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Standing Height and its Estimation Utilizing Foot Length Measurements in Adolescents from Western Region in Kosovo

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A B S T R A C T

The purpose of this research is to examine standing height in both Kosovan genders in the Western Region as well as its association with foot length, as an alternative to estimating standing height. A total of 664 individuals (338 male and 326 female) participated in this research. The anthropometric measurements were taken according to the protocol of ISAK. The relationships between body height and foot length were determined using simple correlation coefficients at a ninety-five percent confidence interval. A comparison of means of standing height and foot length between genders was performed using a t-test. After that a linear regression analysis were carried out to examine extent to which foot length can reliably predict standing height. Results displayed that Western Kosovan male are 179.71±6.00cm tall and have a foot length of 26.73±1.20cm, while Western Kosovan female are 166.26±5.23cm tall and have a foot length of 23.66±1.06cm. The results have shown that both genders made Western-Kosovans a tall group, a little bit taller that general Kosovan population. Moreover, the foot length reliably predicts standing height in both genders; but, not reliably enough as arm span. This study also confirms the necessity for developing separate height models for each region in Kosovo as the results from Western-Kosovans don't correspond to the general values.

Key words: *prediction, measurement, stature, foot length, Kosovan*

Introduction

According to Komunat e Kosovës (2013), Kosovo is a democratic, multi-ethnic and secular republic which administratively is subdivided into seven districts (Ferizaj, Gjakova, Gjilan, Mitrovica, Peja, Pristina and Prizren) and five regions (Eastern, Western, Northern, Southern and Central). This study analyzes the standing height and its estimation utilizing foot length measurements in adolescents in western region which contains two districts (Peja and Djakova) and seven municipalities (Deçan, Gjakova, Junik, Rahovec, Pejë, Istok and Klina). This region (Figure 1) covers the area of 2,494 square kilometers and has population of 368,907 inhabitants, while average density per square kilometer is 150 inhabitants (Komunat e Kosovës, 2013). Although Kosovo doesn't have too big territory, it has a very varied relief that mostly belongs to Dinarides range and the author assumed this fact might influence the main objective of this study, because of the type of the soil as well as other socio-economical and geographical characteristics as a potential influencing factors (Arifi, 2017; Arifi, Sermaxhaj, Zejnullahu-Raçi, Alaj, & Metaj, 2017b).

There are lots of scientific findings which confirms that the measurement of standing height is a vitally important variable when assessing nutritional status (cited in Arifi et al., 2017a; Datta Banik, 2011; Popovic & Bjelica, 2016), as well as when assessing the growth of children, evaluating the basic energy

Figure 1. Geographical Location of Western Region in Kosovo

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requirements, adjusting the measures of physical capacity and predicting the drug dosage and setting standards of physiological variables such as muscle strength, metabolic rate, lung volumes and glomerular filtration (Golshan, Amra, & Hoghogi, 2003; M. Golshan, Crapo, Amra, Jensen, & R. Golshan, 2007; Mohanty, Babu, & Nair, 2001; Ter Goon, Toriola, Musa, & Akusu, 2011). However, according to Quanjer and his collaborators (2014), the exact standing height cannot always be identified and resolved in the usual way (e.g. paralysis, fractures, amputation, scoliosis and pain). Because of these factors, an estimate of standing height has to be acquired from other reliable anthropometric indicators such as hand and foot lengths, knee height, length of the forearm, length of the sternum, vertebral column length, sitting height, length of scapula, arm span as well as cranial sutures, skull, facial measurements et cetera (cited in Gardasevic, Rasidagic, Krivokapic, Corluka, & Bjelica, 2017; Popovic, 2017). Therefore, all these anthropometric indicators, which are used as an alternative to estimate standing height, are very important in predicting loss in standing height connected with aging. Also, to diagnose individuals with disproportionate growth abnormalities and skeletal dysplasia or standing height loss during surgical procedures on the spine (Mohanty et al., 2001), as well as to anticipate standing height in many older people as it is very difficult to measure it precisely, and sometimes impossible because of mobility problems and kyphosis (Hickson & Frost, 2003). Lastly, it is important to state that this knowledge finds its importance in sport since the standing height represents a significant factor which influences the success in various sport disciplines (Popovic, 2017).

Several researches have reported the benefit of using various body parameters in predicting standing height, and arm span happened to be one of the most reliable ones in adults (Hickson & Frost, 2003; Jalzem & Gledhill, 1993; Mohanty et al., 2001; Ter Goon et al., 2011), while foot length measurement is the most reliable predictor during adolescent age, due to the fact that ossification and maturation occurs earlier in the foot than the long bones and standing height could be more accurately predicted from foot measurement as compared to long bones during adolescent age (cited in Singh, Kumar, Chavali, & Harish, 2012). In addition, the relationship of long bones and standing height was found to vary in different ethnic and racial groups (Bjelica, Popovic, Kezunovic, Petkovic, Jurak, & Grasgruber, 2012; Brown, Feng, & Knapp, 2002; Popovic, Bjelica, Georgiev, Krivokapic, & Milasinovic, 2016; Popovic, Bjelica, Molnar, Jaksic, & Akpinar, 2013; Popovic, Bjelica, Tanase, & Milasinovic, 2015; Reeves, Varakamin, & Henry, 1996; Steele & Chenier, 1990) as well as various regions (Arifi, 2017; Arifi et al., 2017b; Milasinovic, Popovic, Matic, Gardasevic, & Bjelica, 2016; Milasinovic, Popovic, Jaksic, Vasiljevic, & Bjelica, 2016). Hence, researchers have derived a specific formula for calculating standing height from long bones for each ethnic/race group. The mentioned variations might be the case with foot length predictions too, mostly due to the fact that the Dinaric Alps population has specific body composition than national as well as regional point of view (Popovic, 2017). Even though many studies with this essence are available on neighboring countries as well as worldwide population, only narrow data is available on Kosovan subjects, just one conducted by Popovic and his collaborators (Popovic, Arifi, & Bjelica, 2017; Popovic & Bjelica, 2017) that has covered whole Kosovan population, while there were no regional analyses so far. Considering rather sparse recent scientific literature, the purpose of this research was to examine the standing height in both Western-Kosovan genders and its association with foot length.

Methods

The nature of this research gave extension to the 664 high-school students last year (338 male and 326 female) from Western Region of Kosovo to be subjects. Two reasons which qualified the selected individuals are: the first is related to the fact that the growth of an individual ceases by this age, while the second is related to the fact that there is no age-related loss in standing height at this age. The average age of the male subject was 18.24±0.43 years old (range 18-20 years), while the average age of the female subject was 18.25±0.45 years old (range 18-20 years). It is important to underline that the researchers have excluded from the data analysis of the individuals with physical deformities as well as those without informed consent. The exclusion criterion was also being non-Western Kosovan.

The anthropometric measurements, including standing height and foot length, were taken according to the protocol of the International Society for the Advancement of Kinanthropometry (Marfell-Jones, Olds, Stew, & Carter, 2006). The trained measurers have measured selected anthropometric indicators (same measurer for each indicator), while the quality of their performance was evaluated against the prescribed "ISAK Manual". Lastly, the age of the each subject was reached directly from the birthdays.

The analysis were performed by using the Statistical Package for Social Sciences (SPSS) version 20.0. Means and standard deviations (SD) were obtained for both anthropometric variables. A comparison of means of standing height and foot length between genders was performed using a t-test. The relationships between standing height and foot length were determined using simple correlation coefficients at ninety-five percent confidence interval. Then a linear regression analysis were carried out to examine the extent to which the foot length can reliably predict standing height. Statistical significance was set at $p<0.05$.

Results

A summary of the anthropometric measurements in both genders is shown in Table 1. The mean of the standing height for male was 179.71±6.00 centimeters and foot length was 26.73±1.20 centimeters, while for female the standing height was 166.26±5.23 centimeters and foot length was 23.66±1.06 centimeters. The sex difference between standing height and foot length measurements was statistically significant (standing height: $t=30.759$; $p<0.000$, and foot length: $t=29.802$; $p<0.000$).

Table 1. Anthropometric Measurements of the Study Subjects

Subjects	Body Height Range (Mean±SD)	Foot Length Range (Mean±SD)
Male	163.5-196.4 (179.71±6.00)	22.10-29.80 (26.73±1.20)
Female	153.3-181.8 (166.26±5.23)	21.10-28.30 (23.66±1.06)

In Table 2. the simple correlation coefficients and their ninety-five percent confidence interval analysis between the anthropometric measurements are displayed. The associations between standing height and foot length were significant ($p<0.000$) and high in this sample, regardless of gender (male: 0.634; female: 0.628).

Table 2. Correlation between Body Height and Foot Length of the Study Subjects

Subjects	Correlation Coefficient	95% confidence interval	Significance p-value
Male	0.634	0.544–0.708	<0.000
Female	0.628	0.529–0.695	<0.000

The results of the linear regression analysis are shown in Table 3. The first of all models were extracted by including age as a covariate. However, it was found that the contribution of age was insignificant and therefore the age was dropped and estimations were derived as a univariate analysis. The high values of the regression coefficient (male: 0.634; female: 0.628) signify that foot length notably predicts standing height in both Western-Kosovan genders (male: $t=15.03$, $p<0.000$; female: $t=14.52$, $p<0.000$), which confirms the R-square (%) for the male (40.2) as well as for the female (39.4).

Table 3. Results of Linear Regression Analysis Where the Foot Length Predicts the Body Height

Subjects	Regression Coefficient	Standard Error (SE)	R-square (%)	t-value	p-value
Male	0.634	4.647	40.2	15.03	0.000
Female	0.628	4.078	39.4	14.52	0.000

The associations between foot length measurements and standing height among the above models is sketched as a scatter diagrams (Figure 2).

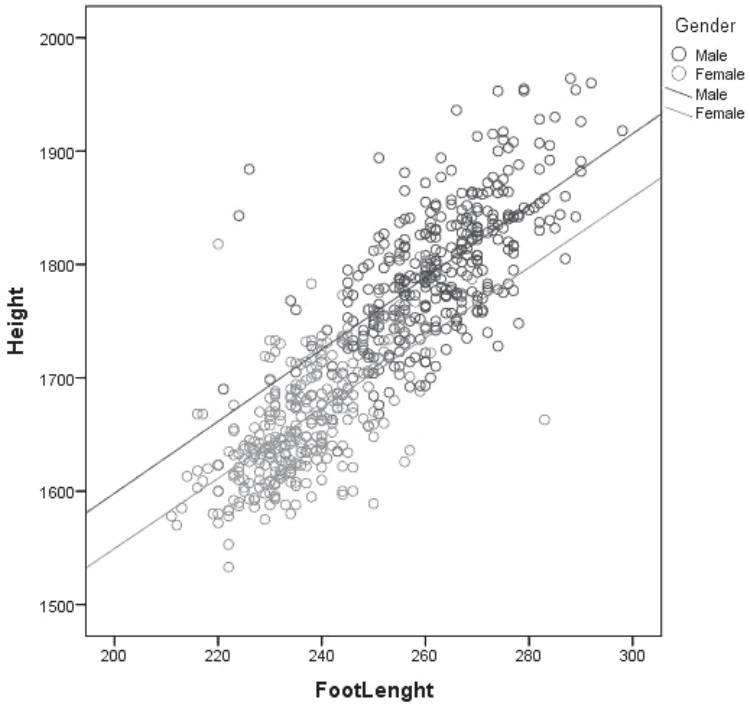

Figure 2. Scatter Diagram and Relationship between Foot Length Measurements and Body Height among Both Genders

Discussion

The assessment of standing height using various anthropometric measures is very typical from the past centuries and it has been attempted to be studied by many researchers. However, it is important to underline that the arm span has been obtained as the most reliable body indicator for predicting the standing height of an individual (Mohanty et al., 2001; Ter Goon et al., 2011), while foot length is was very close (Kanchan et al., 2008; Singh et al., 2012; Uhrova et al., 2015). In parallel, it is important to emphasize that the individual and ethnic variations referring to standing height and its association with foot length might vary from ethnic group to ethnic group as well as race to race, because the racial and ethnic differences are affective on these measures and reduce the possibility of generalizing (cited in Bjelica et al., 2012). This fact confirms the study conducted by Chinese authors (Cheng et al., 1998) who confirmed a very high linear correlation between standing height and foot length in both genders, as well as in another study which confirmed that foot length can explain up to 77% variations in standing height (cited in Uhrova et al., 2015), while the research study conducted by Uhrova and her collaborators (Uhrova et al., 2015) shows significant correlation between standing height and all measure anthropometric parame-

ters in both genders of Slovak population. The highest correlation coefficient in this population was found for foot length in males (r=0.71) as well as in females (r=0.63).

All above-mentioned have confirmed the necessity for developing separate standing height models for each population on account of ethnic differences and the recent study conducted by Popovic and his collaborators (Popovic et al., 2017; Popovic & Bjelica, 2017) who have analyzed the entire Kosovan population and have found specific correlation coefficient in Kosovan male (r=0.669) and female (r=0.625) population; however, some recent studies have also confirmed the regional differences between the same ethnic groups too (Arifi, 2017; Arifi et al., 2017b; Milasinovic et al., 2016a; 2016b), which caused the need for additional caution. Therefore, the main goal of this research was to test the hypothesis if above-mentioned facts are true for the Western-Kosovans, that is, for the one of five Kosovan regions. Hence, in the present research it was remarked that the foot length/standing height ratio in Western-Kosovan male is quite lesser (male: 40.2%; female: 39.4%) comparing to entire Kosovan (male: 44.3%; female: 38.6%) and other available population that estimate over 70% each and more in male population, while female population is much more in parallel to previously measured populations. As the correlation between foot length and standing height was significant in both Western-Kosovan genders, the foot length measure therefore seems to be a reliable indirect anthropometric indicator for estimating standing height in both genders of Western-Kosovan population. Even though these relations are similar, the estimation equations, which are obtained in the Western-Kosovans, considerably differ from entire Kosovan and other available populations.

The results of the study conducted by Popovic and his collaborators (Popovic et al., 2017; Popovic & Bjelica, 2017) confirm the necessity for developing separate standing height models for both genders in Kosovo but the authors of the same study have recommended that further studies should consider dividing the population of this country to regional subsamples and analyze it separately, just to be sure there are no geographical differences (such as type of the soil) influencing the average standing height in both Kosovan genders as well as its association with foot length. This concern was based on the fact that entire Kosovo doesn't fall into Dinaric Alps racial classification. In parallel, this study confirms the assumption mentioned above and also confirms that it is necessary to develop separate standing height models for each population on account of regional variations in Kosovo.

Next to highlighted issue, the obvious constraint of this research might also be the composition of the measured sample that consisted of high school students. This limitation is based on the fact there are some studies which assumed the growth of an individual doesn't cease by this age (Grasgruber, P., personal communication, 2016; Jurak, G., personal communication, 2017). This assumption might be supported by the fact that university-educated individuals have been founded to be taller than the high school population in Bosnia and Herzegovina (Grasgruber et al., 2017; Gardasevic et al., 2017), Poland (Wronka & Pawlinska-Chmara, 2009) and Hungary (Szollosi, 1998). On the other hand, this wasn't the truth in Montenegro (Popovic, 2016) and comparing the average standing height measures of this study to the results of some study sampled by university students might give the science much precise conclusions. One more obvious limitation of this study is also the fact that both genders of Kosovo did not reach their full genetic potential yet, since various environmental factors controlled their development. Further continuous monitoring is necessary, mostly due to the reason it is expected the secular changes influencing standing height will ascend in the following two or three decades.

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Effects of Experimental Volleyball Rules Quantified by Type and Number of Jumps, Hits and Contacts

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A B S T R A C T

The purpose of this study was to determine the influence of the two new rules tested at the inaugural U23 Men's Volleyball World Championship (21-point set excluding the fifth set, and 15 seconds between rallies–10 seconds from the finished point until the referee's whistle for serve and five seconds for performing the serve) on number and types of jumps and number of contacts and hits. The analysis comprised 25,930 jumps (an essential physical activity for volleyball), 15,706 contacts and 10,224 hits during 36 matches played by 144 males aged under 23 at the first Under 23 Men's World Championships organized in Uberlandia, Brazil, in 2013. Two investigations were conducted: 1) Analysis of jumps by Jump type, In-game role and Level of set win; 2) Analysis of contacts (reception, setting, block, defense) and hits (serve and attack) by Type, In-game role and Set outcome. Significant differences ($p=0.000$) were found between in-game role and jump type, as Middle blocker performed the most (34.7%), followed by Outside hitter (24.9%), Setter (24.6%) and Opposite (15.8%). Significant differences were found for number and types of Hits between set Winner and Loser teams only for serves by Setter ($p<0.001$) and Middle blocker ($p<0.05$). The results showed major differences in jumps, hits and contacts between in-game roles: Middle blocker was the most frequent jumping position, followed by Outside hitter and Setter. The Libero showed a new tendency of being Setter with a jump after the initial Setter defense.

Key words: *in-game role, libero, setting, attack, block*

Introduction

Volleyball has become a very popular sport played in many countries worldwide (Aouadi et al., 2012; Sheppard et al., 2008; Sheppard et al., 2011). Throughout the history of volleyball the rules have been modified to make it a more exciting spectator sport (Ureña, Gallardo, Delgado, Hernández, & Calvo, 2000). The changes tested by Fédération Internationale de Volleyball (FIVB) during the first Under 23 (U23) Men's World Championship, in 2013, were intended to modernize volleyball and make it more appealing for fans attending matches or watching games on television (FIVB, 2013c). Two of the main characteristics of volleyball are the jump and the specific types of contact with the ball.

Investigations into players' ability to reach upwards, attack frequently from height and achieve a high blocking position showed that jumping is an important athletic skill for high performance in volleyball (Aouadi et al., 2012; Borràs, Balius, Drobnic, & Galilea, 2011; Marcelino & Mesquita, 2008; Sheppard, Gabbett, & Taylor, 2007; Sheppard et al., 2008; Vilamitjana et al., 2008). The attack and block, as important actions of a volleyball game, were identified as the best predictors in matches (Afonso, Esteves, Araújo, Thomas, & Mesquita, 2012; Castro & Mesquita, 2008; Marcelino & Mesquita, 2006; Marcelino, Mesquita, & Afonso, 2008; Rodríguez-Ruiz et al., 2011). Volleyball includes several types of jump techniques (jump for jump float serve, spike and spin serve, setting and block) and new studies can focus on identifying optimum physical preparation for performing these kinds of jumps during competition.

Very few studies of volleyball and beach volleyball have defined or accurately categorized types of ball touches. In a beach volleyball study (Palao, Valadés, Manzanares, & Ortega 2014), the authors did not specifically define which touches corresponded to hits and contacts. Almujahed, Ongor, Tigmo, and Sagoo (2013) equated all touches of the ball as follows: serve and attack with hits, and reception, set, block and dig-defense with contacts. Others associated them individually: serve with hit (Lidor & Mayan, 2005; López, 2013); reception, set, block and dig-defense with contact (Afonso et al., 2012; Palao et al., 2014); and attack with hit (Palao et al., 2014). In this study, every touch of the ball during the point is divided into one of two basic groups: hits and contacts. Serve and attack belong to the group of hits and all other touches (reception, pass by setter, block and defense (dig) belong to the group of contacts.

Vilamitjana et al. (2008) assessed jump profile in elite male volleyball players with particular reference to playing position. Part of the study by Sheppard, Gabbett, and Stanganelli (2009) addressed the jumping ability of various playing positions in elite male volleyball players. Using different terminology from our study, Marcelino and Mesquita (2008) examined the number of contacts and performance in volleyball by set result.

The purpose of this study was to determine the influence of the two new rules tested at the first U23 Men's Volleyball World Championship (21-point set excluding the fifth set, and 15 seconds between rallies–10 seconds from the finished point until the referee's whistle for serve and five seconds for per-

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forming the serve) on the number and types of jumps related to In-game role and Level of set win, and number of contacts and hits related to each In-game role and Set outcome.

Methods

A total of 36 of the 38 matches played at the U23 Men's World Championships in Uberlandia (Brazil) were analyzed. At this unique tournament in the history of volleyball, changes to the Rally Point System were tested for the first time. The U23 World Championships took place in October 2013, with 12 national teams participating. The tournament followed the FIVB competition system with the addition of two new rules tested: set to 21 points per set (excluding the fifth set, to 15 points) with a minimum two-point difference at the end of sets, and 15 seconds before the referee's whistle for serve (FIVB, 2013b).

Official authorization from FIVB was granted for this study to use all the videos of matches and data from the Volleyball Information System (VIS) and the FIVB website. The competition had two rounds: a group phase (Pool A and B), and semifinals and finals. In the group phase, 30 matches were played, and in the semifinals and finals, eight were played. All 12 teams, divided into two groups of six, played according to the round-robin system to determine the ranking and were classified from 1st to 6th. The team ranked 3rd in Pool A played the team ranked 4th in Pool B. The team ranked 3rd in Pool B played the team ranked 4th in Pool A. The losers of the semi-final matches played for 7th and 8th final places, and the winners of the semi-final matches played for 5th and 6th places. The team ranked 1st in Pool A played the team ranked 2nd in Pool B. The team ranked 1st in Pool B played the team ranked 2nd in Pool A. The losers of the semi-final matches played for 3rd and 4th place and the winners of the semi-final matches played for 1st and 2nd place (FIVB, 2013a).

The study was conducted in two parts.

Investigation 1: Number and types of jumps

The first investigation analyzed jumps in relation to the new rules tested. Data were collected by watching 36 matches using a previously prepared data form containing all variables. In total, 25,930 jumps during 36 matches of the inaugural U23 Men's World Championships in Uberlandia were analyzed.

Investigation 2: Number and types of contacts and hits

The second investigation analyzed the contacts and hits in relation to the new rules tested. Data were collected from 36 matches from the VIS posted on the FIVB website and recorded on an analysis scheme form, as recommended by Tsimpiris, Tsamourtzis, Sfingos, Zaggelidis, and Zaggelidis (2006) for defining and examining variables.

Participants

The analysis comprised 15,706 contacts and 10,224 hits during 36 matches played by 144 male players under 23 years of age at the first U23 Men's World Championships, in Uberlandia. The average age of players was 21.1±1.4 years. This age group competes successfully in the highest men's volleyball leagues internationally and therefore the games are of a similar level to elite men's volleyball. FIVB officially authorized this study and the use of all match videos and data from the VIS statistical recording program and the FIVB website. The study was performed in accordance with the Helsinki Declaration of 1975 and approved by the Ethics Committee of the University of Las Palmas de Gran Canaria. For both investigations, players were classified as setters, outside hitters, middle blockers, opposites and liberos.

Measuring equipment

The data were collected from 36 pre-recorded videos. All matches were recorded using a PANASONIC HC-V720 HD digital camcorder in AVCHD format. To obtain the best angle to capture everything happening on and beside the court, the camera was always located behind the court at a height of 5 meters above the floor (Claver, Jiménez, Gil, Moreno, & Moreno, 2013). FIVB's VIS software quantifies individual skills and is accepted as a valid instrument in volleyball research, as it has been used in various studies (Marcelino & Mesquita, 2008; Marcelino et al., 2008; Marcelino et al., 2009).

Value categories (measures)

Vilamitjana et al. (2008) used the following variables: 1) frequency of jumps per player, grouped by four field positions, 2) percentage of jumps in volleyball skills (spiking, spiking approach, jump service, blocking and setting) by player, 3) work time during the set: total set time minus resting. Total number of jumps and total work time were calculated per player. Work-rate profile (WRP) during competition was determined by the ratio between total number of jumps and work time.

Several authors (Marcelino & Mesquita, 2008; Marcelino, Mesquita, Sampaio, & Moraes, 2010) used similar variables for contacts: number of spike points, spike errors, spike continuity, block points, block errors, block continuity, serve points, serve errors, serve continuity, dig excellent, dig errors, dig continuity, set excellent, set errors, set continuity, reception excellent, reception errors and reception continuity, set win and set loss.

In Investigation 1, the variables analyzed were the jumps performed during actions A-E below, related to in-game role (setter, outside hitter, middle blocker, opposite, and libero), and Level of set win (Walkover, Balanced, and Tough set), where Walkover sets were the group of sets finished by 21:15 (and less than 15 points), Balanced sets were finished with 21:16, 21:17, and 21:18, and Tough sets finished with a two-point difference (21:19, 22:20… or 15:13, 16:14… in the fifth set).

A. Jump for Jump Float Serve (JFS).
B. Jump for Jump Spin Serve (JSS).
C. Jump for attack.
D. Jump for setting.
E. Jump during block.

In Investigation 2, the following variables were analyzed by in-game role (setter, outside hitter, middle blocker, opposite and libero) and Set outcome (set Winner and set Loser):

A. Hit
    a. Serve.
    b. Attack.
B. Contacts
    a. Reception.
    b. Setting.
    c. Block.
    d. Defense.

Procedures (observing data protocol)

The FIVB technicians specially trained for VIS, who were approved, supervised and appointed by the FIVB Technical Commission, collected data about contacts and hits. VIS software is the method most commonly used by coaches and observers to assess individual and collective performance of volleyball players in each phase of the game. It has become the most frequently used software for FIVB data collection because of its efficiency, simplicity and accuracy (FIVB, 2000).

To ensure consistency in the criteria and quality in coding the data, the observer was trained beforehand. Training comprised a briefing on the definition of the variables and a data re-

cording period of two weeks until he obtained a Cohen's Kappa value higher than 0.90. The observer had at least three years' experience in data logging in earlier volleyball research and extensive experience as a scout and coach in this sport.

Reliability

To ensure reliability, 12% of the rallies were re-analyzed, exceeding the reference value of 10% (Tabachnick & Fidell, 2013). Cohen's Kappa ranged from 0.84 to 0.91 for inter-observer reliability and 0.82 to 0.92 for intra-observer reliability. All values met the criterion of 0.75 suggested in the literature (Fleiss, Levin, & Paik, 2003).

Statistical analysis

All numerical data are shown by frequency, separated into each volleyball element analyzed. Pearson's Chi-Square test was used to test significant differences between frequencies registered in individual subsamples. Significance between means established for specific elements in specific subsamples was tested using the T-test and One-Way ANOVA. Statistical analysis was conducted using IBM SPSS Statistics V19 software. Statistical inference was performed at the level of significance of 0.05 ($p<0.05$).

Results

Investigation 1

Match and set analysis of absolute and relative frequency of jump types showed that the highest number of jumps made by all teams was during the elements attack (M_{match}=103±27 jumps; M_{set}=30±7 jumps) and block (M_{match}=102±26 jumps; M_{set}=30±7 jumps). Half as many jumps were performed during setting (M_{match}=51±15 jumps; M_{set}=15±5 jumps) and fewest jumps were registered during JFS (M_{match}=38±15 jumps; M_{set}=11±4 jumps) and JSS (M_{match}=22±8 jumps; M_{set}=7±3 jumps). In percentages, 33% of jumps were performed during attack, 32% during block, 16% during setting, 12% during JFS and only 7% during JSS. No significant differences were found for the distribution of jump types by Level of set win.

Analysis of number of jumps by in-game role showed that Middle blocker performed the most jumps during the match, followed by Outside hitter, Setter and Opposite in-game roles (Table 1). Although Libero registered a low number of jumps, it was interesting to analyze the type of jumps this in-game role performed.

Table 1. Average Distribution of Jumps by In-game Role

Jump	Setter (%)	Outside hitter (%)	Middle blocker (%)	Opposite (%)	Libero (%)	Total (%)
JFS	26.2	30.2	36.5	7.1	/	100
JSS	12.7	44.1	11.9	31.3	0.0	100
Attack	1.6	28.5	46.3	23.7	0.0	100
Setting	95.6	1.0	1.6	1.1	0.6	100
Block	14.4	26.9	43.7	15.0	/	100
Total	24.6	24.9	34.7	15.8	0.1	100

Chi-Square = 13794.922* p=0.000

Note. Asterisk (*) indicates statistically significant difference.

Analysis of individual positions in the game showed that Setter, as expected, performed the highest number of jumps during setting (M=98±88 jumps), block (M=29±26 jumps) and Jump Float Serve (M=20±17 jumps), and the lowest number of jumps in Jump Spin Serve (M=6±3 jumps) and attack (M=3±2 jumps).

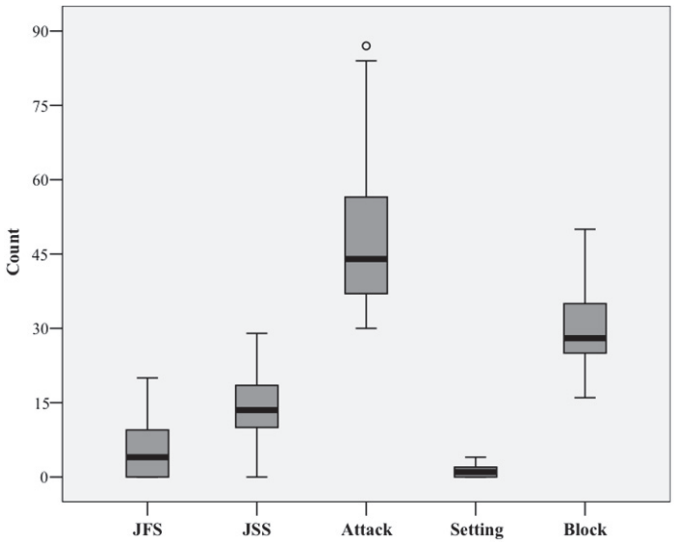

Figure 1. Average descriptive indicators for jumps by opposite in-game role per match. Circle (°) above the bar represents an individual extreme value that exceeded 3 standard deviations and is excluded from the analysis as parasitic data

Outside hitter performed almost the same number of jumps in attack (M=59±54 jumps) and block (M=55±49 jumps). Mean values for this in-game role were 23±19 jumps during serve by Jump Float and 20±17 jumps during Jump Spin Serve. As expected, the minimum number of jumps was in setting (M=1±1 jump).

Middle blocker in-game role, the leading jump position, had a mean value of 96±87 jumps in attack per match and a slightly lower value in block (89±80 jumps). During Jump Float Serve

the average was 28±24 jumps, with more than five times fewer during Jump Spin Serve (M=5±4 jumps). In setting, as expected, this in-game role performed minimum jumps (M=2±1 jumps).

Opposite in-game role had a mean value of 49±45 jumps per match in attack, with a maximum value of 87 jumps and a minimum of 30 (Figure 1). In block, this in-game role performed an average of 30±9 jumps, followed by jumps in Jump Spin Serve (M=14±12 jumps) and Jump Float Serve (M=6±4 jumps). Opposite in-game role performed minimum jumps during setting (M=1±1 jump).

Jumps by Libero were registered in only 14 of the 36 matches analyzed. From a total of 20 jumps Libero performed during the whole tournament, 19 were during setting. In eight matches Libero performed one jump per match during setting, in three matches two jumps per match and in one match five jumps. Analysis of the 13 matches in which Libero jumped during setting showed a low average value of 1.62±1.12 jumps (minimum 1, maximum 5). Calculating the values for 36 matches, the values registered for Libero were M=0.58±1.025 jumps, Min=0 jumps, Max=5 jumps.

Investigation 2

T-test analysis of number and types of Hits showed a significant difference between set Winner and set Loser teams only for serves by Setter ($p<0.001$) and Middle blocker ($p<0.05$), while no statistical differences were found for other Hit performers (Table 2). Setter and Middle blocker from set Winners hit the ball significantly more (by 4-5 hits) during serve than the same in-game roles from set Losers.

Table 2. Statistical Descriptive for Hit Elements (per Match)

Hit	Team	N	Mean	Std. Deviation	Std. Error Mean	T-test	p
Serve.S	Winner	36	15.61	5.738	0.956	4.157*	0.000
	Loser	36	10.75	4.038	0.673		
Serve.OH	Winner	36	23.08	5.949	0.992	1.433	0.156
	Loser	36	20.61	8.473	1.412		
Serve.OP	Winner	36	9.97	3.707	0.618	1.289	0.202
	Loser	35	8.80	3.954	0.668		
Serve.MB	Winner	36	21.81	5.651	0.942	2.844*	0.006
	Loser	36	17.75	6.425	1.071		
Attack.S	Winner	33	2.48	1.326	0.231	-0.969	0.336
	Loser	32	2.84	1.648	0.291		
Attack.OH	Winner	36	34.03	11.000	1.833	-1.462	0.148
	Loser	36	38.36	13.970	2.328		
Attack.OP	Winner	36	24.86	9.372	1.562	-0.453	0.652
	Loser	36	26.00	11.835	1.972		
Attack.MB	Winner	36	14.03	5.945	0.991	0.291	0.772
	Loser	35	13.63	5.610	0.948		
Attack.L	Winner	1	1.00	/	/	/	/
	Loser	2	8.50	2.121	1.500		
Total hits	Winner	36	145.69	33.126	5.521	0.883	0.380
	Loser	36	138.28	37.996	6.333		

Note. ^{S}=Setter, ^{OH}=Outside Hitter, ^{MB}=Middle blocker, ^{OP}=Opposite, ^{L}=Libero.
Asterisk (*) indicates statistically significant difference.

In the Hits group, Outside hitter performed 22±7 hits during serve, followed by Middle blocker (M=20±6 hits), Setter (M=13±6 hits) and Opposite (M=9±4 hits) (Figure 2).

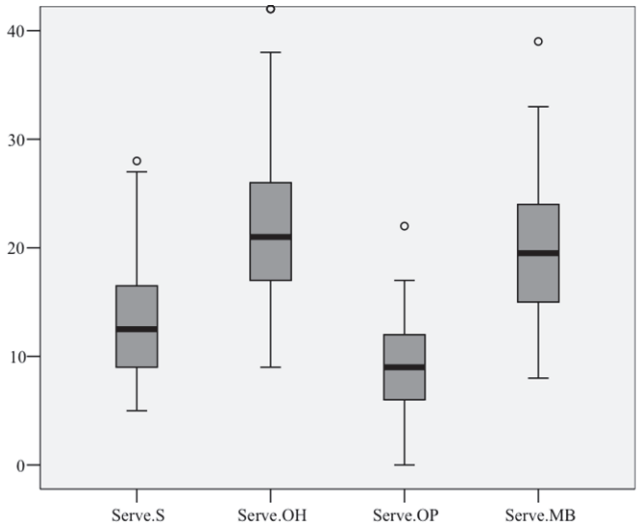

Figure 2. Descriptive for hits performed by servers (per match). Circles (^{o}) above the bars represent individual extreme values that exceeded 3 standard deviations and are excluded from the analysis as parasitic data. ^{S} = Setter, ^{OH} = Outside hitter, ^{MB} = Middle blocker, ^{OP} = Opposite

In attack, Outside hitter executed the most hits (M=25±11 hits), followed by Opposite (M=25±11 hits), Middle blocker (M=14±6 hits) and Setter (M=2±2 hits).

T-test comparison between set Winner and set Loser data for contacts showed significant differences in block by Opposite players ($p<0.05$) and Middle blocker players ($p<0.05$), and in reception by Libero ($p<0.05$). The in-game role that touched the ball most per match was Setter from set Loser teams in setting (M=66±18 contacts), followed by the same position from set Winner teams in setting (M=60±22 contacts). The second in-game role by number of contacts was Outside hitter from set Loser teams during reception (M=41±13 contacts), followed by the same position from set Winners during reception (M=36±13 contacts) (Table 3).

Table 3. Statistical Descriptive for Contact Elements (per Match)

Contact	Team	N	Mean	Std. Deviation	Std. Error Mean	T-test	p
Block.S	Winner	36	5.33	3.295	0.549	0.837	0.405
	Loser	35	4.71	2.916	0.493		
Block.OH	Winner	36	10.36	3.322	0.554	0.884	0.380
	Loser	36	9.44	5.261	0.877		
Block.OP	Winner	36	6.89	3.740	0.623	2.111*	0.038
	Loser	35	5.17	3.073	0.519		
Block.MB	Winner	36	16.67	7.282	1.214	2.270*	0.026
	Loser	36	13.08	6.054	1.009		
Defense.S	Winner	36	8.39	3.705	0.618	-1.294	0.200
	Loser	36	9.50	3.582	0.597		
Defense.L	Winner	36	13.53	5.406	0.901	-0.195	0.846
	Loser	36	13.78	5.452	0.909		
Defense.OH	Winner	36	15.83	6.153	1.025	-1.326	0.189
	Loser	36	18.31	9.344	1.557		
Defense.OP	Winner	36	6.58	3.324	0.554	-0.795	0.429
	Loser	35	7.26	3.807	0.643		
Defense.MB	Winner	36	4.89	2.638	0.440	-1.360	0.178
	Winner	35	5.91	3.649	0.617		
Setting.S	Winner	36	60.36	22.049	3.675	-1.120	0.267
	Loser	36	65.72	18.415	3.069		
Setting.L	Winner	33	4.09	2.185	0.380	-1.291	0.201
	Loser	35	4.80	2.336	0.395		
Setting.OH	Winner	33	4.03	2.114	0.368	-1.714	0.091
	Loser	35	4.97	2.395	0.405		
Setting.OP	Winner	21	2.33	1.017	0.222	0.541	0.591
	Loser	27	2.19	.879	0.169		
Setting.MB	Winner	29	3.00	1.626	0.302	0.799	0.428
	Loser	33	2.67	1.652	0.288		
Reception.L	Winner	36	13.06	6.568	1.095	-2.056*	0.044
	Loser	36	16.64	8.139	1.356		
Reception.OH	Winner	36	35.61	13.122	2.187	-1.692	0.095
	Loser	36	40.81	12.928	2.155		
Reception.MB	Winner	11	1.45	.934	0.282	-.994	0.329
	Loser	19	2.00	1.667	0.382		
Reception.S	Winner	8	1.00	0.000	0.000	/	/
	Loser	13	1.00	0.000	0.000	/	/
Reception.OP	Winner	0	/	/	/	/	/
	Loser	9	7.11	6.353	2.118	/	/
Total	Winner	36	209.42	64.748	10.791	-1.194	0.236
Contacts	Loser	36	226.47	56.129	9.355		

Note. ^{S}=Setter, ^{OH}=Outside hitter, ^{MB}=Middle blocker, ^{OP}=Opposite, ^{L}=Libero.
Asterisk (*) indicates a statistically significant difference.

For contacts with the ball during block per match, Middle blockers performed the highest number (M=15±7 contacts), followed by Outside hitter (M=10±4 contacts), whereas Opposite (M=6±4 contacts), and Setter (M=5±3 contacts) touched the ball considerably less (Figure 3).

For contacts with the ball in defense, Outside hitter had a mean value of 17±8 contacts per match, followed by Libero (M=14±5 contacts), with considerably lower values achieved by Setter (M=9±4 contacts), Opposite (M=7±4 contacts) and Middle blocker (M=5±3 contacts).

For contacts with the ball during setting, Setter is the absolute leader for number of touches, with a mean value of 63±20 contacts per match, followed by Outside hitter (M=4±3 contacts), Libero (M=4±3 contacts), Middle blocker (M=2±2 contacts) and Opposite (M=2±1 contacts).

Outside hitter led in the number of contacts during recep-

tion, with a mean value of 38±13 contacts, followed by Libero with a mean of 15±8 contacts, and minimum values were obtained by Opposite (M=1±3 contacts), Middle blocker (M=1±1 contact) and Setter.

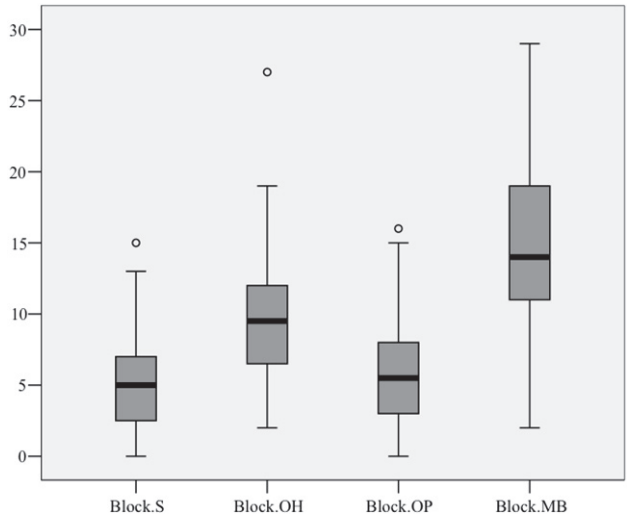

Figure 3. Descriptive for contacts made by blockers (per match). Circles (^{o}) above the bars represent individual extreme values that exceeded 3 standard deviations and are excluded from the analysis as parasitic data. ^{S} = Setter, ^{OH} = Outside hitter, ^{MB} = Middle blocker, ^{OP} = Opposite, ^{L} = Libero

Discussion

Few studies have addressed the number and type of jumps by in-game role and Level of set win or hits and contacts by in-game role and Set outcome in volleyball. In beach volleyball, Palao et al. (2014) found no statistical difference between in-game roles for average jumps, contacts and hits per play. Marcelino et al. (2010) reported significant differences for contacts. Serve point, serve continuity and spike point are the performance indicators most correlated with win in volleyball (Marcelino & Mesquita, 2008), which is closely related to the parts of this study concerning Hits.

Jumps

Information about the number and type of jumps gives coaches appropriate insight into the physical exertion and technical requirements by each in-game role. Sheppard et al. (2007) and Sheppard et al. (2009) identified Middle blocker as the most frequent performer of jumps during block in comparison to Setters and Outsides hitters, while Middle blockers performed more jumps during attack than Outside hitter and Setter, concurring with our study. Vilamitjana et al. (2008) reported that the most frequent performer of jumps is Middle blocker, followed by Outside hitter, Setter and Opposite, also concurring with our study. The same authors found that most jumps are performed during block (37.9%) and attack (21.7%), in agreement with our study, although the values in our study were similar (about 33% each, of total jumps). In the same study, 17.6% of jumps were performed during Jump Serve and 14.5% during setting, compared to 7% during JSS, 12% during JFS and 16% during setting in our study.

To be able to compare our results to the study by Vilamitjana et al. (2008), a simple conversion process into percentages was necessary. Vilamitjana et al. (2008) identified Setter with about 67.5% of jumps during setting, recording a similar percentage (15%) of both jumps in block and serve, whereas in our study Setter performed 62.6% during setting, 18.8% during block and 16.5% in serve, including both JFS and JSS. The same authors found that Outside hitter performed most jumps during block (45%), followed by jumps during spiking (about 32%) and serve (about 21%), whereas in our study the same in-game role performed most jumps during attack (37.4%), followed by block (34.8%) and jump serve using both JFS and JSS (27.2%). According to Vilamitjana et al. (2008), Middle blocker performed about 47% of jumps during block, about 17% during serving and 14% during spiking, whereas in our study the same position jumped less in block (30.5%), considerably more in attack (43.6%) and slightly less in Jump Serve, including JFS and JSS (15.2%). Opposite is the absolute leader in jumps during attack, in which this in-game role performed about 46% of total jumps in the study by Vilamitjana et al. (2008) and around 17% during Jump Serves, whereas in our study the value for jumps during attack was slightly higher (49.0%), 19.4% during both JFS and JSS, and 30.5% during block.

Given the lack of references to jumps by Libero in the literature, this study will be among the first to draw attention to the new tendency of Libero to jump during setting. In our study, 95% of jumps performed by Libero were during setting. Libero can also attack according to official volleyball rules (FIVB, 2012), but in official matches it has been seen that coaches often become frustrated because of a limited understanding of the rules of the game.

Hits and Contacts

For hits, the significant difference for setter and middle blocker by set outcome and in-game role agree with the findings of Marcelino and Mesquita (2010), who found significant differences in attack and serve by set outcome. According to Marcelino and Mesquita (2006), the average attack attempt (corresponding to the term "attack hit" in this study) per match is 97.09±20.25 and the average serve attempt (corresponding to "serve hits") is 88.15±16.17.

Marcelino et al. (2010) found significant differences in reception, block, defense and between set Winners and Losers, whereas in our study significant differences were found for Set outcome for three in-game roles: Libero for reception and Opposite and Middle blocker for block. In the study by Marcelino

and Mesquita (2006), the term "average block attempts" (48.30±14.93) corresponds to contacts in block, "dig attempts" (M=55.63±16.48 attempts) corresponds to contacts in defense and "reception attempts" (70.82±14.59) corresponds to contacts in reception. Analysis of setting shows that Setter must be technically and physically well prepared to perform about 63±20 passes, whereas Outside hitter and Libero perform only 4±3 passes per match. Middle blocker and Opposite appear to set extremely rarely.

Conclusion

In high-level volleyball each in-game role is characterized by a specific physical and technical profile. This investigation revealed major differences in jumps, hits and contacts between in-game roles, identifying Middle blocker as the most frequent jumping position, followed by Outside hitter and Setter. Middle blocker was found to be the most decisive in-game role in the serve and in contacts during block. Libero showed a new tendency of being Setter with a jump after the initial Setter defense action. This study provides researchers with full details about jumps, contacts and hits in volleyball under the new rules tested. It can be a good base for future research, such as conducting a comparison with the present rules (25-point set, no time limit between rallies) in all men's categories. If FIVB applies these rules, similar research could be conducted among all men's and women's categories. The study does not examine the relation between jumps and Set outcome, which could provide interesting information such as whether players from set Winners or Losers jump more frequently and which types of jumps they use. This complex study of each jump, contact and hit during every volleyball set provides an in-depth definition of the game.

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Muscle Power during Standing and Seated Trunk Rotations with Different Weights

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A B S T R A C T

This study compares peak and mean power during standing and seated trunk rotations with different weights. Twenty seven fit men completed four trials of trunk rotations in both standing and seated positions with a bar weight of 5.5, 10.5, 15.5, and 20 kg placed on the shoulders. The FiTRO Torso Premium was used to monitor basic biomechanical parameters throughout the movement. Results showed significantly higher peak power during standing than seated trunk rotations at weights of 20 kg (274.4±63.5 vs. 206.4±54.6 W, p=0.004), 15.5 kg (371.2±93.9 vs. 313.5±72.3 W, p=0.007), and 10.5 kg (336.9±77.8 vs. 286.3±66.0 W, p=0.009) but not at 5.5 kg (191.6±46.2 vs. 166.0±37.0 W, p=0.061). Similarly, mean power in the acceleration phase of trunk rotations was significantly higher when performed in standing than seated position at weights of 20 kg (143.2±32.1 vs. 101.9±23.7 W, p=0.008), 15.5 kg (185.1±42.3 vs. 150.4±36.5 W, p=0.019), and 10.5 kg (169.8±40.7 vs. 139.7±31.6 W, p=0.024) but not at 5.5 kg (107.4±29.4 vs. 86.5±21.1 W, p=0.111). Furthermore, peak and mean power during standing trunk rotations significantly correlated with values achieved in the seated position at the weight of 5.5 kg (r=0.684, p=0.027; r=0.676, p=0.033) but not at 10.5 kg (r=0.589, p=0.089; r=0.552, p=0.143), 15.5 kg (r=0.493, p=0.243; r=0.436, p=0.298), and 20 kg (r=0.357, p=0.361; r=0.333, p=0.417). In conclusion, power production is greater during standing as compared to seated trunk rotations, with more pronounced differences at higher weights. This fact has to be taken into account when training and testing the trunk rotational power.

Key words: *additional load, rotational power, standing/sitting positions, trunk movement*

Introduction

There is considerable debate on effectiveness of seated vs standing resistance exercises. Though seated exercises are more stable and safer, these seems to be less effective in power production than standing resistance exercises. This is especially true for rotational movements of the torso when using an additional load. If the weight is heavy, the use of legs can help to execute the exercise more effectively although maintaining balance may be somewhat more difficult during standing than seated trunk rotations.

The same issue may be observed when testing muscle strength and power during trunk rotational movements. Typically, isokinetic machines (Newton, Thow, Somerville, Henderson, & Waddell, 1993; Kumar, Dufresne, & Van Schoor, 1995; Kumar, 1997) or electromyography (Pope, Andersson, Broman, Svensson, & Zetterberg, 1986; McGill, 1991; Kumar & Narayan, 1998) are used to measure strength characteristics during axial rotation movements. However, when using an isokinetic dynamometer with a torso rotation attachment, no significant differences in peak torque were found within or between groups of healthy individuals who do not play golf and those who are highly skilled at the sport (Lindsay & Horton, 2006). The authors also reported no significant difference in the endurance of trunk muscles between the healthy elite golfers and the non-golfing controls. Similarly, Suter and Lindsay (2001) were unable to show any significant differences in the static holding times or a decline in the electromyography median frequency between low-handicap golfers with low back pain and healthy, age-matched controls who did not golf.

The limitation of these measurements is that torso rotation performed while sitting on the chair with straps around the back and legs provides artificial movement patterns. Additionally, most of the custom-made equipments are relatively expensive and not portable for use on the sporting field. To avoid these drawbacks, one can use a system attached to the barbell or weight machine that allows monitoring of basic biomechanical parameters during rotational movement of the trunk. So far, the

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study of Andre et al. (2012) determined the test-retest reliability of the kinetic rotational characteristics of the pulley trainer when performing a rotational exercise of the axial skeleton in the transverse plane while sitting on a box. The authors found that a pulley system and an external dynamometer can be used together as a reliable research tool to assess rotational power (ICC values above 0.90). Although such a test is suitable for canoeing, for example, for many other sports, such as hockey or tennis, rotational movement performed during standing would be a more specific alternative.

Therefore, the exercise that closely replicates the upper/lower body rotation movements should be preferred in testing in order to assess sport-specific power. The test adapted from the wood chop exercise provides conditions similar to those imposed in many sports involving trunk rotation in standing position (baseball, golf, karate, etc.). Recent study showed that evaluation of maximal muscle power and trunk rotational endurance during the standing cable wood chop exercise on a weight stack machine is both a reliable method and sensitive to differences among physically active individuals (Zemková, Cepková, Uvaček, & Šooš, 2016). Specifically, mean rotational power is reliable (ICC values above 0.90 at all weights tested) and sensitive parameter able to discriminate within-group differences. Therefore, this method of assessing (a) maximal values of power using maximal effort single repetitions of the standing cable wood chop exercise with increasing weights and (b) the rotational endurance of the trunk muscles using a set of a predetermined number of repetitions performed at a previously established weight at which maximal power was achieved may be used in functional performance testing, namely for athletes who require the production of rotational power during training or competition.

Such a computer-based system that can be directly connected to the weights on stack machine may be considered to be a suitable and practical alternative for sport-specific and fitness-oriented testing of trunk rotational power. However, some practitioners prefer free weights in their weight training workout routine. While machines are good for training of muscle strength they neglect key stabilization components of the core. Using free weights is a way to 'functional' training that places greater demands on stabilizing muscles. In addition, exercises with free weights allow performing a full range of trunk motion. Moreover, free-weight exercises are closer to many sports and daily activities, can be performed in any sporting fields and are less expensive than exercises on weight machines.

Accordingly, it is necessary to provide testing conditions as close as possible to those used during training and/or competition. Usually, single repetitions of a particular exercise with increasing weights stepwise up to the 1 repetition maximum are performed to obtain individual force-velocity and power-velocity curves or to analyze power/velocity and weight lifted relationship. It is known that with increasing weights there is a decrease in velocity in the concentric phase of lifting. Contrary to this, power increases from lower weights, reaches a peak, and then toward higher weights, decreases again. Such an optimal velocity, that is, the one allowing the production of the greatest power, depends on ratio of fast and slow twitch muscle fibers (Tihanyi, Apor, & Fekete, 1982); thus, it may be hardly changed with training. However, the optimal weight at which maximal power is achieved may increase with the training.

This testing procedure consisting of maximal effort single repetitions with increasing weights may also be applied for obtaining maximal values of trunk rotational power. Since standing rotational movement allowing more involvement of the lower body is less confined to the trunk, it is likely that it is much more effective in power production than seated trunk rotations. However, the question remains to what extent the rotational power during standing and sitting depends on amount of the load used. This study aims to test the hypothesis that differences in peak and mean values of power between standing and seated trunk rotations are more pronounced at higher than lower weights.

Methods

Participants

Twenty seven fit men (age 22.7 ± 2.9 y, height 178.6 ± 8.6 cm, body mass 86.3 ± 11.1 kg) volunteered to participate in the study. All of them had on average 3.5 years' experience with resistance training including exercises to strenghten the trunk muscles. They were no active in any sport at a competitive level that would require loaded trunk rotations. The participants were included in the study only if they subjectively did not report back pain. Individuals who had previously undergone surgery or other medically invasive procedures for low back pain were

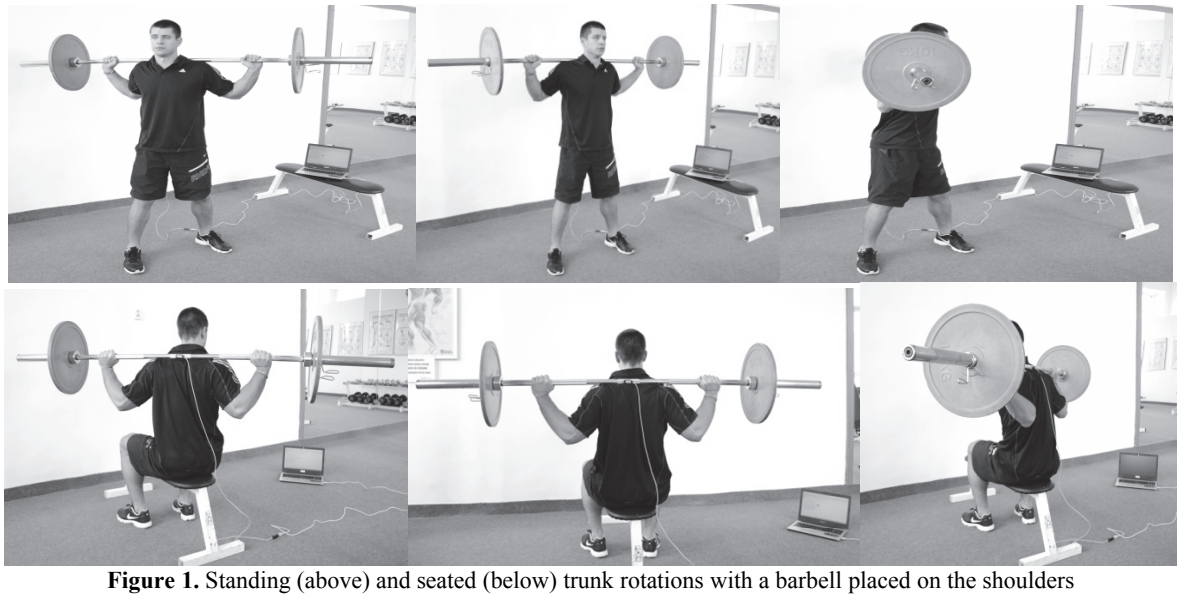

Figure 1. Standing (above) and seated (below) trunk rotations with a barbell placed on the shoulders

excluded from participation in the study. All of them were informed of the procedures and the main purpose of the study. The procedures presented were in accordance with the ethical standards on human experimentation and in compliance with the Helsinki Declaration.

Experimental Protocol

Participants were asked to avoid any strenuous exercises during the study. The procedure and time of day were identical for all participants. The same experienced researchers conducted the measurements during testing sessions.

Following the warm-up, participants were exposed to a familiarization trial during which they performed standing and seated trunk rotations in a slow and controlled manner while keeping the back straight. Afterwards, they completed two repetitions of trunk rotations to each sides in both standing and seated positions with a bar weight of 5.5, 10.5, 15.5, and 20 kg placed on the shoulders (Figure 1). They were instructed to perform trunk rotations with maximal effort in the acceleration phase. Emphasis was placed on the proper position of the body, namely during the standing trunk rotations. In the first case they stood with their feet wider than shoulder width apart and toes slightly pointed outwards, in the second they seated on a bench with feet placed on the ground while holding the barbell on the shoulders. They rotated their torso forcefully from the right (or the left) towards the opposite side until the body reached the end position, and then they slowly returned to the starting position. The test was then repeated for the opposite side of the body. They had to engage their abdominal / core muscles to stiffen the torso and stabilize the spine. A laboratory assistant made sure that participants remained upright throughout the movement and that their head, chest and torso were aligned over their hips.

Power Assessment

Basic biomechanical parameters throughout the movement were monitored using the FiTRO Torso Premium system (FiTRONiC, Slovakia), Figure 2. The system consists of an inertia measurement unit in a small box with an integrated USB interface and software. While inserted on the barbell axis, the sensor unit registers instant angular of rotation movement. Calculations of force and power are based on the Newton´s second law of mechanics. Force produced to accelerate and decelerate a rotation movement is obtained as a product of barbell mass and acceleration of its center of gravity (CoG). Angular acceleration is obtained by derivation of angular velocity. For the transformation of angular velocity and acceleration into their real values, a rotation radius (distance between rotation axis and barbell mass CoG) is used. Power is calculated as a product of force and velocity.

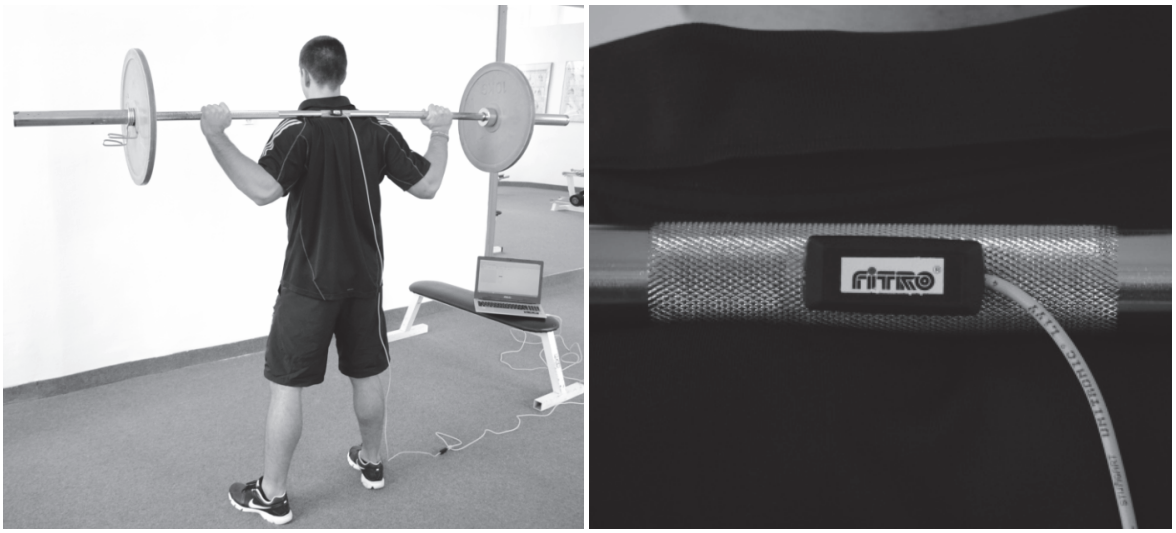

Figure 2. Measurement of basic biomechanical parameters throughout the trunk rotational movement (left) using the FiTRO Torso Premium system (right)

Statistical Analysis

Data analyses were performed using the statistical program SPSS for Windows version 18.0 (SPSS, Inc., Chicago, IL, USA). Analysis of variance (ANOVA) with repeated measures design was used to determine the differences in peak and mean values of power for two types of trunk rotations (standing, seated) at four loading conditions (5.5, 10.5, 15.5, and 20 kg). Bonferroni's post hoc analysis was conducted if the ANOVA showed statistically significant main effects or interaction effects. The significance level was set at $p<0.05$. The relationship between trunk rotational power in the standing and seated position with all weights used was established using Pearson's product moment correlation coefficient. All data were presented as means and standard deviations.

Previous study showed no significant differences in peak torque in strength testing or in total work in rotational endurance testing between the dominant and non-dominant side in healthy golfers, control group and golfers with low back pain (Lindsay & Horton, 2006). Likewise, there were no significant differences in mean power produced during the standing cable wood chop exercise on the left and the right side with all weights used in a group of fit healthy men (Zemková et al., 2016). Therefore, we assumed no side-to-side differences in power outputs in participants of the present study and used average values of better trial on each side for data analysis.

Results

The ANOVA revealed a significant effect for the type of trunk rotations on peak and mean power (F=11.76, P=0.002 and F=10.73, P=0.003, respectively). The ANOVA also identified a significant main effect for loading conditions on peak and mean power (F=8.24, P=0.004 and F=7.76, P=0.005, respectively). In addition, there was a significant type of trunk rotations x loading conditions interaction for peak and mean values

of power (F=7.17, P=0.007 and F=6.39, P=0.009, respectively).

Peak power was significantly higher during standing than seated trunk rotations at weights of 20 kg (24.8%, p=0.004), 15.5 kg (15.5%, p=0.007), and 10.5 kg (15.0%, p=0.009) but not at lower weight of 5.5 kg (13.4%, p=0.061) (Figure 3).

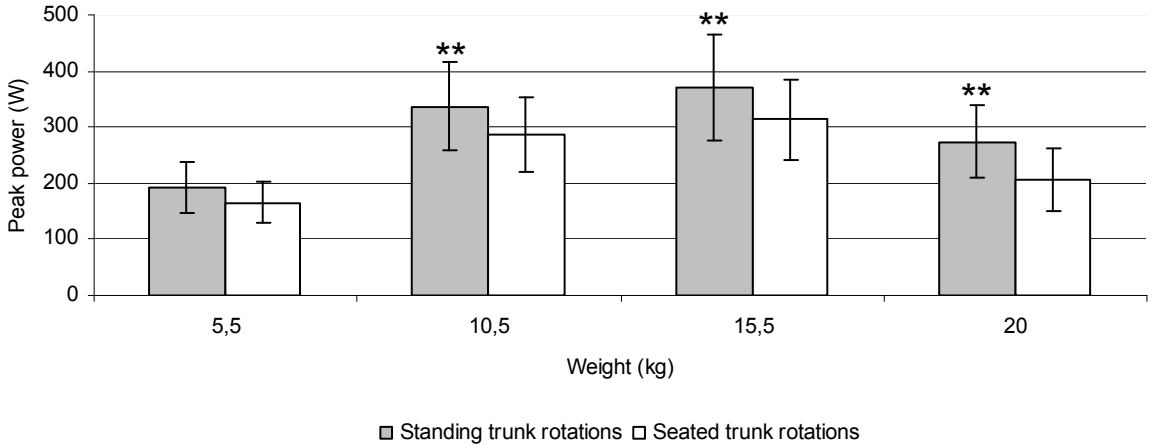

Figure 3. Peak power during standing and seated trunk rotations with different weights (**$p \leq 0.01$)

Mean power in the acceleration phase of trunk rotations was also significantly higher in standing than seated position at weights of 20 kg (28.8%, p=0.008), 15.5 kg (18.7%, p=0.019), and 10.5 kg (17.7%, p=0.024) but not at 5.5 kg (19.5%, p=0.111) (Figure 4).

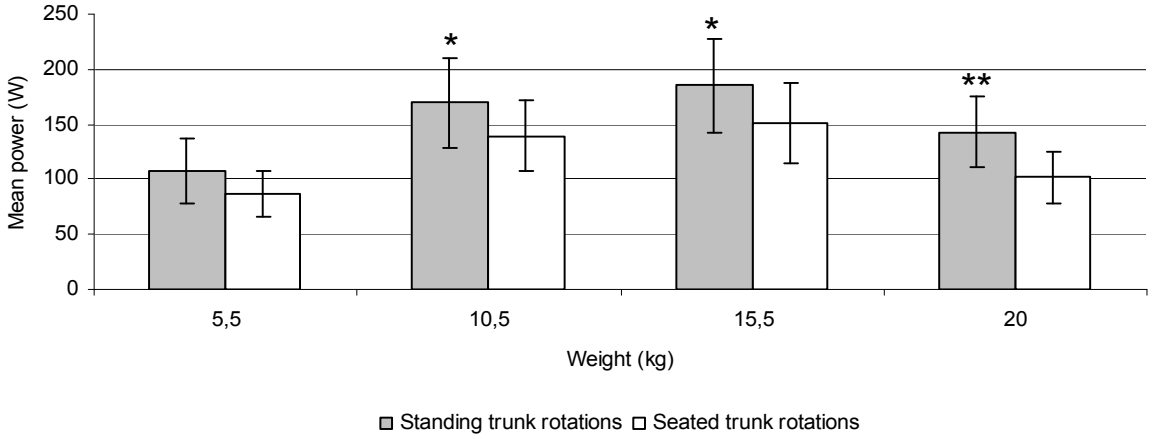

Figure 4. Mean power in the acceleration phase of standing and seated trunk rotations with different weights (*$p \leq 0.05$, **$p \leq 0.01$)

Differences in peak and mean values of trunk rotational power while standing and sitting are displayed in Figures 5 and 6.

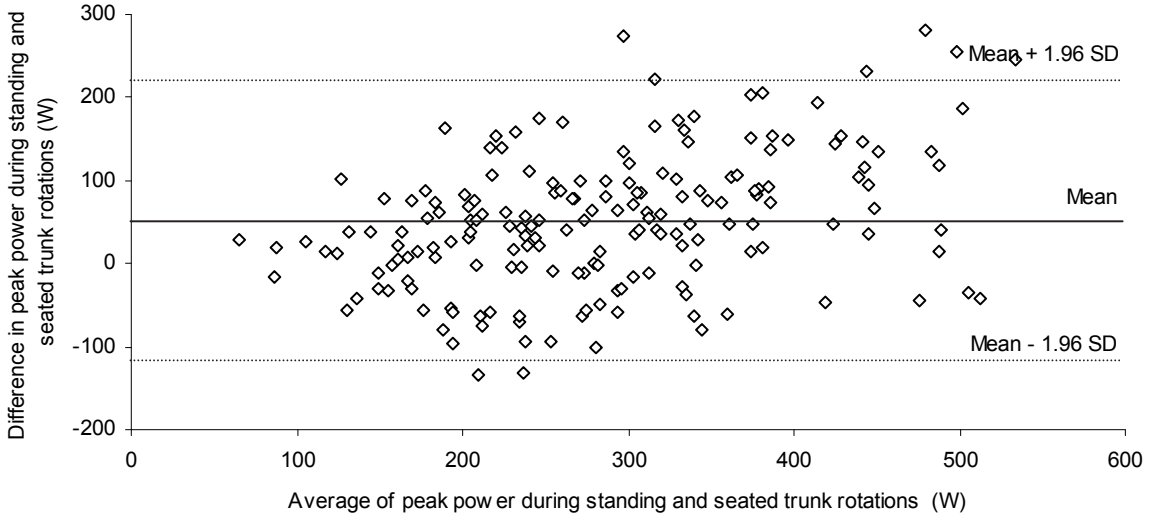

Figure 5. The difference in peak power during standing and seated trunk rotations

Furthermore, there were significant correlations between peak and mean values of power during standing and seated trunk rotations with the weight of 5.5 kg (r=0.684, p=0.027, 95% CI [0.621, 0.712]; r=0.676, p=0.033, 95% CI [0.617, 0.707]), whereas low correlations were found at weights of 10.5 kg (r=0.589, p=0.089, 95% CI [0.542, 0.619]; r=0.552, p=0.143, 95% CI [0.501, 0.586]), 15.5 kg (r=0.493, p=0.243, 95% CI [0.442, 0.523]; r=0.436, p=0.298, 95% CI [0.390, 0.463]), and 20 kg (r=0.357, p=0.361, 95% CI [0.313, 0.393]; r=0.333, p=0.417, 95% CI [0.294, 0.366]).

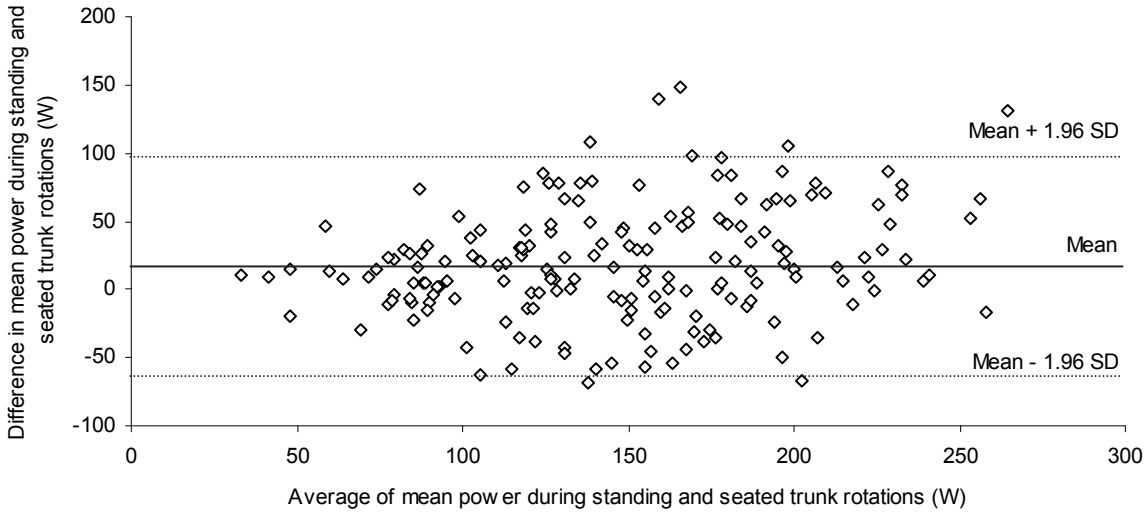

Figure 6. The difference in mean power in the acceleration phase of standing and seated trunk rotations

Discussion

Peak and mean values of power were significantly higher during standing than seated trunk rotations, however only with weights ≥10.5 kg. This may be ascribed to a greater range of trunk motion while standing as compared to sitting, which allowed participants to accelerate the movement more forcefully at the beginning of rotation. As a result was a greater trunk rotational velocity and consequently also overall power outputs. Indeed, peak and mean values of velocity in the acceleration phase of trunk rotation as well as respective angular displacements were significantly higher during standing than seated trunk rotations with weights of 20, 15.5, and 10.5 kg but with the weight of 5.5 kg.

On the other hand, seated trunk rotations reduced the involvement of legs and contribution of thoracic/hip mobility to the upper-body rotational power. Reduced range of motion of the hips and the thoracic spine, which allow the greatest rotation because of the orientation of the joints (Sahrmann, 2002), could contribute to lower movement velocity of the trunk and consequently influence ball velocity in throwing and striking sports. These sports that involve throwing motions require production of explosive movement in either the transverse or oblique planes (Earp & Kraemer, 2010). The force is transferred sequentially from the proximal segments, such as hips, toward the more distal segments, such as the shoulders and arms. Because of the kinetic linkage of the proximal to distal sequence in throwing (Putnam, 1993), the rotational mobility may play an important role in production of trunk rotational power. This power transference of the proximal segments, such as the hips and upper trunk, may be crucial to throwing velocity.

Core strength does have a significant effect on an athlete's ability to create and transfer forces to the extremities (Shinkle, Nesser, Demchak, & McMannus, 2012). It is obvious that the effective execution of the tennis stroke or golf swing not only requires rapid movement of the extremities but also substantial rotational power and/or velocity of the trunk muscles. Trunk extensors, flexors, rotators, and lateral bend agonists are active throughout the stroke in baseball and tennis as well as the golf swing. Actually, all trunk muscles are relatively active during the acceleration phase of the golf swing with the trail-side abdominal oblique muscles showing the highest level of activity (Watkins, Uppal, Perry, Pink, & Dinsay, 1996).

Given the importance of trunk rotational power in these sports, core strengthening and core stabilization exercises should be considered an integral part of functional training. Core exercises incorporated into strength and power training regimens require bilateral agonist-antagonist coactivation to produce movement and stabilize the spine. When the trunk muscles must be co-activated to stabilize the spine, that exercise is by definition a core stability exercise (Lehman, 2006). Core stability is the ability of the lumbopelvic-hip structures and musculature to withstand compressive forces on the spine and return the body to equilibrium after perturbation (Willson, Dougherty, Ireland, & Davis, 2005). Factors such as the endurance, strength, power, and coordination of the abdominal, hip, and spine musculature are important components of core stability. The study by Keogh, Aickin, & Oldham (2010) suggests that similar to strength, core stability exhibits relatively high levels of task specificity. The implication of this is that once some initial conditioning of the core musculature is obtained, core stability training should be as specific as other aspects of the conditioning program if functional performance is to be improved. It could be argued that one way to achieve this would be the use of functional total body exercises that mimic in some respects actual movements that are routinely performed by the athletes in their sports. These total body exercises may also be used to assess functional core stability. The challenge remains as to what aspects of performance in these total body tasks would be assessed and how this would be quantified in an objective manner.

Selecting a single appropriate test to fully evaluate core stability is difficult, given the complex interaction of the lumbopelvic-hip structures and musculature. A number of static single-joint core stability measures and ratios were unable to

distinguish resistance-trained subjects with high and low strength and power levels or to evaluate the efficiency of training involving complex dynamic core exercises. Implements, such as the medicine ball and cable pulleys, can be very useful in developing and quantifying power as they allow motion in all three planes. Both medicine ball throws (side, overhead, scoop) and the chop and lift for rotational power assessment have shown high reliability (ICC=0.84-0.99 and 0.87-0.98, respectively) (Kohmura, Aoki, Yoshigi, Sakuraba, & Yanagiya, 2008; Palmer & Uhl, 2011; Rivilla-García, Martínez, Grande, & Sampedro-Molinuevo, 2011; Lehman, Drinkwater, & Behm, 2013). Rivilla-Garcia et al. (2011) reported a high correlation (r=0.90) between a light overhead medicine ball throw (0.8 kg) and handball-throwing velocity. Conversely, Kohmura et al. (2008) reported that the scoop medicine ball throw has very little shared variance with baseball fielding (throwing distance, standing long jump, and agility T-test) (~7%) compared with batting (~14%). Recently, Talukdar, Cronin, Zois, and Sharp (2015) examined the role of rotational power and mobility on cricet ball throwing velocity using a linear position transducer attached to the weight stack of a cable pulley system to measure chop and lift power. According to the authors, greater ROM at proximal segments, such as hips and thoracic, may not increase throwing velocity in cricet as reduced ROM at proximal segments can be useful in transfering the momentum from the lower extremity in an explosive task such as throwing. These discrepancies may be ascribed to the task specificity and weight of the medicine ball or amount of load used during the chop and lift.

Thus, there is a need to develop a sport-specific test able to evaluate rotational power of the trunk. It is especially important to design the test that require little or no equipment and hence is inexpensive and fast to administer. Most current tests evaluate the endurance (e.g., trunk flexor and extensor endurance tests and the lateral bridge test) rather than the strength and power component of core stability. Given that rotational power is a better predictor of athlete performance, the test that measure this component of the core may be more useful, especially because it may better mimic the demands imposed by sports. The value of this novel method for assessing muscle power during the standing or seated trunk rotations is that it simulates movement that occurs in many sports (baseball, basketball, cricket, golf, hockey, tennis, soccer, canoeing etc.). The difference is mainly the velocity of the trunk movement and the unloading or loading conditions under which it is being performed.

In the present study, low correlations between the power achieved during standing and seated trunk rotations with weights ≥10.5 kg were found, suggesting that these tests measure distinct qualities. This is because core muscles facilitate the movement of the trunk easier when the body is in an upright position. On the contrary, there was a strong relationship between power produced during standing and seated trunk rotations with lower weight of 5.5 kg. This indicates that these exercises are similar in terms of power production.

In conclusion, muscle power is greater during standing as compared to seated trunk rotations, with more pronounced differences at higher weights (≥10.5 kg). These findings indicate that standing trunk rotations are much more effective for power production than those performed in the seated position. Therefore, in sports involving loaded trunk rotations, standing posture should be preferred when testing athlete´s specific performance as opposite to currently used dynamometers allowing movements of the trunk in seated and fixed position.

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Differences between Female Subjects Practicing Pilates and Aerobics

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A B S T R A C T

The aim of this study was to establish if there are differences in strength between female subjects who practice Pilates and aerobics. Research was conducted on a sample of two groups, each consisting of 28 subjects, with tests being push-ups, "hundred" and wall squat hold. Differences between groups have been established by T-test for independent samples. Research has shown certain differences between aerobics and Pilates programs. Subjects who practice aerobics scored better results in all tests than subjects who practice Pilates. It can be concluded that aerobics program is much better for development of these types of strength. However, because this is not a representative sample that cannot be claimed.

Key words: *program types, fitness, women*

Introduction

Various forms of recreational forms of exercise are conducted in fitness centers. Most common types of group exercising are aerobics and Pilates, and the reason behind that is that there are simple activities which enable women to participate in this types of exercising without any problems and without previously acquired knowledge. Contemporary aerobics enables development and conservation of vital functional abilities which are a requirement for healthy life, and therefore enable for every individual to improve their health (Furjan-Mandić, 2007). Pilates method is a system of stretching and strength exercises which strengthens and shapes muscles, corrects posture, gives flexibility and balance, unifies mind and body, and perfects body figure (Siler, 2003). Exercises for strength development are present in both forms of exercising, but in a different way. In aerobics, it is conducted through a dynamic type of training, in Pilates through a static type of training. Final goal of both types of exercising is strengthening and balancing of the body, minimizing stress and increasing endurance through exercises, as well as enabling a person to feel better and to confront everyday challenges more easily. There is a numerous studies from areas of aerobics and Pilates, and on their impact on certain abilities (Nikić & Milenković, 2013; Marques et al., 2011; Kloubec, 2010; Dorado, Calbet, Lopez-Gordillo, Alayon, & Sanchis-Moysi, 2012; Kloubec & Banks, 2004). On the other hand, scientific studies of strength between Pilates and aerobics programs are seldom, and for that reason, the goal of this research was to determine if there are differences in strength between women who practice Pilates and aerobics.

Methods

Sample of subjects

Sample of subjects involved in this research consists of two groups of exercisers (28 female subjects in each group) in a fitness center in Zagreb. One group of women practices Pilates, and other practices aerobics. Age of exercisers is from 20 to 50 years, and duration of involvement in each activity ranges from 1 to 4 years. All of them have in common that they exercise regularly, 3 times a week for 60 minutes, trainings are quite intensive and require greater fitness and motor readiness.

Sample of variables

Sample of observed variables consists of following tests for evaluation of relative repetitive and static strength: test for evaluation of arm and shoulder region strength (push-ups), test for evaluation of abdomen strength ("hundred") and test for evaluation of leg strength (wall squat hold)

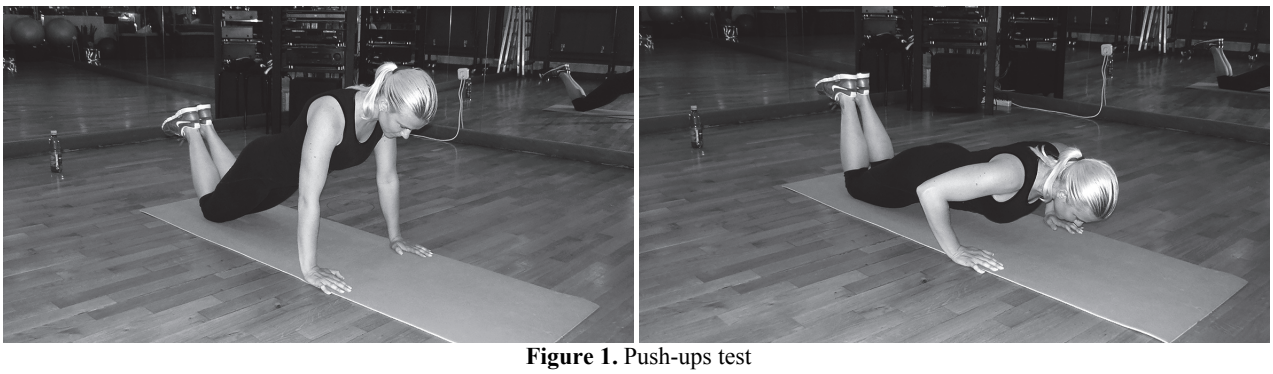

Figure 1. Push-ups test

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Test descriptions

Test for evaluation of arm and shoulder region strength - push ups

Subjects performed push-ups in frontal hold and on knees (Figure 1). From frontal hold on knees, with raised lower legs, palms are placed in shoulder width, as the subject inhales, the body is lowered into a push up position. As the subject exhales, body returns back to the starting position. Head is straight in extension of the spine, subject leans on knees above patella, and lumbar part of spine should not be arched. Exercise was performed until exhaustion, with as much repetitions as possible. Relative repetitive motor strength was measured with this test

Figure 2. "Hundred" test

Test for evaluation of abdomen strength - "hundred"

From lying position on back, subject raises head upwards, so the support is on lower part of scapula (Figure 2). Simultaneously, legs are raised and extended diagonally forward, with hands extended beside the body in abdomen height. Exercise was performed until exhaustion, as long as possible. Static strength of abdomen was measured with this test.

Figure 3. Wall squat hold test

Test for evaluation of leg strength -wall squat hold

Subject leans on the wall with knees and hips bent under 90° (Figure 3). Hands are extended beside the body. Head is straight in extension of the spine. Exercise was performed until exhaustion, as long as possible. Static leg strength was measured with this test.

Collection of data

Data was acquired during classes of Pilates and aerobics. For the purpose of satisfying criteria of objectivity of measuring instrument, measuring of all subjects was performed by the examiner personally. Manner of execution of tasks was explained and demonstrated to subjects. General goal of the research was also briefly explained.

Data processing methods

Basic descriptive parameters (arithmetic mean, standard deviation, minimum and maximum of results, skewness and

kurtosis) have been calculated by descriptive analysis of data. Differences between groups of subjects have been determined by T-test for independent samples.

Results

Descriptive statistics results display average values and standard deviations of variable push-ups, "hundred" and wall squat hold.

Table 1. Basic descriptive parameters of variables of pilates group

	AM	SD	MIN	MAX	R	Skewness	Kurtosis
PUSH-UPS	19,14	8,08	10,00	33,00	23,00	0,34	-1,45
"HUNDRED"	1,28	0,58	0,41	2,53	2,12	0,57	-0,19
SQUAT	1,14	0,72	0,19	2,57	2,38	0,50	-0,94

Legend: AM-arithmetic mean, SD-standard deviation, MIN-minimal value, MAX-maximal value, R-total range, skewness-asymmetry distribution coefficient, kurtosis-curvature distribution coefficient

In the first part of statistical data processing, basic descriptive parameters of variables of strength between Pilates and aerobics are displayed. Results show that subjects who perform aerobics had better results in all three tests (Table 1 and 2), and that the biggest difference was perceived in the push-ups test.

Table 2. Basic descriptive parameters of aerobics group

	AM	SD	MIN	MAX	R	Skewness	Kurtosis
PUSH-UPS	23,57	7,16	10,00	37,00	27,00	-0,07	-0,73
"HUNDRED"	1,52	0,56	0,40	2,52	2,12	0,27	-0,50
SQUAT	1,51	0,75	0,40	3,02	2,62	0,49	-0,51

Legend: AM-arithmetic mean, SD-standard deviation, MIN-minimal value, MAX-maximal value, R-total range, skewness-asymmetry distribution coefficient, kurtosis-curvature distribution coefficient

Table 3 displays statistically significant difference in test for evaluation of arm and shoulder region strength - push-ups, between individual groups on the level of significance p=0.03. Data indicates that subjects who perform aerobics have better results, and therefore higher strength in upper body part.

Table 3. T-test for independent samples results between pilates and aerobics group

	AMp	AMa	T	df	p	Np	Na	SDp	SDa	F-var	p-var
PUSH-UPS	19,14	23,57	-2,16	54	0,03	28	28	8,08	7,16	1,27	0,53
"HUNDRED"	1,28	1,52	-1,57	54	0,12	28	28	0,58	0,56	1,06	0,86
SQUAT	1,14	1,51	-1,89	54	0,06	28	28	0,72	0,75	1,09	0,82

Legend: AMp-arithmetic mean pilates, AMa-arithmetic mean aerobics, t-value, df-degrees of freedom, p-error, Np-number of pilates subjects, Na-number of aerobics subjects, SDp-standard deviation pilates, SDa-standard deviation aerobics, F-var-value for testing significance of differences of variance of groups, p-var-error which claims that variance difference is statistically significant

Discussion

Relative repetitive arm and shoulder region strength was measured in the test push-ups, aerobics subjects have attained higher number of repetitions and because of that arithmetic mean is larger. Standard deviation is smaller, which indicates larger homogeneity of results, and respectively, that subjects have more equal upper body strength. Pilates subjects are somewhat weaker, and result homogeneity is smaller. In test "hundred", for evaluation of abdomen static strength, differences in strength are not very big, although aerobics subjects attained slightly better results, which indicates that they have stronger abdominal muscles. Standard deviations in both groups are not large, and that indicates homogeneity of results, an respectively, equal abdomen strength in both groups separately. This test was measured on time (as long as possible), which means that aerobics subjects have a slightly better endurance. Third test used was wall squat hold, where static leg strength was measured. Aerobics group had better time values and a larger arithmetic mean. Although Pilates group had lower results, standard deviation is smaller, which indicates a higher result homogeneity, and respectively, that Pilates subjects have smaller differences between themselves in leg strength evaluation test (although inferior to subjects who perform aerobics). This test was also measured on time, and aerobics subjects have shown greater endurance.

Goal of this research was to establish if there are differences between aerobics and Pilates in regard to strength of women. Results have shown that there are certain differences between these two programs. Acquired data in push-ups test has shown that there are statistically significant differences, while "hundred" and wall squat hold tests have shown that there are no statistically significant differences, although differences do exist. It could be concluded that aerobics program is much more suitable for development of these types of strength. However, because this was not a representative sample, that cannot be claimed. It can only be assumed that this is a better program for development of strength and other motor and functional abilities.

This is another study which displays certain differences in programs of aerobics and Pilates. Various other programs are also offered in fitness centers. All these programs have a positive impact on health and psychophysical state of a person. It is important that a person selects a program that will satisfy his/her needs and with which health goals will be achieved. That should also be our primary task.

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The Effect of Static Stretching in Agility and Isokinetic Force at Football Players

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A B S T R A C T

Cool Down is very important for the recuperation of a football player. The objective of this research is to prove the effect of recuperation with static stretching in agility and isokinetic force at the young football players. This research has taken place between August and November 2015 with a sample of 24 football players of age 15.6±0.4 years, divided in the control group and the experimental group. At first measurements have been initialed body weight 61.1±0.4 kg and body height 175.7±6.4 cm, and agility (20 m zig-zag with and without ball) and isokinetic force (peak torque flexion and extension). Both groups of the football players have completed the regular training program. The experimental group (despite the control group) during the stage of recuperation (cool down), except the running with slow pace did also carry out the experimental program which did take place through static stretching. Experimental program consisted of 17 exercises bodily static stretching which are applied in the final training session (cool-down). After the experimental phase is finished the participants did undergo the final measures. The conducted results with univariate analysis of variance (ANOVA) in two tests (initial and final) have shown unimportant statistical values between the control group and the experimental one in the isokinetic force and agility. From the collected results we can conclude the recuperation with static stretching during the cool down has an unimportant statistical impact in the agility and isokinetic force of the young football players.

Key words: *soccer players, recovery, static stretching, isokinetic strength, agility*

Introduction

Football is a sport that is characterized by numerous and varied complex dynamic kinesiology activities that are characterized by a large number of cyclic and acyclic movements (Bjelica, Popović, & Petković, 2013; Gardasevic, Bjelica & Vasiljevic, 2016). The conditional preparation is the base to execute all the elements techno-tactical and responsible to differentiate between the high and low levels of the football players (Popović, Akpinar, Jakšić, Matić & Bjelica, 2013; Popović, Bjelica, Jakšić & Hadžić, 2014). During a football match the players carries out around 1200-1400 different moving activities from which 700-800 of those are movements with change in directions and only 11% of the total distance of these movements are executed with high intensity and important for the outcome of the match (Stolen, Chamari, Castanga & Wilsloff, 2005). All these mentioned movements are closely linked with the production of dymanic force during the flexion and extension of the knee (Newman, Tarpenning & Marino, 2004). So we can suppose that the isokinetic forces and agility are highly responsible or responsible for the taking of these actions in the football players.

Recuperation of organism is one of many important components to increase sport performance (Rey, Carlos, Luis & Joaquin, 2012; Kinugasa & Kilding, 2009; Tesitore, Meeusen, Cortis & Caprinica, 2007). The final cool-down phase of the training session is important to accelerate the recovery where activities like static stretching and running with slow tempo are typical for this part. Relaxation of the body is reached by extension static (static stretching), as one of the fundamental processes that is applied for prevention, and maintenance of physical performance components "recovery of the players" (Dawson, Gow, Modra, Bishop & Stewart, 2005).

The static stretching for decades has been part of the warming up during the training but also during the competitions with the aim to raise flexibility and to prevent injuries etc. The execution of high number of movements with changing the pace and the direction of the movement, jumping, execution of technical elements, despite others is also depended on the flexibility of the locomotoric system (Gardasevic & Bjelica, 2013). A number of researches carried out in the last decade have shown that the static stretching applied during the warming up has had an impact in lowering the performances in jumping, speed and agility (Behm, Chaouachi, Lau & Wong, 2011; Gelen, 2010). The research that was carried out suggests that during the warming up should be applied exercises of dynamic flexibility combined with the static stretching exercises with controlled movements and a fully optimal amplitude (ROM) which are more effective in developing the flexibility and improvement of the explosive force of sprint (Andersen, 2005).

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All types of stretching are effective in growing the movement amplitude (Walker, 2006). Stretching after exercise is commended as a preventative measure for delayedonset muscle soreness and improved range on motion through dispersion of edema or tension reduction of the muscletendon unit (Montgomery et al., 2008). A research carried out with 26 football coaches of Mauritius Football Association (MFA), 76% of those think that stretching should be exercised three times a week during the "getting ready" period and 2 times during the week while in competition, especially from the regular sessions with duration of 0.6 to 1.3 hours a week (Kelly, Fawzi & Rajiv, 2012).

The aim of this research was to prove the impact of the static stretching in the exercises which are applied during the phase of recuperation (cool down) in the agility and isokinetic force of the young football players under the age of 17. Agility in the football game is a form of exercise where a person provides running to change direction with and without ball (Popovic et al., 2014), and Isokinetics is a form of exercise where a person provides a maximum muscle contraction against a resistance or lever arm, (isokinetic dynamometer) at a fixed speed through a given range of motion. This type of muscle action can be done either concentrically or eccentrically at the given joint. Peak Torque is the greatest amount of force produced by a muscle (Kowalski, 2003). This can be determined within each repetition or the entire set. Peak Torque indicates the muscles maximum capability of developing force. This is also equivalent to a 1-repition maximum isotonic strength test. Peak torque is an absolute value (Kowalski, 2003). Static Stretch The technique of lengthening a muscle group by slowly moving a joint to its maximal range of motion and maintaining the position for a period of time (Guissard & Duchateau, 2004).

Methods

In order to carry out this research, first of all the whole sample has carried out the medical check up at the medical sport centre in Prishtina and it has been proved that all the football players are healthy to participate in football, and in accordance with the Helsinki decleration, all the participants have been informed with the aim of the testing procedures and the experimental treatment.

Participants

In this study have participated twenty four young football players under the age of 17, part of the football school of the club Ramiz Sadiku from Prishtina which were under direction of a UEFA licensed coaches where they have carried out regular training sessions and champion competition in the elite league of football of Kosovo, in the first macrocycle (training sessions and competitions) of the autumn season from 1st of August to 1st of December 2015.

Procedures

Participants divided in the control group (n=12) and experimental (n=12) have been compared in the initial tests and the anthropometrical final ones (height and body weight), motoric performance (agility and isokenentic force). All these measures have taken place in the the parquet flooring and the diagnostification lab of the Sports College Universi in Prishtina in the same time and date, from a specialized team. The initial testing took place before the beginning of the pre-season while the final testing was performed at the end of the season (after 4 months of intervenation with static stretching exercise). At the beginning of the study to all participants is measured body height 176.2±6.4 cm (anthropometer of Martin) and body weight of 61.95±8.5 kg (In body 720). Average age of the participants in the initial measurements was 15.7 years. Football players in this study after the warming up, did go under agility test; test 20 m zig-zag with and without ball (Idrizovic, 2014) and isokinetic force; Peak Torque flexion and extension (Grbovič, 2013; Zakas, Doganis, Galazoulas & Vamvakoudis, 2006; Dirnberger, Kösters & Müller, 2012). On the parquet flooring, agility performances was performed and measured with New Test, i.e. Power timer 300 photocells with exact time of 0.01 sec. The isokinetic strength of the knee flexors and extensors (dominant leg) was measured in the diagnostification lab with the isokinetic dynamometer Biodex System 4. Isokinetic extension and flexion peak torque was measured at 120°/s (degree/sec) in sitting position with a hip angle 100 degree. Individual seat settings were stored in PC memory before measuring the leg and were automatically activated in the process of measuring and follow up-testing. At the beginning of the follow-up testing individual settings were rechecked and adjusted if necessary. The participants were instructed to hold the hand-grips located at the side of the seat during all testing efforts. During the testing procedure the players were provided with concurrent visual feedback in the form of an isokinetic strength curve displayed on the dynamometer monitor.

Participants of this research divided into two groups (control and experimental) during the period of August and November 2015 have exercised 3 times a week, in total doing 48 training sessions, under the plan and the program of the football school of the Ramiz Sadiku Club in Prishtina. Protocol of control group (general warm up 5-7 min, specific warm up 10-15 min, the main part 35-45 min, cool down 10 min recovery by running). Protocol of experimental group general warm up 5-7 min, specific warm up 10-15 min, the main part 35-45 min, cool down 10 min recovery with running and 15 min static stretching. The experimental group (compared to the control group) except the regular training, did undergo the experimental program (recuperation with static stretching) which has taken place during the cooling down phase. The experimental program was planned from the research author based on the recommendations of the authors of this field (Walker, 2006) and did involve 17 stretching exercises–static stretching; upper body-flexibility exercises (Neck stretch, Upper Back, Chest and Back, Shoulder and mid–upper Back, Shoulder and triceps, Lateral flexion right-left) and lower body flexibility exercises (Hamstring Two Leg Stretch, Achiles and Back Stretch, Quadriceps Stretch, Hamstring and Groin Stretch, Standing Groin Stretch, Groin Stretch, Chest Stretch, Sitting Hamstring Stretch, Lower Back Stretch, Two Legs Seat Hamstring Stretch, Achiles Tendon Stretch). Every exercise has been completed within the duration of 20 seconds.

Statistical analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS version 21.0). Mean and Standard Deviation (SD) were calculated for both groups in initial and final measurement for anthropometric (body height and body weight), agility performance (zig zag 20m with and without ball), isokinetic force (peak torque flexion and extension). With univariate analysis of variance (ANOVA) were calculated differences between arithmetic means of control and experimental group before and after experimental programme (static stretching). The level of significant is $p<0.05$.

Results

The descriptive parameters are displayed in Table 1. for both groups in initial measures.

Table 1. The variables data of anthropometric (body height and body weight) and motoric performance (agility and isokinetic force) of the control and experimental group at the initial measurement

Variable	control group (M±SD)	experimental group (M±SD)	F	p-value
Age (years)	15.6±0.4	15.9±0.6	-	-
Weight (kg)	61.1±10.2	62.7±7.6	.181	.675
Height (cm)	175.7±6.4	176.7±6.7	.141	.711
20 m zig-zag without ball	6.47±0.3	6.50±0.4	.028	.868
20 m zig-zag with ball	7.99±0.6	7.97±0.4	.013	.912
peak torque flexion	76.66±28.8	82.80±20.1	.364	.552
peak torque extension	109.30±30.1	99.97±20.2	.281	.601

The results of the anthropometric measures in the Table 1. show that with the univariate analysis of variance (ANOVA) based on the coefficient F–relations and the value of the statistical significane p–value have been proved that there are unimportant statstical differences between the control group and the experimental one, which does prove the homogenity of the groups in the initial measures of the main anthropometric parameters (body weight and height) and motoric performance; agility test (20 m zig-zag with and without ball) and isokinetic force (peak torque flexion and extension) at the football players under the age of 17.

Table 2. The significance of differences between arithmetic means of variables data of anthropometric (body height and body weight) and motoric performance (agility and isokinetic force) of the control and experimental group at the final measurement

Variable	control group (M±SD)	experimental group (M±SD)	F	p-value
Age (years)	15.9±0.4	16.2±0.6	-	-
Weight (kg)	62.2±8.8	64.0±8.0	.288	.597
Height (cm)	177.1±6.5	177.6±6.7	.043	.838
20 m zig-zag without ball	6.23±0.3	6.16±0.3	.324	.575
20 m zig-zag with ball	7.73±0.5	7.73±0.4	.000	.997
peak torque flexion	115.41±29.9	130.98±29.8	1.628	.215
peak torque extension	120.27±30.3	126.48±26.9	.790	.384

The reults of the agility and isokinetic force performances have been shown in the Table 2. and show that with univariate analysis of variance (ANOVA) based on the coefficient F–relations and the value of statistical importance (significant) p–value have been proved unimportant statistical differences in the final testings anthropometric parameters (body weight and height), motoric performance; agility test (20 m zig-zag with and without ball) and isokinetic force (peak torque flexion and extension) at the football players under the age of 17.

The given results do prove that the experimental programme (static stretching exercises) have not had any impacts in diferentiating between the groups in the final measurses variables of the agility and isokinetic force.

Although a great number of studies have focused on researches of training programs for improving of agility (Behm et al., 2011; Milanovic, Sporiš, Trajkovic, James & Samija, 2013) and isokinetic strength of knee flexors and extensors (Gioftsidou et al., 2008; Lehnert, Psotta, Chvojka & Croix, 2014). The static stretching is still one of the main discussions in sport and medicine. Stretching should be applied during the cooling down session or the warming up session, to stimulate the motoric performances to prevent the injuries, or for other reasons, so, there are different thoughts that exist in what form and when, the application of the stretching exercises do have an impact in favor or not in favor in the anthropologic status of the football players. From a lot of researchers it has been proved that the exercises of the static stretching applied in the warming up session have a negative impact with an statistical importance in the speed, agility and the explosive force of the football players (Gelen, 2010; Brandey, Ajit, Richard & Jennifer, 2012; Haddad et al., 2014). Compared to the mentioned researches above, some researches have researched in the impact of the combined stretching (dynamic and static) and have not proved any determinant impacts in the motoric performances: speed and agility (Behm et al., 2011). In the last decade the impact of the static stretching in the motoric performance applied in the warming up session has been researched from a lot of medicine researches. But the main reason for this study is that numerous researches have shown that static stretching can decrease soccer performance especially agility with and without ball and isokinetic force during knee extension and flexion (isokinetic peak torque) in the youth soccer players. Wrigley (2000) suggested that isokinetic testing of knee flexor and extensors is reliable and sensitive enough to explore seasonal changes in soccer players.

The results according to the univariate analysis of variance (ANOVA) have shown that the static stretching exercises applied at the end of the training session “cool down” have had no important impact in the agility and isokinetic force of the football players under the age of 17. Details of results of the tests for agility and isokinetic force (peak torque flexion and extension) do reflect statistically unimportant differences among the control and experimental group at initial and final tests, thus suggesting that static stretching exercises during the cool down have no significant effect on motoric performance (agility and isokinetic force) of the football players under the age of 17.

Discussion

In this research it has been proved that the static stretching exercises applied 3 times a week during the cooling down period, in a duration of 16 weeks did not have any important statistical effect in the testing of the agility and isokinetic force at the football players U17. We can conclude that the static stretching exercise applied in the end of the training sessions (cool down) do not have any impact in the agility and isokinetic force of the young football players. So at the young football

players we can recommend the application of the static stretching in the end of the training session 2-3 times a week or also in the special training sessions with the objective to raise the optimal flexibility of the body as one of the pre conditions to execute the speed movements, agility, coordination, explosive force and the execution of the technical elements of the football match. These results can be used to fill in the existing knowledge of the impact of the static stretching in the cool down at the young football players in the performances of the agility and isokinetic force and to rationalise the processes when it comes to the plan and program content of the training sessions.

Furthermore the results of this study can be used as an incentive to research the impact of the static stretching in the cool down and other characteristics of the anthropologic status (morphologic characteristics, other motoric performances, functional, psychological, rehabilitation, recuperation, prevention of injuries, demonstration of the technical elements.

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Utilization of Research for Elite Sport in the Czech Republic

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A B S T R A C T

In 2015 and 2016, the author conducted an audit of the Czech national elite sports policy using the international research methodology called SPLISS (Sports Policy Factors Leading to International Sporting Success). Based on the audit results in Pillar 9 this paper analyses the situation regarding the existence of structural factors for the dissemination of research applicable in elite sport and the extent to which these research outputs serve as scientific input to elite sport in the Czech Republic. The results from this qualitative and quantitative study focus on the utilization of knowledge from sport science in a country context, providing the base for a comparison with other countries and proposing the way towards effective and efficient cooperation between academia and sport practice in this regard.

Key words: *elite sport, utilization of research, knowledge transfer, institutionalization*

Introduction

As international competition among countries in sports is becoming stronger and financial support for elite sport is increasing, national governing bodies in sport should focus on strategic approaches to develop world-class athletes. Considering this, it seems that the need to analyse the factors leading to international sports success is legitimate (De Bosscher, Shibli, Westerbeek, & Van Bottenburg, 2015). Therefore, also in the Czech Republic analysis with regard to the Czech national elite sports system was conducted. The analysis was based on a comparative international research methodology called SPLISS (Sports Policy Factors Leading to International Sporting Success; De Bosscher et al., 2015). The data was collected in 2015 and 2016 when the author of the article conducted the research project using the SPLISS methodology. The results of the SPLISS study in the Czech Republic identified several underdeveloped elite sports policy areas that are considered to be critical for sporting success and among them also the Pillar 9 - Scientific research and innovation. According to this pillar, the search for innovation and the use of applied scientific research in the development of elite sport is seen as a key issue in the strategic development of performance in elite sport. Currently, a lot of national reports are available as a result of separate research activities mapping the situation in general, and in particular sports (Judge, Hunter, & Gilreath, 2008; Judge, Young, & Wanless, 2011; Martindale & Nash, 2013; Reade, Rodgers, & Hall, 2008; Kilic & Ince, 2015) and also comparative studies based on SPLISS methodology (De Bosscher et al., 2015). Thus our qualitative and quantitative study focuses on the utilization of knowledge from sport science in a country context providing the base for a comparison with other countries and proposing the way towards effective and efficient cooperation between academia and sport practice in this regard.

Methods

The data was collected in a national context, employing two instruments. An inventory of conditions for, and use of, sport science in the elite sport system consists of 9 critical success factors and a qualitative approach – desk research and content analysis was applied in order to gather the relevant information with regard to the overall sport policy in this area. The second instrument used was an on-line survey conducted among elite athletes and coaches and part of a standardized, officially translated and piloted questionnaire relevant to the topic of the study (SPLISS, Pillar 9) was used. Purposive sampling was employed following the SPLISS methodology (De Boscher et al. 2015) that led to the sample of elite athletes N=847; response rate 10.98% (n=93) and the sample of elite coaches N=168; response rate 11.9% (n=20). Data collection was realized during the winter of 2015/2016. The data from the on-line survey was analysed with the IBM SPSS Statistics (24.0) software. All the information was then used to compare the situation in the Czech Republic with other countries in order to identify the gaps and to propose measures for bridging academia and elite sport and thus improve the state of the art in terms of dissemination of scientific knowledge and its utilization.

Results

Pillar 9 assesses the scientific input to elite sport, and examines the extent to which a coordinated approach to the organisation and dissemination of research and scientific information is present in the country. The athletes' and coaches' survey is complementary to the inventory performed by researchers and indicates the modes of searching for innovation and the use of applied scientific research in the development of high performance sport. The results from the overall sport policy inventory of the conditions in the elite sport system in relation to SPLISS Pillar 9 are presented in the Table 1.

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Table 1. Sport Policy Inventory - Critical Success Factors SPLISS Pillar 9

I. There is sufficient support for scientific research and innovation and sport science is provided at each level of elite sport development	
CSF	**Inventory results**
There is (sufficient) (financial) support for scientific research and innovation in elite sport.	The Ministry of Education and Sport in the Czech Republic does not provide direct financial support for scientific research and innovation regarding elite sport. Research activities in this field are scarce and rely on the individual initiatives and interests of researchers and particular sports clubs and associations.
Different areas of elite athlete development (all pillars) are supported by applied scientific research and innovation projects and there are 'field laboratories' and/or embedded scientists that in situ develop, test and/or apply new technologies in cooperation with coaches and athletes at elite sport training centres.	There are no 'field laboratories' or embedded scientists that develop, test or apply new technologies in cooperation with coaches and athletes at elite sport training centres in the Czech Republic. The new strategy for sport up to 2025 was designed recently, but there is no mention of 'field laboratories' or embedded scientists.
II. Scientific research is collected, coordinated and disseminated among coaches and NGBs	
CSF	**Inventory results**
There is a national research centre that conducts applied elite sport research and coordinates research activities in elite sport nationally.	There is no national research centre that conducts applied elite sport research or coordinates research activities in elite sport in the Czech Republic.
There is a specific responsibility within NGBs for developing and coordinating innovative research projects in elite sport.	There has not been any specific responsibility in the Czech Republic for developing or coordinating research and innovation projects in elite sport within the NGBs identified.
Scientific support/innovation in elite sport is provided in strong cooperation with universities and (sport) research centres.	So far, there are no national agreements relating to cooperation between sport organisations and universities or sport research centres with regard to elite sport.
There is a regularly updated database of scientific research that can be consulted by coaches and NGBs.	There is no regularly updated nationally coordinated database of scientific research specifically for elite sport that can be consulted by coaches and governing bodies.
There is a network to communicate and disseminate scientific information to NGBs, clubs, elite athletes and coaches. Coaches receive scientific information from NGBs and other organisations and use applied sport science in their training activities	There is no mechanism in place in the Czech Republic to inform elite coaches and sport governing bodies on a regular basis about the latest methods/ technology/ scientific research in their sport. The Ministry, NOC or respective NGBs do not organize regular conferences or events to disseminate scientific research and there is no web-based network, email newsletter or social media forum. Similarly missing are special initiatives or organizations dedicated to the increase in the uptake of sport science research results by coaches or governing bodies.
Coaches make use of sport scientific information on elite sport, with regard to their sport	Coaches in the Czech Republic can use different types of scientific support services, i.e. in biomechanics, physiology and psychology, but this happens on the individual demand or interests and on the basis of individual agreements with relevant research centres or university units.
Scientific research is embedded in coaches' education and coaches are taught how to search for scientific information and how to use research results as part of their coaching	Scientific research and technology development is embedded in coach education in the Czech Republic, but its extent is quite limited. Demand in this area is covered by universities that organize lifelong educational courses and offer specialized higher education programmes for coaches. Thus, only those attending these courses are also taught how to search for scientific information and how to use research results as part of their coaching.

Note. CSF = Critical Success Factors. NGBs = National Governing Bodies. NOC = National Olympic Committee

Pillar 9 in the Czech Republic is characterized by the non-structured environment with regard to the dissemination of scientific knowledge and utilization of knowledge in elite sport. Key weaknesses are linked to the non-existence of specialised units, which could look at elite sport, and the application of science and technology into it, including data collection and analysis. The policy inventory was supplemented by the on-line athletes' survey and on-line coaches' survey.

Athletes' responses

More than one third of the athletes were not able to judge the applicability of applied scientific research (biomechanics, physiology), developments in new technology and innovation in their sport and only 24% rated the applicability of scientific research as very high and high. 32.8% of the athletes rated developments in new technology as very and fairly high. The applicability of innovations was rated as very high and high by 25.8%.

One third of the athletes were not able to rate the opportunities they get to use the applied scientific research (biomechanics, physiology), developments in new technology and innovation in their sport. Just 8.6% rated the opportunity they get to use applied scientific research (biomechanics, physiology) as very high and fairly high. The low score was also assigned to developments in new technology (12%) and innovations (13.8%).

Coaches' responses

Forty percent of the coaches frequently actively search for scientific information related to their training activities for the development of their elite athletes (at least once a month), 33.3% sometimes (1-2 times a year), while 26.7% do not perform this search at all.

Almost twenty seven percent of the coaches actively used applied scientific research related to their training activities for the development of their elite athletes over the past 12 months, whereas 73.3% did not. All the coaches who participated in the on-line survey stated that they do not receive at least annually from their national governing body or club, a magazine which contains, amongst other things, scientific knowledge on their sport.

Sixty percent of the coaches confirmed that their national governing body, club or national sport agency organized seminars over the past 12 months that updated them with information or relevant scientific knowledge/research. 40% responded that this did not happen in their case.

More than eighty six percent of the coaches consider that there is insufficient scientific research in the Czech Republic related to their area of elite sport and 66.7% consider that scientific knowledge is not disseminated sufficiently well amongst the elite coaches in their sport.

Almost sixty seven percent of coaches consider that scientific knowledge is disseminated sufficiently well amongst the elite coaches in their sport, while the rest of the coaches did not agree with this.

More than six percent of the coaches were not able to rate the applicability of applied scientific research (biomechanics, physiology), 13.3% developments in new technology and 20% innovation in their sport. 33.3% of them rated the applicability of applied scientific research (biomechanics, physiology) and developments in new technology as very high and fairly high.

Twenty percent rate the same way the applicability of innovations. At the same time, 20% of the coaches were not able to rate the opportunities they get to use applied scientific research (biomechanics, physiology), developments in new technology and innovation in their sport. 26.7% rated the opportunities they get to use applied scientific research (biomechanics, physiology), and innovations as very low and fairly low. 33.4% rated this opportunity as very low and low in the case of developments in new technology. At the same time, 6.7% of the coaches rated the opportunities they get to use applied scientific research (biomechanics, physiology) developments in new technology and innovation in their sport as very high.

As is obvious from the abovementioned results from the online survey active search for, and use of, scientific information related to training activities for the development of elite athletes is quite limited as is also the provision of a specialized magazine by the national governing bodies. Dissemination of scientific knowledge amongst elite coaches is insufficient. The applicability of applied scientific research, developments in new technology and innovation is considered by coaches as average. The majority of the elite athletes were not able to rate the applicability and opportunities coming from applied scientific research, developments in new technology and innovation in their sport.

Discussion

The results from the Czech national context confirmed that the situation with regard to a coordinated approach to the organisation and dissemination of research and scientific information into elite sport is very similar to that which can be found in the majority of studies related to this topic (Kilic & Ince, 2015). To satisfy the need for providing opportunities to use scientific information for elite sport, the most widely used coach-to-coach knowledge transfer (Kilic & Ince, 2015) must be supplemented by a more systematic approach that would abolish the barriers to the coaches' and athletes' access to sport science such as the time that is needed to become familiar with scientific journals and be capable of understanding sport scientists (Nová, 2015). National strategies for developing mutually beneficial communication between academia and practice that would remove the barriers in knowledge transfer are today of utmost importance not only for elite success but above all for the health benefits of elite athletes. Another source of information with regard to the comparison in the utilization of research for elite sport in the Czech Republic are the results from an international comparison of the Sport Policy Factors Leading to International Sporting Success (SPILSS 2.0) in 15 nations (de Boscher et al., 2015). The key findings from the overall inventory of critical success factors in Pillar 9 - Sport science support, scientific research and innovation in sport show that the best performing nations in summer and winter sports generally score well in scientific research and innovation. They have a national sport research centre and co–ordinate, disseminate and communicate scientific information well (de Boscher et al., 2015). The situation in the Czech Republic resembles the situation in Denmark, Spain, Portugal, Northern Ireland, Brazil and Wallonia. In these countries similarly to the Czech Republic the national co-ordination and dissemination of scientific research as well as financial support provided for research are not developed at the level comparable with Australia, Japan and Canada, where the national research centres (Australian Institute of Sport; Japanese Institute of Sport Science; network of seven Canadian Sports Centres that collaborate with NGBs) play a vital role in this sense. From the stakeholders' view (the results from the elite sport climate survey by coaches and athletes) it is perceived that there is generally room for improvement on Pillar 9 in all countries (de Boscher et al., 2015). The main findings from 15 countries are very much in tune with the findings from the survey conducted in the Czech Republic. There is a dissatisfaction among coaches with regard to the applicability and the dissemination of research data for their sport as a result of the gap that exists in the knowledge transfer from universities to sport practice. As is obvious from this international comparison for all countries, as well as for the Czech Republic, the crucial role in Pillar 9 is assigned to the existence of a national research centre that would conduct applicable research for elite sport and would be able to disseminate the results from it into elite sport practice. Collaboration with relevant universities based on formal agreement is the second most important success factor in this Pillar. Therefore, our suggestions for improvement in the above-mentioned areas focus on following aspects:

Utilization of the institutionalization theory in the process of establishing a national research centre for elite sport in the form of the one or a network of cooperating organizations

To foster the transfer of scientific results into elite sport policy, strategy and the systematic background created by a set of cooperating stakeholders / interest groups the existence of separate organizational structures responsible for the transfer of scientific results into elite sport is also missing. The institutionalization theory is based on the belief that the creation of the structures, which are also carriers of the desired values, is important when pursuing the policies in society and in a process

of social change. If we accept the idea that effective utilization of the research by elite sport is one of the important policies of sports, we can also identify the need for its enforcement by a sufficient institutional base. The common idea that unifies different approaches to institutionalization is that the structures remain whereas individuals come and go. Structures (bodies) form a greater regularity in human behaviour than would normally occur and it depends on the extent / degree of institutionalization (Peters, 2000). To assess the extent of institutionalization the criteria proposed by Huntington (1965) and Goetz and Peters (1999) namely autonomy, adaptability, complexity, coherence, congruence and exclusivity, may help in measuring the degree of institutionalization, and hence in measuring institutions themselves. Following the concept of institutionalization, the creation of the appropriate structures and the network of mutually complementary organizations meeting all dimensions of institutionalization to support utilization of research for elite sport policy within the country context is of the utmost importance. Unless the network of stakeholders/interest groups is represented by the organizations that will be able

to adopt and implement their own decisions in the field of utilization of research for elite sport to generate sufficient budget for their activities even in a changing environment and at the same time they will not create unhealthy competition, it will be not possible, in our opinion, in the Czech Republic to promote long-term and sustainable strategies of utilization of research for elite sport and to ensure their implementation.

Utilization of knowledge transfer theories for closing the gap between universities and practitioners in elite sport

As our analysis shows, it is obvious that Czech universities currently lack the appropriate forms of cooperation with elite sport practice and innovation transfer into elite sport. Therefore, we suggest implementing the measures proposed by Nová (2011).

Practical implication of the paper

This paper represents the first attempt to analyse the structural factors for the dissemination of research applicable in elite sport and the extent to which these research results serve as the scientific input to elite sport in the Czech Republic. On the basis of sound methodology and research findings, the author has proposed concrete measures using well-known theories, namely institutionalization and knowledge transfer. Implementation of the proposed measures can pave the way for improvement in the state of the art in the utilization of research for elite sport in the Czech Republic.

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Differences between Students of two Different Study Programs in Assessment of Water Sports Teaching Standard

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A B S T R A C T

The aim of the research was to determine if there was a difference in assessment of pedagogical-material standard in Water sports teaching between students of the Old study program in the period from year 2001 to year 2007 and students of the New (Bologna) study program in the period from year 2010 to 2015. The research was conducted on 2400 students, of which 1797 student entered the sample. Students have assessed 12 variables on a five-grade Lickert type scale through anonymous questionnaire. Variables of assessment were traveling, accommodation, food, teachers, assistants, vessels, climate and curricula for sailing, windsurfing, rowing and kayaking. The results of the arithmetic means for each variable were more positive for students in the new study program. Total arithmetic mean for the Old study program was 4.15, and for the New study program it was 4.46. Based on the results acquired it is determined that there is a difference in assessment between the students of the Old study program and the students of the New study program.

Key words: *students, sailing, windsurfing, rowing, kayaking, teaching*

Introduction

Water sports is one of the regular subjects on the Faculty of Kinesiology of the University of Zagreb. Curriculum is realized through theoretical, theoretical-practical and practical teaching. The aim of the subject is to convey to students basic theoretical and practical knowledge on structure of movement, methods of teaching, learning and training and also application value of Rowing, Kayaking, Sailing and Windsurfing in the fields of education and recreation.

Due to small number of teaching hours (60 hours) teachers and assistants are trying to amend the evident deficiency of lessons for as much as four mentioned Olympic sports through organization of the subject. The subject has been held in its today's form since 1999, and great efforts are invested to increase the quality of realization of teaching. According to Old study program curriculum (until2009) the subject was held at the end of 8th semester, being the last subject students were taught in undergraduate study for those generations. According to New study program (since 2008) Water sports teaching is held in 6th semester of integrated graduate study. The teaching is held so that in the beginning of the summer semester theoretical lectures are held and in the same time theoretical-practical lessons are conducted in rowing, first in the rowing gym and after on a rowing track on the lake(Jarun–Zagreb). At the beginning of June students go to the field teaching which is held in the aquatorium of Badija, situated between Korčula island and little island of Badija. Through seven-day field lessons, students were acquiring knowledge in sailing, windsurfing and kayaking.

Organization of the field teaching consists of transportation to the site of training, accommodation, food, material-technical conditions and professional staff to carry out the teaching process. With the aim of increasing the quality of the teaching, from the year 2001 anonymous questionnaire was conducted among students. Based on its results it is attempted to increase the quality of organization of Water sports teaching. Monitoring of attitudes of students until today shows high satisfaction with the teaching realized (Oreb, Barešić, Oreb, Prlenda, & Kostanić 2009). Using the questionnaires other authors too are discovering possible deficiencies, differences between groups in the teaching process, and on that basis they are willing to improve their own teaching (Cigrovski, Radman, Matković, Gurmmet, & Podnar, 2014; Duplančić, Mladineo, & Drašinac, 2008; A. Redžić & M. Redžić, 2003).

The aim of the research is to determine possible differences between students of the Old study program in the period from the year 2001 to the year 2007, and the students of the New study program (Bologna program) in the period from the year 2010 to 2015 in the assessment of the pedagogical-material standard of the Water sports teaching.

Methods

Subjects

Population of the examinees in the period from the 2001 to 2015 consisted of 2400 regular male and female students of Kinesiology faculty of the University of Zagreb. 770 of those examinees were students of Old study program until year 2007, and 1027 of them were students of New (Bologna) study program from 2010 to 2015. Because of the overlapping of the generations in 2008 and 2009, 603 examinees were not included into analysis, so the total number of examinees taken into analysis was 1797, consisting of men and women in the age of 21 to 25.

Variables

At the end of the teaching process, examinees filled out an anonymous questionnaire constructed with the aim of assessment of pedagogical–material standard of the practical teaching of Water sports. The questionnaire consisted of 12 variables

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which were graded by students using grades from 1 to 5, where 1 meant very bad, 2-bad, 3-good, 4-very good, and 5-excellent. Variables consisted of questions for assessment of traveling arrangements, accommodation, food, teachers, assistants, vessels, curriculum, sailing, windsurfing, rowing, kayaking and climate.

Procedures

Water sports as a subject integrates curricula for sailing, windsurfing, rowing and kayaking. The field teaching lasts for total 8 days including traveling, of which there is 7 days of practical teaching, and on the last day there is also a practical exam. In one week, teaching is conducted for maximum 45 students divided into 3 teaching groups of 15 students each. Basic programs in sailing, windsurfing, and rowing (kayak–canoe) are realized through 2 school lessons a day for every individual activity, on a principle of stations. In every teaching group demonstrators, teachers and the subject teacher are demonstrating and teaching basic elements of technique for the aforementioned sports.

Sailing lessons were conducted on ballast keel sailboats for four person. A teacher was present on every sailboat. Windsurfing was conducted under direct guidance of teachers and demonstrators. Ashore teaching was conducted using simulators, while on the sea multipurpose stabile boards were used with suitable sails. For rowing (kayak–canoe) stable tourist „sit-on-top" type kayaks were used. The lessons were carried out from 8:30 to 13:00 hours, and after students had arranged lunch in a hotel. Afternoon hours were reserved for training of acquired elements of the technique for individual sport. The test was conducted on the seventh day, after morning lessons were completed and after lunch break.

Statistical analysis

Using Excel 2013 program, arithmetical means were calculated for all the examinees by year and by every variable specifically. On the basis of acquired arithmetical means the difference in assessment between students of the New study program and the Old study program was determined, both in total and for every variable specifically.

Results

To determine the differences between examinees, students of the Old study program, and examinees, students of a New study program (Bologna program) results of the arithmetical means were compared for every answer (Table 1) and results of arithmetical means by single variable (Table 2).

Table 1. Arithmetic means for old and new study program

Study program	Year	AM	Total am for period
Old	2001	3.52	4.15
	2002	/	
	2003	4.08	
	2004	4.28	
	2005	4.43	
	2006	4.38	
	2007	4.20	
(Bologne) New	2010	4.46	4.46
	2011	4.36	
	2012	4.49	
	2013	4.55	
	2014	4.54	
	2015	4.33	

Note: AM-arithmetic mean

It is visible from the table that all the results are more positive for students in the new study program. The greatest change is visible in variables *Kayak* (1.34), *Windsurfing* (0.9), *Sailing* (0.87) and *Traveling* (0.84). The smallest change is present in variable *Accommodation* (0.11) and *Climate* (0.12). The highest grade by examinees of the old study program was assigned to variables *Climate* (4.62), *Assistants* (4.48) and *Food* (4.40), while the examinees of the new study program assigned the highest grades to the variables *Sailing* (4.79), *Windsurfing* (4.78), *Food* (4.78) and *Climate* (4.74). The lowest grades were assigned to the variables *Kayak, Traveling* and *Rowing* by all the examinees.

Table 2. Results of the arithmetical means of variables and their differences

Variable	AM Old	AM New	Difference
Traveling	2.79	3.63	0.84
Accommodation	4.04	4.15	0.11
Food	4.40	4.78	0.38
Teachers	4.34	4.68	0.34
Assistants	4.48	4.69	0.21
Vessels	4.27	4.73	0.46
Curriculum	4.20	4.61	0.41
Sailing	3.92	4.79	0.87
Windsurfing	3.88	4.78	0.90
Rowing	3.22	4.05	0.83
Kayak	2.52	3.86	1.34
Climate	4.62	4.74	0.12

The results in Table 1 show arithmetic means acquired on the basis of 12 variables for each generation in the period from 2001 to year 2015. Total average grades are in the scope from 3.52 to 4.55. Maximum grade was recorded in 2013 (4.55), and minimum in year 2001 (3.52). In the period from year 2001 to 2007 total arithmetic mean was 4.15, and from 2010 to 2015 it was 4.46.

Discussion

By inspecting the results in the Table 1 it is visible that total arithmetic mean for Old study program was 4.15, and for the New study program 4.46. The difference of 0.31 is in favor of the New study program. The reason for such a result can be found in the increasing of the quality of teaching, and also in the more mature approach of the students of the New study program. More mature approach of the students of the New study program can be the result of positioning of the subject in the middle of the study, as opposed to the Old study program where Water sports were the last subject before the end of study. Based on those results, it is possible to conclude that positioning of individual subjects in the course of study affects the total assessment of quality of conducted lessons. Besides, it is important to mention that teaching process affects the attitude towards individual sport (Vlašić, Oreb, & Katović, 2012; Cigrovski et al., 2014). Since in the aforementioned research questionnaire was conducted at the end of teaching process, great influence was surely made by the teaching staff too. The importance of choosing quality teaching staff is great, especially if we know that attitude is permanent evaluation of people, objects and ideas (Aranson, Wilson, & Akart, 2005) and that once formed, such attitudes are very hard to change, as long as there is a functional and motivational basis on which the attitude is formed. When the results shown by variables are assessed (Table 2) it is evident that all the results are also in favor of the New study program. The greatest change is visible in the variables *Kayak* (1.34), *Windsurfing* (0.9), *Sailing* (0.87) and *Traveling* (0.84). It is assumed that the great increase in the variable *Traveling* is influenced by building the Zagreb–Ploče highway. Mentioned section of the highway opened in 2013, while shorter section to Vrgorac opened in 2010. Specified section greatly accelerated traveling on a relation Zagreb–Korčula, affecting certainly the satisfaction level in examinees. It can be assumed also that in variables *Kayak, Windsurfing* and *Sailing* by developing of methodic approach in teaching (Prlenda, Oreb, & Cigrovski, 2011; Prlenda, 2012.) as by investing in the more modern equipment, learning of mentioned sports was facilitated. In the end it is expected that all those things combined affected the formation of a more positive attitude towards those sports. The least, but still visible increase was in assessment of the variable *Accommodation* (0.11) and *Climate* (0.12). Considering that those two variables have not changed, shows that improvement in individual factors resulted in increase of total satisfaction rate in examinees, although it was very high also in the students of the Old study program.

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Historical Development of the Olympic Movement

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A B S T R A C T

The Olympic Movement is a term that covers all areas related to the phenomenon of Olympism. From its creation, the Olympic Movement has had to follow and to respond to numerous challenges and changes of the 20th and 21st century. The successful work of the International Olympic Committee (IOC) on the implementation of their projects related to world peace, the education of youth, equal inclusion of women in every aspect of the Movement, the establishment of the Women's Commission, the Sport for All Commission, and the Sports and the Environment Commission are facts indicating that the IOC has a significant impact on the values of the Olympic Movement. In addition to equal participation of all athletes, today, the Olympic Movement provides Olympic solidarity, education and other programs. The basic method that was used in this study was the historical method, which includes heuristic, empirical and theoretical study of the origin and development of the IOC and its operation as part of the Olympic Movement. Research results indicate that the management of the IOCas a sporting organization that manages this Movement is directed at achieving the goal to contribute to building a more peaceful and better world by educating young people through sports, and in accordance with the Olympic values. With proper management, the IOChas improved sports and has grown into an organization that is at the head of the Olympic Movement.

Key words: *history, the Olympic movement, management*

Introduction

Modern Olympic Games and Olympism as a movement of global proportions have kept the basic principles of the ancient Olympic Games. However, modern times with all the technology (training, pharmacological, communication technology, etc.) in addition to solving the existing problems brings some new ones as well. The basic Olympic principles are forgotten in a rush to the new records, where the means to achieve them are not important, which certainly leads to the dehumanization of sports.

The International Olympic Committee (IOC) encourages the development of sports. It cooperates with other sports organizations in order to bring sports at the service of humanity. They realize the Olympic principles through a large number of committees and projects, which are in accordance with the Olympic Charter (IOC, 2016). Under the supreme authority and leadership of the IOC, the Olympic Movement encompasses organizations, athletes and other persons that agree to act in accordance with the Olympic Charter. The goal of the Olympic Movement is to contribute to building a more peaceful and better world by educating young people through sports, and in accordance with the Olympic values (IOC, 2016).

The International Sports Federations (ISFs) and the National Olympic Committees (NOCs) are included in the movement through membership in the IOC. In addition to the above, the Olympic Movement also includes the following: the Organizational Committees of the Olympic Games, national associations, clubs and persons belonging to the ISFs and the NOCs, especially athletes whose interests are a fundamental element of the operation of the Olympic Movement; as well as referees, coaches and other sports officials and technicians. The Olympic Movement includes other organizations and institutions that are recognized by the IOC.Any individual or organization that belongs to the Olympic Movement in any capacity is obliged to behave in accordance with the Olympic Charter, and to abide by the decisions of the IOC (2016).

Methods

The basic method that was used in this study was the historical method, which includes heuristic, empirical and theoretical study of the origin and development of the International Olympic Committee and its operation as part of the Olympic Movement.

The Olympic Movement

At the celebration of the 5th anniversary of the establishment of the Union of French Societies of Athletic Sports, which was held in Paris at the Sorbonne in 1892, Baron Pierre de Coubertin, as Secretary General of this organization, managed to present a proposal on the need for internationalization of sports by organizing joint competitions with multiple sports branches under the name Olympic Games. The proposal was accepted and a three-member Commission composed of professor William Milligan Sloane from Princeton University, the United States, M. K. Herbert, president of the Amateur Athletic Association of England, and Pierre de Coubertin himself had the obligation and task to explain the justification for this proposal (Šiljak, 2007). At the next session of the Union of French Societies of Athletic Sports, which was held in 1893, the Commission's proposal was accepted, and it was decided to convene the next International Sports Congress the following year, where a decision on the renewal of the Olympic Games would be made (Šiljak, 2007). It can be said that in 1894, Baron Pierre

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de Coubertin successfully justified the importance of renewing the Olympic Games for the whole world.

Renewal of the Olympic Games in 1894 at the founding congress of the IOC may be considered the starting point for the formation of the Olympic Movement as it is today. From its creation, the Olympic Movement has had to follow and respond to numerous global challenges and changes of the 20th and 21st century, to adapt and change with them, so that the Olympic Games could be more successful in all their aspects (Skembler, 2007; Škaro, 2012).

The development of the Olympic Movement must be observed through several aspects. The question is what factors have influenced the development of the Olympic Movement to reach the dimensions that it has today?

From its creation in 1894 until 1915, the headquarters of the IOC were in Paris. As Switzerland has always aspired to neutrality in political terms, in the midst of the First World War, relocating the headquarters of the IOC from war-affected Paris to a country that has never been at war was a logical decision. Had the headquarters of the IOC remained in Paris it is likely the Olympic Movement would have had a different development path. Pierre de Coubertin himself initiated the relocation of the IOC to Lausanne because he thought that in Lausanne there were better conditions for faster development of the Olympic Movement (De Coubertin, 2000).

The First Olympic Charter, an official document that governs the operation of the International Olympic Committee and its members was created in 1908. Since then it has been amended and adapted for a total of 68 times. Aims and objectives of the Olympic Movement are explained in detail in the Olympic Charter, which was established and adopted in Lausanne in 1921. The Charter speaks of the fundamental principles and values of Olympism, determines the rights and obligations of both the IOC and the NOCs, national federations and organizations that have a role of organizing the Olympic Games, and represents the statute of the IOC. The last Olympic Charter was published in 2016. The first seven Olympic Charters were issued only in French, while all others have been published in English and French. This document has been issued twice in the same calendar year as many as nine times. These facts indicate that the IOC, following the need for a clear definition and determination of certain rules, was forced to respond in a timely manner to preserve the fundamental principles of Olympism. By analyzing these documents, we can see that the IOC recognizes the term Olympic Movement and incorporates it in the Olympic Charter for the first time as late as 1991.

At the beginning, the Olympic Movement had a very rigid stance on the participation of athletes, and the inclusion of new members in the IOC. The number of 14 Member States from the founding 1894 Congress doubled by the Stockholm Games in 1912. It was in 1968 in Mexico that there were more than 100 participating countries (112) and in Athens in 2004 over 200 countries (201) took part in the Games for the first time (https://www.olympic.org/national-olympic-committees). This number indicates the pace of inclusion of the countries as the IOC members.

The period from the late 19th century, when the IOC/Olympic Movement first emerged until the World War I can certainly be called the pioneering period of Olympism. A period when not all of the countries of the world were interested in supporting and developing the Olympic idea, when the Games were held after 5-6 months as part of the World exhibitions, when the financial aspect brought the survival of the Olympic Games into question is very important because the Games survived thanks to the persistence of enthusiasts. For this reason, the activity of spreading the Olympic idea in every country which was admitted as a member of the IOC in this period is important.

Today, the Olympic Charter guarantees equality for women (IOC, 2016). However, historical facts point to their almost century-long persistence in the equal involvement in all aspects of the Olympic Movement. Not one woman took part in the First Olympic Games in Athens. It is well known that Pierre de Coubertin was an opponent of their involvement in the competitions at the Olympic Games, both because they did not take part in the ancient Olympic Games and because he believed that they were not physically fit for the stress of training and competing (Parčina, Šiljak, Perović & Plakona, 2014). Although sports historians have the knowledge on organizing the women's Olympic Games, the name Alice Milliat is still not well known to the general public and neither is the importance of her work for the inclusion of women in the Olympic Movement.

The role of Alice Milliat in the more equal acceptance of women in the track and field competitions at the Olympics in the early 20th century is undeniable. By organizing the Women's World (Olympic) Games and establishing the Federation, Milliat managed to overcome the resistance of Pierre de Coubertin and allow women to participate equally in the Olympic Games, as well as for the IAAF to take women's track and field seriously. Thanks to the effort of Alice Milliat and her collaborators, the IOC was forced to include women in the track and field competitions at the Olympic Games.

Discussion

The challenges of global socio-political developments in the first half of the 20th century, and the tumultuous political changes that occurred primarily because of the First World War followed by the Second World War, caused a major upheaval and changes in the organization of the Olympic Games. They were not even held in 1916, 1940 and 1944, which stopped the development of the Olympic Movement in the entire world. This was clearly followed up by economic and political changes in the entire world, as a side effect of those wars, that halted economic development of many countries with their destruction. But in spite of everything, new challenges permanently appeared before the organizers of the Olympic Games.

Due to high demand and following by a large number of spectators, sports competitions have always been a possibility for various affirmation of individuals, teams, nations as well as for the expression of political or national protests by political groups and individuals. That entry and interference of politics with sports or the struggle for political ends at the very Olympics has caused a lot of damage to the development of the Olympic Movement, and has repeatedly threatened to significantly disrupt relations in the international Olympic Movement or even terminate the organization of the Olympic Games. That is what happened in Berlin in 1936, in Melbourne in 1956, in Mexico City in 1968, in Munich in 1972, in Montreal in 1976, in Moscow in 1980, in Los Angeles in 1984, in Seoul in 1988, and in Barcelona in 1992.

For these reasons, the IOC was forced to seek appropriate forms of operation and management during the Olympic Games in order to eliminate problems caused by these challenges and changes of modern times. In this sense, it formed the appropriate working groups that looked at and fought with the above problems.

Decolonization and poverty of former colonial countries led to the formation of the Solidarity Fund in 1961, which had the task of financing the sports development and other financial assistance programs, and reducing differences between developed and developing countries as soon as possible, in particular the former colonial countries of Africa and Asia. As part of its program and tasks in the development of culture as a supporting factor of the Olympic Movement, the IOC established a Culture Commission in 1968. Unregulated legal issues in sports in general, and especially abuse of athletes and their rights caused the formation of the Legal Committee in 1972. The increased problems in the use of doping that threatened the health of athletes and often ended fatally in sports arenas led to the establishment of the Medical Commission in 1974. The right of every person to play sports is one of the basic ideas of Baron Pierre de Coubertin, and the modern Olympism in general, and it called for the establishment of a special body called the Sport for All Commission in 1983.

A special organizational problem throughout the entire period of modern Olympism has been the emergence of new sports and continuous development of the existing ones, which are quickly divided into specific sports events. In recent years, this has led to large organizational problems and in general problems with planning and management of increasing needs and changes, which today represents a special challenge for the IOC and the host organizers of the Olympic Games. It has a special dimension when it comes to the preparation of facilities, equipment and props for an increasing number of competitive events, and on the other hand a growing number of athletes, referees, officials and organizers.

Sports are inherently characterized by competition to achieve better results, especially beating the existing records to achieve one's own sports targets while earning the appropriate recognition and fame. However, national interests for the affirmation of their countries and political systems at the time of the sharp opposition between East and West (socialist and capitalist countries) have given a new dimension in the "race for the records". Further development of professionalism, which opposed amateurism as a basic Olympic principle, despite the long struggle of the Olympic Movement with it, followed by large cash compensations and rewards, suppress basic sports and Olympic principles, condition unscrupulous sports fights and bring a new principle of winning at all cost. Winning becomes imperative for every individual and team, whereby deviating from the basic principles of the Olympic Movement and ignoring the respect for the rules, fair play, referees, opponents, and fans.

The commercialization of sports and thus the Olympic Games, advertising of large companies, and their sponsorship in terms of huge monetary compensation introduce a new aspect of winning for the company that pays, advertises or sponsors an individual or a team. This moves the participants even further away from the basic Olympic principles, which creates increasing problems to the IOC in the organization and management of not only the Olympic Games, but the Olympic Movement as a whole.

Sports haven't been a game for a long time, but are rather an economic activity dominated by profit corporations. The Olympic Games as the biggest global spectacle have become one of the best sports market products. They have their own marketing strategy, the popularity of athletes and teams, and help from the mass media, primarily television. The largest companies in the world are competing to sponsor the IOC and the organizers of the Olympic Games so that they could use this event to identify with the best athletes of the world and offer their advertising to the market. For the money that sponsors give they receive a lot of publicity because the athletes and the venues are their billboards. In this way, the image of the company and athlete grows together.

Today, the Olympic Movement definitely involves the economic aspect that borders on business. A maecenas of the first few Olympic Games, Pierre de Coubertin, who spent all his wealth on the Olympic Movement in order to help it survive, was after all the only one in the world.

As a side effect of the effort to defeat someone better than oneself, violence is created at sporting events and venues as compensation for helplessness, and also a means to achieve victory no matter how. Violence spreads to the stands and to the city streets before, during, and after the competition, and this has become a serious social phenomenon, which forces the organizers of the Olympic Games to spend huge sums of money for the safety and security of this sporting event.

An increasing departure from the basic Olympic principles and insufficient knowledge of the essence and meaning of Olympism in general led the IOC to establish a special Olympic Education Commission in 1994, which in collaboration with the NOCs established a National Olympic Academy responsible for the implementation of the Olympic education program. Further, the main bearer of the entire program is the International Olympic Academy from Olympia, founded in Olympia in 1960.

The second half of the 20th century saw significant problems in terms of environmental pollution. As healthy environment and preservation of natural conditions are of particular interest for sports, the IOC established a special commission called the Sports and Environment Commission in 1994.

Despite the fact that women have won equal rights in terms of participation in sports, it has, however, been noted that they are not being enforced equally in all parts of the world, that is, in certain countries. Therefore, a Commission under the name of Women in Sport was established in 1995.

The moral principles in sports are fundamental principles of both the ancient and the modern Olympism. But as new times brought on new challenges, especially in the field of winning, which often turn into a motto "win at all cost", with the fundamental ethical principles being violated, the IOC formed an Ethics Commission in 1999.

The successful work of the IOC on the implementation of their projects related to world peace, the education of youth, equal inclusion of women in every aspect of the Movement, the establishment of the Women's Commission, the Sports for All Commission, and the Sports and the Environment Commission are facts indicating that the IOC has a significant impact on the values of the Olympic Movement (Arnold, 1996; Defrantz, 1997; Šiljak, 2013).

Conclusion

Since its creation, the Olympic Movement has contributed much to the development and preservation of the Olympic spirit. The obtained research results have confirmed that a number of developments over the past century have caused significant changes in its structure and management system. Some of them have shaken the foundations of Olympism and required the operation of the IOC in order to preserve the basic Olympic principles and ideals. However, the human factor as the cause of all events is the same as three millennia ago. The disputed referee decisions, the use of doping substances in order to win at all cost, amateurism that has grown into professionalism, political boycotts, terrorism, and commercialization are present at

today's Olympic Games. The study of the historical development of the Olympic Movement has determined that negative situations which the IOC has encountered produced its positive reaction in order to preserve the Olympic spirit of the Games. Thus, very strict security measures are being implemented during the organization of the Games, incluing a large number of volunteers that help out, andthe founding of the Olympic Movement for peace in the tradition of ancient ekeheria, the Solidarity Fund to help athletes, cooperation with the Anti-Doping Agency, and so on.

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Differences in Some Motor Abilities of Girls Engaged and those that are not Engaged with Aesthetic Activities

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A B S T R A C T

Study aim was to analyze the difference in motor abilities for assessing coordination in rhythm and frequency of movement, between those girls whose only physical activity is clasess of physical and health education at school and those which are for two or more years involved with aesthetic activities, ie. sports such as dances, rhythmic gymnastics and majorette dance. The participants in this research were 62 girls, from 8-10 years of age, out of which 31 girls engaged with aesthetic activities and 31 of them are girls who are not involved in any sports except regular classes of physical and health education. Using Independent Samples T-Test we see that the examinees differ on a statistically significant level in most variables for assessment coordination in rhythm and frequency of movement, and that all values in used variables for girls engaged with aesthetic activities are higher than the values in girls who are not engaged in aesthetic activities, for which it can be said that the results are in favor of girls engaged in aesthetic activities.

Key words: *dances, rhythmic gymnastics, majorette dance, coordination in rhythm, frequency of movement*

Introduction

The main objective of physical and health education is to meet the basic human and biological needs for locomotion, but also to raise human capabilities and skills to the level that will enable easier socialization in the society and solving life tasks. According to the majority experts in the field of kinesiology, two hours of physical and health education in primary and secondary schools is not even close to enough. Despite the great possibilities of choice of sports, quality of trainers and training, children are relatively little join the activities of sports clubs. Sports, aesthetic activities (dance, rhythmic gymnastics and majorette dance) that were taken in this study, are partly as a mandatory part of physical and health education in schools, about which write a lot of research (Miletić, 1999; A. Nožinović & Z. Nožinović, 2005). Research of Vajngerl and Wolf-Cvitak, (2000) which is based on determining the structure of motivation of girls and their sports with a prominent aesthetic component, shows that the highest values have motives such as the harmony of movements that are associated with the enjoyment of music, achieving of physical fitness and expressiveness of movement inspired by music, and socializing. It is particularly significant application of dance structures as kinesiology operators in the transformation and retention of anthropological status of children and adolescents, about which a lot of research was writing (Miletić, Katić, & Srhoj, 1998; Miletić, 1999; Srhoj & Miletić, 2000; Mutavdžić, Nejić, Ranželović, & Nožinović, 2008).

The development o f the children at a younger age of primary school are characterized by a relatively slow development, so they faster and easier solve motor tasks. Children at this age need to provide daily physical exercise, because it is a developmental period when the changes and the ability to be the most affected (Findak, 1999.). Application of operators of rhythmic gymnastics and dance in school practice is especially desirable (Wolf-Cvitak, 1984, 1995; Miletić, 1999.). From studies of motor skills in school practice we emphasize researches of Gredelj, Metikoš, Hošek and Momirović, (1975); Mraković and Katić, (1992); Katić, Zagorac, Živičnjak and Hraski, (1994); Katić, (1996); Mutavdžić, (1996); Popović, (1998); Srhoj and Miletić, (2001); Jelavić Mitrović, Miletić and Dundić, (2006).

The use of motor stimulation only within the regular classes of physical and health education in most cases is not enough to cause significant improvements of anthropological characteristics, so it is necessary to encourage children to become involved in additional sports activities according to their preferences outside of regular classes. Indicators, as well as evidence for these claims are in research of authors Breslauer, Marši and Mesarić, (2004).

The aim of this research is to determine the difference in motor abilities for assessing coordination in rhythm and frequency of movement, between those girls whose only physical activity is clasess of physical and health education at school and those which are for two or more years involved with aesthetic activities, ie. sports such as dances, rhythmic gymnastics and majorette dance.

Methods

Participants

The sample consisted of 62 girls, out of which 31 girls engaged with aesthetic activities (dance, rhythmic gymnastics and majorette dance) that we named AA group, and 31 of them are girls who are not involved in any sports except regular classes of physical and health education two times a week, for 45 min-

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utes that we named NA group. All the girls in this sample are from about the same age, from 8-10 years of age.

Variables

For the assessment of some motor abilities (Srhoj & Miletić, 2001; Miletic, Mladineo, & Božanić, 2006), were taken variables of coordination in rhythm: MKRBUB - arhythmic drumming, MKRBNR – drumming with legs and hands, MKRPLH – drumming at the horizontal panels, MKPOUR – bounces in rhythm, MKTOSP – coordination with bat; and variables of frequency of movement: MBFTAR – hand tapping, MBFTAN – foot tapping, MBFTNZ – foot tapping on the wall, MBFPZ – bend - twist – touch, MBFKRR – hand circling.

Procedure

In preparation for the implementation of the research was made an agreement with the coaches, directors and teachers of schools, where they were all familiar with the project and measuring instruments to be used, and on the basis of the agreement we get consent for the realization of research in clubs and schools. In each of the schools and clubs testing is performed according to the same protocol, which enable equable approach to all examinees. The main objective of the guidelines was to introduce participants to the issue of testing. All participants were informed of the procedures and potential risks, and gave their written consent to participate in testing.

Data analysis

Data obtained in this study were analyzed using a software system for data. In order to determine whether there are differences between the groups, based on involvement in aesthetic activities, we used Independent Samples T-Test.

Results

Table 1 shows the results of Independent Samples T-Test for arithmetic means (M), standard deviations (SD) and the level of significance of differences (p), for all variables, in particular for the group NA, and in particular for a group of AA.

Table 1. The Results of Independent Samples T-Test

Group Statistics	GROUP	N	M	SD	p
MKRBUB	NA	31	5.68	1.620	.000**
	AA	31	8.13	2.754	
MKRPLH	NA	31	4.00	2.875	.000**
	AA	31	11.77	4.047	
MKRBNR	NA	31	5.77	2.376	.001**
	AA	31	7.48	1.546	
MKPOUR	NA	31	5.39	2.092	.000**
	AA	31	17.10	4.182	
MKTOSP	NA	31	20.4194	10.95151	.000**
	AA	31	7.7839	2.64362	
MBFTAP	NA	31	16.29	2.506	.000**
	AA	31	20.74	2.944	
MBFTAN	NA	31	25.94	3.949	.000**
	AA	31	33.74	4.782	
MBFTAZ	NA	31	12.87	2.540	.000**
	AA	31	15.74	3.011	
MBFPZ	NA	31	10.13	2.187	.828
	AA	31	10.26	2.449	
MBFKRR	NA	31	18.97	3.799	.269
	AA	31	20.10	4.158	

Legend: GROUP AA- girls engaged with aesthetic activities; GROUP NA- girls who are not involved in any sports; N-number of examinees for each group; M–arithmetic mean; SD–standard deviation; p-level of statistical significance **p<.01

Results show that the average values of the used variables in the group NA are statistically significantly different from the average values obtained in the group AA, except for variables MBFPZ – bend - twist – touch, (p=.828) i MBFKRR – hand circling (p=.269). The value of the arithmetic mean shown in the variables MKTOSP – coordination with bat, point to the lower scores for subjects AA group, while in the other variables, in which the average values of arithmetic means are statistically significantly different between the groups, can be seen that in these variables all values, in girls engaged with aesthetic activities, are higher than the values in girls who are not engaged in aesthetic activities, for which it can be said that the results are in favor of girls engaged in aesthetic activities.

Discussion

According to previous research, the authors Jelavić Mitrović, Miletić and Dundić (2006) have obtained similar results with girls where they determined connections with the variables for assessing coordination in rhythm with the dance steps, on the statistically significant level (p=.000), while authors Delija, Jelenić and Breslauer (2005) state in their research statistically significant differences between groups in the motor tests of explosive leg strength, coordination and static strength and functional test of endurance with girls who were involved in various extra-curricular activities, which also speaks in favor of our research and that different kinesiology treatments produce quite significant differences between groups of examinees. Authors Metikoš and Hošek (1972) (according to Miletić, Mladineo, & Božanić, 2006) defined the dimension of coordination in rhythm as the ability to perform set of movements in default or arbitrary rhythm while later research Hošek, Horga, Viskić, Metikoš, Gredelj and Mrčelja (1973) (according to Miletić, Mladineo, & Božanić 2006.) confirm the reliability and validity of tests for assessing factors for coordination in rhythm. Also research of Gajić and Kalajdžić, (1986) confirms that the development of coordination and flexibility becomes more intense

in the younger elementary school children, which imposes a task that on aforementioned and similar motor skills must act with targeted exercises especially accompanied by the music. In determining the effects of the program of rhythmic gymnastics on coordination Dimitrijević (2002) in his research on a sample of primary school girls on the basis of the program for a period of eight weeks noticed that he was efficient in favor of the experimental group, while it cannot be said for the control group, that the time spent practicing on the standard school program of physical and health education.

In accordance to obtained results we can say that girls engaged in aesthetic activities have significantly better developed coordination skills as well as the speed of frequency of movement which enables them to easily and quickly overcome everyday motion activities as well as regular and healthy growth and development. Results also in another way remind teachers of physical education and educators on opportunities that provide aesthetic activities (dance, rhythmic gymnastics and majorette dance), as well as the reasons for which should be represented in the education of the children. The dances are a form of modern recreation to be more applied, support the development of motor skills, fine coordination, develop agility, attention, memory, sharpen the sense of hearing, sense of rhythm, a sense of orientation in space, and balance. A person who applies dances already gotten used to regular work, develops the will, self-confidence, perseverance in working, versatile aesthetic raising, developing friendship. For this and similar reasons precisely this paper, as well as similar papers related to the aesthetic activity to indicate that the next transformation, the ability of such activities significantly affect the consolidation of health and the formation of a number of social values, a sense of freedom, the development of artistic experience, possess a variety of educational value in the formation of habits and new motor stereotypes and so ultimately enrich the human (Ladešić & Mrgan, 2007). Application of dances and of rhythmic gymnastics in the curricula of schools, given that the program of rhythmic gymnastics and dance can be implemented at every stage of instruction, must be at a higher professional level, and above all accurate.

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Effect of an 8-week Judo Course on Muscular Endurance, Trunk Flexibility, and Explosive Strength of Male University Students

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A B S T R A C T

Judo is a worldwide sport played as a main competition in the Olympic Games and World Judo Championship with different age categories present for each competition. The level of physical fitness, tactical skills, and techniques required in judo is high as it is a high-intensity short exercise done in a periodic manner. There are very few studies that find the effects of judo exercises on judo non-athletes. The purpose of the research was to determine the impact of an 8-week judo course on the muscular endurance, trunk flexibility, and explosive strength of male university students. Twenty students had complete data after the course. Pre and post measurements were obtained for standing long jump, sit-ups, and sit and reach to assess explosive strength, abdominal muscle endurance, and flexibility, respectively. The data were tested for normality using the Shapiro-Wilk Test. Pre and post data which were normal were compared with paired t-test, while non-normal data were compared with the Wilcoxon Signed Rank Test. Statistical significance was set at $p<0.05$, while Cohen $d>0.2$ was considered of practical significance. There were significant improvements from pre to post in all measured parameters ($p<0.05$, Cohen $d>0.2$). The increase in values of standing long jump, sit-ups, and sit and reach at end of the course is evidence that the explosive strength, muscular endurance, and trunk flexibility of the students improved, respectively. Thus, there is evidence that the course improved some aspects of their health-related fitness even though they were not judo athletes.

Key words: *judo, university students, health-related fitness, physical education*

Introduction

Judo is a worldwide sport played as a main competition in the Olympic Games and World Judo Championship, with different age categories present for each competition (Franchini, Del Vecchio, Matsushigue, & Artioli, 2011). The level of physical fitness, tactical skills, and techniques required in judo is high (Franchini, Takito, Kiss, & Strerkowicz, 2005) as it is a high-intensity short exercise done in a periodic manner (Degoutte, Jouanel, & Filaire, 2003). A typical judo match lasts for 3–4 minutes. The classifications in each competition represent the differences in tactical and physiological aspects (Franchini et al., 2011).

Given an increasing prevalence of obesity due to rising physical inactivity (World Health Organization, 2016), offering a physical education (PE) course to students in their early university years is a useful contribution to increasing their physical activity levels. Physical activity has been shown to have positive benefits, like preventing obesity, diabetes, and cancer (Warburton, Nicol, & Bredin, 2006). Moderate intensity physical activity done for at least 30 minutes is recommended for people who are healthy, or do not have any disease related to physical activity if they are between 18–65 years old (Haskell et al., 2007).

Very few studies that find the effects of judo exercises on non-athletes have been found. But it has been reported that martial arts programs do have positive fitness benefits for those who practice them (Winkle & Ozmun, 2003). The purpose of the study was to determine the impact of an 8-week judo course on the muscular endurance, trunk flexibility, and explosive strength of male university students.

Methods

Participants and assessment

The participants were all college-level students who registered for the judo class offered by the University. None of them were PE majors. Pre and post measurements were obtained for standing long jump, sit-ups, and sit and reach to assess explosive strength, abdominal muscle endurance, and flexibility, respectively.

Ethics

The study was conducted in accordance with the Declaration of Helsinki. This study was approved in advance by the Ethical Committee of the Physical Education Department of KFUPM. Each participant voluntarily provided a written informed consent before participating. The privacy of the students was guaranteed.

Judo course

The course was done twice a week for eight weeks. Each session was 50 minutes and had different training drills. Fitness training was achieved by asking the students to do 50 push-ups and 100 sit-ups. Stretching exercises and rolling/falling technique was done for 10 minutes to train for flexibility. Judo technique steps were taught to train for agility. Three minutes

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free spar was used to train for strength and endurance, while cardiovascular training was done with five minutes running, jump rope, and jumping jack. Standing and ground judo techniques were taught to the students to train for agility, strength, endurance, and flexibility.

Data Analysis

The data were tested for normality using the Shapiro-Wilk Test. Normal pre and post data were compared using the paired t-test, while non-normal data were compared with the Wilcoxon Signed Rank Test. Alpha values were set at 0.05, and Cohen d>0.2 was considered of practical significance.

Results

Twenty students had complete data at the end of the course. All data were compared with the paired t-test. Table 1 shows the means of the pre and post data for the measured variables, and the results of the comparison between them. There were statistically significant improvements ($p<0.05$) in all parameters.

Table 1. Data of selected health-related fitness variables (N=20)

Test Exercise	Pre	Post	p value	95 % CI	Percentage Improvement	Cohen d
Standing Long Jump (cm)	168.1 (26.3)	183.15 (30.5)	0.002*	[6.3, 23.8]	9	0.81
Sit Ups (repetitions)	24 (6)	28 (4)	0.001*	[2, 7]	19.4	0.90
Sit and Reach (cm)	23 (8)	28 (7)	0.004*	[1, 7]	17.5	0.72

Note. All data in mean (standard deviation). CI=Confidence interval. *p<0.05

Discussion

The research aimed at determining the effect of a judo PE course after 8 weeks on the following health-related fitness parameters: explosive strength, muscular endurance, and flexibility. The improvements from pre to post in standing long jump, sit-ups, and sit and reach indicate that the explosive strength, muscular endurance, and trunk flexibility of the students improved, respectively. This showed evidence that the course positively influenced these health-related fitness parameters.

Demiral (2011) reported an improvement in explosive strength among 7–12-year-old children who participated in a 12 months judo program. Masleša, Videmšek and Karpljuk (2012) reported improvements in sit-ups, sit and reach, and standing long jump among intellectually disabled people after performing the program for eight weeks.

These improvements can be accounted for by the nature of the exercises done in the course. Performing standing and ground judo practices requires flexibility, strength, and endurance for execution. The continuous training of the students to enable them execute the judo techniques properly can explain the improvements in the measured parameters.

There are additional reasons for the observed improvements. A reason for muscular endurance improvements can be attributed to the 100 sit ups which were done during the sessions. The explosive strength improvements are also as a result of the 3 minutes sparring sessions. The 10 minutes stretching exercise per session, and teaching the rolling/falling technique contributed in improving the flexibility of the students. The students acquired more musculoskeletal fitness which will help them execute other activities (Warburton et al., 2006).

Because the course was for students, this study cannot be compared with elite players. More importantly, the aim of the PE judo course was to promote physical activity and improve the health of the university students; not to train them as athletes. Despite these improvements from pre to post, a limitation of the study is the absence of a control group.

The judo course improved the trunk flexibility, explosive strength, and muscle endurance of the students, which are needed for judo and for healthy living. Even though the participants are not judo athletes, the benefits they got from the course improved some aspects of their health-related fitness. These results provide evidence that judo is a good sport to be included in a PE program.

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- A structured abstract of less than 250 words;
- Maximum number of references is 100.

Editorials are written or commissioned by the editors, but suggestions for possible topics and authors are welcome. It could be peer reviewed by two reviewers who may be external or by the Editorial Board.

☐Open Submissions ☑Indexed ☑Peer Reviewed

Editorials should be:

- Up to 1000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 10.

Short reports of experimental work, new methods, or a preliminary report can be accepted as two page papers. Your manuscript should include the following sections: Introduction, Methods, Results, and Discussion.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Short reports should be:

- Up to 1500 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 15.

Peer review - fair review provides authors who feel their paper has been unfairly rejected (at any journal) the opportunity to share reviewer comments, explain their concerns, and have their paper reviewed for possible publication in SMJ.

☑Open Submissions ☑Indexed ☐Peer Reviewed

Peer review - fair review should be:

- Up to 1500 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 15.

Invited papers and award papers include invited papers from authors with outstanding scientific credentials. Nomination of invited authors is at the discretion of the SMJ editorial board. SMJ also publishes award papers selected by the scientific committee of the International Scientific Conference on Transformation Processes in Sport.

☐Open Submissions ☑Indexed ☐Peer Reviewed

Invited papers and award papers should be:

- Up to 3000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 30;
- Maximum combined total of 6 Tables/Figures.

1.3. Submission

SMJ only accepts electronic submission to the e-mail of the Journal Office: **sportmont@ac.me**.

Submitted material includes:

- A manuscript prepared according to the Guidelines for the Authors;
- A signed form that states the study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere, that states that all of the authors are in agreement with submission of the manuscript to SMJ, and that, for studies that use animal or human individuals, authors must include information regarding their institution's ethics committee, and which identifies the official approval number;
- A signed form that there is no conflict of interest.

Name the files according to the family name of the first author. Authors submitting revised versions of the manuscript can use the identification number of their manuscript as provided by the Journal Office. *See* example:

- ✓ FAMILY NAME-manuscript.doc – (main manuscript file)
- ✓ FAMILY NAME-statement.PDF – (authorship statement)
- ✓ FAMILY NAME-declaration.PDF – (declaration of potential conflict of interest)
- ✓ FAMILY NAME-fig1.tiff – (Figure 1)

1.4. Peer Review Process

A manuscript submitted for publication will be submitted to the review process as long as it fits the following criteria:

- The study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere;
- All persons listed as authors approved its submission to SMJ;
- Any person cited as a source of personal communication has approved the quote;
- The opinions expressed by the authors are their exclusive responsibility;
- The author signs a formal statement that the submitted manuscript complies with the directions and guidelines of SMJ.

The editors-in-chief and associate editors will make a preliminary analysis regarding the appropriateness, quality, originality and written style/grammar of the submitted manuscript. The editors reserve the right to request additional information, corrections, and guideline compliance before they submit the manuscript to the ad-hoc review process.

SMJ uses ad-hoc reviewers, who volunteer to analyze the merit of the study. Typically, one or two expert reviewers are consulted in a double-blind process. Authors are notified by e-mail when their submission has been accepted (or rejected). Minor changes in the text may be made at the discretion of the editors-in-chief and/or associate editors. Changes can include spelling and grammar in the chosen language, written style, journal citations, and reference guidelines. The author is notified of changes via email. The final version is available to the author for his or her approval before it is published.

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SMJ only publishes studies that have been approved by an institutional ethics committee (when a study involves humans or animals). Fail to provide such information prevent its publication. To ensure these requirements, it is essential that submission documentation is complete. If you have not completed this step yet, go to SMJ website and fill out the two required documents: Declaration of Potential Conflict of Interest and Authorship Statement. Whether or not your study uses humans or animals, these documents must be completed and signed by all authors and attached as supplementary files in the originally submitted manuscript.

1.6. After Acceptance

After the manuscript has been accepted, authors will receive a PDF version of the manuscripts for authorization, as it should look in printed version of SMJ. Authors should carefully check for omissions. Reporting errors after this point will not be possible and the Editorial Board will not be eligible for them.

Should there be any errors, authors should report them to the Office e-mail address **sportmont@ac.me**. If there are not any errors authors should also write a short e-mail stating that they agree with the received version.

1.7. Code of Conduct Ethics Committee of Publications

SMJ is hosting the Code of Conduct Ethics Committee of Publications of the **COPE** (the Committee on Publication Ethics), which provides a forum for publishers and Editors of scientific journals to discuss issues relating to the integrity of the work submitted to or published in their journals.

2. MANUSCRIPT STRUCTURE

2.1. Title Page

The first page of the manuscripts should be the title page, containing: title, type of publication, running head, authors, affiliations, corresponding author, and manuscript information. *See* example:

Talented High School Football Players' Perception of Talent Identification Criteria

Original Scientific Paper

Talent Identification Criteria

Vazjwar Matin[1] and Stig Arve Sæther[1]

[1]University of Science and Technology, Department of Sociology and Political Science, Trondheim, Norway

Corresponding author:

S. A. Sæther

Norwegian University of Science and Technology

Department of Sociology and Political Science

Dragvoll, 7491 Trondheim, Norway

E-mail: stigarve@ntnu.no

Word count: 2,946

Abstract word count: 236

Number of Tables: 3

Number of Figures: 0

2.1.1. Title

Title should be short and informative and the recommended length is no more than 20 words. The title should be in Title Case, written in uppercase and lowercase letters (initial uppercase for all words except articles, conjunctions, short prepositions no longer than four letters etc.) so that first letters of the words in the title are capitalized. Exceptions are words like: "and", "or", "between" etc. The word following a colon (:) or a hyphen (-) in the title is always capitalized.

2.1.2. Type of publication

Authors should suggest the type of their submission.

2.1.3. Running head

Short running title should not exceed 50 characters including spaces.

2.1.4. Authors

The form of an author's name is first name, middle initial(s), and last name. In one line list all authors with full names separated by a comma (and space). Avoid any abbreviations of academic or professional titles. If authors belong to

different institutions, following a family name of the author there should be a number in superscript designating affiliation.

2.1.5. Affiliations

Affiliation consists of the name of an institution, department, city, country/territory (in this order) to which the author(s) belong and to which the presented / submitted work should be attributed. List all affiliations (each in a separate line) in the order corresponding to the list of authors. Affiliations must be written in English, so carefully check the official English translation of the names of institutions and departments.

Only if there is more than one affiliation, should a number be given to each affiliation in order of appearance. This number should be written in superscript at the beginning of the line, separated from corresponding affiliation with a space. This number should also be put after corresponding name of the author, in superscript with no space in between.

If an author belongs to more than one institution, all corresponding superscript digits, separated with a comma with no space in between, should be present behind the family name of this author.

In case all authors belong to the same institution affiliation numbering is not needed.

Whenever possible expand your authors' affiliations with departments, or some other, specific and lower levels of organization.

2.1.6. Corresponding author

Corresponding author's name with full postal address in English and e-mail address should appear, after the affiliations. It is preferred that submitted address is institutional and not private. Corresponding author's name should include only initials of the first and middle names separated by a full stop (and a space) and the last name. Postal address should be written in the following line in sentence case. Parts of the address should be separated by a comma instead of a line break. E-mail (if possible) should be placed in the line following the postal address. Author should clearly state whether or not the e-mail should be published.

2.1.7. Manuscript information

All authors are required to provide word count (excluding title page, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References), the Abstract word count, the number of Tables, and the number of Figures.

2.2. Abstract

The second page of the manuscripts should be the abstract and key words. It should be placed on second page of the manuscripts after the standard title written in upper and lower case letters, bold.

Since abstract is independent part of your paper, all abbreviations used in the abstract should also be explained in it. If an abbreviation is used, the term should always be first written in full with the abbreviation in parentheses immediately after it. Abstract should not have any special headings (e.g., Aim, Results…).

Authors should provide up to six key words that capture the main topics of the article. Terms from the Medical Subject Headings (MeSH) list of Index Medicus are recommended to be used.

Key words should be placed on the second page of the manuscript right below the abstract, written in italic. Separate each key word by a comma (and a space). Do not put a full stop after the last key word. *See* example:

Abstract

Results of the analysis of

Key words: spatial memory, blind, transfer of learning, feedback

2.3. Main Chapters

Starting from the third page of the manuscripts, it should be the main chapters. Depending on the type of publication main manuscript chapters may vary. The general outline is: Introduction, Methods, Results, Discussion, Acknowledgements (optional), Conflict of Interest (optional). However, this scheme may not be suitable for reviews or publications from some areas and authors should then adjust their chapters accordingly but use the general outline as much as possible.

2.3.1. Headings

Main chapter headings: written in bold and in Title Case. *See* example:

- ✓ **Methods**

Sub-headings: written in italic and in normal sentence case. Do not put a full stop or any other sign at the end of the title. Do not create more than one level of sub-heading. *See* example:

- ✓ *Table position of the research football team*

2.3.2 Ethics

When reporting experiments on human subjects, there must be a declaration of Ethics compliance. Inclusion of a statement such as follow in Methods section will be understood by the Editor as authors' affirmation of compliance: "This study was approved in advance by [name of committee and/or its institutional sponsor]. Each participant voluntarily provided written informed consent before participating." Authors that fail to submit an Ethics statement will be asked to resubmit the manuscripts, which may delay publication.

2.3.3 Statistics reporting

SMJ encourages authors to report precise p-values. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Use normal text (i.e., non-capitalized, non-italic) for statistical term "p".

2.3.4. 'Acknowledgements' and 'Conflict of Interest' (optional)

All contributors who do not meet the criteria for authorship should be listed in the 'Acknowledgements' section. If applicable, in 'Conflict of Interest' section, authors must clearly disclose any grants, financial or material supports, or any sort of technical assistances from an institution, organization, group or an individual that might be perceived as leading to a conflict of interest.

2.4. References

References should be placed on a new page after the standard title written in upper and lower case letters, bold.

All information needed for each type of must be present as specified in guidelines. Authors are solely responsible for accuracy of each reference. Use authoritative source for information such as Web of Science, Medline, or PubMed to check the validity of citations.

2.4.1. References style

SMJ adheres to the American Psychological Association 6th Edition reference style. Check "American Psychological Association. (2009). Concise rules of APA style. American Psychological Association." to ensure the manuscripts conform to this reference style. Authors using EndNote® to organize the references must convert the citations and bibliography to plain text before submission.

2.4.2. Examples for Reference citations

One work by one author
- ✓ In one study (Reilly, 1997), soccer players
- ✓ In the study by Reilly (1997), soccer players
- ✓ In 1997, Reilly's study of soccer players

Works by two authors
- ✓ Duffield and Marino (2007) studied
- ✓ In one study (Duffield & Marino, 2007), soccer players
- ✓ In 2007, Duffield and Marino's study of soccer players

Works by three to five authors: cite all the author names the first time the reference occurs and then subsequently include only the first author followed by et al.
- ✓ First citation: Bangsbo, Iaia, and Krustrup (2008) stated that
- ✓ Subséquent citation: Bangsbo et al. (2008) stated that

Works by six or more authors: cite only the name of the first author followed by et al. and the year
- ✓ Krustrup et al. (2003) studied
- ✓ In one study (Krustrup et al., 2003), soccer players

Two or more works in the same parenthetical citation: Citation of two or more works in the same parentheses should be listed in the order they appear in the reference list (i.e., alphabetically, then chronologically)
- ✓ Several studies (Bangsbo et al., 2008; Duffield & Marino, 2007; Reilly, 1997) suggest that

2.4.3. Examples for Reference list

Journal article (print):

Bangsbo, J., Iaia, F. M., & Krustrup, P. (2008). The Yo-Yo intermittent recovery test: a useful tool for evaluation of physical performance in intermittent sports. *Sports Medicine, 38*(1), 37-51.

Duffield, R., & Marino, F. E. (2007). Effects of pre-cooling procedures on intermittent-sprint exercise performance in warm conditions. *European Journal of Applied Physiology, 100*(6), 727-735.

Krustrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine and Science in Sports and Exercise, 35*(4), 697-705.

Journal article (online; electronic version of print source):

Shaw, A. (1999). The planning and development of New Bombay [Electronic version]. *Modern Asian Studies, 33*(4), 951-988.

Journal article (online; electronic only):

Chantavanich, S. (2003, October). Recent research on human trafficking. *Kyoto Review of Southeast Asia, 4*. Retrieved November 15, 2005, from http://kyotoreview.cseas.kyoto-u.ac.jp/issue/issue3/index.html

Conference paper:

Pasadilla, G. O., & Milo, M. (2005, June 27). *Effect of liberalization on banking competition*. Paper presented at the conference on Policies to Strengthen Productivity in the Philippines, Manila, Philippines. Retrieved August 23, 2006, from http://siteresources.worldbank.org/INTPHILIPPINES/Resources/Pasadilla.pdf

Encyclopedia entry (print, with author):

Pittau, J. (1983). Meiji constitution. In *Kodansha encyclopedia of Japan* (Vol. 2, pp. 1-3). Tokyo: Kodansha.

Encyclopedia entry (online, no author):

Ethnology. (2005, July). In *The Columbia encyclopedia* (6th ed.). New York: Columbia University Press. Retrieved November 21, 2005, from http://www.bartleby.com/65/et/ethnolog.html

Thesis and dissertation:

Pyun, D. Y. (2006). *The proposed model of attitude toward advertising through sport.* Unpublished Doctoral Dissertation. Tallahassee, FL: The Florida State University.

Book:
Borg, G. (1998). *Borg's perceived exertion and pain scales*: Human kinetics.

Chapter of a book:
Kellmann, M. (2012). Chapter 31-Overtraining and recovery: Chapter taken from Routledge Handbook of Applied Sport Psychology ISBN: 978-0-203-85104-3 *Routledge Online Studies on the Olympic and Paralympic Games* (Vol. 1, pp. 292-302).

Reference to an internet source:
Agency. (2007). Water for Health: Hydration Best Practice Toolkit for Hospitals and Healthcare. Retrieved 10/29, 2013, from www.rcn.org.uk/newsevents/hydration

2.5. Tables

All tables should be included in the main manuscript file, each on a separate page right after the Reference section.

Tables should be presented as standard MS Word tables.

Number (Arabic) tables consecutively in the order of their first citation in the text.

Tables and table headings should be completely intelligible without reference to the text. Give each column a short or abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading. All abbreviations appearing in a table and not considered standard must be explained in a footnote of that table. Avoid any shading or coloring in your tables and be sure that each table is cited in the text.

If you use data from another published or unpublished source, it is the authors' responsibility to obtain permission and acknowledge them fully.

2.5.1. Table heading

Table heading should be written above the table, in Title Case, and without a full stop at the end of the heading. Do not use suffix letters (e.g., Table 1a, 1b, 1c); instead, combine the related tables. *See* example:

- ✓ **Table 1.** Repeated Sprint Time Following Ingestion of Carbohydrate-Electrolyte Beverage

2.5.2. Table sub-heading

All text appearing in tables should be written beginning only with first letter of the first word in all capitals, i.e., all words for variable names, column headings etc. in tables should start with the first letter in all capitals. Avoid any formatting (e.g., bold, italic, underline) in tables.

2.5.3. Table footnotes

Table footnotes should be written below the table.

General notes explain, qualify or provide information about the table as a whole. Put explanations of abbreviations, symbols, etc. here. General notes are designated by the word *Note* (italicized) followed by a period.

- ✓ *Note.* CI: confidence interval; Con: control group; CE: carbohydrate-electrolyte group.

Specific notes explain, qualify or provide information about a particular column, row, or individual entry. To indicate specific notes, use superscript lowercase letters (e.g. $^{a, b, c}$), and order the superscripts from left to right, top to bottom. Each table's first footnote must be the superscript ^{a}.

- ✓ ^{a}One participant was diagnosed with heat illness and n = 19.^{b}n =20.

Probability notes provide the reader with the results of the texts for statistical significance. Probability notes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || etc.

- ✓ *P<0.05,†p<0.01.

2.5.4. Table citation

In the text, tables should be cited as full words. *See* example:

- ✓ Table 1 (first letter in all capitals and no full stop)
- ✓ ...as shown in Tables 1 and 3. (citing more tables at once)
- ✓ ...result has shown (Tables 1-3) that... (citing more tables at once)
- ✓ ....in our results (Tables 1, 2 and 5)... (citing more tables at once)

2.6. Figures

On the last separate page of the main manuscript file, authors should place the legends of all the figures submitted separately.

All graphic materials should be of sufficient quality for print with a minimum resolution of 600 dpi. SMJ prefers TIFF, EPS and PNG formats.

If a figure has been published previously, acknowledge the original source and submit a written permission from the copyright holder to reproduce the material. Permission is required irrespective of authorship or publisher except for documents in the public domain. If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph whenever possible permission for publication should be obtained.

Figures and figure legends should be completely intelligible without reference to the text.

The price of printing in color is 50 EUR per page as printed in an issue of SMJ.

2.6.1. Figure legends

Figures should not contain footnotes. All information, including explanations of abbreviations must be present in figure legends. Figure legends should be written bellow the figure, in sentence case. *See* example:

- ✓ **Figure 1.** Changes in accuracy of instep football kick measured before and after fatigued. SR – resting state, SF – state of fatigue, *p>0.01, †p>0.05.

2.6.2. Figure citation

All graphic materials should be referred to as Figures in the text. Figures are cited in the text as full words. *See* example:

- ✓ Figure 1
- × figure 1
- × Figure 1.
- ✓ ….exhibit greater variance than the year before (Figure 2). Therefore…
- ✓ ….as shown in Figures 1 and 3. (citing more figures at once)
- ✓ ….result has shown (Figures 1-3) that... (citing more figures at once)
- ✓ ….in our results (Figures 1, 2 and 5)... (citing more figures at once)

2.6.3. Sub-figures

If there is a figure divided in several sub-figures, each sub-figure should be marked with a small letter, starting with a, b, c etc. The letter should be marked for each subfigure in a logical and consistent way. *See* example:

- ✓ Figure 1a
- ✓ …in Figures 1a and b we can…
- ✓ …data represent (Figures 1a-d)…

2.7. Scientific Terminology

All units of measures should conform to the International System of Units (SI).

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples.

Decimal places in English language are separated with a full stop and not with a comma. Thousands are separated with a comma.

Percentage	Degrees	All other units of measure	Ratios	Decimal numbers
✓ 10%	✓ 10º	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 º	× 10kg	× 12 : 2	× .056

Signs should be placed immediately preceding the relevant number.		
✓ 45±3.4	✓ p<0.01	✓ males >30 years of age
× 45 ± 3.4	× p < 0.01	× males > 30 years of age

2.8. Latin Names

Latin names of species, families etc. should be written in italics (even in titles). If you mention Latin names in your abstract they should be written in non-italic since the rest of the text in abstract is in italic. The first time the name of a species appears in the text both genus and species must be present; later on in the text it is possible to use genus abbreviations. *See* example:

- ✓ First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*

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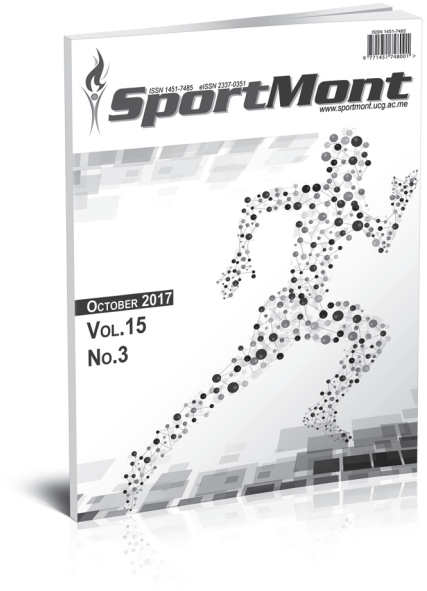

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- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

SMJ is published three times a year, in February, June and October of each year. SMJ publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

SMJ covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the SMJ website: http://www.sportmont.ucg.ac.me/?sekcija=page&p=51. Contributors are urged to read SMJ's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to sportmont@ac.me or contact following Editors:

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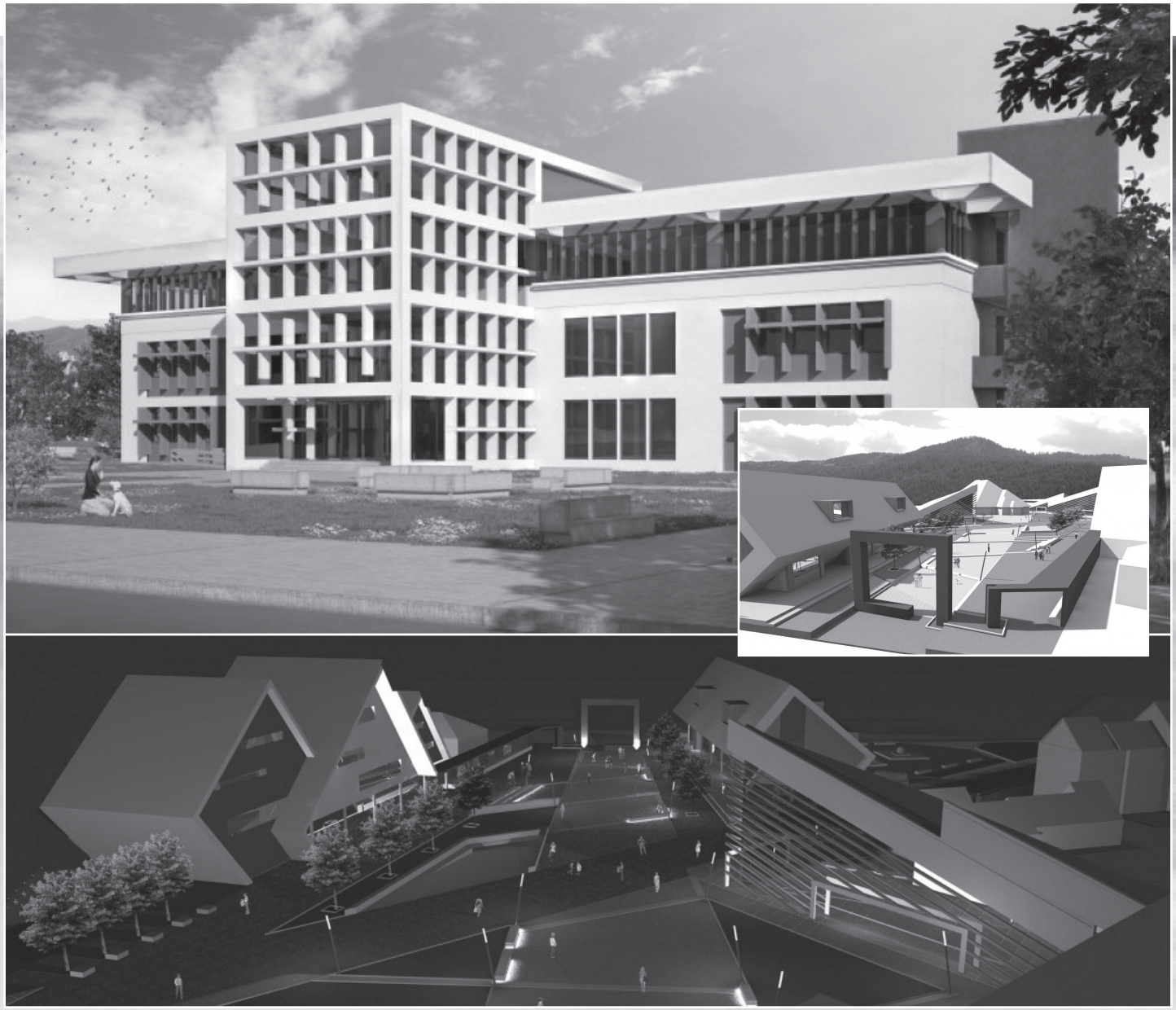

The goal of establishment of our institution is the education highly qualified professional cadre based on the best knowledge of the theory and practice in the world, and its application to the development and implementation of plans and projects in the space - as a basic condition for the quality valorization, programming, management and protection of natural and inherited built environment. In this way conceptualized school forms internationally experts in all areas of creativity - in the field of urban planning, architecture, construction and design - which includes the ability to create useful objects, architectural forms of all categories, urban and vacant space at different levels. Such qualified cadre are the spiritus movens of development of culture and technology in the modern world.

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The University of Montenegro is the leading higher education and research institution in Montenegro. It is a public institution, established by the state, operating as a unique legal entity represented by the Rector. It is an integrated university organized on the model of the most European universities. Organizational units are competent for provision of study programmes, scientific-research and artistic work, use of allocated funds and membership in professional associations.

Since its foundation, the University of Montenegro has continuously been conducting reforms in the area of education and research, while since 2003 in line with the trends in EHEA. After adoption of the Bologna Declaration, University of Montenegro organized systematic preparation of documents aligned with it. Already in 2003, the experimental teaching programme started and today, all studies are organised in line with the Bologna principles. During the last two years systematic reforms of the University`s study programes have been conducted in order to harmonize domestic higher education system with European standards and market needs to highest extent.

The University of Montenegro has unique academic, business and development objectives. It comprises 19 faculties and two research institutes. The seat of the UoM is in Podgorica, the capital city, while university units are located in eight Montenegrin towns. The University support services and centers (advisory services, accounting department, international cooperation, career orientation) are located in the Rectorate.

Academic community of University of Montenegro is aware of the importance of its functioning for further development of the state and wider region. It has been so far, and will be in the future, the leader in processes of social and cultural changes, along with the economic development.

In the aspect of attaining its mission, University of Montenegro is oriented towards the priority social needs of the time in which it accomplishes its mission; open for all the students and staff exclusively based on their knowledge and abilities; dedicated to preservation of multicultural and multi-ethnic society in Montenegro; entrepreneurial in stimulating social and economic application of supreme achievements within the scope of its activities.

In 2015/16 there were a total of 1.192 employees at UoM, 845 of which were engaged in teaching. In the same year there were 20.236 students registered at all three cycles of studies.

Internationalization is high on the agenda of UoM priorities, thus it has participated in a number of international projects – over 50 projects funded under the Tempus programme, over 15 Erasmus Mundus Action 2 projects for student mobility, a number of projects under FP7 funding scheme or IPA supported projects, Erasmus + capacity building and International credit mobility projects and other.

For more information about University of Montenegro, please visit our website www.ucg.ac.me or send e-mail to pr.centar@ac.me.

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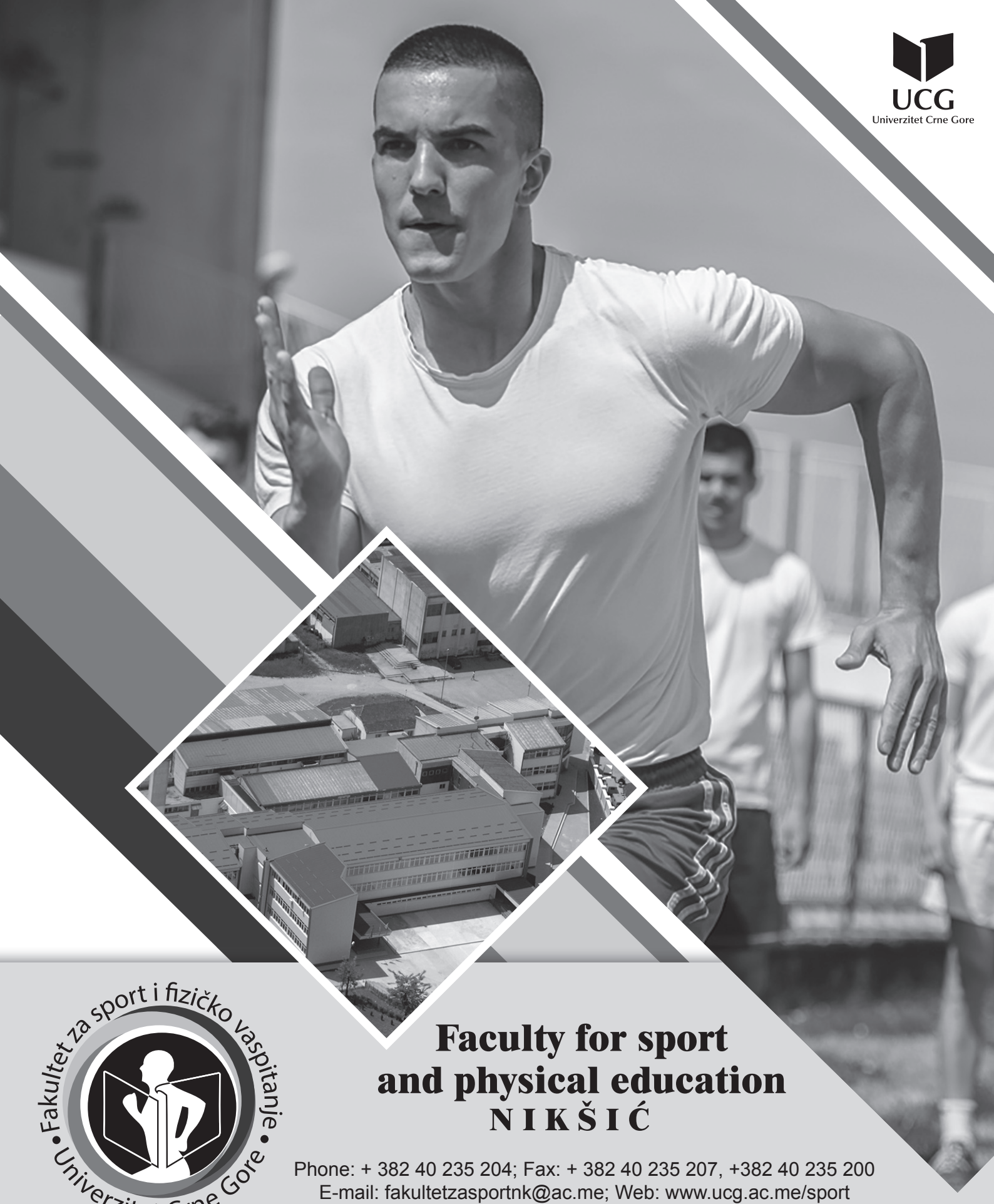

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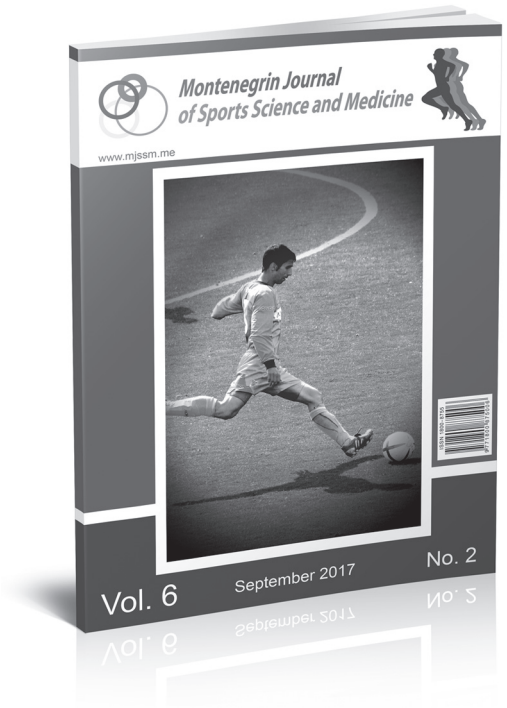
Montenegrin Journal of Sports Science and Medicine

MONTENEGRIN JOURNAL OF SPORTS SCIENCE AND MEDICINE



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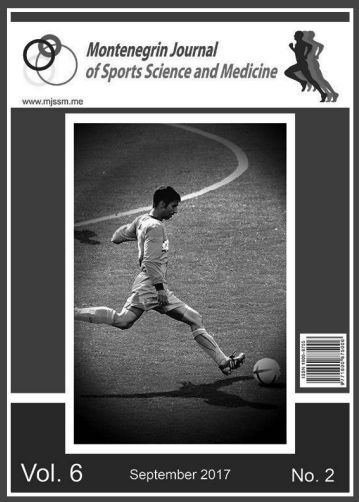

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