level proved highly significant as a covariate in analyses involving male respondents, political affiliation, as measured along a seven-point continuum, appeared more significant as a covariate among females.

Regarding mass media, although limited, the bivariate findings concerning television exposure and pride in athletic performance success moved in the direction anticipated; that is, those who watched more television expressed greater levels of pride. Television broadcasts of events such as the Olympics, the World Cup and the Tour de France tend to heroify American athletes, as do the many advertisements that accompany the broadcasts. In contrast to television, newspaper exposure showed a bimodal distribution, with those exposed everyday and those who never read the newspaper expressing more nationalistic attitudes. Respondents in the two categories may have expressed the same sentiment for qualitatively different reasons, with newspaper readers exposed to more nationalistic and ethnocentric press coverage and those not exposed to the newspaper drawing on personal dispositions.

REFERENCES

Agnes E, Ivo H, Remko, (2012). Creating or awakening national pride through sporting success: A longitudinal study on macro effects in the Netherlands**.** Intern. Review for the Sociology of sport.

Bairner, A. (2001). *Sport Nationalism and Globalization: European and North American Perspectives*. New York: SUNY Press.

Billings, AC (2008). *Olympic Media: Inside the Biggest Show on Television*. London: Routledge.

Billings, AC and Tambosi, F (2004). Portraying the United States vs. portraying a champion. *International Review for the Sociology of Sport* 39: 157–165.

Butterworth, ML (2010). Do you believe in nationalism? American patriotism in *Miracle*. In: Hundley HL, Billings AC (eds) *Examining Identity in Sports Media*. Thousand Oaks, CA: SAGE, 133–152.

Caraley, DJ (2009). Three trends over eight Presidential elections, 1980–2008: Toward the emergence of Democratic majority realignment? *Political Science Quarterly* 124: 423–442.

Coakley, J (2004). *Sports in Society: Issues & Controversies*, 8th edn. New York: McGraw-Hill.

Davis JA and Smith TW (2009) General Social Surveys, 1972–2008 [machine-readable data file].

Delgado, F (2003). The fusing of sport and politics: Media constructions of U.S. versus Iran at France 98. *Journal of Sport & Social Issues* 27: 293–307.

DeMaris, A (1992). *Logit Modeling: Practical Applications*. Newbury Park, CA: SAGE.

Denham, BE (2004). Hero or hypocrite? United States and international media portrayals of Carl Lewis amid revelations of a positive drug test. *International Review for the Sociology of Sport* 39: 167–186.

Denham, BE and Desormeaux, M (2008). Headlining the head-butt: Zinedine Zidane/Marco Materazzi portrayals in prominent English, Irish and Scottish newspapers. *Media, Culture & Society* 30: 375–392.

Denham, BE and Duke, A (2010). Hegemonic masculinity and the rogue warrior: Lance Armstrong as (symbolic) American. In: Hundley HL, Billings AC (eds) *Examining Identity in Sports Media*. Thousand Oaks, CA: SAGE.

Maguire, J (1999). *Global Sport: Identities, Societies, Civilizations*. Cambridge: Polity.

Monroe, KR, Hankin J, and Van Vechten, RB (2000). The psychological foundations of identity politics. *Annual Review of Political Science* 3: 419–447.

Pirsl, D (2011). Rhetorical and metadiscoursal structures in sports discourse, unpublished doctoral dissertation, University of Novi Pazar, Serbia.

Pirsl, D (2010). English in physical education and sport, University of Nis, Serbia.

Rubin, DB (1987). *Multiple Imputations for Nonresponse in Surveys*. New York: Wiley.

Smith, E (2007). *Race, Sport and the American Dream*. Durham, NC: Carolina Academic Press.

SPSS, Inc. (2008). *SPSS Missing Values 17.0*. Chicago, IL: SPSS, Inc.

Tajfel, H and Turner, JC (1986). The social identity theory of intergroup behavior. In: Worchel S, Austin W (Eds) *Psychology of Intergroup Relations*. Chicago, IL: Nelson-Hall, 7–24.

Tomlinson, A. (1996). Olympic spectacle: Opening ceremonies and some paradoxes of globalization. *Media, Culture & Society* 18: 583–602.

Tomlinson, A and Whannel, G (1986). *Off the Ball: The Football World Cup*. London: Pluto.

Tuchman G (1978) *Making News: A Study in the Construction of Reality*. New York: Free Press.

Turner, JC, Hogg MA, Oakes PJ, Reicher SD, and Wetherell M (1987). *Rediscovering the Social Group: A Self-categorization Theory*. Oxford: Blackwell.

Whannel, G (2002). *Media Sport Stars: Masculinities and Moralities*. New York: SUNY Press.

COMPARING THE EXPLOSIVE POWER OF THE LOWER EXTREMITIES WITH CHILDREN ATHLETES AND NON-ATHLETES WITHIN THE AGE15 TO18

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SUMMARY

The purpose of this research is to compare explosive power of the lower extremities among children athletes and non-athletes between the age of 15 and 18, in order to determine if inclusion of children into an additional training process influences the development of their motor skills, therefore explosive power. For the purpose of this study 30 male respondents participated. Fifteen of them are members of the judo club "Kinezis" in Nis, and the other fifteen that are non-athletes are students of the Elementary School "Bubanjski heroji" in Nis. Respondents were the average age of 16.3 ± 1.2 (Mean ± St.Dev.) years, average weight 69.23 ± 6.3 (Mean ± St.Dev.), expressed in kg. Cause of variables: 1. Height (expressed in cm); 2. Power (power expressed in W/kg); 3. Force (force expressed in N/kg); Velocity (velocity expressed in cm/s). Each respondent performed five countermovement jumps during which the device Myotest automatically calculated the mean of mentioned variables. All data is processed by descriptive statistics, the Kolmogorov-Smirnov test which establishes if the results possess normal distribution, and a T-test for establishing differences and they are shown through tables. Based on the significance of the T-test (sig < 0.005) a conclusion can be made that significant differences are existent in the results of the tested groups of athletes and non-athletes. It is necessary to perform additional research in this area, to examine and analyze a larger number of motor skills in order to establish results that are more valid and useful.

INTRODUCTION

Explosive power represents a highly genetic determined motor skill. Explosive power expressed through vertical leaps are defined as an individual ability of the neuromuscular system of the respondent to express muscle straining in the shortest period of time (Verhosanski, 1979). Guzalovski (1984) as a sensitive phase for the development of explosive power stated the age from 11 to 13 years. In this period a large number of children begin to train a sport which has a positive affect on the development of their motor skills. Comparing certain motor skills is very often among athletes of different sports, athletes and non-athletes and athletes of different level of competition.

Tako Baker (2001) compares the force of professional rugby players and rugby players of the college league and comes to the conclusion that the professional rugby players have considerably larger power that is assumed to be because of the quality of the workout. The period between 15 and 18 years of age belongs to the older children school age and can be divided into the pre adolescent and adolescent age. The characteristics of development in this period are more expressed in regard to the previous periods of development. Increase of height is more intensive as well as the growth of the lower extremities and the musculature (Mladenovic-Ciric 2008).

The purpose of this research is to compare explosive power of the lower extremities among

children athletes and non-athletes between the age of 15 and 18, in order to determine if inclusion of children into an additional training process influences the development of their motor skills therefore explosive power.

METHODS USED DURING THE RESEARCH

Sample of the respondents

For the purpose of this study 30 male respondents participated. Fifteen of them were members of the judo club "Kinezis" in Nis, and the other fifteen that are non-athletes are students of the Elementary School "Bubanjski heroji" in Nis. Respondents were the average age of 16.3 ± 1.2 (Mean ± St.Dev.) years, the average weight 69.23 ± 6.3 (Mean ± St.Dev.), expressed in kg, without any injuries or diseases that may influence the results gained during the testing.

Sample of the variables

1. Height (expressed in cm)
2. Power (power expressed in W/kg)
3. Force (force expressed in N/kg)
4. Velocity (velocity expressed in cm/s)

Procedure of measuring

Measuring was conducted in the Elementary School "Bubanjski heroji"in Nis and the Faculty of sports and physical education of the University in Nis. The respondents were placed a belt around their waists with an accelerometer Myotest which automatically calculated the mean of mentioned variables during countermovement leaps. Each respondent performed five countermovement leaps, during which the device Myotest automatically calculated the mean of mentioned variables. Previous to the measuring the respondents had an adequate warm-up: 400m of jogging, 3x20 low skips, 3x20 high skip, sideway movement and static stretching.

Processing data

All data is processed by descriptive statistics, the Kolmogorov-Smirnov test which establishes if the results possess normal distribution, and a T-test for establishing differences and they are shown through tables.

RESULTS AND DISCUSSION

TABLE 1 Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Hight	30	26.20	43.40	33.4400	4.45875
Power	30	25.20	58.20	39.3100	10.35126
Force	30	20.10	31.40	24.2500	3.17248
Velocity	30	156.00	281.00	226.3333	28.38569
Valid N (listwise)	30				

TABLE 2 Kolmogorov

		Hight	Power	Force	Велоциту
N		30	30	30	30
Normal Parameters[a,,b]	Mean	33.4400	39.3100	24.2500	226.3333
	Std. Deviation	4.45875	10.35126	3.17248	28.38569
Most Extreme Differences	Absolute	.121	.159	.169	.166
	Positive	.121	.159	.169	.166
	Negative	-.094	-.125	-.095	-.143
Kolmogorov-Smirnov Z		.665	.873	.925	.910
Asymp. Sig. (2-tailed)		.768	.432	.360	.379

a. Тест distribution is normal.

Based on the results of the Kolmogorov-Smirnov test we come to the conclusion that the distribution of the results is normal

TABLE 3 Т-тест.

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
Hight	Eqyal variances assumed	1.897	.179	6.051	28	.000
	Eqyal variances not assumed			6.051	23.608	**.000**
Power	Eqyal variances assumed	18.128	.000	4.982	28	**.000**
	Eqyal variances not assumed			4.982	18.027	.000
Force	Eqyal variances assumed	15.197	.001	3.100	28	**.004**
	Eqyal variances not assumed			3.100	18.118	.006
Velocity	Equal variances assumed	9.679	.004	3.352	28	**.002**
	Equal variances not assumed			3.352	15.914	.004

From the table we can see that considerable statistic differences are existent in the variables Height (sig. 0.000), Force (0.004) and velocity (0.002).

Based on the significance of the T-test (sig < 0.005) a conclusion can be made that significant differences are existent in the results of the tested groups of athletes and non-athletes. In this study Bencke at all 2001. examines children of age 11 and

divides their explosive power into two groups, the elite and non-elite, and came to the same conclusion that the first group of respondents has considerably better results and that they are the product of workouts before and after the pubertal period. Monteiro (2011) in his study compares three groups: 1) the elite judo players 2) junior judo players 3) non-athletes.

Regarding variables he analysis the leaps, the Squat Jump - SJ and the Countermovement Jump CMJ, the force, velocity and time necessary to exhibit the largest force. He comes to the conclusion that the largest difference is within the height of the leap, SJ and SMJ, and then in the amount of time for exhibiting the maximum power. Prahovic (2006) compares the motor skills of children that participate in different sports and non-athletes. One of these characteristics is explosive power where children non-athletes by far have lower results.

CONCLUSION

Programs of physical education are not enough for correct development of children, and some experts consider that they are not implemented well. Sport has a great influence on the development of a child, and from this research we can come to the conclusion that judo, although being a sport where the ability to jump dominates, has a big affect on the development of explosive power of the lower extremities. That is why it is very important to timely include children into sports activities because additional physical activity allows them to develop correctly. This kind of research indicates the positive influence of sport and its importance for increasing the mass and quality of working with children. It is necessary to perform additional research in this area, to examine and analyze a larger number of motor skills in order to establish results that are more valid and useful.

REFERENCES

Baker, D. (2001). Comparasion of upper-body strenght and power between professinal and collage-aged rugby league players. *The Journal of Strenght and Conditioning Research.* 15(1), 29-36.

Bencke, J., Damsgaard, R., Saekmose, A., Jorgensen, P., & et al.(2002). Anaerobic power and musule strenght characteristic of 11 years old ečite and non-elite boys and girls from gymnastics, team handball, tennis and swimming. *Scandinavian Journal of Medicine & Science in Sports.*12 (3), 171-178.

Castro-Pinero, J.,Gonzalez-Montensions, J., Mora,J., Keating, X. & et al. (2009). Percentile values for muscular strenght field tests in children aged 6 to 17 years: Influence of weight status.

The Journal of Strenght and Conditioning Research. 23 (8), 2294-2311.

Monteiro, L., Massuca, L., Garcia, J., Carratala, V & Proenca, J. (2011). Plyometric muscular action tests in judo and non athlets.. *Isokinetics and Exerecise Science.* 19 (4), 287-293.

Mladenović-Ćirić, I.(2008). *Biological Bases of Sport.* Nis: Sven.

Prahović, M., & Protić, J. (2006). *The differences between the anthropological obeležijima četrnestogodišnjih players, basketball, handball, and those who do not play sports.* Croatian Kinesiology Association. Proceedings. 16th (p. 470-476). Zagreb: Faculty of Kinesiology, University of Zagreb.

Verhošanski, J.V. (1979). *Strength of the sport*. Partisan, Belgrade.

Živanović, N., Stanković, V., Ranđelović, N. & Pavlović, P.(2010) *Theory of Physical Education*. Nis: Mkops Nis.

UPOREĐIVANJE EKSPLOZIVNE SNAGE DONJIH EKSTREMITETA KOD DECE SPORTISTA I NE SPORTISTA UZRASTA OD 15 DO 18 GODINA

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SAŽETAK

Cilj ovog istraživanja je da se uporedi eksplozivna snaga donjih ekstremiteta kod dece sportista i ne sportista uzrasta od 15 do 18 godina, tj. da se utvrdi da li uključivanje dece u dodatni trenažni proces utiče na razvoj njihovih motoričkih sposobnosti odnosno eksplozivne snage. U istraživanju je učestvovalo 30 ispitanika muškog pola. Petnaest ispitanika bili su članovi džudo kluba '' Kinezis'' u Nišu, a drugih petnaest ispitanika nesportista učenici Osnovne škole '' Bubanjski heroji'' u Nišu. Ispitanici su bili prosečne starosti 16.3 ± 1.2 (Mean±St.Dev.) godina, prosečne telesne težine 69.23 ± 6.3 (Mean±St.Dev.) izražene u kg. Uzorak varijabli: 1. Height (visina izražena cm); 2. Power (snaga izražena W/kg); 3. Force (sila izražena u N/kg); 4. Velocity (brzina izražena cm/s). Ispitanici su izveli po pet skokova iz počučnja, pri čemu je aparat Myotest automatski izračunavao srednje vrednosti pomenutih varijabli. Svi podaci su obrađeni deskritivnom statistikom, Kolmogorov-Smirnov testom kojim se utvrđuje da li rezultati imaju normalnu distribuciju i T-testom za utvrđivanje razlika i prikazani su tabelarno. Na osnovu značajnosti T-testa koje su (sig< 0.005) može se zaključiti da postoje statistički značajne razlike između testiranih grupa sportista i nesportista u dobijenim rezultatatima. Potrebno i izvršiti dodatna istraživanja u ovoj oblasti, ispitati i analizirati veći broj motoričkih sposobnosti i tako doći do validnijih i korisnijih rezultata.

ANALYSIS OF MUSCLE STRENGTH OF WRIST IN STUDENTS OF THE FACULTY OF SPORT AND PHYSICAL EDUCATION IN MONTENEGRO

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SUMMARY

The problem of this research is to determine the strength of the wrist muscles in the students of the Faculty of Sports and Physical Education from Niksic.

The sample included 90 students of both sexes (male = 76; female = 14) who regularly attend classes at the Faculty of Sports and Physical Education at the University of Montenegro. The measurements were carried out in the diagnostic center at the Faculty of Sports and Physical Education at the University of Montenegro. Strength of the muscles of the wrists (left and right) was measured with a portable isokinetic dynamometer of EASYTECH'' Prima DOC'' brand.

The survey data were analyzed using the statistical program v.SPSS 19.0, customized to run on personal computers. Descriptive statistical values are expressed in terms of the mean value (SD) for each of the predicted variables, as well as the minimum and maximum values.

The force generated by the muscles of the wrists of both hands in male students has the lowest value at the fourth year of study while it reaches its maximum at the third year of study. However, these values differ slightly, so we can say that the forces generated by the muscles of the wrist of both hands in male students deviate as the students move to the beginning and end of the study. The force generated by the muscles of the wrist of both hands in female students have similar variations during the four years of studies, as was the case with the male students.

From all the above and the obtained results it can be concluded that the average values, for both sexes separately and for the total population, are in the range of 7 to 70 kg, while the average value for both samples is 43.2 kg.

Key Words: analysis, students, strength, muscle, dynamometer.

INTRODUCTION

Static strength of the upper extremities is important in a number of sports disciplines, and when the segments of competitive sports are applied in teaching physical education, special attention should be paid to the difference between the sexes. In a number of disciplines good motor performance with left and right side of the body is directly connected with success in the realization of the task ..

Dynamometer is a measuring instrument for measuring torque (momentum). Dynamometer can be used to measure the intensity of electric, magnetic, or other force. Isokinetic dynamometer is used for measuring and / or exercise of all larger joints and muscles of the human body. Isokinetic testing measures the strength and the disposition of it in the range of motion, force, and accomplished work, muscular endurance. Data are processed by computer program, by which the measured values are correlated, as well as the relationship between agonist / antagonist, the time of acceleration, the

speed of reciprocity of movement, maximum and average power produced, and the index of fatigue or endurance of a single muscle.

Similar studies were also carried out on the top footballers Carey and associates. (2001). As well as on the younger age groups (Teixeira Silva & Carvalho, 2003), where there was a positive effect of training in which motor technical football knowledge was practiced with both feet.

One of the ways to record differences between the left and right side of the body is also through the estimation of static power of fist by dynamometer. Holtzen (2000) in a study conducted on the top tennis players from 1968 to 1999, has established the dominance of left-handers, and their success he explains with better neuroanatomical base for performance of neurocognitive motor tasks.

The aim of this research is to determine the strength of the wrist muscles in the students of the Faculty of Sports and Physical Education from Niksic.

METODS

The sample included 90 students of both sexes (male = 76; female = 14) who regularly attend classes at the Faculty of Sports and Physical Education at the University of Montenegro.

A sample of measuring instruments: Strength of the muscles of the wrists (left and right) was measured with a portable isokinetic dynamometer of EASYTECH'' Prima DOC'' brand.

Statistical analysis of data: The survey data were analyzed using the statistical program v.SPSS 19.0, customized to run on personal computers. Descriptive statistical values are expressed in terms of the mean value (SD) for each of the predicted variables, as well as the minimum and maximum values.

RESULTS

Basic descriptive statistical data are shown in the first table for both sexes, firstly the number of subjects, then the arithmetic mean of force generated by the muscles of the wrist (N), standard deviation, and maximum and minimum value.

TABLE 1 Basic descriptive statistical data that describe the value of the force generated by the muscles of the right hand wrist (N) in students

Sex	Number of respondents	AS	SD	Min	Max
M	76	52,9	10.7	23	70
F	14	24,9	6.6	10	33
Total	90	48,5	14.3	10	70

TABLE 2 Basic descriptive statistical data that describe the value of the force generated by the muscles of the left hand wrist (N) in students

Sex	Number of respondents	AS	SD	Min	Max
M	76	47,3	10.0	27	70
F	14	21,1	7.2	7	30
Total	90	43,2	13.5	7	70

From the obtained results, concerning the force generated by the muscles of the wrist (kg), it can be concluded that the average values, for both sexes separately and for the total population, are in the range of 7 to 70 kg, while the average value for both samples is 43.2 kg.

The graphical description (Diagram 1 and 2) shows the relation of force generated by the muscles of the wrist of both fists (N) in the male population

of students at the Faculty of Sport and Physical Education as well as the year of study on which they were in moment of the measurement.

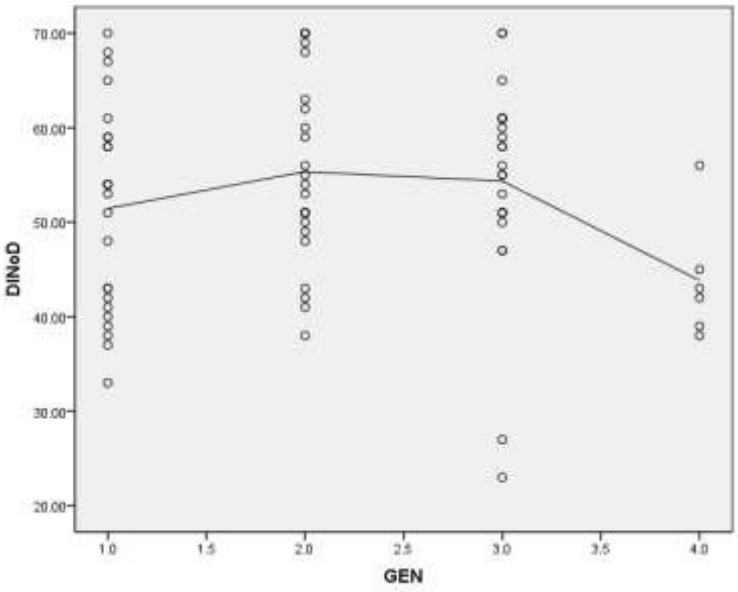

Diagram 1. The ratio of force generated by the muscles of the right hand wrist (N) in the students of male population and the years of study (GEN)

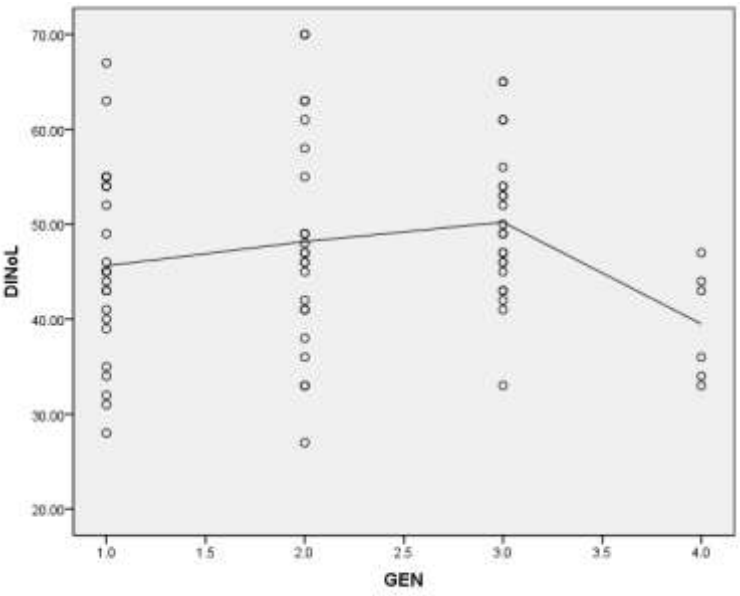

Diagram 2. The ratio of force generated by the muscles of the left hand wrist (N) in the students of male population and the years of study (GEN)

The graphical description (Diagram 3 and 4) shows the ratio of force generated by the muscles of the wrist (N) in the female population of students at the Faculty of Sport and Physical Education and the year of study on which they were in moment of the measurement.

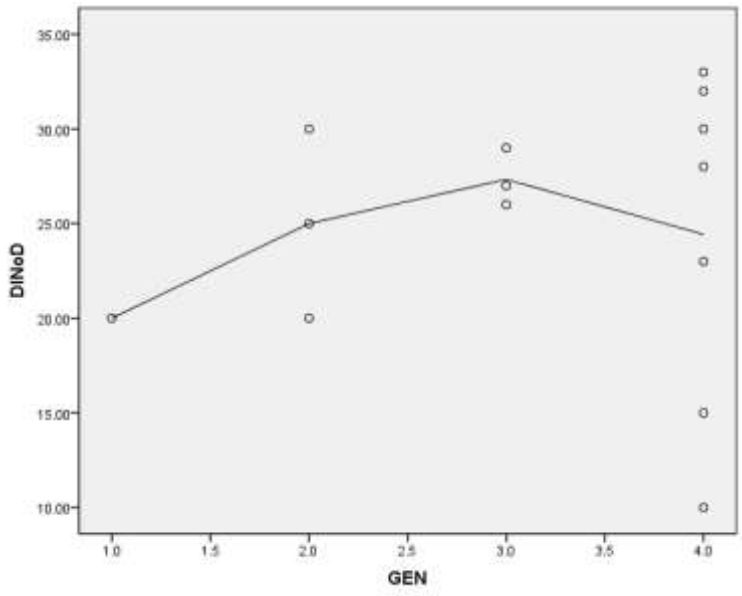

Diagram 3. The ratio of force generated by the muscles of the right hand wrist (N) in the students of female population and the years of study (GEN)

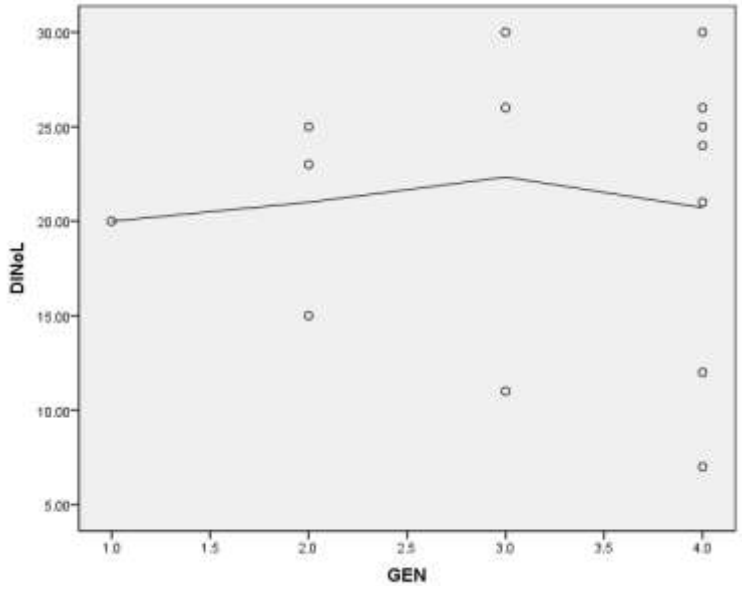

Diagram 4. The ratio of force generated by the muscles of the left hand wrist (N) in the students of female population and the years of study (GEN)

DISCUSSION

If we compare the results of arithmetic mean of hand grip in pupils aged 15 years, taht are obtained by the work of Čular, Tomljanović and Jurk (2009), we may conclude that the values of hand grip in girls are (23.6 kg left and 25.2 kg left right), while in student the values of hand grip are (21.1 left and 24.9 right), which can be interpreted as approximate values, when it comes to the female population. Ross and associates have establised the existing correlation between height, weight and length of fists with grip of fist. (2002). They can justify the results obtained for the female population.

As for the results achieved in the male population of students and in the students in the mentioned test pupils (33.8 left and 35.6 right), students (47.3 left, 52.9 right), the results which are in favor of the students were expected, since they were students at the Faculty of Sports and Physical Education.

It is interesting to notice that the force generated by the muscles of the wrists of both hands in male students has the lowest value at the fourth year of study while it reaches its maximum at the third year of study. However, these values differ slightly, so we can say that the forces generated by the muscles of the wrist of both hands in male students deviate as the students move to the beginning and end of the study.

Also, it is interesting to notice that the force generated by the muscles of the wrist of both hands in female students have similar variations during the four years of studies, as was the case with the male students. However, it is worth to emphasize that the above variation, when we talk about left hand, is slightly weaker.

CONCLUSION

The subject of this research is the analysis of the strength of the wrist muscles among the students of sport and physical education in Niksic. From all the above and the obtained results it can be concluded that the average values, for both sexes separately and for the total population, are in the range of 7 to 70 kg, while the average value for both samples is 43.2 kg.This study can serve as a basis for similar problems that we want to study.

Following the modern trends in sport training, recreation and rehabilitation as a guideline for future testing we can recommend a new device, Kin Com isokinetic dynamometer 125AP. Kin Com 125 AP works on dynamometric principle and allows the muscle contractions to be performed at a constant angular velocity over the entire movement amplitude.

REFERENCES

Carey, D.P., G. Smith, D. T. Smith, J. W. Shepherd, J. Skriver, L. Ord, & A. Rutland (2001). *Footedness in world soccer: an analysis of France '98.* Journal of Sport Science 19 (11): 855-864.

Čular, D., Tomljanović, M., Jurko, D. (2009). *Relacije nekih dimenzija antropološkog statusa i statičke snage kod učenika i učenica srednjoškolske dobi.* Ljetnja škola kineziologa Republika Hrvatska.

Holtzen, D. W. (2000). *Handedness and professional tennis.* International Journal of neuroscience 105 (1-4): 101-119.

Ross, L, CH, Rösblad B. (2002). *Norms for grip strength in children aged 4-16 years*. Acta Paediatrica, 91 (6) : 617-625.

Teixeira, L. A., M. V. M. Silva, M. A. Carvalho (2003). *Reduction of lateral asymmetries in dribbling: The role of bilateral practice.* Laterality 8 (1): 53-65.

ANALIZA JAČINE MIŠIĆA ZGLOBA ŠAKE KOD STUDENATA FAKULTETA ZA SPORT I FIZIČKO VASPITANJE U CRNOJ GORI

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SAŽETAK

Problem ovog istraživanja predstavlja utvrđivanje jačine mišića zgloba šake kod studenata Fakulteta za sport i fizičko vaspitanje iz Nikšića.

Uzorak ispitanika je obuhvatio 90 studenata oba pola (muški=76; ženski=14) koji redovno pohađaju nastavu na Fakultetu za sport i fizičko vaspitanje na Univerzitetu Crne Gore. Mjerenja su sprovedena u dijagnostičkom

centru na Fakultetu za sport i fizičko vaspitanje na Univerzitetu Crne Gore. Jačina mišića u zglobu šake (lijeve i desne) je mjeren sa prenosivim izokinetičkim dinamometrom marke EASYTECH ''Prima DOC''.

Podaci dobijenu u istraživanju su obrađeni korišćenje statističko programa v.SPSS 19.0 prilagođenog za rad na personalnim računarima. Deskriptivne statističke vrijednosti su izražene u obliku srednje vrijednosti (SD) za svaku od predviđenih varijabli, kao i minimalnih i maksimalnim vrijednosti.

Sila koju su stvarali mišići zgloba obije šake kod studenata muškog pola ima najniže vrijednosti na četvrtoj godini studija dok svoj maksimum dostiže na trećoj godini studija. Međutim, ove vrijednosti toliko malo odstupaju da se slobodno može konstatovati da sile koju su stvarali mišići zgloba obije šake kod studenata muškog pola odstupa kako se ide prema početku i kraju studija. Sila koju su stvarali mišići zgloba obije šake kod studenata ženskog pola ima slična odstupanja tokom četiri godine studija kao što je bio slučaj kod studenata muškog pola.

0Iz svega navedenog i na osnovu dobijenih rezultata može se zaključiti da se prosječne vrijednosti, kako za oba pola pojedinačno, tako i za ukupnu populaciju, nalaze u rasponu od 7 do 70 kg, dok je prosječna vrijednost za oba uzorka 43,2 kg.

Ključne riječi: analiza, studenti, snaga, mišič, dinamometar .