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Dear Readers,

The Montenegrin Sports Academy is a rapidly growing academic publication in the fields 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, in various formats: original papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in two academic journals (MJSSM and SMJ), as well as academic books, conference proceedings, brochures etc. However, it is well-known, our journal, the Montenegrin Journal of Sports Science and Medicine is the most powerful brand-building tool of the Montenegrin Sports Academy. Since this journal has been indexed in Thomson Reuters Core Collection, the volume of submissions has increased dramatically and I would like to announce our Editorial Board has a plan to increase the number of articles in the upcoming issues (March and September 2017). So, I would invite potential authors worldwide to take this opportunity and submit their work in order to broaden our knowledge in the area of sport science and medicine.

I would also add in this issue's welcome speech that my main goal as an editor-in-chief is to make sure that you, our readers, can be assured that the time you spend with the Montenegrin Journal of Sports Science and Medicine will be filled with the most important, creative, scholarly, and meaningful articles, studies, and essays produced by members of our community, mostly due to the reason I am sure the Montenegrin Journal of Sports Science and Medicine provides an ideal forum for educators, researches, clinicians, and administrators to share their best ideas to improve the sports science and medicine. I do believe that through the sharing of our creativity and ideas we can envision the future of sports science and medicine and inspire our readers to take actions that will turn the ideas into reality. As I have already mentioned, the Montenegrin Journal of Sports Science and Medicine focuses on following areas: 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, and seeks to publish articles that advance our knowledge and understanding of the difficult challenges faced by all segments of sport industry and the communities it serves. I am particularly interested in articles that go beyond description of problems to offer innovative scholarly solutions to the problems.

The Montenegrin Journal of Sports Science and Medicine strives to create a community of scholars, thinkers, and visionaries through the discourse that appears in its pages, but honors the past through understanding the forces that have created our current dilemmas and finds the threads leading forward to our future. As editor-in-chief of the Montenegrin Journal of Sports Science and Medicine, I am excited about the journal's opportunity to influence the future through the dissemination of ideas and the journal's role in providing a forum to celebrate the best work of our community's scholars.

Thank you for reading us and we hope you will find this issue of MJSSM informative enough.

Editor-in-Chief
Prof. Duško Bjelica, PhD

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Original scientific paper
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Accuracy and Criterion-Related Validity of the 20-M Shuttle Run Test in Well-Trained Young Basketball Players

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A B S T R A C T

The purpose of the present study was to evaluate the specificity of a 20-m shuttle run test (SRT) as a measure of maximal oxygen consumption (VO_{2max}) in young well-trained basketball players. Thirty-four volunteers (mean ± SD; age 15.74 ± 1.23 years, height 187.61 ± 7.95 cm, body mass 74.09± 11.61 kg; training experience 6.30± 2.15 years) participated in the study. The 20-m shuttle run test was performed wearing a portable gas analyzer (K4b2, Cosmed) to measure VO_{2max} during the test. SRT-derived VO_{2max} underestimated directly measured values (48.91 ± 4,11 vs 55.45 ± 4.98). Mean bias was 6.54± 3.89 ml kg^{-1} min^{-1} (95% CI- 5.18 to 7.90 ml kg^{-1} min^{-1}). Typical error of the estimate was 3.85 ml/kg/min^{-1} (95% CI- 3.10 to 5.10 ml kg^{-1} min^{-1} ; ES= 0,77). There was a moderate correlation between VO_{2max} directly measured and estimated by SRT (r= 0.65; 95% CI- 0.40 to 0.81, power = 0.84, p < 0.01). Although very popular among coaches, it seems that SRT is not an appropriate field test to measure maximal oxygen consumption in young well-trained basketball players.

Key words: *Team sports, Field test, Maximal oxygen consumption.*

Introduction

Performance in basketball is multifaceted and depends on a complex interaction of several factors, with well-developed physical fitness considered to be one of the most important (Ostojic, Mazic, & Dikic,2006). As the game is saturated with jumps and other explosive activities variable in time and distance (Ben Abdelkrim, Castagna, El Fazaa & El Ati, 2012), anaerobic power is widely recognized as a strong determinant of basketball performance (McInnes, Carlson, Jones & McKenna 1995; Delextrat & Cohen 2008). However, the intermittent activity pattern demands for aerobic qualities sufficient to sustain repeated short bouts of high-intensity anaerobic exercise (Bishop, Edge & Goodman 2004), as restoration of phosphocreatine was found to be largely dependent on aerobic metabolism (Piiper & Spiller 1970). Maximal oxygen consumption (vo_{2max}) has been found to be significantly correlated to both total time spent in high-intensity activity during (Ben Abdelkrim, Castagna, El Fazaa & El Ati, 2012) and basketball-specific repeated sprint ability test after the game, indicating its importance to overall game-intensity (Meckel, Gottlieb & Eliakim 2009). Consequentlly, VO_{2max} is considered an important fitness atribute regularly tested in modern basketball.

Maximal oxygen consumption in basketball players can be evaluated using a variety of testing protocols, with tests on a treadmill measuring gas exchange in laboratory settings considered to be the "gold standard". However, trained personnel, expensive equipment required and considerable time spent in testing one player at the time, preclude laboratory testing as the preferred method of aerobic fitness assessment in basketball, except for professional players (Gore, 2000). Therefore, several continuous field-tests have been proposed as practical alternatives (Ramsbottom, Brewer & Williams, 1988; Krustrup et al, 2003), with the 20-m shuttle run test (SRT) arguably the most popular. It requires limited equipment, is time-saving and easy to administer. Although several equations have been developed to estimateVO2max from maximal speed attained during the 20-m shuttle run test, Ramsbottom *et al*. equation (via Brewer *et al*. table) is the one commercially presented and widely used in practice. Interestingly, the SRT criterion-related validity has not been thoroughly examined, with controversial results presented accros different populations. While few studies revealed high correlations (r ≥ 0.81; Paliczka, Nichols & Boreham 1987;

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Ramsbottom, Brewer & Williams, 1988), several others reported low correlation coefficient between predicted and measured VO_{2max} (Cooper, Baker, Tong, Roberts & Hanford, 2005; Liu, Plowman & Looney, 1992; Stickland, Petersen & Bouffard, 2003; Ruiz, Silva, Oliviera, Ribeiro, Oliveira, & Mota, 2009). Conflicting results have also been published concerning the accuracy of SRT, with estimated VO_{2max} frequently shown to underpredict data obtained while continously running on the treadmill (Grant, Corbett, Amjad, Wilson & Aitchison, 1995; Penry, Wilcox & Yun, 2011; St. Clair Gibson, Broomhead, Lambert & Hawley, 1988; Stickland, Petersen & Bouffard, 2003).

The 20-m shuttle run test is widely used to estimate aerobic power in team sports, including basketball. Its stop-and-turn actions on a 20m distance clearly resembles a basketball game and practice movement patterns and is therefore believed to have a high level of ecological validity. However, despite its popularity among basketball coaches and purported validity, to the author's best knowledge, no study has been conducted to examine accuracy and criterion-related validity of SRT in young basketball players (population validity; Te Wierike et al, 2014). Although there are several equations to predict VO_{2max} from SRT test results, the table of values presented by Brewer *et al* (1988) and accompanying the original SRT CD has been extensively used in basketball practice. In addition, there is concern about the specificity of conventional treadmill protocols used to produce maximal values of oxygen consumption (Beltrami, Froyd, Mauger, Metcalfe, Marino & Noakes,2012). For example, it has been suggested (Kang, Chaloupka, Mastrangelo, Biren & Robertson, 2001) that the most desirable treadmill test protocol for trained subjects should involve the speed/gradient combination that is similar to what the individual uses during regular training. In that context, it has been argued that the preferred protocol for assesing VO_{2max} in basketball players should mimic sport activity patterns of frequent decelerating and accelerating, which is obtainable through shuttle run test (Flouris & Klentrou, 2005). Portable gas analyzers with high precision and validity have been presented a while ago, making direct metabolic measurements during field-testing feasible (McLaughlin, King, Howley, Bassett & Ainsworth, 2001). Consequently, elucidating the relationship between VO_{2max} directly measured when performing the 20-m shuttle run test and estimated VO_{2max} derived from the 20-m shuttle run test could provide more valid data concerning SRT applicability as a measure of aerobic fitness in basketball youngsters.

The SRT has not been validated using a young basketball playing population. Changes in body size and composition with growth and maturation influence the anaerobic and aerobic performances (Baxter-Jones, 1993) and may in turn influence SRT. Therefore, the aim of the present study was to evaluate the specificity of 20-M shuttle run test (SRT) as a measure of VO_{2max} in young well-trained basketball players.

Methods

Experimental Approach to the Problem

A cross-sectional study design was carried out close to the end of the competition period (first two weeks in April 2011). All tests were performed during early-evening (16^{30}-18^{30}) training sessions on wooden basketball court, at "Lukovski" basketball center in Novi Sad (Serbia). Players not scheduled for testing were engaged in training consisted mainly of low-intensity tactical drills after a standard warm up. The environmental temperature was 22 to 25°C and the relative humidity ranged from 40 to 60% on all testing days. All participants performed the 20-m shuttle run test according to procedure (Brewer, Ramsbottom & Williams, 1988), wearing a portable gas analyser for VO_{2max}. To establish relationships between directly measured and estimated VO_{2max}, obtained results were correlated using Pearson's correlation analysis. Difference between two means was tested with paired t-test.

Subjects

Thirty four volunteers (mean ± SD; age 15,74 ± 1.23 years, height 187.61 ± 7.95 cm, body mass 74.09± 11.61 kg; training experience 6.30± 2.15 years) were randomly chosen within a population of young elite-level basketball players of Vojvodina region (Serbia), in the study approved by the Ethical Advisory Commission. All subjects were members of three teams continuosly competing in the «Serbia quality league», with all teams qualifying for the final-four tournaments for their respective age-group during the calendar year when the study was conducted. All of the subjects and their parents/guardians gave written informed consent after a detailed explanation about the aims, benefits, and risks involved in this investigation. All participants were informed that they could withdraw from the study at any time without penalty. All the players were practicing basketball for at least 3 seasons and participated in 4-5 training sessions a week, for 75-90min per session and played a competitive match every weekend. They were all healthy and free of injuries at the moment of testing, and were not taking any medications. All measurements were obtained by the certified four-man squad. Subjects were familiarized with the test as they perform it as a part of their regular training process over the season. They were advised to avoid intensive exercise 48 h prior to the data collection.

Procedures

Before the testing, body mass and height were measured for each subject. Body mass was measured using body composition monitor (BC-554, Tanita Corporation, Tokyo, Japan) to the nearest 100 gram, and height was determined with portable stadiometer (SECA 210, Hamburg, Germany) to the nearest millimeter, with barefoot participants wearing underwear only. The same investigator carried out all anthropometric measures.

The SRT was performed in accordance to published procedures (Brewer, Ramsbottom, & Williams, 1988). In a nutshell, participants performed the test in groups of 5 and were instructed to run back and fort between two lines 20 m apart, while keeping pace with audio signals emitted from a pre-recorded CD. The speed at the first minute was 8.5 km h^{-1} and was increased by 0.5 km h^{-1} every minute. The test ended when the participant stopped or failed to maintain the prescribed pace for two consecutive signals, based on umpire opinion. Strong verbal encouragement was provided during the test. The final stage reached is recorded and VO_{2max}, estimated using the table provided by Brewer et. al (1988).

During the SRT test, portable gas analyzer was worn by one participant (K4b2, Cosmed, Rome, Italy), with a purpose of sampling metabolic and ventilatory data. Before each test was conducted, the oxygen and carbon dioxide analyzers were calibrated according to the manufacturer's instructions. It has been previously reported that wearing the portable gas analyzer during the 20-m shuttle run test does not significantly alter participants' energy demands (Flouris, Metsios & Koutedakis, 2005). Directly measured VO_{2max} were obtained with VO_{2max} defined as the mean VO_2 value measured during the last 15 seconds of exercise. The criteria for attaining VO_{2max} included any two of the following: volitional exhaustion; attainment of at least 90%

of the age predicted HR_{max} (220-age); RER equal to or greater than 1.10; and VO_2 leveled off even with an increase in intensity (Gore, 2000).

Statistical Analyses

Data analyses were performed using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA). Before using parametric tests, the assumption of normality was verified using the Shapiro—Wilks test. Comparison of mean scores for predicted and measured VO_{2max} has been performed with paired *t*-test. Simple correlation was performed using the Pearson product moment correlation coefficient. Confidence intervals (95%CI) were calculated and presented where appropriate. Validity was further elaborated using the typical error of the measurmenet (Hopkins, 2005), which divided by the standard deviation of the criterion measure (Standardized Cohen effect size) was used to determine if the difference between the directly measured and estimated VO_{2max} by SRT were trivial (<0.20); small (0.2-0.6); moderate (0.6-1.2); large (1.2-2.0) or very large (>2.0). Power calculations were calculated using G*Power (Version 3.1, University of Dusseldorf, Germany). The probability of type 1 error (alpha) was set a priori at 0.01 in all statistical analyses. Data are presented as mean ± SD.

Results

All participants achieved maximal effort during the test. Directly measured and estimated VO_{2max} while performing the 20-m shuttle run test were 55.45± 4.98 $mLkg^{-1}min^{-1}$ and 48.91± 4.11 $mLkg^{-1}min^{-1}$ respectively, with significant difference between 2 means (p= 0.000) (Figure 1).

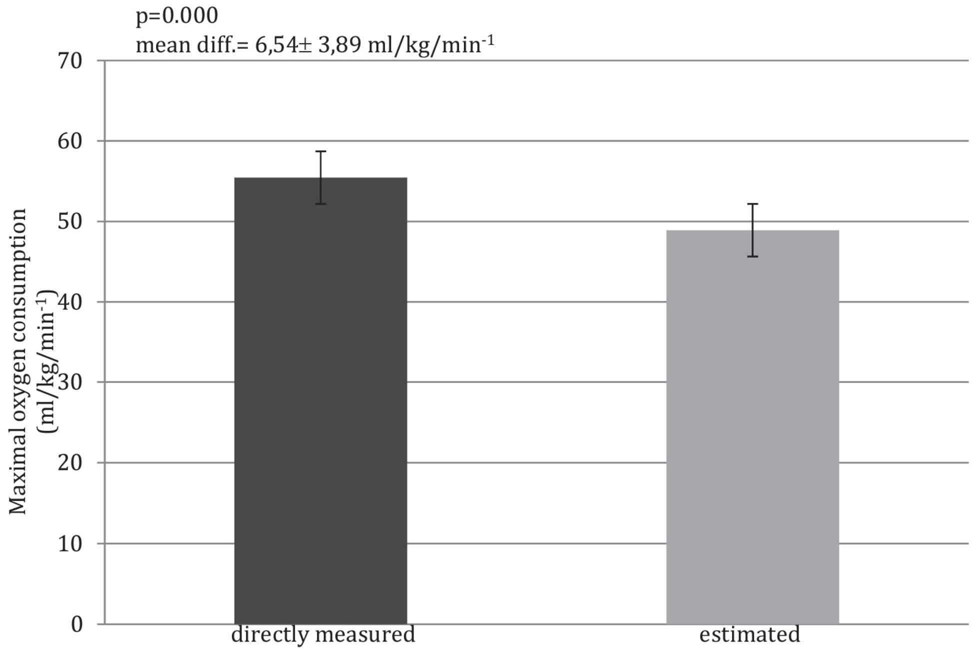

Figure 1. Directly measured and estimated Vo_{2max} (p= 0.000); mean difference= 6.54± 3.89 $ml/kg/min^{-1}$

Mean difference was 6.54± 3.89 ml $kg^{-1}min^{-1}$ (95% CI- 5.18 to 7.90 ml $kg^{-1}min^{-1}$). Typical error of the estimate was 3.85 $ml/kg/min^{-1}$ (95% CI- 3.10 to 5.10 $ml/kg/min^{-1}$), with the corresponding standardized Cohen effect size of 0.77 scored as "moderate". There was a significant correlation between VO_{2max} directly measured and estimated by SRT (r= 0.65; 95% CI- 0.40 to 0.81, power = 0.84, $p < 0.01$) (Figure 2).

Discussion

In this study, we examined the criterion validity of the 20-m shuttle run test to predict VO_{2max} in young male basketball players. The results demonstrated that 20-m shuttle run underestimate directly measured VO_{2max} during the test, with an average value somewhere between 5.18 and 7.90 ml $kg^{-1}min^{-1}$ for the population. Typical error of estimate between measured and estimated VO_{2max} is reported to be of "moderate" magnitude, with only moderate correlation between two measures observed (r= 0.65). To our knowledge, this study is the first to demonstrate that 20-m shuttle run test is not a valid procedure for VO_{2max} estimation in young well-trained basketball players.

Obtained results are in line with several previously reported on the sample of physically trained and/or adolescent population. Kavcic et al (2012) reported that the correlation between the measured and predicted VO2max was too weak (r= .58) to predict the aerobic capacity of young football players, with measured VO2max significantly higher (p<.05), by as much as 8.5 ml $kg^{-1}min^{-11}$ than the SRT-predicted VO2max. Cooper, Baker, Tong, Roberts and Hanford (2005) reported that SRT provides results that are repeatable but underestimates VO_{2max} when compared to laboratory determinations on the sample of 30 active young men. Authors also stated that when scrutinized with more appropriate analysis, the SRT does not provide valid predictions of VO_{2max}. St. Clair Gibson et al (1988) confirmed under prediction of directly measured VO_{2max} by SRT estimation on the sample of 20 trained athletes and reported only "moderate" correlation (r=0.67, p < 0.01), almost identical to result in our study. Sproule, Kunalan, McNeill & Wright (1993) found that 15 out of 20 physical education students had a lower SRT-predicted VO_{2max} value (p < 0.01) compared with results gained by direct measurements. The poorest association between directly measured and SRT-estimated VO_{2max} has been reported in the study of O'Gorman, Hunter, Mc Donnacha and

Kirwan (2000), with nonsignifacant correlation of r=0.41 and r= 0.42 for 15 competitive sports participants and seven international-level rugby players, respectively. Interestingly, when the results from both groups were combined, a significant ($p < 0.05$) correlation (r = 0.61) was found. This significant improvement authors attributed to the greater range in both VO_{2max} and SRT scores of combined data.

The present results are also similar to those reported in previous studies done with adolescents. Armstrong, Williams and Ringham (1998) have reported that VO_{2max} in young boys was not accurately predicted by the 20-MST (r= 0.54), while Ruiz et al (2009) reported both similar (r = 0.587; Leger equation) and higher results (r = 0.758; Ruiz equation) for a group of 13- 19 years-old children. The later research is of particular relevance for us, as it has the same study design, with VO_{2max} directly obtained while running the SRT. Interestingly, the reported mean difference for the Leger equation was almost identical to one we found (5.5 vs 6.54 $mLkg^{-1}min^{-1}$) and unusually high in comparison with studies using VO_{2max} values directly measured from treadmill-based protocols (Cooper et al, 2005, Stickland et al, 2003). Although speculative, it could be argued that specific shuttle run movement pattern is likely responsible for the observed difference. It has been reasoned that in order to yield best VO_{2max} results, the test should consist of sport specific performance; VO_{2max} is highly specific to the musculature employed during maximal exercise, as well as to the exercise mode utilized (Stromme, Ingjer & Meen, 1997). Additionally, stopping, turning and side-stepping at the end of each 20-m shuttle has been shown to significantly increase net muscle activation (Besier, Lloyd & Ackland, 2003) and provoke higher maximal level of oxygen consumption compared to steady-state forward running (Flouris, Metsios, Famisis, Geladas & Koutedakis, 2012). Thus, any covered distance during SRT might be by accompanying nomogram assigned with “unspecific” oxygen consumption value. Underestimated energy needs during the continuous cycles of acceleration, deceleration and change in direction consequently produce augmented discrepancy between predicted and measured VO_{2max} during the test.

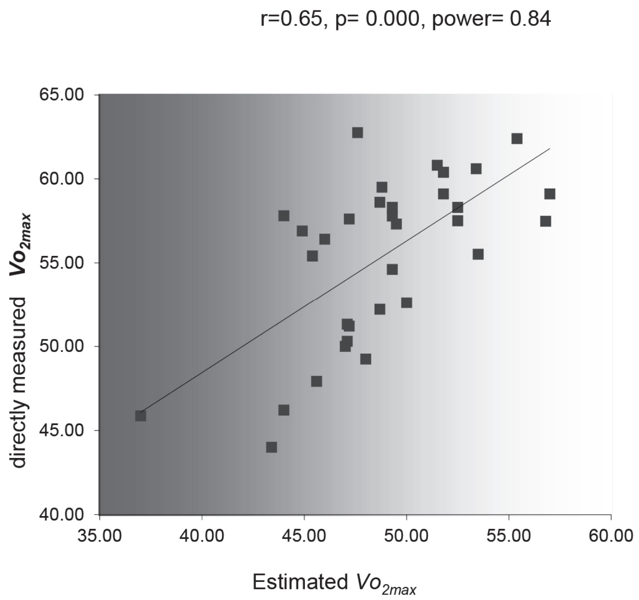

Figure 2. Relationship between directly measured and estimated VO_{2max} (r= 0.65, power = 0.84, $p < 0.01$)

Several other factors could attribute to observed poor applicability of shuttle run test for the prediction of VO_{2max} in young well-trained basketball players. Anaerobic characteristics have been found a strong predictor of distance running performance in well-trained athletes (Houmard, Costill, Mitchell, Park & Chenier, 1991; Marcinik, Potts, Schlabach, Will, Dawson & Hurley, 1991). Authors stated that participants with higher anaerobic capacity are able to exercise for the longer time during an incremental test on treadmill. Considering that shuttle run is also an incremental test it could be hypothesized that this statement is valid for shuttle run test performance, too. Therefore, subjects anaerobic capacity, heavily taxed in the later stages of SRT (Ahmaidi, Collomp, Caillaud, & Préfaut, 1992), likely have profound effect on total distance covered and estimated VO_{2max} and consequently is reasponsible for «bluring» the VO_{2max} – SRT distance covered relationship. Paavolainen, Häkkinen, Hämäläinen, Nummela and Rusko (1999) also suggested that distance running performance could be significantly influenced by the muscle power level, with performance in continuous acceleration-deceleration type of movements likely even more dependent on this physical attribute. It has been reported that leg power development could improve the stretch-shortening cycle efficacy and consequently running economy, especially during movement patterns with frequent changes of direction (Thomas, Nelson & Silverman, 2005). Additionally, in the study by Stojanovic, Stojanovic, Ostojic and Fratric (2007), it was shown that total distance covered during shuttle-run test by young basketball players is not VO_{2max} - only dependent, with standing long jump as a measure of muscle power found to be significant contributor of 65% SRT-variance explained group of predictors. Muscle power is considered to be of great importance in basketball, is used in the identification of talented young players (te Wierike *et al*, 2014) and regularly stressed in training, suggesting that well-trained young basketball players used in present study could posses similar level of this physical quality. However, based on some previous findings (Drinkwater, Hopkins, McKenna, Hunt, & Pyne, 2007) it is reasonable to assume that our group of subjects is not homogenous in this distinct ability Therefore, such discrepancies could affect SRT total distance covered and consequently relationship between directly measured and estimated VO_{2max}.

The present study support the notion of previously reported studies that shuttle run test under predicts VO_{2max} on the sample of trained and/or adolescent population. Further, with only moderate correlation between two measures and typical error of estimate of "moderate" magnitude, SRT should not be viewed as viable procedure for VO_{2max} determination. Several other factors, such as anaerobic characteristics and muscle power are likely influential for the total distance covered and consequently estimated VO_{2max}. As such, 20-M shuttle run test should not be used to evaluate VO_{2max} in well-trained young basketball players.

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Inter and Intra Positional Differences in Ball Kicking Between U-16 Croatian Soccer Players

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A B S T R A C T

The main goal of this research was to determine inter and intra positional differences in ball kicking speed between U-16 Croatian soccer players. 44 young soccer players (15.7 ± 1.5 years) were tested with 8 specific soccer field tests that evaluate kicking velocity by using Pocket radar that was reading the ball velocity in km/h. The tests took place two days in a row; beginning at 8 A.M. Prior to the tests, players warmed up and stretched for 20 minutes (13 minutes of running with and without the ball, 7 minutes of dynamic stretching). Inter positional differences were significant (p ≤ 0.05) between midfielders and defenders in all tests and in one test midfielders scored better than strikers. The fastest kicks were instep kicks when stationary and non-stationary ball was kicked. Shots were taken by midfielders with 106.94±7.07 and 101.61±7.88 km/h respectively. Similar to dominant leg, midfielders also achieved the fastest instep kicks with non-dominant leg (91.44±9.56 km/h). Intra positional differences revealed that soccer kick velocity is one of possible selection tools, because more efficient players in all playing lines shoot faster kicks than less efficient players.

Key words: *Instep kick, Side-foot kick, Kicking velocity.*

Introduction

Soccer consists of various types of movements and actions like tackling, jumping, sprinting and kicking (Reilly et al., 2000; Amiri-Khorasani, Osman and Yusof, 2009). Soccer kicking is the major asset when team is attacking an opponent's goal. Team that shoot more shots on an opponent's goal, over the course of match are likely to be successful or win more games than the opponent (Wong, Chamari and Wisløff, 2010; Lago-Peñas and Lago-Ballesteros, 2011). Although there are several types of soccer kicks, instep and side-foot kicks are the most commonly used kicks in soccer. Side-foot kick is widely and mostly used for passing, shooting from shorter distances or shooting when shot accuracy is more important than shot velocity. Instep kick on the other hand is frequently used for shooting from greater distances and in situations where shot power is more important than precision (Nunome et al. 2002; Arpinar-Avsar and Soylu, 2010). Furthermore, as it is important to kick ball with great velocity, it is also very important to kick it powerfully with both feet (McLean and Tumilty, 1993). The goal scoring opportunities are very rare in top-level soccer and opponents are getting more and more aggressive, so players who can use both feet adequately, depending on the giving situation, have higher chance to score a goal or to be more successful.

Modern soccer developed into a very fast and dynamic game. Top-level players change direction and activities every 4 – 6 seconds, which is between 1200 – 1400 times per game (Reilly et al., 2000), most of which occurs while opposing defenders are very close and are trying to take possession of the ball. In order to maintain possession of a ball or make a shot on an opponent's goal, it is extremely important to have a good kicking technique and kicking velocity while dribbling and running with the ball, also using both feet in the process.

Previous studies concentrated mostly on relations between strength and kicking velocity, or effects of different training loads or stretching types on kicking speed (Manolopoulos, Papadopoulos and Kellis, 2006; Anthrakidis et al., 2008; Billot et al., 2010; Amiri-Khorasani, Osman and Yusof, 2011a; Amiri-Khorasani et al., 2012; García-Pinillos et al., 2014) while other studies focused on biomechanics and kinematics of soccer kicks (Lees and Nolan, 1998; Asai et al., 2002; Barfield, Kirkendall and Yu, 2002; Dørge et al., 2002; Ozaki and Aoki, 2008; Lees et al., 2009; Amiri-Khorasani, Osman and Yusof, 2011b; Shan and Zhang, 2011). There are only a few research articles about ball kicking and kicking speed regarding differences between playing positions (Amiri-Khorasani, Osman and Yusof, 2009) or differences between various skill levels of soccer players (Arpinar-Avsar and Soylu, 2010; Cometti et al., 2001; Ford et al., 2006). Some authors measured kicking speed for both feet but didn't separate results on dominant and non-dominant leg. Instead, they separated results on left and right leg which left certain things unexplained considering a number of players that could have left leg as a dominant. To author's knowledge, there are no scientific papers that explored intra positional differences in soccer regarding speed of the kicked ball. It is important to detect differences between better and worse players of the same playing position, especially in kicking speed. Better players often score more goals as well as more accurate long passes throughout the match and the season, due to higher kicking power.

In addition, majority of papers measured kicking speed when stationary ball was kicked (Billot et al., 2010; García-Pinillos et al., 2014; Dørge et al., 2002; Cometti et al., 2001; Katis et al., 2013) which is in contrast to actual game situations where stationary ball is kicked only when free kick or corner kick is taken. Involvement of different kicking techniques such as kicking a non-stationary ball (Bacvarevic et al., 2012) is required for more complex and precise evaluation of soccer kicking and its implications on success.

Giving the complexity of the game and relatively unexplored differences between different playing positions and skill

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levels, it would be of considerable importance to evaluate differences between players of different playing positions in shooting tests. Thus, the main goal of this research was to determine inter and intra positional differences in ball kicking speed between U-16 Croatian soccer players.

Methods

Participants

Research was conducted on a sample of 44 young soccer players (15.7 ± 1.5 years) members of NK „Adriatic" and HNK „Krilnik" from Split, Croatia. Both teams trained 4 times and played one competitive match per week. This study was approved by Faculty of Kinesiology and its Ethic Committee. In addition, parental and players' consent was obtained.

Experimental design

In this cross-sectional research, dependent variable was a first team status of the players. Players were divided as starters or non-starters, while the independent variables were soccer-specific shooting tests. All players were tested with 8 soccer–specific field tests that evaluate kicking velocity using both feet with standing ball and after dribbling, both with instep and side-foot kicks. Respondents were tested in July at the end of the competitive season 2012/2013. The tests took place two days in a row; beginning at 8 A.M. Prior to the tests, players warmed up and stretched for 20 minutes (running with and without the ball – 13 minutes, dynamic stretching – 7 minutes). Players were divided in pairs and each pair had their own ball for warm up. They did passing while moving and standing, increasing range between them and kicking speed. Finally, they did shots to one another using both legs and kicking stationary and non-stationary ball. After that, they had 8 warming shots, one for each shooting style they would shoot afterwards. All tests were conducted on a natural grass surface in dry, consistent weather conditions. Players wore their own soccer boots during the test. Balls used in these tests were official Adidas Europass balls used in 2008 Euro cup. Balls were FIFA approved 69 – 69.25 cm in circumference, weighted between 441 and 444 grams.

After performing the shot, all respondents waited for others to shoot. That way all players had enough time to recover for the next shot. The same order was kept for each player across all tests. Players' aim for all 8 soccer-specific field tests was a center of the goal and they were kicking ball from 16 meters as powerful as they can. During the tests examiner was standing with Pocket radar behind the goal vertical to the shooting trajectory, and was reading the ball velocity in km/h.

Soccer-specific shooting tests

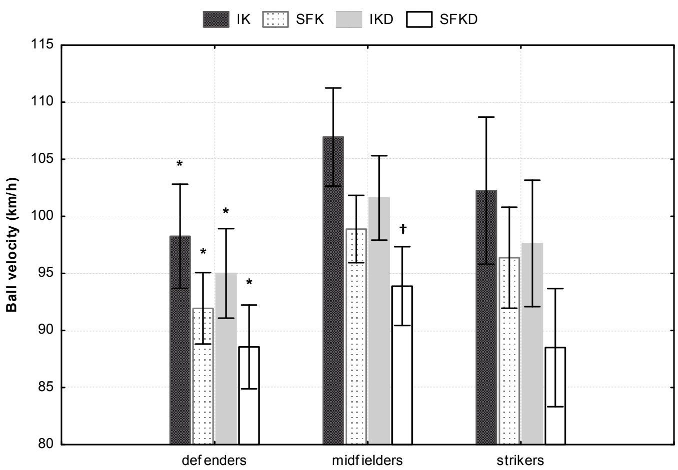
In four tests ball was stationary on 16 meter line: (IKDL – instep kick with dominant leg, IKNDL – instep kick with non dominant leg, SFKDL – side foot kick with dominant leg, SFKNDL – side foot kick with non-dominant leg). In other four tests the task was to dribble and run with the ball from 25 meters distance and shoot from 16 meter line after using arbitrary technique and touching the ball at least 3 times (IKDLD – instep kick with dominant leg after dribbling, IKNDLD – instep kick with non-dominant leg after dribbling, SFKDLD – side-foot kick with dominant leg after dribbling, SFKNDLD – side-foot kick with non-dominant leg after dribbling). All metric characteristics for the given variables were good and evaluated previously (Grgantov et al., 2013).

Statistical analysis

Basic descriptive statistics were calculated; means (AS), standard deviation (SD), minimum and maximum results (Min., Max.) and normality analysis (KS-test). Two factors 3x2 ANOVA with Fisher LSD post-hoc analysis were used to determine interaction effects between starters and nonstarters.

Results

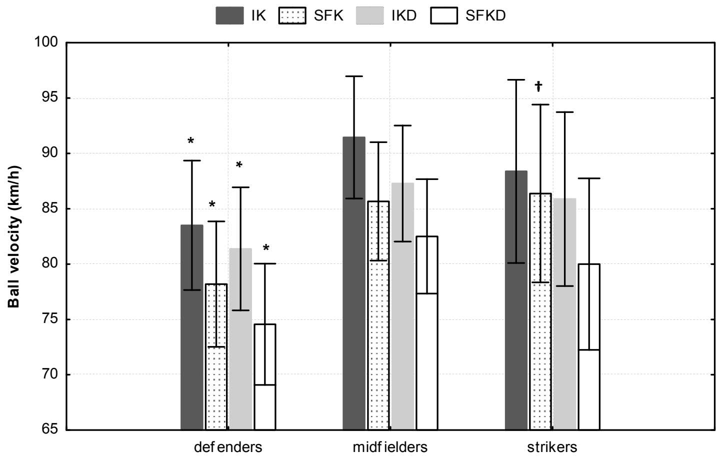
Figure 1 shows differences in ball velocity between diferent playing lines when shooting with preffered leg. Overall, midfielders have demonstrated the best kicking power. There were significant differences ($p \leq 0.05$) between midfielders and defenders in all tests and in one test (side foot kick after dribbling) midfielders scored better than strikers. The fastest kicks were instep kicks when stationary and non-stationary ball was kicked. Shots were taken by midfielders with 106.94±7.07 and 101.61±7.88 km/h respectively.



Legend: IK – instep kick; SFK – side foot kick; IKD – instep kick (after dribbling); SFKD – side foot kick (after dribbling); Fischer LSD post-hoc tests, $p \leq 0.05$: * – significant differences in relation to midfielders; † – significant differences in relation to strikers.

Figure 1. Inter-positional differences of young male soccer players (N=44) in kicking velocity with dominant leg

Figure 2 shows differences in ball velocity between diferent playing lines when shooting with non-preffered leg. Similar to figure 1 midfielders had the best kicking velocities, and in all four tests with non-dominant leg were significantly ($p \leq 0.05$) better then defenders. Strikers scored better than defenders when shooting side-foot kicks on stationary ball. Highest ball speed was measured during instep kicks by midfielders with 91.44±9.56 km/h.



Legend: IK – instep kick; SFK – side foot kick; IKD – instep kick (after dribbling); SFKD – side foot kick (after dribbling); Fischer LSD post-hoc tests, $p \leq 0.05$: * – significant differences in relation to midfielders; † – significant differences in relation to defenders.

Figure 2. Inter-positional differences of young male soccer players (N=44) in kicking velocity with non-dominant leg

Table 1 presents intra–positional differences for 8 soccer–specific shooting tests. In all measured tests for ball kicking speed more skillful (MS) players were better and kicked ball faster than less skillful (LS) players. Additionally, differences between different skill levels were significant ($p \leq 0.05$) in 5 out of 8 tests for defenders, and in 7 out of 8 shooting tests for midfielders and strikers.

Table 1. Intra-positional differences of young male soccer players (N=44) in ball velocity

Variables	Criterion of quality	Defenders (LS=10, MS=6)	Midfielders (LS=7, MS=11)	Strikers (LS=5, MS=5)
		Mean±SD	Mean±SD	Mean±SD
IKDL	LS	96.54±9.24	100.14±2.12	93.00±11.52
	MS	105.67±0.58 *	111.27±5.42 *	111.50±1.91 *
IKNDL	LS	80.85±13.27	83.29±7.59	81.75±14.38
	MS	95.00±4.36 *	96.64±6.68 *	95.00±4.40 *
SFKDL	LS	91.00±5.82	95.14±5.01	91.00±6.68
	MS	96.34±2.65	101.27±5.57 *	101.75±2.99 *
SFKNDL	LS	75.46±15.14	81.29±6.58	80.00±7.26
	MS	90.08±5.20 *	88.45±6.83 *	92.75±7.32 *
IKDLD	LS	94.31±7.50	94.86±6.36	91.50±8.74
	MS	98.00±4.36	105.91±5.39 *	103.75±1.89 *
IKNDLD	LS	78.69±11.86	78.86±5.79	77.00±12.36
	MS	93.08±3.61 *	92.64±6.07 *	94.75±3.20 *
SFKDLD	LS	88.08±6.08	87.71±4.61	85.50±7.33
	MS	90.67±4.73	97.82±6.81 *	91.50±9.68
SFKNDLD	LS	71.77±14.83	80.14±7.63	73.75±7.27
	MS	86.67±6.11 *	84.00±4.38	86.25±9.11 *

Legend: IKDL – instep kick dominant leg; IKNDL – instep kick non dominant leg; SFKDL – side foot kick dominant leg; SFKNDL – side foot kick non dominant leg; IKDLD – instep kick dominant leg (after dribbling); IKNDLD – instep kick non dominant leg (after dribbling); SFKDLD – side foot kick dominant leg (after dribbling); SFKNDLD – side foot kick non dominant leg (after dribbling); * – statistically significant intra-positional differences between less successful and more successful young male soccer players in the analyzed variables, independent t-test, $p \leq 0.05$.

Discussion

The main goal of this research was to determine inter and intra positional differences in ball kicking speed between U-16 Croatian soccer players. In this research, players that are more efficient kicked faster shots then less efficient players, and midfielders were players who kicked the fastest shots. Results obtained were hard to compare considering the fact that almost all previous studies concentrated on all respondents regardless of their playing position. Furthermore, in majority of other papers ball speed results were gained after performing instep kicks. Taking that, and also taking results from this research into consideration, it can be seen that average ball velocities (IKDL – instep kick with dominant leg) from shots taken by midfielders are higher than the ones gathered in previous studies (Nunome et al., 2002; Dørge et al., 2002; Bacvarevic et al., 2012), revealing significantly lower ball velocities. However, it should be noted that their recordings were gathered with cameras and only several meters from the ball kicking spot while the ball still hasn't reach its full speed. Respondents in a few previous studies (Amiri-Khorasani, Osman and Yusof, 2009; Nunome et al., 2006) achieved higher ball velocities than the ones in this research. These studies had a much smaller sample of participants who were highly skilled and professional (Olympic and U-17 international) selected soccer players so the results of this kind were expected. According to the present study's findings, more efficient defenders, midfielders and attackers had higher kick velocities than less efficient players of the same playing position. These intra positional differences were not fully explored and the results indicate the importance of a ball shooting speed in soccer. In all variables, differences were numerically present and in summary starters were significantly better in 19 out of 24 possible variables in comparison with non-starters. As an integral part of the game, ball kicking is one of the major assets for success and therefore we can assume it is one of the distinctions between more efficient and less efficient soccer player. These results are in a way contrary to findings of Commeti et. al. (2001) who detected no significant differences in ball kicking velocities between division 1 players, division 2 players and amateurs (D1=106.37±12.89 km/h, D2=106.94± 7.52 km/h, AM=107.77±5.71 km/h). Since their findings are, as most previous ones, gathered on whole sample of respondents, not taking into consideration different playing lines, there is additional space for much detailed classification of players and interpretation of results. According to this study, the biggest difference between starting and non-starting defenders is in a shooting speed with a non-dominant foot. Apparently, fast and dynamic soccer game requires a good shooting power and kicking technique with both dominant and non-dominant leg. Similar differences were obtained between starting and non-starting midfielders and attackers, although to a lesser extent. Results obtained in this study showed inter positional differences in kicking velocities of 8 soccer-specific shooting tests. As expected, midfielders had the highest ball velocities. Midfielders and attackers were significantly better than defenders what is similar to other findings (Amiri-Khorasani, Osman and Yusof, 2009). Midfielders dictate the tempo of the game; their passes and shots must be precise and fast in order to obtain possession or to score a goal from larger distances. In addition, during the talent identification process trainers often select the midfielders by their knowledge of ball kicking. Contrary to midfielders, defenders are often selected based on their ability to disrupt opposition attacks and their physical dominance rather than their kicking technique. Defenders in this research had slower shots than midfielders in all 8 measuring variables, and slower SFKNDL (side-foot kick with non-dominant leg) than attackers. Most coaches practice simple passing game with defenders who are supposed to deliver the ball to midfield. Also, game roles of defenders are rarely related to shooting, and they use weaker (non-dominant) leg less than attackers who are supposed to shoot and score with both feet, so this study findings are somewhat expected. Midfielders were more successful than strikers in side-foot kicking with dominant leg after dribbling. This type of shooting is similar for both midfielders and attackers, but midfielders use it more often. Throughout the game attackers can often find themselves in goal scoring chances without nearby defenders, in so-called "face to face" encounters with goalkeepers after quality passes from midfielders. On the other hand, midfielders find themselves quite rarely in these situations, most of the time they need to dribble past the opponent in order to shoot on an opponent's goal.

Conclusion

Soccer kicking speed is a very important factor of the game and should be evaluated thoroughly. Inter and intra positional differences in ball kicking speed can provide coaches with much needed information, especially throughout the selection process. This research showed that kicking velocity could be one of the factors for talent identification in soccer, because more successful players in all playing lines kicked faster shots than less successful players. Furthermore, midfielders are the ones that shoot faster kicks than the other playing lines. With one of the used, simple shooting tests, youth soccer coaches can get additional, very useful information for position specialization of the soccer players. Soccer is such a fast and dynamic game and the ability to kick faster shots than the opponent is of great importance. That way team and players generate shots that are harder to defend and even the ball possession is better because opponents have less time to intercept the passes. It could be a crucial difference between winning and losing a soccer match. Soccer kicking is one of the major aspects of the game. Therefore, evaluation of the kicks should be included in the youth soccer academy both as a talent identification marker and as a tool for the selection process.

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Perceived Muscle Soreness, Functional Performance and Cardiovascular Responses to an Acute Bout of Two Plyometric Exercises

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ABSTRACT

Although a few studies examined the effects of plyometric exercise on cardiovascular responses and symptoms of muscle damage, the data about the different types of plyometric exercise such as eccentric-based vs. concentric-based exercise is scarce. The purpose of the present investigation was to compare the effects of eccentric and concentric-based plyometric exercises on post-exercise systolic (SBP) and diastolic blood pressure (DBP), heart rate (HR) and symptoms of muscle damage. Nineteen healthy men volunteered to participate in this study and were randomly assigned to two groups: Depth jump group (DJG; N=9; Eccentric) and Box jump group (BJG; N=10; Concentric). After plyometric exercise SBP, DBP and HR were measured every 10 min for a period of 90 min post-exercise. Also, muscle soreness, vertical jump and 10-m sprint were assessed at 24, 48, and 72 h post-exercise. There were no significant changes in SBP and DBP, and no significant differences between groups in SBP and DBP, whereas the DJG showed greater increases in HR when compared with BJG. Both the groups indicated significant differences in muscle soreness, vertical jump and 10-m sprint at 24, 48 and 72 h post-exercise without significant differences between them. The findings of this study demonstrated that there were no differences in SBP and DBP between groups and both groups showed increases in symptoms of muscle damage following plyometric exercise.

Key words: *Blood Pressure, Heart Rate, Plyometric Exercise, Soreness, Performance.*

Introduction

Plyometric jump training is characterized by a series of exercises involving hops and jumps used to capitalize on the stretch shortening cycle of the muscle (Chu, 1998). Plyometrics consists of a rapid stretching of a muscle (eccentric phase) immediately followed by a concentric or shortening action of the same muscle and connective tissue. The stored elastic energy within the muscle is used to produce more force than can be provided by a concentric action alone (Chu, 1998). It is believed that training with plyometrics facilitates adaptations in muscle function that will increase an athlete's explosive power, which is defined as force time's distance over time (Chu, 1998). Plyometrics has been shown to be an effective method in increasing lower-body power, as measured by vertical jump, sprint and overall athletic performance (Carlson, Magnusen, & Walters, 2009, Arazi, & Asadi, 2011, 2012, Arazi, Coetzee, & Asadi, 2012).

It has been well documented that eccentric muscle contractions during plyometric exercise (PE) induced more force and tension in the cross sectional area of active muscle fibers. These tension and force during eccentric exercise induced muscle damage and soreness, particularly when the muscles were unaccustomed to this type of exercise (Tofas et al., 2008). In comparison of eccentric-based vs. concentric-based PE on acute symptoms of muscle damage, Jamurtas et al. (2000) reported that an acute bout of eccentric exercise induced greater muscle damage than concentric exercise. Frequently observed acute symptoms of plyometric exercise include muscle soreness (Twist, & Eston, 2005), increase in plasma creatine kinase activity (Tofas et al., 2008, Chazinikolaou et al., 2010), loss of strength (Chazinikolaou et al., 2010) and power (Byrne, & Eston, 2002) and a reduction in joint range of motion (Chazinikolaou et al., 2010, Eston, & Peters, 1999). Although above authors explored the effects of plyometric exercise on anaerobic-type activities (e.g., power and sprint), there were a few data about this type of exercise on aerobic components. It has been well reported that aerobic variable of physical fitness is important for enhancing performance, daily life activity and health, therefore, this component can be improve by PE resulting cardiovascular stimulations and their effects on heart rate and blood pressure (MacDonald et al., 1999, Pescatello et al, 2004, Brown et al., 2010, Arazi et al., 2012). Moreover, it seems that PE may induce benefits on VO2max, running economy and other components of aerobic activities. Blood pressure (BP) and heart rate are vital components for cardiovascular and aerobic-type activity measures. It appears that resistance and endurance exercise/training has significant effects on the management of blood pressure and decreases resting heart rate (MacDonald et al., 1999, Pescatello et al, 2004). Newly, plyometric exercise is widely used in athletes for increasing functional performance, but

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the information about this kind of exercise on cardiovascular system; especially on BP is not completely understood.

To our knowledge, a few studies have investigated the BP responses following plyometric exercise, and these studies have shown conflicting results (Arazi et al., 2013, 2014). Previous studies showed that plyometric exercise could increase BP after each set of exercise (Brown et al., 2010, Arazi et al., 2012), but the information about the effects of plyometric exercise on post-exercise hypotension is scarce and no study examined this approach. Moreover, eccentric and concentric phases in plyometrics have differences in stretch-shortening cycle pattern. During eccentric phase, elastic energy stored within the muscle and during concentric phase this energy released. When the PE go to more time between eccentric to concentric exercise the elastic energy change to heat and can influenced on the efficiency of PE and resulting worsens of aerobic and anaerobic performances (Chu, 1998, Arazi, Coetzee, & Asadi, 2012). Depth jump exercises is one of the best exercise in increasing performance and include fast SSC jump (eccentric-based exercise) and Box jump exercise is concentric-only jump (Chu, 1998, Arazi et al., 2013, 2014).

With regard to differences between two types of PE in SSC pattern and performance, the data about these types of PE on cardiovascular and muscle function after a session of exercise is scarce. Therefore, the purpose of this study was to examine the influence of a session of depth jump (eccentric-based exercise) vs. box jump (concentric-based exercise) exercises on post-exercise hypotension (PEH), muscle soreness and functional performance.

Methods

Participants

Nineteen healthy men, who were familiar with plyometric exercise and training, volunteered to participate in this study and were randomly assigned to two groups: Depth jump group (DJG; N=9: age, 20.8±1.3 years; height, 173.6±5.3 cm; and weight, 67.4±7.4 kg) and Box jump group (BJG; N=10: age, 20.8±1.3 years; height, 174.7±5.5 cm; and weight, 70.1±7.7 kg). The subjects were healthy, free from any lower body injuries and had not medical, cardiovascular and orthopedic problems that were confirmed by physician. Before data collection, participants were informed about the nature, benefit, and potential risks of the study, and signed a written informed consent form before beginning the study and the University Human Subjects Institutional Review Board approved all testing and training protocols.

Study Design

The data collection was performed on five consecutive days with 24 h interval between sessions and testing sessions were performed between 2:00 and 4:00 PM. At the first session, subjects recruited to laboratory for the measurement of age, weight and height. During this session, each participant was instructed to proper form and technique of depth jump and box jump exercises and was tested for the baseline of delayed onset muscle soreness (DOMS), vertical jump (VJ) and 10-m sprint. At the second session, subjects reported to laboratory and performed plyometric exercise. Before performing the depth jump or box jump exercise, the subjects performed 10 min warm-up including light running, static stretching and ballistic movements, and then remained seated for 10 min, in a calm and quiet environment. Then, the HR and BP were measured based on pre-exercise value. Then they performed plyometric exercises for 20 min. Also after performing the protocols, subjects seated for 90 min in a quiet and comfortable place, to measure the post-exercise BP every 10 min. An experienced appraiser performed the measurements at before and after exercise for all subjects. In exercise session, rating of perceived exertion was also assessed after each set of exercise. At day 3, 4 and 5, only subjects were reported to laboratory for measuring DOMS, VJ and 10-m sprint tests. The ambit temperature was fixed at 27±1 C° and the air humidity during the tests ranged between 60% and 70%.

Plyometric Exercise

After a 10-min warm-up, participants performed plyometric protocols including 5 set of 20 repetitions box jumps on a 50-cm box (concentric-only jump) and 5 sets of 20 repetitions depth jumps from a 50-cm plyometric box (eccentric jump). Participants had a 2 min rest between sets and 8 seconds interval between jumps.

Box jump procedure: Subjects stood in an upright position, with their feet shoulder-width apart. When the subjects were ready to jump, they dropped quickly into a quarter squat, then extended their hips, swing their arms, and pushed their feet through the floor to propel themselves onto the 50-cm box (Asadi, 2014).

Depth jump procedure: Subjects in the DJ group began by standing on a 50-cm box and were instructed to lead with one foot as they stopped down from the box and landed with two feet on the land. After land contact, they were instructed to explode off the land by jumping as quickly and as high as possible (Arazi et al., 2013, 2014).

Blood Pressure and Heart Rate Measurements

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by the indirect auscultatory method using a sphygmomanometer (Missouri®) and stethoscope (Rappaport® GF Health Products, Northeast Parkway Atlanta). The BP was assessed before the exercise bout and at 10 min interval for 90 minutes after the exercise bout. The HR was measured using Polar S610i heart rate monitor (FIN, 90440, FINLAND) (beat/min).

Rating of Perceived Exertion (RPE)

The rating of perceived exertion (RPE) using the Borg 6-20 RPE Scale 19 was recorded immediately following each set of jumps. After the final repetition, participants were reminded to think about feelings of exertion in the active muscle group, in accordance with previous procedures (Brown et al., 2010, Asadi, 2014).

Delayed Onset Muscle Soreness (DOMS)

Each participant was asked to indicate perceived muscle soreness of the knee extensors using a visual analogue scale. The scale was numbered from 1 to 10 (on the reverse side of the sliding scale) with 1 indicating no muscle soreness and 10 signifying that the muscle was too sore to move. With hands on hips and squatting to an approximate knee angle of 90 deg, participants were asked to indicate the level of perceived soreness based on the rating scale. This corresponded to the location of perceived muscle soreness on the continuum (Tofas et al., 2005, Chatzinikolaou et al., 2010).

Vertical Jump (VJ)

The VJ height was assessed using the VERTEC jump system. Jump height was assessed with a rapid preparatory downward eccentric movement, which utilized the stretch-shortening cycle followed by a maximal jump. Before the assessment of jump height, all participants received a standardized warm-up of three sub-maximal continuous jumps. Participants performed three maximal jumps and the highest jump height was used for further analyses. Participants were encouraged to perform their maximal capacity and to try to jump higher than their previous jump (Asadi, & Arazi, 2012).

10-m Sprint

The participants performed 2 sets of a single 10-m sprint from a standing start on an indoor track with a 3-min recovery. Sprint time was recorded using 2 electronic photo cells positioned at 0 (start) and 10-m. Time for sprint performance was recorded to the nearest 0.01 second via telemetry to a handheld system. The fastest time recorded was used for analysis (Twist, & Eston, 2005).

Statistical Analyses

Data are presented as mean ± SD. Data normality was checked and verified with the Kalmogorov-Smirnoff test. A repeated-measures ANOVA (2 × 10, group × time) was used to analyze SBP, DBP and HR data (SPSS 16.0). To assess changes in RPE between sets, a 2 (group) × 5 (set) ANOVA was applied to the data. Also, to assess changes in DOMS, VJ and 10-m sprint, 2 × 4 (group × time) ANOVA was used to the data. When a significant F value was achieved, a Bonferroni post hoc test was used to detect differences in the measures. Significant level was set at $p < 0.05$.

Results

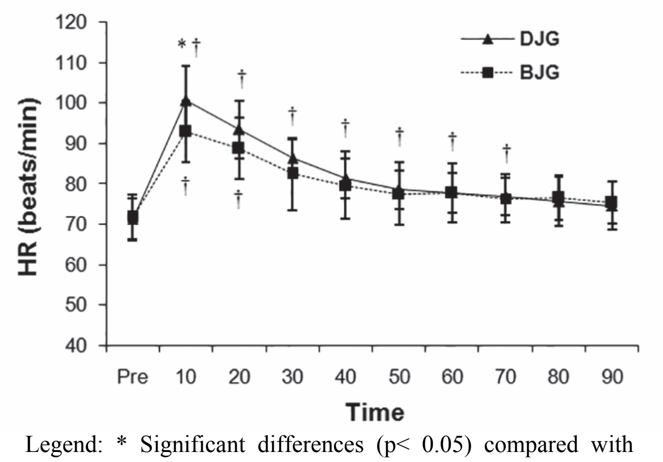
At the beginning of the study, no significant differences were observed between groups in SBP, DBP, HR, DOMS, VJ and sprint ($p > 0.05$).

Table 1. Changes (mean ± SD) in systolic (SBP) and diastolic blood pressure (DBP) at pre and 90 min post Depth jump (DJG) and Box jump (BJG) plyometric exercise.

Time	DJG		BJG	
	SBP (mm Hg)	DBP(mm Hg)	SBP (mm Hg)	DBP (mm Hg)
Pre-exercise	119.1±6.1	75.8±4.2	115.8±8.1	77.1±5.7
10th min	124.2±7.2	75.6±3.7	121.9±8.3	78.3±8.2
20th min	120.8±7.3	76.5±4.6	115.3±9.2	75.5±6.4
30th min	118.2±8.4	75.2±4.6	113.1±7.3	74.6±7.1
40th min	115.7±9.1	74.4±5.7	112.7±8.4	74.6±7.2
50th min	115.3±8.8	74.3±5.5	112.5±9.4	74.8±7.1
60th min	116.4±8.4	74.3±5.2	113.1±9.6	73.8±5.1
70th min	117.5±8.3	75.2±4.8	113.2±8.6	75.2±6.8
80th min	117.2±7.1	74.8±4.9	113.5±8.4	75.3±6.8
90th min	117.4±6.7	75.1±4.9	113.5±8.8	75.1±6.9

Means and SD for SBP and DBP values are presented in Table 1. No significant differences were observed between post-exercise SBP when DJG and BJG were compared. Although the changes in SBP for both the DJG and BJG were not statistically significant, in the SBP the DJG showed increases until 30 min post-exercise and after this point the SBP decreased, whereas the BJG showed increases in 10 min post-exercise and after this point the SBP decreased. No statistically significant changes were seen between groups in DBP and the changes in DBP were not significant for the both groups.

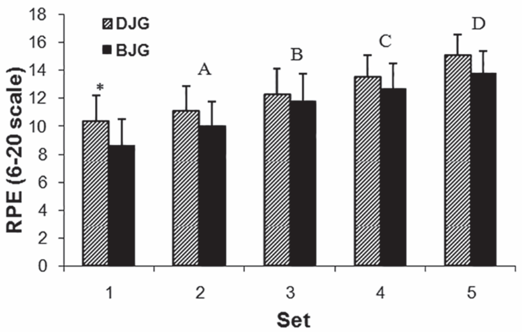
Significant differences were observed between post-exercise HR at 10th min when DJG and BJG were compared (F3.9, 66.4GG=3.5, $p < 0.05$). The DJG showed significant increases in HR until 70 min post-exercise, whereas the BJG showed significant increases until 20 min post exercise when compared to pre-exercise (Figure 1).



Legend: * Significant differences (p< 0.05) compared with BJG; † Significant differences (p< 0.05) compared with pre-exercise value.

Figure 1. Changes (mean ± SD) in heart rate (HR) at pre and 90 min post Depth jump (DJG) and Box jump (BJG) plyometric exercise

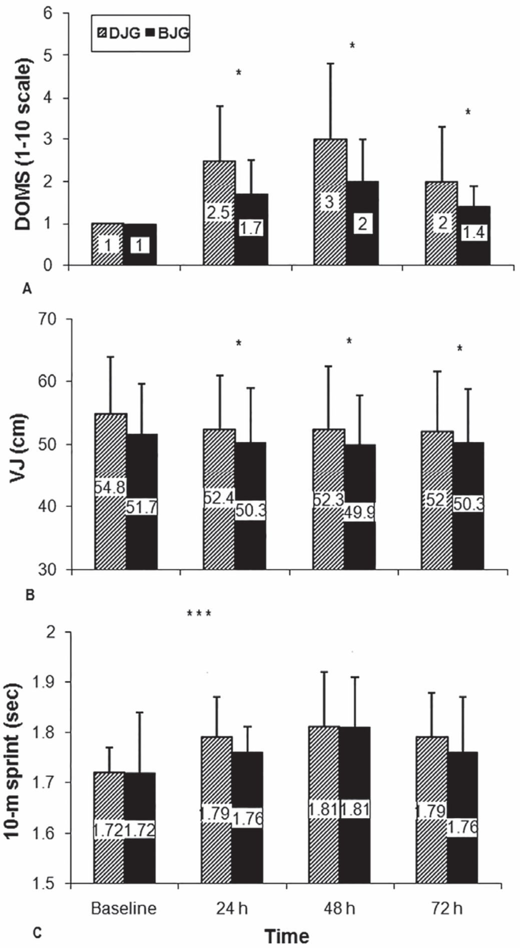
The RPE increased progressively throughout the plyometric exercises (DJG and BJG), with set 2 being harder than set 1, set 3 harder than set 1 and 2, set 4 being harder than set 1, 2 and 3, and set 5 being harder than set 1, 2, 3 and 4. A significant interaction of time and group (F1.7, 28.5GG=125.5, $p < 0.05$) demonstrated that the DJG displayed an increase in perceived exertion greater than BJG at set 1 (Figure 2).



Legend: * Significant differences (p< 0.05) compared with BJG; A Significant differences (p< 0.05) compared with set 1; B Significant differences (p< 0.05) compared with set 1 and 2; C Significant differences (p< 0.05) compared with set 1, 2 and 3; D Significant differences (p< 0.05) compared with set 1, 2, 3, and 4.

Figure 2. Changes (mean ± SD) in rating of perceived exertion (RPE) during 5 set of Depth jump (DJG) and Box jump (BJG) plyometric exercise

The DOMS significantly increased in DJG and BJG at 24 h post-exercise, peaked at 48 h and remained elevated for 72 h during recovery (F1.9, 32.3GG=14.3, p < 0.05). Although, there were no significant differences between groups, the DOMS was greater for the DJG at all time points (Figure 3).



Legend: * Significant differences (p< 0.05) compared with baseline value for both groups.

Figure 3. Changes (mean ± SD) in delayed onset muscle soreness (DOMS, A), vertical jump (VJ, B) and 10 m sprint performance (C) at baseline and 24, 48, and 72 h post Depth jump (DJG) and Box jump (BJG) plyometric exercise

The VJ performance changes are shown in figure 3 B. The VJ declined 24 h post-exercise and remained significantly below baseline until 72 h within recovery (F2.7, 44.2GG=8.5, $p < 0.05$), however there were no significant differences between groups.

Sprint time in the DJG and BJG over 10-m were significantly increased at 24 h, peaked 48 h and remained elevated for 72 h during recovery (F2.3, 38.7GG=6.5, $p < 0.05$). No significant differences between groups were seen in 10-m sprint (Figure 3 C).

Discussion

With regard to important role of plyometric exercise and training on improving muscular performance, the effects of this type of exercise on acute cardiovascular responses is important and few studies focused on this area and information about this aspect is very little. Also, to the best of our knowledge no study compared eccentric and concentric plyometric exercises on blood pressure and heart rate responses and symptoms of muscle damage. Therefore, this study was designed to examine the effect of a bout of plyometric exercise with differing in pattern (eccentric-based vs. concentric-based) on PEH, HR, and symptoms of muscle damage such as DOMS, VJ performance and 10-m sprint in men.

The results indicated that, however, SBP increased after both PE, these changes were not statistically significant. Also, differences in DBP were not remarkable changes after PE. Although, HR increased progressively for both the groups and these increases were higher for DJG. These findings are in agreement with Brown et al. (2010) who reported no significant changes in post-exercise SBP and DBP. In contrast, Arazi et al. (2013, & 2014) reported decreases or increases after PE on SBP and DBP in normotensive men and or in athletes, respectively. The possible mechanisms for these differences could be subjects' status and different PE protocol. Moreover, the exact mechanisms responsible for these responses are unclear. It is possible that high intensity PE induces an increase in sympathetic nerve activity to the heart and blood vessels and altered vascular responsiveness during exercise resulting not remarkable increases in systolic blood pressure (Arazi et al, 2014). Although, no study compared eccentric and concentric plyometric exercise on DBP, therefore it is difficult to compare our results with those of other investigators. The possible mechanism(s) for unchanged DBP could be interactions between increases in cardiac output and decreases in blood vessel resistance (Asadi, 2014). The increases in HR after PE were confirmed by several studies (Brown et al. 2010, Arazi et al. 2012, 2013, 2014). In our previous studies, we examined the effects of DJ exercise with different intensities and workloads on post-exercise HR responses and found significant increases in HR until 50 min post-exercise (Arazi et al. 2012, 2013, 2014). In the current investigation we examined eccentric vs. concentric type of plyometric exercise and found greater HR for eccentric exercise. The mechanism(s) for this response could be force and intensity of PE and greater involvement of the fast twitch muscle fibers and the size of active muscle mass resulting increases in HR (Arazi et al. 2012, 2013, 2014). In addition, the increases local muscle metabolites and/or heat production are also potential stimuli for the increases heart rate responses after PE (Halliwill, Taylor, & Eckberg, 1996). On the other hand, a decrease in muscle cell pH following PE may stimulate chemosensitive afferent fibers, thereby elevating HR (Victor, Bertocci, & Pryor, 1988). It seems that these responses are greater for DJG vs. BJG. Also, another explanation for the difference in HR between the DJG compared to the BJG may be that the DJG completed 2 jumps per repetition compared to the DJG which only completed 1 jump per repetition.

The RPE increased progressively for both the groups and these increases were greater for DJG. These findings are in line with previous authors who reported progressively increases in perceived exertion during PE (Brown et al. 2010, Arazi et al. 2012, Asadi, 2014a, 2014b). In contrast, Ebben et al. (2008) compared EMG activity during these two exercises, and determined that the BJs were more intense because EMG activity was higher. In a study by Asadi (2014a) the DJ exercise was harder than BJ exercise. The differences between these studies and Ebeen's study could be number of repetitions. It seems that 2 repetitions (Ebben, Simenz, & Jensen, 2008) could not stimulate motor cortex and resulting low intensity (Asadi, 2014a, 2014b), whereas we used 20 repetitions. During the negative phase of a plyometric jump, eccentric activation produces higher tension per cross-sectional area of active muscles mass compared with concentric actions resulting significant perceived exertion (Armstrong, Oglivie, & Schwane, 1983). Therefore, we can say that DJ (eccentric) plyometric exercise is harder than BJ (concentric-only jump) exercise and the results of HR confirmed this conclusion.

Muscle soreness developed following DJ and BJ exercises. Determining muscle damage by using visual analogue scale is the best no invasive method and were used in several studies and appeared high relationship with other muscle damage indicators such as serum CK activity (Jamurtas et al. 2000, Twist, & Eston, 2005). These findings are in line with previous researches who reported DOMS increased significantly following plyometric exercise, peaking between 24 and 48 h, and remained elevated for 72 h (Tofas et al. 2008, Twist, & Eston, 2005, Chatzinikolaou et al. 2010). The present DOMS rise (~ 3) may be considered moderate compared with the respective values after eccentric exercise protocols (Armstrong, Oglivie, & Schwane, 1983) in a 10-point scale that may be interpreted as limited muscle damage. Moreover, we found no significant differences between DJG and BJG in DOMS, but DJG showed greater perceived soreness compared to BJG. It appears that eccentric exercise (DJ) induce greater soreness than concentric-only jump (BJ), because the action of landing from the box generates forces and momentum in the lower extremities that accelerate hip and knee flexion and ankle dorsiflexion (Tofas et al. 2008, Chatzinikolaou et al. 2010). To resist the impact of landing, the knee extensor muscles perform an eccentric action that involves a counter extension movement to absorb kinetic energy (Devita, & Skelly, 1992). It seems likely that these repetitive eccentric muscle actions caused muscle soreness to the knee extensors following the DJ exercise.

The VJ height and 10-m sprint were impaired in the treatment groups. These findings are consistent with previous studies that reported a change in VJ and 10-m sprint performance following plyometric exercise (Twist, & Eston, 2005, Byrne, & Eston, 2002, Chatzinikolaou et al. 2010). It appears that the decreases in VJ height and sprint performance are an artifact of the loss in force-generating capability of the knee extensors following muscle damage and restriction of muscle fiber to contraction by PE (Ingalls et al. 1999, Warren et al. 1993). Previous studies have indicated a reduced excitation-contraction (E-C) coupling efficiency due to a reduction in calcium release per action potential, have shown maximal force production is concurrently impaired for several days following PE (Ingalls et al. 1999, Warren et al. 1993). Therefore a reduction in force-generating capability due to E-C coupling fatigue would unsurprisingly reduce the ability of the muscle to produce power and maximal jump (Ingalls et al. 1999).It is plausible that repeated stretching of the quadriceps during plyometric jumping might have led to preferential disruption in type II muscle fibers (Warren et al. 1993, Brockett et al. 2002, Friden, & Lieber, 1992) as a result of early fatigue and temporary increases in muscle stiffness caused within these fibers by the eccentric component (Enoka, 1996). These fibers would then be less able to contribute to force and power generation following the PE and therefore decreases the VJ height and sprint performance (Ingalls et al. 1999, Enoka, 1996). Also, it appears that the rate of muscle glycogen resynthesis being lower in damaged muscle following PE (Asp et al. 1998). With regard to this evidence, it is possible that PE induced impair muscle glycogen metabolism resulting decreases in jump and sprint performance (Asp et al. 1998, Semark et al. 1999).

In summary, we found that plyometric exercise induced significant increases in HR, DOMS, and decreases in VJ and sprint performance and these changes are greater for eccentric type plyometric exercise; however these differences between groups were not statistically significant. Also, with regard to greater responses in HR and RPE, we found that DJ exercise is harder than BJ exercise and both types of exercise had not statistically positive effects on changing post exercise blood pressure. Thus, it is important for coaches and athletes to note that plyometric depth jump is harder and more aggressive than box jump training with no affects on blood pressure. Further research is needed to examine effects of plyometric exercise with differing in pattern and intensity on PEH and symptoms of muscle damage for increasing data about this area.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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Evaluation of Scoring Skills and Non Scoring Skills in the Brazilian SuperLeague Women's Volleyball

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A B S T R A C T

This study analyzed all the games (n=253) from the 2011/2012 and 2012/2013 Seasons of Brazilian SuperLeague Women's Volleyball, to identify the game-related factors that discriminate in favor of winning and losing teams. In the 2011/2012 Season, the Total Shares Setting (TAL) and Total Points Attack (TPA) were factors that discriminated in favor of a defeat. The factors that determined the victory were the Total Shares Serve (TAS), Total Shares Defense (TAD), Total Shares Reception (TAR) and Total Defense Excellent (TDE). In the 2012/2013 Season, the factor (TAD) most often discriminated in favor of victory and the factor that led to defeat was the Total Points Made (TPF). The scoring skills (TPA) and (TPF) discriminated against the final outcome of the game, but surprisingly are associated with defeat and the (TAS) supposed to victory. The non-scoring skills (TAD), (TAR) and (TDE) discriminate the end result of the game and this may be associated with the victory. The non-scoring skill (TAL) determines the outcome of the game and is supposedly associated with the defeat.

Key words: *Match Analysis, Statistics Related-Gaming and Volleyball.*

Introduction

Through an analysis of the game's structure and its performance indicators used in recent research on game analysis, basic rules emerge in the application of performance indicators for any sport (Sampaio, Janeira, Ibanez and Lorenzo, 2006). For different types of games, it is clear that the classification of the action variables to be used as performance indicators follow rules that transcend the various sports. According to Miskin, Fellingham and Florence (2010), the selection and use of these performance indicators depend on the research questions being posed, but of course certain guidelines will ensure a clear interpretation of these data needs.

The game analysis aims to quantify and analyze the events that occur during the competition and identify strengths and weaknesses of both, own team and the opponent, generating implications for the development of training and game tactics (Carling, Reilly and Williams, 2009). The analysis of game statistics is one method of understanding both individual and collective behavior during the competition (Hughes and Bartlett, 2002).

In the literature, studies of production areas made in this field are referenced from different denominations, including: observation of the game (game observation), game analysis (match analysis) and notational analysis (notational analysis). However, the expression most commonly used in the literature is match analysis (Garganta, 2001), which encompasses different stages of the process, namely the observation of events, the notation of the data, and their interpretation.

Notational analysts focus on the general set of indicators, tactical indicators and technical indicators, and have contributed to our understanding of the physiological, psychological, technical and tactical demands in many sports (Miskin, Fellingham and Florence, 2010; Zetou and Tsigilis, 2007). If presented separately, a single set of data (indicators for a performance of an individual or a team) can give a distorted impression of a performance, ignoring other more or less important variables (Hughes and Bartlett, 2002). In addition, the results should be viewed with caution, as those that are obtained by analyzing a limited number of teams, may not be applicable to all teams (Lago-Peñas et al., 2010).

Volleyball is an opposition-cooperation game (Mesquita, 1996), in which the action of a team develops in a separate space from that of the opponent. This condition promotes a systematic alternation between attack and defense (Paulo Greco and Souza, 2000). Thus, according to Mesquita (2005), the mode of play differs from other team sports (soccer, futsal, basketball, handball, water polo, etc.), as a volleyball team acts with the ball in defense, already in other ways the work is done with the ball on offense and without control of the ball on defense.

Palao, Santos and Ureña (2005) determined that the attack or complex 1 (K1) of a team aims to halt the serve of the other team by receiving and soon after arming the attack and then getting the point. Castro and Mesquita (2008) showed that a team can achieve victory by maintaining uniformity in Side Out or Complex 1. But the Counterattack, or Complex 2 (K2), is the set of actions by a team beginning with their own serve, and then organizing the blockade and the defense to abolish the op-

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ponent's attack, organize the distribution to the setting and end with an attack (Palao, Santos and Ureña, 2002). The K2 is deeply linked to the success of the adversary attack. This sequence of actions is well explained by Marcelino and Mesquita (2007) and João Mesquita, Sampaio and Moutinho (2006).

Volleyball includes different indicators that make up the final result of the game, such as points of attack, block and serve, and opponents' mistakes, as well as the quality of implementation of those foundations that do not score, like setting, defense, and reception (João, Leite, Mesquita and Sampaio, 2010). Understanding the ideal combination of these indicators can help a team achieve athletic success in volleyball. The literature on volleyball commonly focuses on the study of statistics related to the game and its effect on team performance. For example, Server ((Marcelino, Mesquita and Afonso, 2008; Marcelino, Mesquita, Sampaio and Moraes, 2010), reception (Quiroga, García-Manso, Rodríguez-Ruíz, Sarmiento, De Saa and Moreno, 2010; Quiroga, Rodríguez-Ruíz, Sarmiento, Muchaga, Grigoletto and García-Manso, 2012), setting (Durkovic, Marelic and Resetar, 2008; Silva, Lacerda and João, 2014), attack (Mesquita and César, 2007; Bergeles, Barzouka, and Nikolaidou, 2009; Castro, Souza and Mesquita, 2011; Afonso and Mesquita, 2011), block (Buscà and Febrer, 2012; Afonso and Mesquita, 2011) e defense (Inkinen, Häyrinen and Linnamo, 2013; Marelić, Resetar and Jancovik, 2004).

Because of the possibility of directly earning points, the attack, block and serve, are considered "Shares Terminals", most frequently referenced in the literature as Scoring Skills. (Marcelino and Mesquita, 2007). In turn, defense procedures, like pass reception and setting are referred to as Non-Scoring Skills, having in Portuguese, two translation possibilities: "Actions not Terminals" or "Continuity Shares" are foundations that do not generate points directly, but can efficiently build the Side Out.

There are several studies on game analysis in football (Lago-Peñas et al., 2010), American Football (Cohea and Payton, 2011), Rugby (Ortega, Villarejo and Palao, 2009), Water Polo (Escalante, Saavedra, Mansilla and Tella, 2011) among others. There are studies in volleyball, but with different samples (João et al, 2010). Compared to other major national competitions, little is known about Brazilian SuperLeague Volleyball.

The aim of the study was to analyze the games of the 2011/2012 and 2012/2013 seasons of Brazilian SuperLeague Women's Volleyball, to identify the factors related to the game that can discriminate in favor of victory or defeat.

Methods

Participants

We analyzed all the games (n=253) of the Brazilian SuperLeague Women's Volleyball 2011/2012 Season (n=148) and 2012/2013 Season (n=105).

Instruments and Variables

Data were collected from official scouts game through the official website of the Brazilian Volleyball Confederation (CBV), provided by SCConsultoria, a private company dedicated to the measurement of performance of the Brazilian SuperLeague Volleyball teams. Table 1 describes all the variables used and analyzed in this study.

Table 1. Description of Variables

Dependent Variable	Description
Match Result (MR)	Victory or Defeat
Independent Variables	**Description**
Total Points Made (TPF)	Total amount of all the points that the team made
Number of Substitutions (NS)	Substitutions count the team realized
Total Points Attack (TPA)	Total amount of direct points that the team won through specific attack actions
Total Share Attack (TAA)	Total number of specific actions that attack the team conducted
Total Points Block (TPB)	Total amount of direct points that the team won through specific block actions
Total Shares Block (TAB)	Total number of specific actions that block the team conducted
Total Points Serve (TPS)	Total amount of direct points that the team won through specific serve actions
Total Shares Serve (TAS)	Total number of specific actions that serve the team conducted
Opponent Errors (EA)	Total amount of direct points that the team obtained through any errors of the opposing team
Total Defense Excellent (TDE)	Total number of specific defense actions that the team successfully conducted
Total Shares Defense (TAD)	Total number of specific actions that defense the team conducted
Total Setting Excellent (TLE)	Total number of specific setting actions that the team successfully conducted
Total Shares Setting (TAL)	Total number of specific actions that setting the team conducted
Total Reception Excellent (TRE)	Total number of specific reception actions that the team successfully conducted
Total Shares Reception (TAR)	Total number of specific actions that reception the team conducted

Statistical Analysis

Reliability Analysis

The reliability of the observations was tested, with Cohen's Kappa (K) interobserver between 0.96 and 1. The analysis of data reliability was performed with "Statistical Package for Social Sciences (SPSS)" version 20.0, and with a degree of significance of 5%.

Statistical Treatment

Initially, were used Kolmogorov-Smirnov test to analyze the normal distribution of data. Like all independent variables are non-parametric data, were used Mann-Whitney U test to evaluate the differences between the overall averages of all victories with the general average of all defeats in the

2011/2012 and 2012/2013 Seasons. Finally, we used a discriminant analysis (DA) to assess the significance of the game statistics on the probability of staff leaving to winning or losing. It assesses the probability of obtaining a result given a set of independent variables (Tabachnick and Fidell, 2007).

The statistical significance of the obtained function was analyzed, and through the structural canonical coefficients |SC| the most powerful indicators were identified. Thus it was considered that the |SC| with relevant statistical significance would present values equal to or superior to 0.30, i.e. |SC|≥0.30 (Tabachnick and Fidell, 2007).

For all statistical analysis, we used "Microsoft Excel" 2010 to catalog and organize the data and "Statistical Package for Social Sciences (SPSS)" version 20.0 to conduct statistical analysis. For the significance level of p<0.05, the confidence level is 95%, and for p<0.01, the confidence level is 99%.

Results

Table 2 presents the comparison of the data of the victories and defeats of the 2011/2012 Season.

Table 2. Comparison of victories and defeats of the Brazilian SuperLeague Women's Volleyball 2011/2012 Season using the Mann-Whitney test

	Victories (n=148)	Defeats (n=148)			
Factors	(M±SD)	(M±SD)	(U)	(Z)	(*p*)
TPF	88.10 ± 13.62	74.06 ± 19.76	6320.00	-6.32	0.000*
NS	6.74 ± 3.19	8.78 ± 2.46	6657.00	-5.87	0.000*
TPA	49.50 ± 10.02	43.39 ± 12.72	7403.50	-4.82	0.000*
TAA	129.86 ± 32.60	135.65 ± 30.66	9605.50	-1.83	0.067
TPB	13.09 ± 4.40	9.03 ± 4.01	5423.00	-7.53	0.000*
TAB	56.11 ± 13.65	50.39 ± 16.78	8293.00	-3.61	0.000*
TPS	4.01 ± 1.98	2.94 ± 1.98	7421.50	-4.85	0.000*
TAS	86.87 ± 14.02	74.95 ± 19.24	6553.50	-5.98	0.000*
EA	21.30 ± 5.90	18.49 ± 6.09	7972.00	-4.05	0.000*
TDE	65.03 ± 17.64	61.23 ± 19.26	9485.50	-1.99	0.066
TAD	95.89 ± 25.94	98.24 ± 23.71	10248.50	-0.96	0.339
TLE	22.06 ± 9.32	18.45 ± 10.44	8483.50	-3.35	0.001*
TAL	123.28 ± 31.63	130.74 ± 29.39	9244.00	-2.32	0.020*
TRE	31.70 ± 11.79	33.26 ± 12.09	10086.50	-1.18	0.240
TAR	67.62 ± 18.26	80.03 ± 13.21	6401.00	-6.18	0.000*

Legend: * Level of Significance (*p*<0.05).

Significant differences were found in almost all variables, except for Total Share Attack (TAA) (p=0.067), Total Defense Excellent (TDE) (p=0.066), Total Shares Defense (TAD) (p=0.339) and Total Reception Excellent (TRE) (p=0.240).

Table 3, shows the results of discriminant analysis between wins and losses for the factors of all the games in the 2011/2012 Season.

Table 3. Values of function discriminant of factors between victories and defeats the all games of Brazilian SuperLeague Women's Volleyball 2011/2012 Season

Factors	Function 1
	|SC|
Total Shares Setting (TAL)	1.00*
Total Shares Serve (TAS)	-0.83*
Total Points Attack (TPA)	0.61*
Total Shares Defense (TAD)	-0.40*
Total Shares Reception (TAR)	-0.39*
Total Defense Excellent (TDE)	-0.30*
Total Points Serve (TPS)	0.25
Opponent Errors (EA)	0.22
Total Shares Block (TAB)	0.20
Total Points Block (TPB)	0.15
Total Setting Excellent (TLE)	0.09
Total Points Made (TPF)	-0.07
Total Reception Excellent (TRE)	-0.06
Number of Substitutions (NS)	0.06
Total Share Attack (TAA)	-0.02
Wilks´ Lambda	0.10
Chi-Square	649.17
Eigenvalue	8.72
Canonical Correlation	0.95
Mean Centroid – Defeats	2.94
Mean Centroid – Victories	-2.94

Legend: * |SC|≥0.30

The values of |SC| factor (TAL) |SC|=1.00 and (TPA) |SC|=0.61 discriminated in favor of a negative match result (MR), i.e. a defeat. The factors that discriminated in favor of a positive (MR), i.e. a victory, included the (TAS) |SC|=-0.83, (TAD) |SC|=-0.40, (TAR) |SC|=-0.39 and (TDE) |SC|=-0.30.

The results of discriminant analysis between wins and losses for the factors of all the games during the 2011/2012 Season, was discovered to be a function responsible for 100% of the total variance integrated with Wilks Lambda (Λ=0.10) and the value of chi-square (x ²=649.17). In this role, the canonical correlation coefficient was 0.95.

Factors to score near a central average of 2.94 are considered predictive factors that can influence the team to a negative (MR), in this case, a defeat. Factors to score near a central average of -2.94 are considered factors that influence the team to a positive (MR), meaning victory.

In the classification of the discriminant function of the confusion matrix between victories and defeats of the 2011/2012 Season, the success of DA adjustment quality was 100% in both game results. In measuring defeat, 100% of the games (148 of 148) were classified successfully. The measurement of victories was also 100%, with 148 of 148 games successfully classified.

Table 4 displays the comparison of the data of the victories and defeats of the 2012/2013 Season.

Table 4. Comparison of victories and defeats of the Brazilian SuperLeague Women's Volleyball 2012/2013 Season using the Mann-Whitney test

	Victories (n=105)	Defeats (n=105)			
Factors	(M±SD)	(M±SD)	(U)	(Z)	(*p*)
TPF	87.61 ± 13.97	71.36 ± 20.84	3096.50	-5.51	0.000*
NS	6.14 ± 3.46	8.49 ± 2.96	3144.50	-5.40	0.000*
TPA	47.89 ± 9.26	39.99 ± 13.03	3307.50	-5.01	0.000*
TAA	119.66 ± 33.15	125.43 ± 30.53	4902.00	-1.39	0.166
TPB	12.99 ± 4.22	9.71 ± 4.54	3107.00	-5.48	0.000*
TAB	51.71 ± 14.22	48.00 ± 16.78	4632.00	-2.00	0.055
TPS	5.54 ± 3.03	3.22 ± 1.92	2830.50	-6.15	0.000*
TAS	86.36 ± 14.26	72.40 ± 20.45	3233.00	-5.19	0.000*
EA	21.34 ± 6.33	18.50 ± 6.44	4203.50	-2.98	0.003*
TDE	59.68 ± 16.72	54.44 ± 18.84	4518.50	-2.26	0.024*
TAD	89.64 ± 27.02	89.57 ± 24.32	5400.00	-0.26	0.798
TLE	22.04 ± 14.34	17.60 ± 18.49	3506.50	-4.56	0.064
TAL	112.21 ± 34.87	118.09 ± 32.42	4888.00	-1.42	0.156
TRE	26.78 ± 14.48	27.47 ± 12.37	5265.50	-0.56	0.574
TAR	64.96 ± 18.95	79.17 ± 13.04	3209.00	-5.23	0.000*

Legend: * Level of Significance ($p<0.05$).

The analysis found significant differences in almost all variables, except for Total Shares Attack (TAA) (p=0.166), Total Shares Block (TAB) (p=0.055), Total Shares Defense (TAD) (p=0.798), Total Setting Excellent (TLE) (p=0.053), Total Shares Setting (TAL) (p=0.156) and Total Reception Excellent (TRE) (p=0.574).

Table 5. Values of function discriminant of factors between victories and defeats the all games of Brazilian SuperLeague Women's Volleyball 2012/2013 Season

Factors	Function 1
	|SC|
Total Points Made (TPF)	-0.50*
Total Shares Defense (TAD)	0.43*
Opponent Errors (EA)	0.23
Total Points Serve (TPS)	0.18
Total Points Block (TPB)	0.15
Total Setting Excellent (TLE)	0.14
Total Defense Excellent (TDE)	-0.14
Total Shares Attack (TAA)	-0.13
Total Shares Setting (TAL)	0.13
Total Reception Excellent (TRE)	0.10
Total Points Attack (TPA)	0.07
Total Shares Block (TAB)	-0.06
Number of Substitutions (NS)	-0.02
Total Shares Reception (TAR)	0.01
Total Shares Serve (TAS)**	0.13
Wilks´ Lambda	0.10
Chi-Square	462.03
Eigenvalue	9.08
Canonical Correlation	0.95
Mean Centroid – Defeats	-2.99
Mean Centroid – Victories	2.99

Legend: * |SC|≥0.30, ** Unused variable in the analysis, because as failed tolerance test.

Table 5 outlines the results of discriminant analysis between wins and losses for the factors of all games during the 2012/2013 Season.

The values of |SC| factor (TAD) |SC|=0.43 discriminated in favor of a positive (MR), i.e. a victory. The factor that discriminated in favor of a negative (MR), i.e. defeat, was (TPF) |SC|=-0.50.

The results of discriminant analysis between wins and losses for the factors of all the games during the 2012/2013 Season was a function responsible for 100% of the total variance integrated with Lambda Wilks (Λ=0.10) and the value of chi-square (x^2=462.03). In this role, the canonical correlation coefficient was 0.95.

Factors to score near a central average of -2.99 are factors predicted to influence the team to a negative (MR), i.e. a defeat. Factors to score near a central average of 2.99 are factors predicted to influence the team to a positive (MR), meaning victory.

In the classification of the confusion matrix of the discriminant function between victories and defeats of the 2012/2013 Season, the success of DA adjustment quality was 100% in both game results. In measuring defeat, 100% of the games (105 of 105) were classified successfully. The measuring of victories was also 100%, with 105 of 105 games are successfully classified.

Discussion

As shown in Table 2, results from the Brazilian SuperLeague Women's Volleyball 2011/2012 Season demonstrate that significant differences emerged, where the winning teams had higher averages of Total Points Made (TPF), Total Points Attack (TPA), Total Points Block (TPB), Total Shares Block (TAB), Total Points Serve (TPS), Total Shares Serve (TAS), Opponent Errors (EA) and Total Setting Excellent (TLE) than losing teams, thereby leading to victory.

The Total Points Made (TPF) is the sum of the Total Points Attack (TPA), Total Points Block (TPB), Total Points Serve (TPS) and opponent errors (EA) (FIVB, 2012). If a team can maintain higher averages than the opponent in all of these factors, they obviously enhance their chances of winning the match. According to Martins (2010), and Matias Greco (2009), Esteves and Mesquita (2007), Durkovic, Marelic and Resetar (2008), Silva, Lacerda and João (2014) excellent setting is related to the setter to using a maximum speed change of balls, thus improving the chances of attack points. The attack is the most decisive variable in the advantage of the team, noted as determining the acquisition of points and team victories (Afonso and Mesquita, 2011; Castro, Souza and Mesquita, 2011; Bergeles, Barzouka, and Nikolaidou, 2009; Castro and Mesquita, 2008; Mesquita and César, 2007).

The losing teams had a higher average Number of Substitutions (NS), Total Shares Setting (TAL) and Total Shares Reception (TAR) than the winning teams, but still failed to achieve victory.

As shown in Table 3, the results of |SC| factor (TAL) |SC|=1.00 supported the notion that the highest average Total Shares Setting (TAL) of the defeated teams, along with the (TPA) |SC|=0.61, were discriminating in favor of a negative (MR), because scores near a central average of 2.94 will influence the team to earn a defeat. The average (TAA) of the defeated teams was higher than the winning teams, although there was a significant difference. However the average (TPA) of the winning teams was higher with significant differences, which strangely means that the |SC| factor (TPA) discriminated in favor of defeat.

Costa, Barbosa, Freire, Matias and Greco (2014) evaluated 18 games (65 sets) of the 12 teams participating in the Brazilian SuperLeague Women's Volleyball during the 2011/2012 Season to identify possible predictors of victory and defeat in volleyball, and found that the variables related to the survey have no predictive power for any (MR), whether positive or negative. Despite being part of the same sample of our research, the difference in the number of analyzed games (18 games vs. 148 games) may be responsible for the disparity regarding the outcome of the factor (TAL).

The factors that determined a positive (MR) included the (TAS) |SC|=-0.83, (TAD) |SC|=-0.40, (TAR) |SC|=-0.39 and (TDE) |SC|=-0.30 because a score around a central mean of -2.94 influenced the team to victory. These discriminatory values say even more with the highest average Total Shares Serve (TAS) of the winning teams. The results also highlight the fact that the number of withdrawals that result in direct points (TPS) was very low, but higher in winning teams. Marcelino, Mesquita, Sampaio and Moraes (2010), Marcelino, Mesquita and Afonso (2008), Marelić, Reset and Jancovik (2004) found that the team with a better serve had a better chance of winning.

The benefit of the serve is not only the direct point, but rather that the serves has an influence on the further development of the game. Thus, it has been observed that running a good service, affects the receiving performance (Quiroga, Rodríguez-Ruiz, Sarmiento, Muchaga, Grigoletto and García-Manso, 2012; Ureña, Espa, Calvo Lozano Ferrer and Perez, 2002) and the attacking options the opposing team, reducing quick attacks (Papadimitriou, Pashali, Sermaki, Mellas and Papas, 2004; Palao, Manzanares and Ortega, 2009). This influence the serve in the attack of alternative causes an increase in the blocking action, which would facilitate the defense (Palao, Santos and Ureña, 2004).

As shown in Table 4, the results gathered from the Brazilian SuperLeague Women's Volleyball 2012/2013 Season, significant differences, showing that winning teams had higher averages of Total Points Made (TPF), Total Points Attack (TPA), Total Points Block (TPB) Total Points Serve (TPS), Total Shares Attack (TAS), Opponent Errors (EA) and Total Defense Excellent (TDE) than the losing teams, thereby leading them to earn the victory.

As Inkinen, Häyrinen and Linnamo, (2013), Marelić, Reset and Jancovik (2004) note, the defense and the reception are irrefutably valuable Volleyball structures for coaches, of such importance that a new player role was created. The libero is an expert in reception and defense. Maia and Mesquita (2006) first described the prominence of the libero. However, researchers have not pinpointed a challenge in the efficacy of libero reception in relation to the players which is the line of 1st touch in women's volleyball.

Instead, the losing teams had a higher average Number of Substitutions (NS) and Total Shares Reception (TAR) than the winning teams, but still failed to earn the victory. It should be noted that the positive reception led to more opportunities to win the set (Garcia-Hermoso, Davila-Romero and Saavedra, 2013; Quiroga, Rodríguez-Ruíz, Sarmiento, Muchaga, Grigoletto and García-Manso, 2012), while reception errors restricted the occasions to win a game (Patsiaouras, Moustakidis, Konstantinos and Kokaridas, 2011). According to Miskin, Fellingham and Florence (2010), this is especially true because it is more difficult to convert a point after a defense than after a pass. It is understood that, after a pass, the attack is already set up, while after a defense, the attack must usually be rebuilt.

As shown in Table 5, the results of |SC| factor (TAD) |SC|=0.43 discriminated for a positive (MR), because the scores near a central average of 2.99 influence the team to victory. Inkinen, Häyrinen and Linnamo (2013) analyzed adult women's volleyball games worldwide and European junior women's volleyball to clarify the differences between the winners and the losers. We analyzed four 2010 World Cup matches and four games of the 2010 Junior European Volleyball Championship and found that the defense level has an effect on the success of the attack, in which the winning teams registered 72.3% (TDE) and 18.1% defensive errors in the Total Shares Defense (TAD). We conclude, therefore, that defending is an important skill for earning victory in women's volleyball match thus confirming and reinforcing our investigation.

Surprisingly, the factor which caused the (MR) to be negative, was (TPF) |SC|=-0.50 because scores around a central mean of -2.99 influenced the team to defeat. As noted earlier, the factor Total Points Made (TPF) should lead the team to a positive (MR), but that was not the case in our findings.

Conclusions

According to the results obtained from this study, we can say that in Brazilian SuperLeague Women's Volleyball 2011/2012 Season, the Total Shares Setting (TAL) and Total Points Attack (TPA) are associated with defeat. The factors that best discriminated in favor of victory, included Total Shares Serve (TAS), Total Shares Defense (TAD) Total Shares Reception (TAR) and Total Defense Excellent (TDE). In Brazilian SuperLeague Women's Volleyball 2012/2013 Season, the Total Shares Defense (TAD) was the most important factor that discriminated in favor of victory, and the factor that most effectively discriminated in favor of defeat was the Total Points Made (TPF).

Thus, responding to the objectives of this study, Scoring Skills (TPA) and (TPF) discriminate the final outcome of the game but are surprisingly associated with defeat. The Scoring Skill (TAS) determines the final outcome of the game and is reportedly associated with victory. The Non-Scoring Skills (TAD) (TAR) and (TDE) discriminate the outcome of the game and may be associated with victory. The Non-Scoring Skill (TAL) determines the outcome of the game, probably due to the defeat.

With the results and data obtained in the present study, we suggest that these variables must be taken into account in the development of coaches, players, and teams who can use this valuable information to create better training procedures.

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The Influence of Social Capital Domains on Self-Rated Health Among Serbian High-School Students? A School-Based Cross-Sectional Study

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ABSTRACT

Social capital has been shown as a positive asset for improving overall health in children and youth. Thus, the purpose of the present study was to determine the associations between family, neighborhood and school social capital with self-rated health among Serbian high-school students. This cross-sectional study on 1220 high-school students (539 males and 681 females) was carried out in the school year 2015/2016. Main outcome was defined as self-rated health, measured by one question: "How would you rate your health?" with five possible answers: (1) very poor; (2) poor, (3) fair, (4) good and (5) excellent. We binarised the outcome, where answers "very poor", "poor" and "fair" represented "poor health" and "good" and "excellent" "good health". Multiple logistic regression was used to determine the associations between social capital domains and self-rated health. Adjusted by gender, body-mass index, self-perceived socioeconomic status, psychological distress and physical activity, good self-rated health was positively associated only with high family social capital (OR 2.29; 95% CI 1.62 to 3.24). When all the social capital variables were entered simultaneously, self-rated health remained associated with family social capital (OR 2.28; 95% CI 1.61 to 3.24). Family social capital was the only domain strongly associated with self-rated health. Since neighborhood and school social capital represent key support and empathy for children and youth, neighborhood and school-based strategies and policies should be implemented within the system to increase overall physical and mental health.

Key words: *Family, Neighborhood, School, Adolescents, Logistic Regression, Health.*

Introduction

Social capital has been defined as social organisations, like networks, high level of interpersonal trust and reciprocity, which work through individuals and facilitate collective actions (Kawachi, Kennedy, Lochner & Prothrow-Stith, 1997). Because of theoretical development, there has been different forms of social capital (Harpham, Grant & Thomas, 2002). Cognitive social capital is constructed from norms of trust, reciprocity and solidarity, while social social capital refers to activities of networks and insitutions (Harpham et al., 2002). Since social capital was firstly introduced by Hanifan (1916) in local school community, a few studies have been dealing with social capital in school (Morgan & Halglund, 2009; Wit, Karioja, Rye & Shain, 2011; Demaray & Malecki, 2002). Moreover, several studies found out that high social capital could have positive effects on health and well-being among adults (Kim, Subramanian & Kawachi, 2008; Murayama, Fujiwara & Kawachi, 2012; Virtanen, Ervasti, Oksanen, Kiwimäki, & Vahtera, 2013) and youth (Novak, Suzuki & Kawachi, 2015; Currie et al., 2012; Borges, Campos, Vargas, Ferreira & Kawachi, 2010; Furuta et al., 2012).. For example, Novak et al. (2015) found significant positive associations between family, neighbourhood and school social capital on self-rated health among Croatian high-school students. Also, Borges et al. (2010), who investigated different type of social capital, found that adolescents who said that someone else could take advantage of them, who did not take time to participate in some community projects and who did not get together with people from different social status were more likely to report poor self-rated health.

Health state among Serbian adolescents does not differ from other adolescents' health in the world. However, it is necessary to point out several facts. Serbia has been through wars and economic sanctions which led to social disintegration, especially including family and school environment in the last 25 years. In that way, children and youth grew and still growing up without adequate social care, guided by images of vandalism and finding themselves within the society they did not create (The Institute of Public Health of Serbia, 2008).

To authors' knowledge, there has been lacking of studies investigating possible influences between family, neighbourhood and school social capital on self-rated health among adolescents (Novak et al., 2015; Borges et al., 2010). Also, associations between social capital and self-rated health are still unclear in different coutries, due to their different demographic characteristics, tradition, heritage, way of living and history. Thus, the aim of the present study was to investigate possible associations between family, neighbourhood and school social capital with self-rated health among Serbian high-school students aged 17-19 years.

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Methods

Participants

This cross-sectional study on a sample of 1220 high-school students (539 males and 681 females) was carried out in the 2015/2016 school year. The students ranged in age from 17-19 years. Basic descriptive characteristics are presented in Table 1. One of the parents for each subject signed an informed consent form. The students signed an assent form as well. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved in advance by Faculty of Sport and Physical Education.

Self-rated health

Self-rated health was assessed using one-item measure: "How would you estimate your health?". Possible responses were arranged through five-item Likert-scale: very poor (1), poor (2), neither poor or good (3), good (4) and excellent (5). Given responses were binarised, where answers very poor, poor and fair were categorized as poor, while good and excellent represented good self-rated health. Self-rated health, as a measure, has been used in adult (Idler & Benyamini, 1997) and adolescent (Johnson & Richer, 2002) population.

Social capital domains

Social capital in children and youth has been consisted of family, neighborhood and school social trust (Morrow, 1999). Family social capital was assessed using one-item question: "Do you feel that Your family understands and gives attention to you?". Neighborhood social capital was assessed using two-item questions: "Do you feel people trust to each other in your neighborhood?" and "Do you feel that your neighbors step in to criticize someone's deviant behavior during high school. The first neighborhood social capital question referred on neighborhood trust, and the second one on informal social control. School social capital was assesses using three-item questions: "Do you feel that teachers and students trust each other in your high-school?", "Do you feel students trust to each other in your high-school?" and "Do you think students collaborate to each other in your high school?". The first school social capital question referred on vertical school trust, the second one on horizontal school trust and the third on reciprocity at school. Possible answers were arranged across five-item Likert-type scale: (1) strongly agree, (2) agree, (3) neither agree or disagree, (4) low disagree and (5) disagree. We binarised the outcome of each variable as "high" (strongly agree and agree) and "low" (neither agree or disagree, low disagree and disagree).

Table 1. Characteristics of the study subjects, Serbia, 2016

	Total (N=1220)	Males (N=539)	Females (N=681)	p value*
	N (%)	N (%)	N (%)	
Self-rated health				
Poor	323 (26.5)	111 (20.6)	212 (31.1)	
Good	897 (73.5)	428 (79.4)	469 (68.9)	<0.001
Family social capital				
Low	218 (17.9)	97 (18.0)	121 (17.8)	
High	1002 (82.1)	442 (82.0)	560 (82.2)	0.917
Neighbourhood trust				
Low	1041 (85.3)	440 (81.6)	601 (88.2)	
High	179 (14.7)	99 (18.4)	80 (11.8)	<0.001
Informal social control				
Low	729 (59.1)	341 (63.3)	380 (55.8)	
High	499 (40.9)	198 (36.7)	301 (44.2)	0.008
Vertical school trust				
Low	964 (79.0)	400 (74.2)	564 (82.8)	
High	256 (20.1)	139 (25.8)	117 (17.2)	<0.001
Horizontal school trust				
Low	894 (73.3)	369 (68.5)	525 (77.1)	
High	326 (26.7)	170 (31.5)	156 (22.9)	<0.001
Reciprocity at school				
Low	608 (49.8)	259 (48.0)	349 (51.2)	
High	612 (50.2)	280 (52.0)	332 (48.8)	0.267
Body mass index				
Normal	1070 (87.7)	429 (80.0)	645 (94.7)	
Overweight/obese	150 (12.3)	110 (20.0)	36 (5.3)	<0.001
Self-perceived socioeconomic status				
High/middle	734 (60.2)	322 (59.7)	416 (61.1)	
Low	486 (39.8)	217 (40.3)	265 (38.9)	0.632
Psychological distress				
High	154 (12.6)	59 (11.0)	100 (14.7)	
Low	1066 (87.4)	480 (89.0)	581 (85.3)	0.054
Physical activity				
High/moderate	825 (67.6)	414 (76.8)	406 (59.6)	
Low	395 (32.4)	125 (23.2)	275 (40.4)	<0.001

Legend: *Chi-square test.

Covariates

Physical activity was assessed using the validated short version of the International Physical Activity Questionnaire (IPAQ) and was expressed as metabolic equivalent (hours per week) (Craig et al., 2003). As additional potential mediators, we considered body mass index based (BMI) on the calculation from self-reported height and weight (scoring of responses in the range ≥25 kg/m2 vs <25 kg/m2) discriminates between respondents with and without high BMI). Socioeconomic status was entered in our regression models as a potential confounder, that is, theoretically associated with self-rated health and social capital (Subramanian, Kim, & Kawachi, 2002). The classification of socioeconomic status was based on both parents' occupation at the time when the research was conducted. Self-perceived socioeconomic status was categorized into three levels as high (i.e., managers and professionals), middle (white collar) and low (blue collar) (Wang, Byrne, Kenardy, & Hills, 2005) and it was dichotomized as high/middle (responses in the range 2–4) and low (responses in the range 5–6). Psychological distress was also assessed as a potential confounder using the six-item Kessler scale by the questions: ''About how often during the past 30 days did you feel nervous?'', ''During the past 30 days, about how often did you feel hopeless?'', ''During the past 30 days, about how often did you feel restless or fidgety?'', ''How often did you feel so depressed that nothing could cheer you up?'', ''During the past 30 days, about how often did you feel that everything was an effort?'' and ''During the past 30 days, about how often did you feel worthless?" (Kessler et al., 2003). Each question is scored from 0 (none of the time) to 4 (all of the time). Scores of the six questions were then summed (0–24), with a lower score indicating low levels of psychological distress. Previous research has shown that dichotomous scoring of responses in the range 13+ versus 0–12 discriminates between respondents with and without significant psychological distress (Kessler et al., 2003).

Table 2. ORs for good self-rated health among high-school students, Serbia, 2016

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Family social capital				
Low				
High	2.29 (1.62 to 3.24)***			2.28 (1.61 to 3.24)***
Neighbourhood trust				
Low				
High		1.01 (0.68 to 1.50)		0.90 (0.60 to 1.35)
Informal social control				
Low				
High		0.93 (0.70 to 1.22)		0.95 (0.72 to 1.26)
Vertical school trust				
Low				
High			1.29 (0.89 to 1.88)	1.30 (0.89 to 1.91)
Horizontal school trust				
Low				
High			1.02 (0.72 to 1.46)	0.99 (0.69 to 1.42)
Reciprocity at school				
Low				
High			1.07 (0.80 to 1.44)	1.06 (0.78 to 1.43)
Gender				
Male				
Female	0.53 (0.39 to 0.72)***	0.54 (0.40 to 0.73)***	0.55 (0.41 to 0.74)***	0.54 (0.40 to 0.73)***
Body mass index				
Normal				
Overweight/obese	0.59 (0.38 to 0.92)*	0.62 (0.40 to 0.95)*	0.62 (0.40 to 0.95)*	0.60 (0.39 to 0.93)*
Self-perceived socioeconomic status				
High/middle				
Low	0.96 (0.72 to 1.27)	0.99 (0.75 to 1.31)	0.99 (0.75 to 1.30)	0.95 (0.72 to 1.26)
Psychological distress				
High				
Low	0.63 (0.42 to 0.93)*	0.52 (0.35 to 0.75)***	0.52 (0.36 to 0.76)***	0.63 (0.43 to 0.94)*
Physical activity				
High/moderate				
Low	0.56 (0.42 to 0.74)**	0.57 (0.43 to 0.76)**	0.57 (0.43 to 0.76)**	0.56 (0.42 to 0.74)**

Legend: *p<0.05, **p<0.01, ***p<0.001.

Statistical analysis

All the analysis were analyzed using SPSS 18.0 software (SPSS Inc. Chicago, IL USA). Firstly, we determined number of answered questions using percentages (%). Differences for categorical variables were determined using Chi-square test. The associations between social capital variables and self-rated health were determined using multivariate logistic regression. Also, as potential cofounders, we entered gender, body mass index, level of socio-economic status, level of psychological distress and level of physical activity. In the present study, we investigated the associations between family social trust and self-rated health (Model 1), between neighborhood social trust and self-rated health (Model 2), between school social trust and self-rated health (Model 3) and between all social capital determinants simultaneously entered into the model with self-rated health (model 4). Statistical significance was set up at p<0.05.

Results

Among all students, the prevalence of students reporting poor self-rated health was 26.5% (20.6% for males and 31.1% for females). As expected, almost 90% of them reported normal body mass index (80.0% for males and almost 95% for females). Female students reported slightly higher high psychological distress (14.7%) than male students (11.0%). Also, more male students were involved in doing high/moderate physical activity during past 7 days (Table 1).

The associations between social capital domains (separately and simultaneously) are presented in Table 2. Adjusted by gender, body mass index, self-perceived socioeconomic status, psychological distress and physical activity, only family social capital was significantly associated with self-rated health (OR 2.29; 95% CI 1.62 to 3.24). When all variables were entered simultaneously, family social capital remained significantly and positively associated with self-rated health (OR 2.28; 95% CI 1.61 to 3.24). Other social capital domain did not show significant associations with self-rated health, whether they were entered separately or simultaneously.

Table 3. Coefficients for good self-rated health associated with family, neighborhood and school social capital among high school students, Serbia, 2016

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Family social capital				
Low				
High	0.83 (0.49 to 1.19)***			0.83 (0.47 to 1.17)***
Neighbourhood trust				
Low				
High		0.01 (-0.35 to 0.43)		-0.10 (-0.53 to 0.33)
Informal social control				
Low				
High		-0.07 (-0.36 to 0.21)		-0.05 (-0.34 to 0.24)
Vertical school trust				
Low				
High			0.25 (-0.14 to 0.67)	0.27 (-0.12 to 0.68)
Horizontal school trust				
Low				
High			0.02 (-0.33 to 0.38)	-0.01 (-0.36 to 0.35)
Reciprocity at school				
Low				
High			0.07 (-0.23 to 0.38)	0.06 (-0.24 to 0.36)
Gender				
Male				
Female	-0.64 (-0.96 to -0.33)***	-0.62 (-0.91 to -0.32)***	-0.60 (-0.92 to -0.31)***	-0.62 (-0.95 to -0.32)***
Body mass index				
Normal				
Overweight/obese	-0.52 (-0.94 to -0.08)*	-0.48 (-0.92 to -0.01)*	-0.48 (-0.93 to -0.02)*	-0.51 (-0.96 to -0.09)*
Self-perceived socioeconomic status				
High/middle				
Low	-0.04 (-0.36 to 0.23)	-0.01 (-0.32 to 0.29)	-0.01 (-0.31 to 0.29)	-0.05 (-0.34 to 0.24)
Psychological distress				
High				
Low	-0.47 (-0.86 to -0.03)*	-0.66 (-1.03 to -0.26)***	-0.65 (-1.06 to -0.28)***	-0.46 (-0.89 to -0.01)*
Physical activity				
High/moderate				
Low	-0.58 (-0.89 to -0.28)**	-0.55 (-0.83 to -2.64)**	-0.56 (-0.84 to -0.27)**	-0.59 (-0.88 to -0.30)**

Legend: *p<0.05, **p<0.01, ***p<0.001.

The associations between social capital domains and self-rated health, presented by coefficients, are presented in Table 3. According to model 1, family social capital was significantly and strongly associated with self-rated health (β coefficient 0.83; 95% CI 0.49 to 1.19). When all the variables were entered simultaneously, family social capital remained significantly and positively associated with self-rated health (β coefficient 0.83; 95% CI 0.47 to 1.17). Other variables did not show significant associations with self-rated health.

Discussion

The aim of the present study was to examine possible associations between family, neighborhood and school social capital with self-rated health among Serbian high-school students aged 17-19 years.

Results from our study showed that family social trust was the only social capital domain strongly associated with self-rated health. Previous study from Novak et al. (2015) showed that high-school students, who reported high family social capital, were almost 2.5 times more likely to report good self-rated health. Family plays important role and support in children's life. Studies showed that children who regularly talked to their parents, were more likely to report positive body image (Fenton, Brooks, Spencer & Morgan, 2010), self-rated health and not smoking (Pedersen, Granado Alcón & Smith, 2004) and higher life satisfaction (Levin & Currie, 2010). According to Lambert and Cashwell (2004), "warm" communication between father and male adolescent may prevent aggressive and violent lifestyle. One other study showed that family impact was strongly associated with socioeconomic status, higher parental education and the ability of creating enriched learning environment (Bornstein & Bradley, 2003). Since Serbia, also like the other countries from Eastern bloc, moved from socialism to capitalism, families have become more important for financial and social support (Kennedy, Kawachi & Brainerd, 1998).

Our results did not show significant associations between neighborhood and school social capital with self-rated health. Our results were inconsistent with other study (Drukker, Buka, Kaplan, McKenzie & Van Os, 2005). For example, Drukker et al. (2005) reported that community informal social control was associated with higher levels of health. Also, another study from Drukker, Kaplan, Feron & Van Os (2003) showed that high informal social capital served as a preventive method, by keeping them away from engaging in some risk behaviors. Authors of the present study speculate that those result changes occur because of socioeconomic characteristics, tradition and history Serbia had. In one recent study, national sample of Serbian people showed lower level of trust on institutions and networks, in comparison to European Union countries. Also, results from the same study showed that participation in community actions did not lead to higher level of universalistic norms (Stanojević & Stokanić, 2014). According to Putnam (1993), due to different social integration, post-socialistic societies go through a period of low trust, individual competencies and lower level of participation in community actions for the common good. One study showed that the trust of young people was very personalized, where family relations were the only certain social relationship (Tomanović & Stanojević, 2015), which is consistent with our results. Neighborhood and school social trust might be directly associated with children and youth, who did not give enough trust to others with different political, sports or religious beliefs (Tomanović & Stanojević, 2015). Also, results from the same study showed that youth with higher educational degree were more likely to trust others, than those with lower education degree, due to insecurity and competing interest. Serbian people, especially youth, still affected by the Homeland War, increased the distance and community trust towards Croats, Romas and other nations influencing on their future.

Our study has several limitations. First, due to cross-sectional design, we cannot exclude reverse causality, that is, that higher level of family social capital is caused by higher level of self-rated health. Second, since we used questionnaires, as subjective method, possible method bias may occur. Third, since we also gave them to fulfill the questionnaires during the class, it is also possible that environment method bias might occur (because of the teacher standing there). Fourth, social capital might not be fully understandable by the students, pointing out different individual understanding of it. Fifth, future studies are warranted to assess all three domains (family, neighborhood and school social capital) by approaching different sample subjects.

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Guidelines for Authors

Revised September 2014

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Transfer of Learning on a Spatial Memory Task between the Blind and Sighted People Spatial Memory among Blind and Sighted

Original Scientific Paper

Transfer of learning on a spatial memory task

Selcuk Akpinar[1], Stevo Popović[1,2], Sadettin Kirazci[1]

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E-mail:

Word count: 2,980

Abstract word count: 236

Number of Tables: 3

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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):

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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):

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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

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Table footnotes should be written below the table.

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- ✓ *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)
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2.6. Figures

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

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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.

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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.

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× 10 %	× 10 º	× 10kg	× 12 : 2	× .056

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✓ 45±3.4	✓ p<0.01	✓ males >30 years of age
× 45 ± 3.4	× p < 0.01	× males > 30 years of age

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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*

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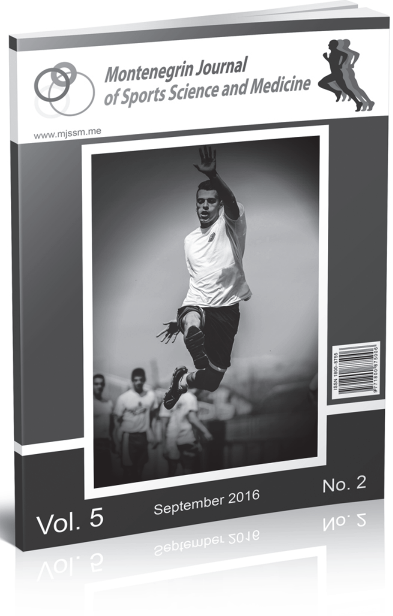

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