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Dear Readers,

As it is already well-known, our journal, Montenegrin Journal of Sports Science and Medicine, provides an ideal forum for exchange of information on aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side, in various formats: original papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers. However, made a step further in this process and I am so proud to announce our journal has been indexed in Thomson Reuters Core Collection last issue.

In recent years, the Montenegrin Journal of Sports Science and Medicine has continued to show important advances in both the content and quality of its published articles, and the volume of submissions has increased substantially. Since the end of 2015, over 100 manuscripts have been processed (peer- and editorial-reviewed, and accepted or rejected). Now indexed in 48 databases, Montenegrin Journal of Sports Science and Medicine has kept recognition as one of Montenegrin leading scientific journals in the area of sports

science and medicine. This is reflected in its new status at “scientific sky”, as recognized by the Thomson Reuters, the Emerging Source Citation Index (ECSI). Additionally, Montenegrin Journal of Sports Science and Medicine has earned a current score of ICV 6.81, as reported in the IC Journals Master List 2014, as well as it is at the last stage of inclusion in Scopus database. As a consequence of these accomplishments, on behalf of our authors, journal board members and anonymous reviewers, all of people who have volunteered to contribute to the success of the journal, I have a pleasure to invite additional members to join us in an effort to make the Montenegrin Journal of Sports Science and Medicine widely recognized international publication.

Finally, we wish to encourage more contributions from the scientific community and industry practitioners to ensure a continued success of our journal. Authors, reviewers and guest editors are always welcome. We also welcome comments and suggestions that could improve the quality of our journal.

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

Editor-in-Chief
Prof. Duško Bjelica, PhD

The acute effects of hip abductors fatigue on postural balance

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ABSTRACT

The aim of this study was to investigate the effects of unilateral hip abductor fatigue on body sway in ipsilateral and contralateral single legged stance. Acute effects repeated measurements design. Thirteen recreationally active middle aged subjects participated in the study. All subjects performed two 30s repetitions of unilateral stance on each leg. The first measurement was obtained at baseline, the second followed a control protocol of active hip abduction in supine position without additional resistance and the third measurement was conducted as aforementioned second protocol, only against elastic resistance. The center of pressure (CoP) movement characteristics during single-leg quiet stance (i.e. body sway) were analyzed by calculating the average velocity of the CoP movement and direction specific (medial-lateral and anterior-posterior) average velocity, amplitude and frequency of the CoP movement. The results of this study indicate that fatigue significantly affected body sway in both single leg stances ($p < 0.05$) and in both medial-lateral and anterior-posterior direction. However, medial-lateral body sway tended to be increased more than in anterior-posterior direction. A significant crossover effect of increased body sway on the opposing limb suggests that in addition to local muscle fatigue, changes in central nervous system might have taken place. The above findings are of greater importance as they allow a more thorough insight into the mechanisms responsible for controlling balance that could have an important implication on designing training programs.

Key words: balance, body sway, fatigue, unilateral stance.

Introduction

Maintenance of postural balance is an important requirement for the efficient performance in undertaking most sporting activities. Maintaining an upright stance is crucial throughout the performance especially in more challenging conditions that athletes face frequently. Athletes are therefore required to compensate for postural perturbations that challenge bilateral and unilateral stances. These stances are maintained and preserved by different balancing strategies known as ankle and hip strategy (Benvenuti, 2001). In the anterior-posterior (a-p) direction, balance is primarily controlled by ankle plantar/dorsal flexion and by hip flexion/extension while in the medial-lateral (m-l) direction; postural control mainly depends on ankle inversion/eversion and hip adduction/abduction (Benvenuti, 2001; Lee & Powers, 2014).

During tasks such as single legged landings and jumping as well as wider squatting in defense commonly observed in agility sports, maintaining posture and appropriate body alignment becomes more challenging. In order to ensure the desired state, the correct and synchronized muscle output is essential (Neumann, 2010; Ward, Winters, & Blemker, 2010). As these events last for a prolonged period of time, coupled with high intensity, expected neuromuscular fatigue develops especially towards the end of the game (Gehring, Melnyk, & Gollhofer, 2009). This causes deterioration of balance, especially in maintaining unilateral stance that reflects on poor landing technique and could possibly lead to lower limb injuries (Lee & Powers, 2014). There-

fore understanding the effects of fatigue on unilateral stance is of great importance.

A number of studies have reported the diminished postural control in experimentally induced fatigue on distal parts of lower limbs (Bisson, Chopra, Azzi, Morgan, & Bilodeau, 2010; Boyas, Hajj, & Bilodeau, 2013; Boyas et al., 2011).

However, according to Allum, Bloem, Carpenter, Hulliger, and Hadders-Algra (1998) trunk and hip inputs may be more important in triggering human balance corrections, while proprioceptive input from the lower extremities mainly helps with the final shaping and intermuscular coordination of postural and gait movements. Therefore inability to produce and sustain force output of hip musculature is vital, especially in unilateral standing where hip strategy becomes more superior in maintaining balance (Winter, 1995). This was confirmed in the study by Reimer and Wikstrom (2010) where proximal muscle fatigue resulted in greater postural control deficits assessed in unilateral stance by fatiguing hip flexors and extensors.

According to Sarabon, Rosker, Loeffler, and Kern (2013) standing on a single leg causes an increase of body sway parameters in m-l direction. The latter is suggested to be primarily controlled by hip adductors and abductors. Gribble and Hertel (2004), as well as Salavati, Moghadam, Ebrahimi, and Arab (2007) have studied the effect of fatigue of hip adductors and abductors on unilateral standing task and found that fatigue alters balance control. However, the studies have focused only on the effects of fatigue on balance when fatiguing ipsilateral side. It is suggested that local muscle fatigue can also alter muscular

performance of other non-fatigued muscles on the contralateral side (Halperin, Chapman, & Behm, 2015), it remains unknown how contralateral effect of fatigue influence balance control.

Based on the above discussion the first aim of this study was to investigate whether unilateral experimentally induce fatigue effects only ipsi- or also contra-lateral balance control (i.e. stance dominant (DO) and non-dominant (ND) leg). In addition, the second aim was to investigate whether isolated hip abductors fatigue alters balance in multiple planes.

Methods

Thirteen healthy and recreationally active subjects (8 women, 5 men; age, $33 \pm 10,8$ y, height $1.7 \pm 0,1$ m, mass, $68,4 \pm 19,8$ kg) with no history of visual, vestibular, neurologic impairments or any injuries to the lower extremity participated in this study. All participants were required to read and sign an informed consent form. The study was approved by the Slovenian committee for Medical Ethics and was performed according to the Declaration of Helsinki.

Study protocol

Postural balance was tested with a single-leg quiet stance task. Subjects were required to stand barefoot on a force plat-

form maintaining a unilateral stance while concentrating on the stationary target positioned at an eye level height at a 2m distance. Subjects were then instructed to remain as still as possible until told to relax. Four trials of 30 seconds (2 trials each leg) were performed at baseline (BSL), after control protocol (CO) and after at the end of fatiguing trials (FAT).

Following completion of the pre-fatigue balance task (BSL), each participant underwent a control protocol. This was set to rule out possible effects of alterations in proprioceptive feedback that could be a result of mono-articular hip movements. The control protocol was performed with subjects laid down on their back, abducting and adducting their DO with the range of motion of 0° to 45° of hip abduction. Participants were instructed to move the leg for three sets of 35 repetitions interspaced by 1-minute rest periods. Immediately after the control protocol and balance task that followed, subjects had a 5-minute rest period before starting the fatiguing protocol. Fatiguing protocol consisted of the same leg movement as in the aforementioned control protocol; however abduction was performed against an elastic resistance (concentric muscle activity in abduction and eccentric muscle activity in adduction) (Figure 1). The fatiguing protocol consisted of: 3 sets, load intensity of 25 to 45 repetition maximum and 1-minute breaks between sets.



Figure 1: Fatiguing task: 0° to 45° hip abduction (arrow) against resistance of the elastic tube attached to the leg (above the ankle of the stance dominant leg) using a cuff.

Measurement and equipment

The signals from the force plate (9260AA6, Kistler, Winterthur, Switzerland) were acquired with 1000 Hz sampling rate and filtered with 2nd order Butterworth, 0.1-20 Hz band-pass filter. The signals were analyzed using a specialized software (MARS, Kistler, Winterthur, Switzerland) calculating the following parameters: average CoP movement velocity (CoPV), average CoP movement velocity in a-p direction (CoPVa-p), average CoP movement velocity in m-l direction (CoPvm-l), average CoP amplitude in a-p direction (CoPAa-p), average

CoP amplitude in m-l direction (CoPAm-l), average frequency of CoP movement direction changes in a-p direction (CoPFa-p) and average frequency of CoP movement direction changes in m-l direction (CoPFm-l). For each parameter an average of two trials were used for further statistical analysis.

Statistical analysis

Statistical analyses was performed using statistical software SPSS 18.0 software (SPSS Inc., Chicago, USA). Descriptive statistics were calculated for all parameters observed. Repeated

measures analysis of variance (rANOVA) was used to analyze the differences in individual CoP movement parameters between BSL, CO and FAT. The two-way rANOVA (Leg (2) \times Condition (3)). Pair-wise comparisons (2-tailed t-test with Bonferroni correction) were used for post hoc analysis. In all tests, statistical significance was set at $p < 0.05$. Additionally, effect sizes were calculated.

Results

Descriptive statistics (mean and standard deviation), results of repeated measures ANOVA and results of paired T-test for each individual parameter of CoP movement are shown in Ta-

ble 1 (for the ND leg) and Table 2 (for the DO leg). A general tendency of an improved balance was suggested following CO. Balance was decreased after FAT for both legs. All CoP parameters changed significantly between the BSL, CO and FAT for the DO leg (exceptions were CoPFa-p and CoPFm-l). On the contrary, balance didn't change between the conditions while standing on the ND leg (exception was the CoPFa-p). The improvement from BSL to CO was statistically significant only for DO leg (exceptions CoPFa-p and CoPFm-l). However, changes from CO to FAT were statistically significant for both legs. A more systematic and higher statistical significance were found in CoPvm-l and CoPAm-l as compared to CoPva-p and CoPaa-p.

Table 1. Results of descriptive statistics, one-way rANOVA and post hoc t-tests for the stance dominant (i.e. exercised) leg; baseline (BSL), control (CO), and fatigued (FAT).

Parameter (unit)	Descriptive (mean \pm st. dev.)			rANOVA		t-test	
	BSL	CO	FAT	BSL : CO : FAT	BSL : CO	FAT : CO	BSL : FAT
CoP _V (mm/s)	33.1 \pm 9.0	30.3 \pm 8.0	35.0 \pm 9.5	F = 6.20; p = 0.01; ES = 0.34	t = 3.32; p = 0.01; ES = 0.69	t = 2.85; p = 0.01; ES = 0.64	t = 1.35; p = 0.20; ES = 0.36
CoP _{Va-p} (mm/s)	20.8 \pm 5.8	19.0 \pm 5.3	21.8 \pm 6.1	F = 5.43; p = 0.01; ES = 0.31	t = 3.24; p = 0.01; ES = 0.68	t = 2.67; p = 0.02; ES = 0.61	t = 1.10; p = 0.29; ES = 0.30
CoP _{Vm-l} (mm/s)	21.9 \pm 6.2	20.0 \pm 5.3	23.2 \pm 6.6	F = 5.24; p = 0.01; ES = 0.30	t = 2.83; p = 0.02; ES = 0.63	t = 2.70; p = 0.02; ES = 0.61	t = 1.21; p = 0.25; ES = 0.33
CoP _{Aa-p} (mm)	6.8 \pm 2.0	6.0 \pm 1.9	6.9 \pm 2.1	F = 5.74; p = 0.01; ES = 0.32	t = 2.83; p = 0.02; ES = 0.63	t = 2.54; p = 0.03; ES = 0.59	t = 0.15; p = 0.88; ES = 0.04
CoP _{Am-l} (mm)	7.7 \pm 2.1	6.7 \pm 1.9	8.2 \pm 1.9	F = 7.81; p = 0.00; ES = 0.39	t = 2.46; p = 0.03; ES = 0.58	t = 3.45; p = 0.00; ES = 0.71	t = 1.63; p = 0.13; ES = 0.43
CoP _{Fa-p} (Hz)	3.1 \pm 0.4	3.3 \pm 0.5	3.2 \pm 0.6	F = 1.05; p = 0.36; ES = 0.08	t = -1.47; p = 0.17; ES = 0.39	t = -0.16; p = 0.88; ES = 0.05	t = 1.43; p = 0.18; ES = 0.38
CoP _{Fm-l} (Hz)	2.9 \pm 0.6	3.0 \pm 0.5	2.9 \pm 0.7	F = 2.37; p = 0.12; ES = 0.16	t = -1.73; p = 0.11; ES = 0.45	t = -1.72; p = 0.11; ES = 0.44	t = -0.22; p = 0.83; ES = 0.06

Table 2. Results of descriptive statistics, one-way rANOVA and post hoc t-tests for the stance non-dominant (i.e. non-exercised) leg; baseline (BSL), control (CO), and fatigued (FAT).

Parameter (unit)	Descriptive (mean \pm st. dev.)			rANOVA		t-test	
	BSL	CO	FAT	BSL : CO : FAT	BSL : CO	FAT : CO	BSL : FAT
CoP _V (mm/s)	32.6 \pm 8.9	30.9 \pm 7.8	34.5 \pm 10.9	F = 2.65; p = 0.09	t = 1.06; p = 0.31; ES = 0.29	t = 3.37; p = 0.01; ES = 0.70	t = 1.00; p = 0.34; ES = 0.28
CoP _{Va-p} (mm/s)	21.3 \pm 6.1	19.7 \pm 5.1	21.6 \pm 7.0	F = 2.05; p = 0.17; ES = 0.15	t = 1.50; p = 0.16; ES = 0.40	t = 3.11; p = 0.01; ES = 0.67	t = 0.26; p = 0.80; ES = 0.07
CoP _{Vm-l} (mm/s)	20.8 \pm 5.6	20.1 \pm 5.4	22.9 \pm 7.6	F = 2.95; p = 0.07; ES = 0.20	t = 0.57; p = 0.58; ES = 0.16	t = 3.23; p = 0.01; ES = 0.68	t = 1.46; p = 0.17; ES = 0.39
CoP _{Aa-p} (mm)	6.6 \pm 1.9	6.5 \pm 1.7	6.8 \pm 2.8	F = 0.01; p = 0.99; ES = 0.00	t = 0.09; p = 0.93; ES = 0.03	t = 0.10; p = 0.92; ES = 0.03	t = -0.01; p = 0.99; ES = 0.00
CoP _{Am-l} (mm)	7.3 \pm 1.7	7.1 \pm 2.1	7.8 \pm 2.6	F = 1.61; p = 0.22; ES = 0.12	t = 0.86; p = 0.41; ES = 0.24	t = 2.73; p = 0.02; ES = 0.62	t = 0.73; p = 0.48; ES = 0.21
CoP _{Fa-p} (Hz)	3.3 \pm 0.4	3.1 \pm 0.5	3.3 \pm 0.5	F = 3.46; p = 0.05; ES = 0.22	t = 1.91; p = 0.08; ES = 0.48	t = 2.40; p = 0.03; ES = 0.57	t = 0.26; p = 0.80; ES = 0.08
CoP _{Fm-l} (Hz)	2.9 \pm 0.6	2.9 \pm 0.5	2.9 \pm 0.6	F = 0.59; p = 0.56; ES = 0.05	t = -0.44; p = 0.67; ES = 0.13	t = 0.77; p = 0.45; ES = 0.22	t = 0.99; p = 0.34; ES = 0.27

The results of two-way rANOVA are presented in Table 3. Statistical significance was observed between the conditions (exceptions were CoPaa-p, CoPFa-p and CoPFm-l) but not bet-

ween the legs. The interaction effects were observed only for CoPaa-p and CoPFa-p but did not show any distinctive tendencies.

Table 3. Results of two-way rANOVA with intra-subject factors Leg (dominant (DO) and non-dominant (ND)) and Condition (baseline (BSL), control (CO), and fatigued (FAT)) and their interaction. Statistically significant outcomes are marked bold

Parameter (Unit)	Leg	Condition	Leg × Condition
CoP _V (mm/s)	F = 0.04; p = 0.85; ES= 0.00	F = 7.30; p = 0.00; ES= 0.38	F = 0.23; p = 0.80; ES= 0.02
CoP _{Va-p} (mm/s)	F = 0.32; p = 0.58; ES= 0.03	F = 5.55; p = 0.01; ES= 0.32	F = 0.33; p = 0.72; ES= 0.03
CoP _{Vm-l} (mm/s)	F = 0.60; p = 0.45; ES= 0.05	F = 7.01; p = 0.00; ES= 0.37	F = 0.37; p = 0.62; ES= 0.03
CoP _{Aa-p} (mm)	F = 0.08; p = 0.79; ES= 0.01	F = 1.78; p = 0.19; ES= 0.13	F = 4.15; p = 0.03; ES= 0.26
CoP _{Am-l} (mm)	F = 0.63; p = 0.44; ES= 0.05	F = 9.62; p = 0.00; ES= 0.44	F = 1.21; p = 0.31; ES= 0.09
CoP _{Fa-p} (Hz)	F = 0.04; p = 0.84; ES= 0.00	F = 0.69; p = 0.51; ES= 0.05	F = 5.44; p = 0.01; ES= 0.31
CoP _{Fm-l} (Hz)	F = 0.15; p = 0.70; ES= 0.01	F = 1.06; p = 0.36; ES= 0.08	F = 1.65; p = 0.21; ES= 0.12

Discussion

The main finding of this study was that unilateral stance postural balance was affected bilaterally (dominant and non-dominant side) by fatigue induced on the stance dominant side. Body sway in both single leg stances was increased in a-p and m-l direction; however the increase was more apparent in m-l direction. These findings suggest that central mechanisms might have been involved in alterations of balance control. In addition, mono-articular non-fatiguing movement of the hip (i.e. CON) improved balance, signifying the importance of hip proprioceptors in relation to body sway control.

Central mechanisms of cross-education have been well studied in relation to strength and power, but not in relation to postural balance control. Unilateral strength training could affect supraspinal centers that control the opposing limb and cause short lasting neuro-modulations. These changes can last longer following continuous training. Unilateral adaptations in balance have been suggested in different pathologies (Hung, 2015), with the opposing limb also suffering from neuro-muscular adaptations that are not identical to the injured limb.

Contralateral changes in balance could have been caused by the phenomenon known as non-local muscle fatigue (Halperin et al., 2015). It has been demonstrated that the decreased local muscle performance could lead to changes in function of the contralateral or other remote non-fatigued muscles. Halperin et al. (2015) suggest that fatigue could have a negative effect on other muscles via neurological pathways, biochemical mediators, biomechanical alterations and finally by psychological effects. On the other hand, decreased pH accompanying local fatigue can decrease muscle spindle firing rate (Fischer & Schafer, 2005), leading to impaired proprioceptive input especially regarding position and movement sense (Proske & Gandevia, 2012). This was not in accordance with the present study, as no differences were observed between the limbs. It could be hypothesized that negative effects of fatigue on muscle spindle function was compensated by sensory input from other muscle or joint proprioceptors.

The contralateral effect of fatigue could also be a result of decreased muscle functioning of important pelvis and trunk stabilizers that have been active during the fatiguing task. Possible conditioning of these muscles would affect body sway control

in contralateral stance as they control the pelvic tilt and trunk alignment. An interesting finding of this study was the positive effect of uni-articular hip movement on balance. It could be suggested that by moving the leg through abduction and adduction would cause activation of slow adapting hip proprioceptors, proposing increased and continuous sensory drive to the central nervous system. As described in the introduction, the hip is important for initiating corrective reactions in balance that could benefit from more abundant proprioceptive feedback.

The third finding indicated an increase in body sway, both in m-l and in a-p direction. This is in line with the study conducted by Bisson, McEwen, Lajoie, and Bilodeau (2011), in which they observed bi-planar increase of body sway as a consequence of experimentally induced fatigue to hip flexors and extensors. The above results were expected due multiple functions of the fatigued hip abductors (i.e. gluteus medius) that are also synergists of hip extension and rotation. As a result, altered body sway control is decreased in all directions; yet, m-l CoP movement was more affected than in the a-p direction. Future research should consider looking at the effects of plyometric and more demanding eccentric fatiguing protocols, as these are more common in sports and have been shown to affect proprioception differently than concentric contractions (Fortier, Basset, Billaut, Behm, & Teasdale, 2010), possibly causing different changes in body sway control.

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Presence of the relative age effect and its effect on playing time among under-20 players in the Norwegian premier league Tippeligaen – a four-year follow up

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ABSTRACT

European top-level soccer clubs are continually looking for talented players. Few clubs, however, are willing to let youth players play at the highest senior level. Perhaps as a consequence, the search for talented players has resulted in an imbalance in the characteristics of these players, towards an overrepresentation of players born early in the selection year, an effect called the relative age effect (RAE). The RAE has been documented to be present among senior top-level players. Even so, few studies have investigated the effect among youth players at the senior level. The aim of this study is to examine RAE among U17-U20 players in the Norwegian premier league Tippeligaen in the 2009-2012 seasons. Participants were 315 male players born in 1990-1996. The results showed that 68% of the players were born in the two first quartiles of the year. The effect was even increasing in the four-year period. As we could expect based on the literature, the oldest players are given more playing time. However, the connection between playing time and RAE was inconsistent. Norwegian top-level soccer seems to be affected by the RAE when selecting their players. These players are not however guaranteed playing time because of the RAE.

Key words: Youth, relative age effect, soccer.

Introduction

European top-level soccer clubs are continually looking for the most talented players. In the global soccer marked talented players are identified in a constant younger age, and given contracts in the big European leagues (Roderick, 2006). Giving playing time to youth players at the top-level have however often been considered as a risk, mainly because of the assumption of unstable performance as a consequence of young players inexperience. Preliminary results from one season in the Norwegian premier league *Tippeligaen*, show that there is a negative connection between a clubs seasonal table position and giving playing time to players under 20 years, even if the results are incoherent (Sæther, 2010). Even so, many top-level clubs are dependent of providing playing time both to be able to hold on to them, but also give them the opportunity to get the experience expected from a stable performer.

Playing opportunities for young players is there for essential both in a player and club perspective. A large number of talent development models have focused on how a player's development depend on environment factors (Bloom, 1985; Cote & Fraser-Thomas, 2008; Gagne, 2000), especially a qualified coach in the start of youth soccer, called the investment years (Ashworth & Heyndels, 2007; Cote et al., 2008). By representing the top-level clubs these players get an advantage in terms of a high performance environment (Simmons & Paull, 2001) and are expected to get a motivational boost and advantage ahead of the non-selected players in the same age cohort (Harter, 1978), and are thereby more likely to continue invest more time and effort in their sport with predictable results (Wilson, 1999). The players are thereby faced with a dilemma, while results on the one hand show that a young player's opportunity to

be selected to an age-specific national team increases if you represent a top-level club (Haulan & Sæther, 2011), while the playing time decreases by choosing a club on the highest level (Poli, Besson & Ravenel, 2013).

Perhaps as a consequence of the clubs dilemma, the search for the most talented players has resulted in an imbalance in the characteristics of these players, towards an overrepresentation of players born early in the selection year (Helsen, van Winckel & Williams, 2005). This effect has been named the relative age effect (RAE) and has been overwhelmingly documented to be present on senior top-level soccer. In fact, the impact of this effect has been prominent in England (Dudink, 1994), Australia, Brazil, Germany and Japan (Musch & Hay, 1999), Sweden (Peterson, 2004), Norway (Wiium, Lie, Ommundsen & Enksen, 2010) and Spain (Jimenez & Pain, 2008). In Norway the effect has been clearly present among the players in the Norwegian premier league *Tippeligaen*, were 60 percent of the squad players were born in the first two quartiles of the year (Wiium et al., 2010). The effect has been documented as even stronger among youth players, and especially among youth national team players (Brewer, Balsom & Davis, 1995; Helsen et al., 2005; Williams, 2010; Sæther, 2015), but also among youth academy and youth professional players (Carling, le Gall, Reilly & Williams, 2009; Diaz Del Campo, Vicedo, Villora & Jordan, 2010; Glamser & Vincent, 2004; Jimenez & Pain, 2008).

The spread of RAE can therefore be considered an essential and influential factor in the talent identification process (Williams and Reilly, 2000). This effect has been shown to be present over time among German senior top-level soccer (Cobley et al., 2008), and the effect was documented to affect playing time between both Belgian semi-professional and amateur senior players (Vaeyens, Philippaerts & Malina, 2005). Even so, few

have investigated the effect among youth players in top-level soccer, and in which degree the effect affects playing time over time. This article focuses on the spread of the RAE among U20 players, in a four year period in the Norwegian premier league *Tippeligaen* and in which degree this effect is connected to the amount of playing time.

Methods

Sample and Data collection

The present study is based on data collected from a website (www.altomfotball.no). Birth dates were acquired from male soccer players born between 1990-1996 given playing time (1 minute or more) selected for one or more match on a premier league team in the period 2009-2012. The players was categorised after age categories described as U17-U20 players, were U17 players turned 16 during the season; the U18 players turned 17 and so forth.

Procedure and Data Analyses

The players' birth of month was categorised into quarters reflecting the Norwegian soccer year. The first quarter includes January, February, and March, and the fourth quarter includes October, November, and December. The results are presented with basic descriptive statistics such as frequency counts and percentages. To be able to compare in which degree RAE effects playing time, the players was categories into quartiles, were quartile 1 was the 25 percent of players given the least playing time, quartile 2 was the middle 50 percent of players given "medium" playing time and quartile 3 was the 25 percent given

the most playing time. Chi-square tests were performed to compare differences between the observed and expected birth rate distribution across the four quarters of the Norwegian soccer year. The significance level of .05 was selected to determine statistical significance. A second analysis examined all the selected players in the period, divided into age categories from U17 to U20, both in terms of birth month and playing time. Thirdly, by focusing on one age cohort of players born in 1993, I follow the RAE effect from U17-U20, indicating in which degree the effect changes in the same age-cohort in the four-year period.

Results

The results show that RAE is present among the total sample of squad players were 68 % of the players were born in the first two quartiles of the year, ranging from 57 to 77 % in the period from 2009 to 2012 (Table 1). This tendency is also increasing from 2009 to 2011 (Table 2). Another finding is that there is a reduction in the percentage of players born in the last quartile of the year in the whole period from 20 % in 2009 to 5 % in 2012 among the players who are given playing time. The number of players selected to the top-level clubs squads was increasing in the period from 72 to 135 players, while the number of players who got playing time was more stable in the same period ranging from 45 to 66 players. This RAE effect was even stronger among the players who got playing time in four seasons, compared with all the players in the clubs squads (Table 4).

Table 1. Birth distribution among U17 to U20 players in the period from 2009-2012, total sample.

Quarter 1	Quarter 2	Quarter 3	Quarter 4	Sample size
40	28	22,5	9,5	315

Table 2. Birth distribution among U17 to U20 players in the period from 2009-2012, according to year.

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Sample size
2009	37,5	22	25	15,5	72
2010	31	36,5	23	9,5	74
2011	50,5	27	17,5	5	97
2012	42	28	24	5	135

Table 3. Playing time distribution among U17 to U20 players in the period from 2009-2012, according to year.

	U20	U19	U18	U17	Sample size
2009	20461	4596	680	3	72
2010	13867	4846	497	83	74
2011	22398	13702	2100	345	97
2012	26908	5326	2061	68	135

When comparing the different age groups, there is a clear tendency that the percentage of players born early in the selection year, are highest among the youngest players, even if these results are somewhat inconsistent (Table 5). Among the youngest players (U17 & U18), no player born in the last quartile was given playing time in the period. Furthermore, with few exceptions there was also a tendency that a larger percentage of the players were born in the first two quartiles of the year, with the exception of the U17 players, where there was a reduction in the period.

The results show a natural increase in the number of playing minutes as the players go from 16-19 years (Table 3). With the exception of 2010 the U20 players get an increasing amount of playing minutes in the four-year period. The same seems to be the case among the U19 players even if the exception for this age cohort is the 2011 season. The U18 and U17 players have more inconclusive results during the period, while the U17 players are given extremely little playing time, as expected. Even so, the U20 and U18 players were given more playing

opportunities the last two years. By tracking the age-cohort of players born in 1993 from U17 in 2009 to U20 in 2012, there was a strong RAE ranging from 66 to 100 % in the period (Table 5).

Table 4. Birth distribution among U17 to U20 players in the period from 2009-2012, for players with playing time, according to year.

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Sample size
2009	36,5	20,5	22,5	20,5	49
2010	26,5	40	24,5	9	45
2011	50	26	16,5	7,5	66
2012	40,5	33,5	21	5	57

Table 5. Birth distribution among U17 to U20 players in the period from 2009-2012, for players with playing time, according to year.

	U20				U19				U18				U17				Sample size
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
2009	37	18,5	18,5	25,9	28,5	21,5	28,5	21,5	57	14,5	28,5	0	0	100	0	0	49
2010	13	43,5	26	17,5	37,5	37,5	25	0	66,5	0	33,5	0	33,5	66,5	0	0	45
2011	48,5	24	18,5	9	52	26	13	9	57	28,5	14,5	0	33,5	33,5	33	0	66
2012	40,5	34,5	15,5	9,5	26,5	40	33,5	0	66,5	22,5	11	0	0	0	100	0	57

Combining the RAE and playing time the results indicated a clear connection between a birth month within the first two quartiles of the year and the highest amount of playing time. When dividing the age cohorts according to birth quartile and amount of playing time from the 25 % of the players with the least, the 25 % with the most playing time and the 50 % in the middle, the results was inconclusive (Table 6). The chi-square

test between these groups did not show any significant results between the players who were given the most playing time and those who were given the least, within each age-cohort within each year in the period. Even so, there was almost a significant difference between the players among the U19 players in 2011 and the U18 players in 2012.

Table 6. Playing time distribution according to quartiles among U17 to U20 players in the period from 2009-2012, according to year.

		U20				U19				U18				U17			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2009	25	50	20	0	28,5	0	33,5	0	0	25	0	50	0	0	100	0	0
	50	20	40	40	28,5	100	33,5	100	100	75	100	50	0	0	0	0	0
	25	30	40	60	43	0	33,5	0	0	0	0	0	0	0	0	0	0
		χ^2	4,466	p	,614	χ^2	8,556	p	,200	χ^2	,875	p	,646				
		U20				U19				U18				U17			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2010	25	0	20	16,5	50	16,5	33,5	0	0	50	0	100	0	0	50	0	0
	50	33,5	60	33,5	25	83,5	50	75	0	0	0	0	0	100	50	0	0
	25	66,5	20	50	25	0	16,5	25	0	50	0	0	0	0	0	0	0
		χ^2	5,379	p	,497	χ^2	3,239	p	,510	χ^2	,750	p	,386				
		U20				U19				U18				U17			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2011	25	19	12,5	33,5	0	33,5	0	0	100	25	50	0	28,5	100	100	0	66,5
	50	56	50	16,5	100	33,5	83,5	66,5	0	75	50	100	71,5	0	0	100	33,5
	25	25	37,5	50	0	33	16,5	33,5	0	0	0	0	0	0	0	0	0
		χ^2	6,267	p	,394	χ^2	11,093	p	,086	χ^2	,875	p	,646				
		U20				U19				U18				U17			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2012	25	7,5	27,5	40	33,5	25	16,5	60	0	66,5	50	0	55,5	0	0	0	0
	50	38,5	54,5	40	33,5	75	83,5	40	0	33,5	50	0	33,5	0	0	100	0
	25	53,5	18	20	33	0	0	0	0	0	0	100	11	0	0	0	0
		χ^2	5,314	p	,504	χ^2	2,475	p	,290	χ^2	9,200	p	,056				

Discussion

The RAE has been proven to have major impact on the selection on the most talented players in European top-level soccer. Consistent with findings of previous studies from European soccer (Jimenez & Pain, 2008; Diaz Del Campo et. al., 2010; Carling et. al., 2009), players born during the first two quartiles of the year appeared to be overrepresented among U17 to U20 players who were given playing time in the Norwegian premier league Tippeligaen. This bias was evident in the total sample in all four seasons, since between 57 and 77 percent of the players were born in the first two quartiles of the year in all these seasons, confirming earlier studies. According to age the number of players born in the two first quartiles of the year varied between 55-75% among the U20, 50-78% among the U19, 66-89% among the U18 and 0-100% among the U17 players. With few exceptions the percentage of players born in the two first quartiles was increasing among the U20, U19 and U18 players in the four-year period. These findings could be described as confirming other studies of both elite and lower level youth soccer, even though there are few studies on the relative age effect among youth players in top-level clubs. All the studies of Jimenez and Pain (2008), Diaz Del Campo and colleagues (2010) and Carling and colleagues (2009) found similar results among Spanish and French youth players, even if these studies mainly cover younger players, which make it difficult to explicitly compare the results. The present study also found large differences among the age cohorts, were the RAE bias seemed to be fluctuating among the different age groups.

The most disadvantaged group is the players born in the last quarter of the year, were approximately 10% of the players are born in this quarter in the total sample of this study. The number of players born in this quarter was decreasing during the four seasons from 20% in 2009 to 5% in 2012. Players born in this quarter of the year are overall the most biased group in the talent development process. Even so, a study of English players divided into who found themselves in a professional and a non-professional club, only 6 per cent (ten players) was born in the last three months of the year, but of those players became 70 percent professional players (Carling et. al., 2009). Furthermore, Ashworth and Heyndels (2007) found that players born late after the cut-off date earn systematically more than those born early after the cut-off date. The authors explained the difference because the born late players are a more selective subset than professional players born early after the cut-off date (Roderick, 2006). Thus, players who are born late after the cut-off date and still become professional have actually survived a system that discriminates against them. A second reason for a wage premium to occur for late-born players lies in the fact that they benefit from training and competing with better players.

Even if RAE is well documented in a range of countries and both among youth and senior players, few of these studies have investigated the RAE impact on playing time for the youngest players in the top-level clubs, and furthermore how it is present over time. Earlier studies have highlighted the decreased likelihood of playing time among high-level clubs (Vaeyens et. al., 2005; Poli et. al., 2013), but an increased likelihood of representing age-specific national team representing high level clubs (Haulan & Sæther, 2011). The present study shows a natural increase in the number of playing minutes as the players go from 16 to 19 years. With the exception of 2010 the U20 players get an increasing amount of playing minutes in the four-year period. The same seems to be the case among the U19 players even if the exception for this age cohort is the 2011 season. The U18 and U17 players have more inconclusive results during the peri-

od, which could be explained by the low number of players who get playing time among these age cohorts, especially among the U17 players. However, the chi-square test did not show any significant results between the players who were given playing time and those who were not, within each age-cohort within each year in the period. Even so, there was almost a significant difference between the players among the U19 players in 2011 and the U18 players in 2012. One reason for this lack of significance could be that RAE already biases the selected players for Norwegian premier league clubs as a group.

Playing time is an important factor in talent development, both from a club and player perspective. The clubs hypotheses risk (Sæther, 2010) and the players' dilemma of playing opportunities (Roderick, 2006), must be considered as essential. Highlighted by the large number of club changes seen among youth players in top-level soccer, young players are willing to swap club to be able to get this playing time. The opportunity of playing time is expected to give these players a motivational boost and advantage ahead of the non-selected players in the same age cohort (Harter, 1978). Initially the selected players could get the confirmation of their skills as a player and are more likely to continue perfecting their abilities and invest more time and effort in their sport with predictable results (Wilson, 1999). However, since many of the squad players got few or non, playing opportunities as U17-U20 players, it could also be likely that some of these players might become discouraged enough to drop out of sport altogether (Gould et. al., 1996), or compete at a lower performance level. As Vaeyens and colleagues (2005) documented among Belgian semi-professional and amateur senior players born in the first quarter of the selected age band, these players received more playing opportunities. For this group of players, the self-fulfilling prophecy can be regarded as an important influence on the playing opportunities in top-level clubs in the four-year period.

Since RAE seems to be an important predictor of playing opportunities, this effect can result in a lowering of the overall quality of the highest competitive teams (Vincent & Glamser, 2006). The English Football Association recognised this problem in the mid-1990s, but still the effect was shown to be present a decade later. Simmons and Paull (2001) suggested that although the differences observed by month of birth could simply be the effect of developmental advantages, they could also reflect training advantages gained from selection for various teams and competition at an earlier age, which was related to their relative maturity at that time. Jimenez and Pain (2008) argue that the current identification and development process, which allows for age bias, results in "wasted potential". Technically gifted, but younger and less mature players drop out or fail to receive advanced training, while older, more mature players fail to develop the technical aspects of their game. Combined, these two factors may diminish the talent pool of talented players for top-level clubs in Norway. This study showed that RAE is stable and present in all four season and even increasing among the oldest age cohorts. It is possible that the long term effect could be different, but a resent study from Sæther (2015) showed that RAE was present among age-specific national team players in a five-year period, even if the players selected for the national teams was changed during the periode.

Conclusion

The results from this study support the conclusion that the relative age effect is as much a major factor in the selection of elite youth male soccer players in Norway as it is in other

countries. This study shows a stable and even increasing RAE over a four-year period, among U17-U20 players representing Norwegian premier league clubs. These results show that the players selected for premier league clubs are systematically selected by their birth of month, on a yearly basis, confirming results from all players in the Norwegian premier league (Wiiium et. al., 2010). Few studies have drawn the attention to

the long term present of the RAE. Most studies are cross-sectional and look at differences in age within one year. Most talented players are a part of a selection and more important reselection processes were they either get to play matches in their club, or they do not. This reselection is vital in terms of given playing time to be able to further develop and get match experience as a top-level soccer player.

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Analysis of the Relevant Factors for the Engaging Women in Various Sports in Croatia

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ABSTRACT

Goals of this research were to determine the correlations among the dimensions of relevant factors about engagement of women in sports, as well as to determine the differences in the dimensions of relevant factors about engagement of women in sports, according to several independent variables: type of sport, educational level, marital status and place of living. A total of 342 female athletes and other sport practitioners are examined, with the average age of 31.53 ± 13.92 years ($M \pm SD$) from several Croatian sport federations: judo, badminton, gymnastics, bowling, acrobatic rock'n roll, handball, sport fishing, Association of the deaf athletes, archery, chess and basketball. The results revealed that according to the type of sport, the differences are statistically significant for: negative environment, relaxation/fun and ambition/self-esteem motives; environmental, obligation and financial/traffic/rules barriers; indirect strategies and already present initiatives for including women in sports. According to the education level, the differences are statistically significant for: positive personal, negative environmental motives and ambition/self-esteem motives; obligations as the barriers; organization out-of-sport commitments and specific strategies for media. The differences in the marital status of participants are statistically significant for the variables: positive personal, negative environmental and ambition/self-esteem motives; environmental and obligation barriers; organization of out-of-sport commitments. At last, only two statistically significant differences are found according to the place of living: for indirect strategies for including women in sports and for the programs created only for women. The results provide the platform for developing programs and strategies for retaining and engaging women in particular sports in Croatia.

Key words: Barriers, commitments, motivation, retaining, strategies.

Introduction

The gender differences in physical activity begin to develop from early age and continue across the lifespan. Boys are physically more active than girls are, while men participate in sports club activities more than women do (Turpeinen, 2012). The Eurobarometer survey on sport and physical activity (2010) among 27 EU member states highlighted that the participation of girls and women in general is not at the same levels of participation as boys and men. Men play more different sports than women do and this disparity is particularly marked in 15-24 age group. The Olympic Charter (International Olympic Committee, 2014) states that one of the roles of the International Olympic Committee is to encourage and support the promotion of women in sport at all levels and in all structures, with a view to implementing the principle of equality of men and women. There is not a vast amount of literature available on the subject of women participating in sports and obstacle factors for their engaging. Furthermore, it is not easy to compare data, because of used methodology and considerable differences between countries. For example, 19% of Canadian women participated in sport, compared to 35% of men, and females comprised 39% of registered competitors (Johnstone & Millar, 2012). In Isla-

mic countries, there are much more tradition-related obstacles for women to participate in sport, which is generally considered a masculine domain (Contomichalos, 2010).

On the contrary, in western societies, having as much as possible equal number of the athletes or other roles in sporting field of both sexes, is one of the measures of progress. Three of the top five sports for both men and women in western countries are swimming, gym, fitness, and cycling. However, female participation in sports is heavily concentrated on swimming and fitness, while male participation is more widely spread across a range of different activities (Jones, Milward & Buriamo, 2011). Football and ice hockey are the examples of sports that have traditionally been men-oriented, but the number of female participants over the last years has increased in some countries, for example in Finland (Turpeinen, 2012). Contrary, in some sports exist almost equal interest between both sexes like in judo (Sindik et al., 2014). Jones et al. (2011) collected data about gender participation in different sports in England. Men have the prevalence of: 90.8% in football, 86% in golf, 71% in table tennis, 69% in cycling, 62% in climbing and mountaineering, 61% in tennis, 61% in badminton, 60% in jogging and bowling. There are some sports with equal sex proportion, like skiing, bowling and gym. In some sports is a greater women proportion, for

example swimming or diving (57% participants are women), ice skating (52% participants are women), aerobic and dance (76% participants) and yoga (82% participants) (Jones et al., 2011). According to the Great Britain (GB) trend analysis in women's participation in sports activities from 2007-2011 (Women's Sport and Fitness Foundation support NGBs, 2011) 12.4% of women and 20.5% of men in population weekly participate in a sports sessions of exercise. Top women sports are: keep fit or going to the gym (13.3%), swimming (8.2%), athletics (3.4%), cycling (2.1%), equestrian (1.2%) and there are sports with less than 1% participants (dance exercise, badminton, tennis, football, netball). In that period in GB the proportion of women active in sport has declined for 0.7%, while the male proportion has raised for 0.5% (Women's Sport and Fitness Foundation support NGBs, 2011). Women (54.0%) are more likely than men (39.2%) not to participate in sport, roughly similar proportions of those who do not take part in sporting activities say that they would like to do sport or active recreation (men 43.8%, women 39.6%) (Jones & Millward, 2011). Some well-known barriers (Johnstone & Millar, 2012) are including: psychological barriers (e.g., lack of confidence or negative attitudes; concerns about body weight, poor body image and low self-esteem), time-based barriers (e.g., too much work or responsibilities to care for children or elderly parents), interpersonal barriers (e.g., low support women's and girls' physical activity engagement; family, partner or parental belief that sport is not as important for females as for males; concerns about being perceived as unfeminine), access and opportunity barriers

(e.g., cost, transportation, access to quality facilities) and programming barriers (e.g. lack of choice and variety). Similar, the data collected in national survey in Australia (Sparks, 2007) show that the most relevant barriers to women participating in sport are time related issues (family and work related), costs and lack of childcare. In some occasions, there are still some ideological reasons, for example, belief that heavier involvement in some sports diminishes femininity and leads to unattractive muscles (Sparks, 2007). Critical issues impacting women's sport still have not been formally and systematically explored enough, but researchers found out that the women proportion has fallen more in lower social grades, neither those with children nor those without children in household, and the proportion decreases as the age group increases (Women's Sport and Fitness Foundation, 2011).

In Croatia, there are lack of surveys about women sports engagement. One of recent studies aimed to determine the relevant factors about engagement of women in judo in relation to educational level, marital status, impulses to engage in judo, then depending are the women competitors or not, members of the Judo Board or not, trainers or not. In Croatia, there are 23% women of registered contestants in judo in all age groups. The results pointed that relatively older women have more obligations and more barriers that oppose to their engagement in judo. The other differences depending on examined independent variables were small (Sindik et al., 2014). What is the situation in other sports in Croatia?

Table 1. Number of male and female registered active athletes competitors according to their age group

Sport / Age group	younger cadets	cadets	younger juniors	juniors	younger seniors and seniors
badminton	F=73 M=66	F=39 M=53	F=35 M=36	F=17 M=21	F=73 M=162
chess	F=165 M=475	F=139 M=399	F=0 M=0	F=44 M=188	F=128 M=2243
skiing	F=262 M=498	F=84 M=147	F=36 M=42	F=21 M=33	F=35 M=66
bowling	F=46 M=106	F=75 M=81	F=89 M=108	F=84 M=108	F=646 M=2239
gymnastics	F=389 M=201	F=915 M=592	F=0 M=0	F=41 M=38	F=316 M=186
archery	F=0 M=0	F=57 M=98	F=0 M=0	F=19 M=42	F=61 M=307
sport fishing	F=95 M=307	F=0 M=0	F=0 M=0	F=45 M=178	F=120 M=1091
distance swimming	F=15 M=21	F=0 M=0	F=0 M=0	F=11 M=20	F=4 M=14
rock'n roll	F=0 M=0	F=0 M=0	F=0 M=0	F=103 M=31	F=408 M=85
motorcycling	F=0 M=0	F=0 M=0	F=0 M=0	F=5 M=29	F=0 M=366
judo	F=354 M=988	F=227 M=676	F=N/A M=N/A	F=184 M=530	F=222 M=905

Legend: M=male; F=female; Source: Croatian Olympic Committee (2015)

Table 1 shows female and male proportion of registered competitors in some sports, less popular comparing to football, which is traditionally masculine domain (Croatian Olympic Committee, 2015). According to the Table 1, the most popular sports for men are chess, bowling, sport fishing, archery and motorcycling what is particularly highlighted in chess, bowling and fishing in senior group, where are few times more male than female participants. Contrary, in rock'n roll and gymnastics participated much more women, what could be expected,

based on the results from other countries (Women's Sport and Fitness Foundation support NGBs, 2011). Proportion of women who are registered competitors in rock'n roll is 81.5%, and in gymnastics is 62% (Croatian Olympic Committee, 2015). Although in badminton and distance swimming are more male registered competitors there are quite similar proportion of female competitors. Situation in skiing depends on age and there

are much more men competitors in younger age groups (cadets and younger cadets) while in other groups proportions are similar (Table 1).

The Croatian Olympic Committee (COC, 2012) had the goal of increasing the percentage of women participating in sports, recommended to all of its national governing body members, to increase the number of women in sports to at least 40% of women in all sports associations by the end of 2015 (Croatian Olympic Committee, 2012). Near to the end of 2015, this article explores how close or how far is Croatian sport to the goal of COC. Research is aimed to identify some factors for engaging women in sports in Croatia. Additionally, this study tried to define relevant factors to be addressed, that could encourage women's greater participation and engaging in sports.

Main goal of this study was to identify reasons and factors of practicing sports in Croatian women, barriers that they perceive disturbing for their continued engagement in sports, either as competitors or as sport employees. Moreover, we have wanted to determine what are the important issues to be addressed that could encourage greater participation of women in sports, which are specific strategies to encourage retaining women in sports and to improve the media coverage of women in sports in general. Specific goals of this research were to determine the correlations among the dimensions of relevant factors about engagement of women in sports (1) and to determine the differences in the dimensions of relevant factors about engagement of women in sports, according to several independent variables: type of sport, educational level, marital status and place of living (2).

Materials and Methods

Participants

Female sport competitors and employees were surveyed. The questionnaires were distributed by email from December 2014 to the end of April 2015, with the aid of the Croatian

Olympic Committee. The questionnaires were also returned to the researchers by email, signed by the surveyed sport practitioners (N=342) to give their informed consent to participate in the research. The average age of the surveyed female sport practitioners was 31.53 ± 13.92 years (M \pm SD), a range from 14 to 74 years, their average work experience in years is 7.09 ± 10.16 , a range from 0 to 42 years and their average years spent practicing their sport is 15.18 ± 10.48 , a range from 1 to 55. Sports included in this survey are: judo 50 participants (14.6 %), badminton 18 participants (5.3%), gymnastics 24 participants (7%), bowling 16 participants (4.7%), acrobatic rock'n'roll 56 participants (16.4%), handball 26 participants (7.6%), sport fishing 50 participants (14.6%), Association of the deaf athletes 14 participants (4.1%), archery 25 participants (7.3%), chess 22 participants (6.4%) and basketball 41 participant (12%). Zagreb has the largest frequency of surveyed participants (140 women in sport which is 79.1%). Only 73 (21.7%) of the surveyed practitioners have not won a medal in a national level championship, while 264 (78.3%) of them have. Hundred and eighty-four (56.1%) of the surveyed female sport practitioners have won a medal at an international level, while 144 (43.9%) of them have not. Before stating this sport 158 (52.7%) of them did not practice any sport and 141 (47.3%) were involved in some other sport before this one. As far as education is concerned, 56 (16.5%) surveyed female sport practitioners have only finished primary school, 128 (37.8%) of them have only a high school diploma, 41 (12.1%) of them have finished post-secondary schools other than college, and 98 (28.9%) of them have finished college without enrolling into a postgraduate program. Only 16 (4.7%) have a postgraduate academic degree. As far as their marital status is concerned, 206 (60.8%) of them are unmarried, 105 (31%) are married, 17 (5%) of them are divorced and 11 of them are widows. Two hundred and twenty two (65.3%) surveyed female sport practitioners do not have children, while 44 (12.9%) have one child, 54 (15.9%) of them have two, 19 (5.6%) of them has three children and only one of them (0.3%) has four or more children.

Table 2. Correlations (Pearson) between the dimensions of relevant factors about engagement of women in sports

Dimension	Environmental	Obligations	Financial rules	Organization sport	Organization out-sport	Media strategies	Indirectly in sport	Directly in sport	Already present initiatives
Positive personal motives	-0.04	-0.05	0.04	0.19**	0.15**	0.20**	0.13*	0.04	0.19**
Negative environment motives	0.36**	0.17**	0.24**	0.04	0.08	0.05	0.16**	0.17**	0.12*
Social motives	0.05	-0.04	0.09	0.29**	0.28**	0.37**	0.08	0.06	0.14*
Relaxation, fun	-0.09	0.01	0.08	0.27**	0.17**	0.32**	0.08	-0.00	-0.02
Ambition and self-esteem	-0.11	-0.12*	0.09	0.41**	0.25**	0.39**	0.09	0.05	0.06
Environmental barriers	1	0.36**	0.52**	-0.08	0.02	-0.09	0.11	0.05	0.10
Obligations as barriers		1	0.38**	0.09	0.08	0.04	0.16**	0.16**	0.15*
Financial, rules, traffic barriers			1	0.03	0.12*	0.02	0.24**	0.18**	0.17**
Organization of women sport commitments				1	0.47**	0.46**	0.12*	0.10	0.11
Organization of women outsport commitments					1	0.51**	0.21**	0.18**	0.23**
Specific strategies media						1	0.17**	0.20**	0.11
Indirectly - sport official							1	0.65**	0.25**
Directly in sport								1	0.22**
Already present initiatives									1

Legend: * Correlation significant with $p < 0.05$ (two-tailed); ** Correlation significant with $p < 0.01$ (two-tailed)

Table 3a. Differences between the dimensions of relevant factors about engagement of women in sports according to the type of sport

Dimension	Sport	Mean	Std. Deviation	Kruskal-Wallis test (p)
positive personal motives	judo	1.64	0.31	0.00**
	badminton	1.78	0.17	
	gymnastics	1.71	0.22	
	bowling	1.70	0.19	
	acrobatic rock'n&roll	1.75	0.16	
	handball	1.74	0.21	
	sport fishing	1.64	0.32	
	Association of the deaf athletes	1.82	0.15	
	archery	1.55	0.35	
	chess	1.65	0.28	
	basketball	1.60	0.20	
negative environment motives	judo	0.34	0.38	0.00**
	badminton	0.29	0.31	
	gymnastics	0.33	0.29	
	bowling	0.43	0.36	
	acrobatic rock'n&roll	0.32	0.36	
	handball	0.44	0.27	
	sport fishing	0.55	0.43	
	Association of the deaf athletes	0.68	0.23	
	archery	0.28	0.33	
	chess	0.64	0.62	
	basketball	0.53	0.43	
social motives	judo	1.07	0.55	0.14
	badminton	1.29	0.60	
	gymnastics	1.24	0.45	
	bowling	1.13	0.57	
	acrobatic rock'n&roll	1.24	0.52	
	handball	1.19	0.58	
	sport fishing	1.02	0.49	
	Association of the deaf athletes	1.43	0.52	
	archery	0.98	0.54	
	chess	0.96	0.49	
	basketball	1.12	0.55	
relaxation and fun motives	judo	1.57	0.53	0.00**
	badminton	1.96	0.11	
	gymnastics	1.70	0.44	
	bowling	1.69	0.37	
	acrobatic rock'n&roll	1.84	0.29	
	handball	1.59	0.41	
	sport fishing	1.52	0.49	
	Association of the deaf athletes	1.72	0.31	
	archery	1.87	0.22	
	chess	1.60	0.43	
	basketball	1.70	0.42	
ambition and self esteem	judo	1.61	0.43	0.00**
	badminton	1.72	0.32	
	gymnastics	1.52	0.40	
	bowling	1.57	0.310	
	acrobatic rock'n&roll	1.69	0.282	
	handball	1.64	0.33	
	sport fishing	1.28	0.48	
	Association of the deaf athletes	1.83	0.27	
	archery	1.61	0.33	
	chess	1.45	0.59	
	basketball	1.47	0.43	

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$; the highest and lowest values of means are bolded

Table 3b. Differences between the dimensions of relevant factors about engagement of women in sports according to the type of sport

Dimension	Sport	Mean	Std. Deviation	Kruskal-Wallis test (p)
environmental barriers	judo	0.17	0.34	0.00**
	badminton	0.09	0.15	
	gymnastics	0.20	0.34	
	bowling	0.19	0.30	
	acrobatic rock'n&roll	0.13	0.23	
	handball	0.25	0.36	
	sport fishing	0.43	0.51	
	Association of the deaf athletes	0.48	0.47	
	archery	0.13	0.24	
	chess	0.44	0.52	
obligation barriers	basketball	0.33	0.50	0.00**
	judo	0.64	0.46	
	badminton	0.85	0.55	
	gymnastics	0.80	0.58	
	bowling	0.76	0.48	
	acrobatic rock'n&roll	0.51	0.43	
	handball	0.85	0.47	
	sport fishing	0.90	0.62	
	Association of the deaf athletes	0.88	0.52	
	archery	0.72	0.57	
financial, traffic and rules barriers	chess	1.10	0.56	0.00**
	basketball	0.62	0.51	
	judo	0.29	0.40	
	badminton	0.37	0.25	
	gymnastics	0.39	0.43	
	bowling	0.19	0.38	
	acrobatic rock'n&roll	0.47	0.36	
	handball	0.53	0.46	
	sport fishing	0.54	0.53	
	Association of the deaf athletes	0.74	0.51	
organization of sport commitments	archery	0.48	0.53	0.37
	chess	0.68	0.59	
	basketball	0.45	0.45	
	judo	3.97	0.85	
	badminton	4.09	0.65	
	gymnastics	3.94	0.62	
	bowling	4.08	0.55	
	acrobatic rock'n&roll	3.90	0.80	
	handball	4.22	0.72	
	sport fishing	3.69	0.93	
organization out of sport commitments	Association of the deaf athletes	4.17	0.70	0.07
	archery	4.19	0.59	
	chess	4.08	0.82	
	basketball	3.91	0.73	
	judo	2.60	0.99	
	badminton	2.94	0.43	
	gymnastics	3.24	0.82	
	bowling	3.31	0.92	
	acrobatic rock'n&roll	2.99	0.94	
	handball	3.27	0.89	
	sport fishing	2.85	0.97	
	Association of the deaf athletes	3.49	0.83	
	archery	3.04	0.70	
	chess	3.17	0.90	
	basketball	2.85	0.93	
	judo			
	badminton			
	gymnastics			
	bowling			
	acrobatic rock'n&roll			

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$; the highest and lowest values of means are bolded

Table 3c. Differences between the dimensions of relevant factors about engagement of women in sports according to the type of sport

Dimension	Sport	Mean	Std. Deviation	Kruskal-Wallis test (p)
specific strategies for media	judo	3.64	1.16	0.06
	badminton	3.72	0.69	
	gymnastics	3.97	0.76	
	bowling	3.98	0.86	
	acrobatic rock'n&roll	3.67	0.77	
	handball	4.02	0.69	
	sport fishing	3.32	1.00	
	Association of the deaf athletes	4.10	0.82	
	archery	3.82	0.73	
	chess	3.79	0.70	
	basketball	3.58	0.87	
indirect strategies for including women	judo	0.65	0.49	0.00**
	badminton	0.60	0.55	
	gymnastics	0.66	0.44	
	bowling	0.85	0.49	
	acrobatic rock'n&roll	0.88	0.52	
	handball	0.98	0.40	
	sport fishing	0.89	0.64	
	Association of the deaf athletes	1.23	0.62	
	archery	0.70	0.55	
	chess	1.11	0.59	
	basketball	0.78	0.49	
direct strategies for including women	judo	0.71	0.69	0.08
	badminton	0.46	0.59	
	gymnastics	0.70	0.61	
	bowling	0.86	0.57	
	acrobatic rock'n&roll	0.60	0.54	
	handball	0.77	0.57	
	sport fishing	0.84	0.74	
	Association of the deaf athletes	0.97	0.73	
	archery	0.82	0.63	
	chess	1.11	0.64	
	basketball	0.75	0.56	
already present initiatives	judo	0.39	0.43	0.00**
	badminton	0.27	0.43	
	gymnastics	0.61	0.54	
	bowling	0.71	0.50	
	acrobatic rock'n&roll	0.81	0.52	
	handball	0.72	0.39	
	sport fishing	0.70	0.45	
	Association of the deaf athletes	1.42	0.50	
	archery	0.32	0.38	
	chess	0.80	0.50	
	basketball	0.52	0.54	

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$; the highest and lowest values of means are bolded

Measuring instruments

The set of questionnaires was disseminated by belonging Croatian sport associations to female active sport competitors: the reasons for practicing certain sport, positive and negative aspects of this sport, involvement in other sports and how much time certain sport takes away from other obligations. In this research, modified items are back-translated from the following questionnaires: 'Attitudes towards women in sports' and 'Obstacles for women in sports' (Khan et al., 2012); 'Obstacles for women in sports'; 'Promoting greater involvement of women in sports'; 'Media coverage of female sports' (Sparks, 2007); 'Motivation for participation in sports' (Sports and Physical Activity, 2010). The items in all the questionnaires can be

seen in previous articles about retaining of women in judo (Rendulić, Sindik and Čorak, 2013; Rendulić, Sindik and Čorak, 2014; Sindik, Rendulić, Čorak and Perinić-Lewis, 2014). All seven questionnaires used to explore women engagement in Croatian judo showed moderate to high satisfactory reliability and good construct validity, in 15 latent dimensions that are revealed (Sindik et al., 2014). In this research, the reliabilities type internal consistency for the dimensions of the questionnaires: Positive personal motives ($\alpha=0.55$); Negative environment motives ($\alpha=0.60$); Social motives ($\alpha=0.79$); Relaxation and fun ($\alpha=0.63$); Ambition and self-esteem ($\alpha=0.69$); Environmental barriers ($\alpha=0.70$); Obligations as barriers ($\alpha=0.64$); Financial rules, traffic barriers ($\alpha=0.59$); Organization of sport commitments for women ($\alpha=0.61$); Organization of out-sport commit-

ments for women ($\alpha=0.63$); Specific strategies for media to improve coverage of women in sports ($\alpha=0.86$); Specific strategies to encourage women to be engaged in sports – indirectly (officials; $\alpha=0.77$); Specific strategies to encourage women to be engaged in sports – directly (competitors; $\alpha=0.76$); Already present initiatives to encourage women to be engaged in sports ($\alpha=0.83$). Except abovementioned variables, sexual abusing defined as binary variable (yes/no) was analyzed, too.

Statistical Analyses

In the statistical analyses of the data, the software package SPSS 20.0 is used. For determining construct validity of the questionnaires, Principal Components Analysis with (or without, in one-component solutions) Varimax Rotation are used. The results in extracted principal components (factors) in certain questionnaires are expressed as the simple linear combinations, and then used in further analysis (differences and correlations). The reliability type internal consistency for all dimensions (components) of relevant factors about engagement of women in sports revealed was determined using Cronbach's alpha coefficients of internal consistency. The correlation analyses were performed using Pearson correlation coefficients. To determine the differences between each two

groups of participants, the t-test for independent samples is used, while in case of several groups of participants, the Kruskal-Wallis test or ANOVA are used. To determine the differences in sexual abusing, Chi square (χ^2) test was used. The significance of all differences and correlations are commented on the probability level of $p < 0.05$.

Results

Correlations among the variables in the research

In following two analyses we have used obtained latent dimensions, expressed in linear combinations, to calculate the correlations among these latent dimensions (Table 2). Out of 81 correlations between all the dimensions in all questionnaires, 43 were statistically significant and very low to low size (all except one were in the positive direction). Environmental barriers showed the least number of statistically significant correlations with other variables, while Specific strategies to improve media coverage of women in sport, Organization of women sport commitments and Organization of women outsport commitments showed the highest number of statistically significant correlations with other variables (seven).

Table 4a. Differences between the dimensions of relevant factors about engagement of women in sports according to the educational level

Dimension	Education level	Mean	Std. Deviation	Kruskal-Wallis test (p)
positive personal motives	elementary school	1.70	0.20	0.00**
	high school	1.65	0.32	
	college (BA, BS)	1.69	0.23	
	university	1.69	0.21	
	postgraduates (PhD, MS)	1.66	0.22	
negative environment motives	elementary school	0.42	0.43	0.05*
	high school	0.42	0.39	
	college (BA, BS)	0.43	0.30	
	university	0.45	0.43	
	postgraduates (PhD, MS)	0.38	0.43	
social motives	elementary school	1.14	0.57	0.75
	high school	1.07	0.52	
	college (BA, BS)	1.32	0.52	
	university	1.13	0.54	
	postgraduates (PhD, MS)	1.12	0.55	
relaxation and fun motives	elementary school	1.71	0.42	0.59
	high school	1.63	0.46	
	college (BA, BS)	1.76	0.31	
	university	1.72	0.41	
	postgraduates (PhD, MS)	1.80	0.35	
ambition and self esteem	elementary school	1.65	0.30	0.01**
	high school	1.52	0.47	
	college (BA, BS)	1.63	0.40	
	university	1.53	0.41	
	postgraduates (PhD, MS)	1.70	0.35	
environmental barriers	elementary school	0.24	0.42	0.41
	high school	0.20	0.36	
	college (BA, BS)	0.27	0.39	
	university	0.30	0.44	
	postgraduates (PhD, MS)	0.29	0.38	
obligation barriers	elementary school	0.48	0.38	0.00**
	high school	0.66	0.51	
	college (BA, BS)	0.75	0.49	
	university	0.97	0.56	
	postgraduates (PhD, MS)	1.04	0.59	

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$; the highest and lowest values of means are bolded

Table 4b. Differences between the dimensions of relevant factors about engagement of women in sports according to the educational level

Dimension	Education level	Mean	Std. Deviation	Kruskal-Wallis test (p)
financial, traffic and rules barriers	elementary school	0.39	0.36	0.90
	high school	0.46	0.48	
	college (BA, BS)	0.56	0.53	
	university	0.46	0.47	
	postgraduates (PhD, MS)	0.42	0.41	
organization of sport commitments	elementary school	3.97	0.64	0.18
	high school	3.84	0.90	
	college (BA, BS)	4.06	0.81	
	university	4.08	0.65	
	postgraduates (PhD, MS)	4.29	0.64	
organization out of sport commitments	elementary school	2.75	0.91	0.01**
	high school	2.85	1.01	
	college (BA, BS)	3.25	0.92	
	university	3.13	0.75	
	postgraduates (PhD, MS)	3.38	0.69	
specific strategies for media	elementary school	3.54	0.69	0.05*
	high school	3.57	1.02	
	college (BA, BS)	3.87	0.84	
	university	3.82	0.79	
	postgraduates (PhD, MS)	4.28	0.82	
indirect strategies for including women	elementary school	0.90	0.50	0.70
	high school	0.79	0.55	
	college (BA, BS)	0.78	0.56	
	university	0.85	0.55	
	postgraduates (PhD, MS)	0.95	0.63	
direct strategies for including women	elementary school	0.75	0.51	0.19
	high school	0.71	0.63	
	college (BA, BS)	0.76	0.67	
	university	0.86	0.70	
	postgraduates (PhD, MS)	0.56	0.65	
already present initiatives	elementary school	0.79	0.45	0.25
	high school	0.60	0.51	
	college (BA, BS)	0.60	0.51	
	university	0.64	0.59	
	postgraduates (PhD, MS)	0.68	0.50	

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$; the highest and lowest values of means are bolded

Differences in the (latent) variables of the research

Statistically significant differences in the frequency of sexual disturbing are found according to the educational level (Chi square(χ^2)=11.921; $df=4$; $p < 0.05$), marital status (χ^2 = 12.093; $df=2$; $p < 0.01$), type of sport (χ^2 = 18.920; $df=9$; $p < 0.05$). More often are sexually disturbed women with college, university or postgraduate educational degrees, as compared with those with high school or elementary school level. More often are sexually disturbed women who are divorced/widow, than those who are single. The most often are sexually disturbed women athletes from chess, while the least often disturbed were those from archery, acrobatic rock'n roll and badminton. The differences among participants in the frequency of sexual disturbing were not statistically significant for: place of living (χ^2 = 0.086; $df=1$; $p > 0.20$), number of children (χ^2 = 4.162; $df=4$; $p > 0.20$), medals won on state championships (χ^2 = 0.865; $df=1$; $p > 0.20$), medals won on international championships (χ^2 = 0.291; $df=1$; $p > 0.20$), still active competitor (χ^2 = 0.192; $df=1$; $p > 0.20$), member of the club board (χ^2 = 5.250; $df=1$; $p > 0.05$), president of the club (χ^2 = 0.780; $df=1$; $p > 0.20$), administrative employee (χ^2 = 3.084; $df=1$; $p > 0.05$) and official (χ^2 = 0.005; $df=1$; $p > 0.20$).

In Table 3 are showed the differences between the dimensions of relevant factors about engagement of women in sports according to the *type of sport*. The differences are statistically

significant for: negative environment motives (the largest difference /highest-lowest/ is found between the association of the deaf athletes and archery); in relaxation and fun motives (the largest difference is found between the judo and badminton); in ambition and self-esteem motives (the largest difference is found between the association of the deaf athletes and sport fishing); environmental barriers (the largest difference is found between the association of the deaf athletes and badminton); obligation barriers (the largest difference is found between the chess and acrobatic rock'n roll); finance, traffic and rules as a barrier (the largest difference is found between the association of the deaf athletes and bowling); indirect strategies for including women (the largest difference is found between the association of the deaf athletes and badminton); already present initiatives (the largest difference is found between the association of the deaf athletes and badminton). In all categories which include association of the deaf athletes, they have the highest means in belonging relevant factors about engagement of women in sports.

Differences between the dimensions of relevant factors about engagement of women in sports according to the *education level* are calculated (Table 4). Several statistically significant differences are found. The differences are statistically significant for: positive personal motives (the largest difference

/highest-lowest/ is found between the participants with elementary school and high school); negative environment motives (the largest difference is found between the university degree and postgraduates (PhD, MS)); ambition/ self-esteem motives (the largest difference is found between the postgraduates (PhD, MS) and high school); obligations as the barriers (the lar-

gest difference is found between the postgraduates (PhD, MS) and elementary school); organization out of sport commitments (the largest difference is found between the postgraduates (PhD, MS) and elementary school); specific strategies for media (the largest difference is found between the postgraduates (PhD, MS) and elementary school).

Table 5. Differences between the dimensions of relevant factors about engagement of women in sports according to the education level according to the marital status

Dimension	Marital status	Mean	Std. Dev.	95% Confidence Interval for Mean		F (df=2, 330)
				Lower Bound	Upper Bound	
positive personal motives	single	1.70	0.26	1.66	1.74	3.18**
	married	1.62	0.24	1.58	1.67	
	divorce/widow	1.71	0.28	1.60	1.83	
negative environment motives	single	0.38	0.39	0.33	0.44	3.64*
	married	0.47	0.36	0.40	0.54	
	divorce/widow	0.57	0.55	0.34	0.79	
social motives	single	1.13	0.55	1.06	1.21	0.02
	married	1.13	0.53	1.02	1.23	
	divorce/widow	1.15	0.49	0.94	1.35	
relaxation and fun motives	single	1.72	0.39	1.67	1.77	1.50
	married	1.63	0.49	1.53	1.73	
	divorce/widow	1.69	0.35	1.55	1.84	
ambition and self esteem	single	1.63	0.37	1.57	1.68	6.63**
	married	1.46	0.46	1.36	1.55	
	divorce/widow	1.43	0.47	1.24	1.63	
environmental barriers	single	0.22	0.34	0.17	0.26	3.80*
	married	0.27	0.42	0.19	0.35	
	divorce/widow	0.44	0.61	0.19	0.68	
obligation barriers	single	0.66	0.49	0.59	0.73	7.38**
	married	0.90	0.54	0.80	1.01	
	divorce/widow	0.76	0.68	0.48	1.04	
financial, traffic and rules barriers	single	0.44	0.41	0.39	0.50	0.41
	married	0.47	0.53	0.37	0.57	
	divorce/widow	0.53	0.55	0.30	0.75	
organization of sport commitments	single	3.94	0.78	3.83	4.05	1.43
	married	4.07	0.74	3.93	4.22	
	divorce/widow	3.84	0.85	3.50	4.18	
organization out of sport commitments	single	2.88	0.91	2.76	3.01	5.71**
	married	3.23	0.89	3.06	3.40	
	divorce/widow	2.78	0.90	2.40	3.16	
specific strategies for media	single	3.66	0.85	3.54	3.78	1.21
	married	3.82	0.95	3.64	4.01	
	divorce/widow	3.63	0.98	3.24	4.02	
indirect strategies for including women	single	0.82	0.52	0.74	0.89	0.33
	married	0.85	0.56	0.74	0.96	
	divorce/widow	0.91	0.69	0.62	1.20	
direct strategies for including women	single	0.71	0.62	0.62	0.80	1.92
	married	0.82	0.64	0.70	0.95	
	divorce/widow	0.92	0.73	0.62	1.22	
already present initiatives	single	0.66	0.52	0.58	0.74	0.93
	married	0.59	0.53	0.48	0.71	
	divorce/widow	0.75	0.50	0.53	0.96	

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$; the highest and lowest values of means are bolded

When testing the differences among three categories of the *marital status* of participants (Table 5), it appeared that statistical significant differences are found in the variables: positive personal motives (the largest difference /highest-lowest/ is

found between the participants who are divorced/widow and married); negative environment motives (the largest difference is found between the participants who are divorced/widow and single); ambition/ self-esteem motives (the largest difference is

found between the participants who are single and divorced/widow); environmental barriers (the largest difference is found between the participants who are divorced/widow and single); obligation barriers (the largest difference is found between the participants who are married and single); organization out of sport commitments (the largest difference is found between the participants who are married and divorced/widow).

When testing the differences among participants according to their *place of living* (in Zagreb and in other cities) in Croatia (Table 6), only two statistically significant differences are found. The differences are statistically significant for: indirect strategies for including women in sports (higher mean for the participants from Zagreb) and for programs created only for women (higher mean for the participants from Zagreb, too).

Table 6. Differences between the dimensions of relevant factors about engagement of women in sports according to the education level according to the place of living

Dimension	Place of living	Mean	Std. Deviation	t-test
positive personal motives	Zagreb	1.69	0.30	0.58
	Other places	1.66	0.19	
negative environment motives	Zagreb	0.41	0.38	0.71
	Other places	0.36	0.38	
social motives	Zagreb	1.19	0.53	1.05
	Other places	1.09	0.55	
relaxation and fun motives	Zagreb	1.75	0.38	2.14
	Other places	1.59	0.51	
ambition and self esteem	Zagreb	1.62	0.38	-0.11
	Other places	1.63	0.41	
environmental barriers	Zagreb	0.22	0.37	0.13
	Other places	0.21	0.40	
obligation barriers	Zagreb	0.77	0.54	0.51
	Other places	0.72	0.45	
financial, traffic and rules barriers	Zagreb	0.45	0.45	1.05
	Other places	0.36	0.43	
organization of sport commitments	Zagreb	4.06	0.73	-0.07
	Other places	4.07	0.65	
organization out of sport commitments	Zagreb	3.06	0.86	1.61
	Other places	2.80	0.93	
specific strategies for media	Zagreb	3.82	0.79	0.62
	Other places	3.73	1.06	
indirect strategies for including women	Zagreb	0.91	0.56	1.96*
	Other places	0.70	0.50	
direct strategies for including women	Zagreb	0.81	0.68	1.13
	Other places	0.67	0.57	
already present initiatives	Zagreb	0.67	0.57	1.47
	Other places	0.51	0.46	
programs created only for women	Zagreb	0.67	0.75	3.11**
	Other places	0.31	0.54	

Legend: * difference significant at $p < 0.05$; ** difference significant at $p < 0.01$

Discussion

Reliability is checked out in all seven questionnaires, which are used for the first time in Croatia in our earlier studies (Rendulić et al., 2013; Rendulić et al., 2014; Sindik et al., 2014), conducted only in women engaged in judo. In this study, reliability type internal consistency of the dimensions increased, the most probably as the consequence of larger sample of participants. However, these coefficients are already low for some dimensions, what could be explained by different situations in different countries, related with relevant factors for engaging women in sports. For example, in Croatia are different factors various related with women's engagement in sports, than in USA or Australia, where the most of the questionnaires are originally constructed.

When observing all the correlations, it can be noticed that number of statistically significant correlations is much higher than in previous research (Sindik et al., 2014). However, high number of significant correlations (especially according to the fact that they are low-sized) could be explained in terms in dependence of the correlation's significance on overall number of

subjects. Similarly as in the case of judo (Sindik et al., 2014), the Environmental barriers are the weakest associated with other relevant factors for engaging women in sports, could be explained on the same way as in the case of judo: these type of barriers could not be easily changed. On the other hand, the fact that highest number of statistically significant correlations with other variables have the variables Specific strategies to improve media coverage of women in sport, Organization of women sport commitments and Organization of women out sport commitments. Specific strategies to improve media coverage of women in sports appeared as the similarly important variable in our previous study (Sindik et al., 2014), so it could be explained in similar way: women's perception of the importance of the media in issues about the engagement of women in sports. On the other hand, possibilities of Organization of women sport commitments and Organization of women out sport commitments are probably decisive factors in women engagement and retaining in some sport.

According to the analysis of the differences, higher educated women are more often sexually disturbed, as compared with those with lower level of education (high or elementary school level). More often sexual disturbing of the women who are di-

voiced/widow, than those who are single, could be explained in terms of higher vulnerability (and belonging estimation of the abusers that divorced/widows could be easier prey). The reason why more often are sexually disturbed women athletes from certain sports (e.g. chess) than from the others (e.g. archery, acrobatic rock'n roll and badminton) could be an issue of speculation.

The results revealed that according to the type of sport, the highest number of statistically significant differences are found for women's motivation (negative environmental, relaxation/ fun and ambition/ self-esteem motives), barriers (environmental, obligation and financial/ traffic/ rules barriers) and finding ways of better including women in sports (indirect strategies and already present initiatives). Namely, negative trend of women's engaging in sports is perceived in several studies (Sparks, 2007; Sport and Physical Activity, 2010; Women's Sport and Fitness Foundation support NGBs, 2011; Khan et al., 2012), but the differences vary across countries and across type of sports which are more or less popular/ developed in certain countries. According to the education level, higher scores in some types of motives (positive personal and negative environmental motives) are found in lower (than higher) educated women, while ambition/ self-esteem motives are higher in the highest educated women (who experientially and consequently have higher ambition in general). All other differences are found between participants who are postgraduates (PhD, MS) (the highest means) and elementary school (the lowest means), where postgraduates have more obligations which are the barriers for them, they have a need to more carefully organize out of sport commitments and who think that specific strategies for media to improve women engagement in sport have to be found.

Differences according to the marital status of participants could be explained in terms of higher ambition/ self-esteem motives in singles, with in general more barriers and difficulties in organizing sport and out of sport commitments in married and divorced/ widows. Divorced/ widows have highest positive personal and negative environmental motives: positive motives could be a compensation of a loss, while negative environmental motives could be in fact a barrier in their extensive engagement in sports. Place of living is not so important factor for women's engagement in sports, but Zagreb as a big city for sure provide better opportunities for women's organized engagement in sports, with proper initiatives for it (programs, strategies).

As compared with our previous study where only small number of differences are found among women engaged in judo (mainly among participants who are members of the Board in the club or Croatian Judo Federation, as compared with those who are not) (Sindik et al., 2014), number of statistically significant differences in this study is obviously higher. Simple explanation is the fact that in this study are included the participants from different sports, with different social attitudes about women in sports, differently socially desirable and with different material and financial resources available (Sparks, 2007; Sport and Physical Activity, 2010). Hence, the main differences appear from essential differences in certain sports and belonging sport federations in Croatia.

The most important advantage of this research is that it is

the first of this type in Croatia (of course, after the study of women in judo as the pilot study). Moreover, we have surveyed relatively large number of women athletes in Croatia. The shortcoming of the research is set of questionnaires which is not convenient for the application in all of the age groups.

Main practical implications of this research is that women like sports and want to be engaged in sports, which in turn enables their personal growth and offers them a sense of accomplishment. However, the main barriers in their engagement and retaining in sports are their job-related and family-related obligations, similarly as in the case of judo (Rendulić et al., 2014). Women, participants in this study, estimate that in spite of current positive initiatives for retaining women in sport in Croatia (Štimac Radin, 2011), these initiatives are not effective enough. As well as in the case of judo (Sindik et al., 2014), half of the surveyed participants suggest hiring women in various positions in sports as a solution (coaches, judges, tournament officials, members of sports club management, members of the general committee of belonging sport federations). Adequate educational courses for achieving avovementioned positions and better media coverage of women sport are the prerequisites for better including women in sports women (Rendulić et al., 2014).

Conclusion

Out of 81 correlations between all the dimensions in all questionnaires, 43 were statistically significant and very low to low size, all (except one) were positive, while the Environmental barriers are the weakest associated with other relevant factors for engaging women in sports. According to the type of sport, the differences are statistically significant for relevant factors for engaging women in sports in Croatia, as following: negative environment, relaxation/ fun and ambition/ self-esteem motives; environmental, obligation and financial/ traffic/ rules barriers; indirect strategies and already present initiatives for including women in sports. According to the education level, the differences are statistically significant for: positive personal, negative environmental motives and ambition/ self-esteem motives; obligations as the barriers; organization out of sport commitments and specific strategies for media. The differences among three categories of the marital status of participants are statistically significant for the variables: positive personal, negative environmental and ambition/ self-esteem motives; environmental and obligation barriers; organization out of sport. At last, only two statistically significant differences are found according to the place of living: for indirect strategies for including women in sports and for the programs created only for women. The results provide the guidance for developing strategies for retaining women in particular sports in Croatia, adjusted to the independent variables used in this study.

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Socioeconomic, Personal and Behavioral Correlates of Active Commuting among Adolescents

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ABSTRACT

The aims of this study were to assess the relationships between commuting to and from school (active vs. passive) and their explanatory variables. A total of 2653 adolescents (1361 boys, 1292 girls; $M\text{ age}=13.4\pm2.6$) participated in this study. The students were questioned about commuting to and from school, physical activity and school sports participation and perceptions of competence and health. Socioeconomic status and body mass index were calculated. Results show that a minority of the students use active transportation to and from school. Also, age increasing, participation in school sports and increasing duration were positively correlated with active commuting for both routes (to and from school). Given that active commuting may be a simple and effective way to increase physical activity level among youth populations, it is important to promote, improve conditions and create strategies in order to increase the number of students that actively commute to and from school.

Key words: Active commuting, passive commuting, students, correlates.

Introduction

Regular physical activity (PA) in adolescence is associated with several health benefits (Janssen & LeBlanc, 2010). In spite of benefits related to PA, research shows that adolescents are not active enough to benefit their health (Baptista et al., 2012). This high prevalence of physical inactivity is a cause of concern. Walking and cycling to and from school are opportunities to improve children's and adolescents' PA levels, as has been previously observed (Tudor-Locke, Ainsworth, & Popkin, 2001). Thus, promoting active commuting to school not only reduces an inactive behavior (passive commuting), but replaces it with a moderate intensity activity (Alexander et al., 2005). Children who walk to school have higher energy expenditure (Tudor-Locke, Ainsworth, Adair, & Popkin, 2003), engage more in PA (Cooper, Page, Foster, & Qahwaji, 2003), and are more likely to meet PA guidelines (Tudor-Locke, Neff, Ainsworth, Addy, & Popkin, 2002) than children who travel to school by a passive way of transportation.

Influences on the choice to walk or cycle to school are complex and include a range of personal, social and environmental factors (Salmon, Salmon, Crawford, Hume, & Timperio, 2007; Timperio et al., 2006). These factors can be systematized as non-modifiable and modifiable. The non-modifiable factors, such as gender, age and socioeconomic status (SES), help in identifying groups using active transportation. On the other hand, modifiable

factors can be used to guide design intervention programs such as perceptions of competence (Van der Horst, Paw, Twisk, & Van Mechelen, 2007), perception of health (Ledent, Cloes, & Piéron, 1997) and of weight status, and PA participation.

Despite the number of studies about the correlates of active commuting, there is little information about Portuguese adolescents. To the best of our knowledge, we found only one study on this and it was only focused on girls (Mota et al., 2007). Therefore, the aim of this study was to analyze the correlates of active and passive commuting to and from school.

Methods

Participants

The participants were 2653 adolescents (1361 boys, 1292 girls) aged 10-18 years ($M\text{ age}=13.4\pm2.6$), attending from grade 5 to 12. Adolescents were from six Portuguese public schools randomly selected in the urban area of Lisbon. The choice of these schools was based on the fact that they are on locations that cover different socioeconomic levels, as well as different numbers of facilities nearby for the practice of PA. An informed written consent was obtained from the students and their legal guardians. The study was conducted according to ethical standards in sport and exercise science research (Harriss &

Atkinson, 2011) and the protocol received approval from both the Ethics Committee of the Faculty of Human Kinetics of the University of Lisbon and the Portuguese Minister of Education.

Commuting to and from school

Students reported how they usually travelled to and from school on most days. Four possible responses were provided (walk, bike, car, bus/tram/train). Afterwards, the answers were dichotomized into active traveller (walk or bike), non-active traveller (car, bus/tram/train). The trip duration were classified on 6-points scale from “less than 5 minutes” to “more than 30 minutes” and cut into 5-minute interval.

Physical activity and school sport participation

A questionnaire developed by Piéron et al. (1997) was used to determine students participation in organized PA (OPA), participation in non-organized PA (NOPA), and participation in school sports (SS). Studies using this questionnaire with Portuguese students were published previously (Marques & Carreiro da Costa, 2013), as well as were the validation procedures (Mota, Almeida, Santos, Ribeiro, & Santos, 2009).

Body mass index

The measurement of height was made using a stadiometer (recorded to the nearest 0.5 cm). For the measurement of weight subjects were wearing shorts and a t-shirt, without shoes (recorded to the nearest 0.5 kg). Body mass index (BMI) was then calculated divided by height (square meters). Adolescents BMI classification was determined based on International Obesity Taskforce criteria (Cole, Bellizzi, Flegal, & Dietz, 2000), with overweight defined as an adult BMI equivalent ≥ 25 according age and sex.

Socioeconomic status

SES was calculated based on parental occupation and educational level. Parents' occupation titles were regrouped in order to classify the subjects as lower, middle, and higher class. The lower class included skilled and unskilled manual workers, farmers, and fishermen; the middle class included service occu-

pations such as nonprofessional health service workers, office clerks, and sales people; the higher class consisted of business-owners, executives, university-educated specialists and professionals (Raudsepp & Viira, 2000).

Perceptions

Lintunen's scale was used to measure students' perceived physical competence (Lintunen, 1990). The 6-items, using a 5-point Likert scale, displayed a good internal consistency ($= 0.9$). Perception of health was assessed with a selection on a 4-point scale ranging from “I am not feeling well” ($= 1$) to “I am very healthy” ($= 4$).

Data analysis

Descriptive statistics were calculated (means, standard deviation and percentages) for all variables. Chi-square and Student t-test were used to assess differences between active and passive commuting to and from school. The effects of each independent variable on the transportation were assessed by a binary logistic regression. Adjusted odds ratio (OR) with 95% confidence intervals (CI) was calculated. Adjustments were performed for all studied variables. An OR greater than 1 reflects an increased likelihood of active transportation. All statistical analyses were performed using IBM SPSS Statistics 22.0. The level of significance was set at 0.05.

Results

The general sample's characteristics are presented in Table 1. Overall, 27% and 34.4% of the sample use an active mode of travel to commute to and from school respectively. The mean duration of these trips were 12.3 ± 7.2 minutes from home to school and 14.2 ± 7.7 minutes from school to home. More than half of the respondents were from a middle/high social class (74.7%) and 22.5% were overweight. Table 1 also shows the data regarding perceptions (competence and health) and PA participation in different contexts.

Table 1. General Characteristics of the Studied Population

Variables	N	% or M \pm SD
Gender		
Boys	1361	51.3
Girls	1292	48.7
Age	2631	13.4 \pm 2.6
Socioeconomic status		
Lower	644	25.2
Middle	1198	46.9
Higher	711	27.8
BMI		
Normal weight	1716	77.5
Overweight	498	22.5
Transportation (home to school)		
Active	715	27.0
Passive	1938	73.0
Transportation (school to home)		
Active	913	34.4
Passive	1740	65.6
Duration (home to school)	2649	12.3 \pm 7.2
Duration (school to home)	2642	14.2 \pm 7.7
Physical activity participation		
Organized physical activity	1494	59.1
Non-organized physical activity	1322	52.3
School sports	460	17.6
Perceptions		
Perception of competence	2628	3.5 \pm 0.8
Perception of health	2653	3.0 \pm 1.0

Legend: BMI - body mass index

Table 2. The Characteristic of Subjects That Use an Active or Passive Commuting from/to School

Explanatory variables	Transportation (home to school)		<i>p</i>	Transportation (school to home)		<i>p</i>
	Active n (%)	Passive n (%)		Active n (%)	Passive n (%)	
Gender			0.046			0.046
Boys	344 (48.1)	1017 (52.5)		444 (48.6)	917 (52.7)	
Girls	371 (51.9)	921 (47.5)		469 (51.4)	823 (47.3)	
Age	13.4±2.4	13.3±2.6	0.008	13.5±2.4	13.3±2.7	<0.001
Socioeconomic status			0.302			0.552
Lower	185 (27.2)	459 (24.5)		211 (24.0)	433 (25.9)	
Middle	317 (46.6)	881 (47)		417 (47.4)	781 (46.7)	
Higher	178 (26.2)	533 (28.5)		252 (28.6)	459 (27.4)	
BMI			0.492			0.788
Normal weight	449 (76.5)	1267 (77.9)		585 (77.2)	1131 (77.7)	
Overweight	138 (23.5)	360 (22.1)		173 (22.8)	325 (22.3)	
Duration	11.1±6.1	12.8±7.5	<0.001	13.1±6.9	14.8±8.1	<0.001
Organized PA			0.849			0.891
No	278 (40.6)	758 (41.1)		353 (40.8)	683 (41)	
Yes	406 (59.4)	1088 (58.9)		513 (59.2)	981 (59)	
Non-organized PA			0.167			0.645
No	342 (50.0)	866 (46.9)		458 (52.9)	800 (48.1)	
Yes	342 (50)	980 (53.1)			864 (51.9)	
School sports			0.004			0.019
No	555 (78.8)	1592 (83.7)		717 (79.9)	1430 (83.6)	
Yes	149 (21.2)	311 (16.3)		180 (20.1)	280 (16.4)	
Perceptions						
Perception of competence	3.5±0.8	3.5±0.7	0.032	3.5±0.8	3.5±0.7	0.199
Perception of health	3.1±1.0	3.0±1.0	0.557	3.1±0.9	3.0±1.0	0.823

Legend: BMI - body mass index; PA - physical activity

Table 2 shows the relationship between socio-demographic and psychosocial characteristic and commuting to and from school. For the gender, significantly more girls (51.9%) than boys (48.1%) commuted to school actively ($p=0.046$). The same was also observed from the route school to home (51.4% vs. 48.6%, $p=0.046$). The prevalence of active transportation to and from school increases slightly but significantly with age

($p=0.008$, $p<0.001$). The SS participation was also related with commuting to and from school, as the active transportation group had higher percentages of adolescents that participated in SS than the passive transportation group, to school (21.2% vs. 16.3%, $p=0.004$) and from school (20.1% vs. 16.4%, $p=0.019$). SES and participating in organized and non-organized PA were not related with active transportation to and from school.

Table 3. Adjusted Odds Ratio for Active Commuting from/to School

Explanatory variables	Home to school	School to home
	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Gender		
Girls	1.00 (ref.)	1.00 (ref.)
Boys	0.844 (0.681-1.046)	0.82 (0.67-1.01)†
Age	1.06 (1.02-1.11)**	1.08 (1.04-1.12)***
Socioeconomic status		
Lower	1.00 (ref.)	1.00 (ref.)
Middle	0.88 (0.68-1.13)	1.09 (0.86-1.38)
Higher	0.72 (0.55-0.96)*	1.02 (0.78-1.32)
BMI	0.89 (0.69-1.15)	0.89 (0.70-1.13)
Duration	0.96 (0.94-0.97)***	0.96 (0.95-0.98)***
Organized PA participation		
No	1.00 (ref.)	1.00 (ref.)
Yes	1.05 (0.84-1.31)	1.00 (0.81-1.23)
Non-organized PA participation		
No	1.00 (ref.)	1.00 (ref.)
Yes	0.93 (0.76-1.14)	1.08 (0.89-1.31)
School sports participation		
Yes	1.00 (ref.)	1.00 (ref.)
No	0.77 (0.58-1.03)†	0.76 (0.58-0.99)*
Perception of competence	1.19 (1.02-1.39)*	1.10 (0.95-1.28)
Perception of health	0.97 (0.86-1.08)	0.99 (0.89-1.10)

Legend: BMI - body mass index; PA - physical activity; † $p<0.1$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$

Table 3 presents the results of the regression analysis for the correlates of active commuting. Age (OR=1.06, CI: 1.02-1.11, $p<0.01$; OR=1.08 CI: 1.04-1.12, $p<0.001$), participation in SS (OR=0.77 CI: 0.58-1.03, $p<0.1$; OR=0.76 CI: 0.58-0.99, $p<0.05$) and duration (OR=0.96, CI: 0.94-0.97, $p<0.001$; OR=0.96, CI: 0.95-0.98, $p<0.001$) were found as correlates of active commuting for both routes (to and from school). In fact, being older and participating in SS increases the probability of engaging in active commuting, while longer travel durations decreases the probability of engaging in active commuting, to and from school. Concerning the route from home to school, having higher SES represents less probability for active commuting than having lower SES (OR=0.72, CI: 0.55-0.96, $p<0.05$) and having a better perception of competence presents a higher probability of engaging in active commuting (OR=1.19, CI: 1.02-1.39, $p<0.05$). For the school to home route, being a girl presents higher probability of engaging in active commuting (OR=0.82, CI: 0.67-1.01, $p<0.1$).

Discussion

The present study examined the correlates of active commuting in a sample of Portuguese adolescents. The results show that a minority of the students use active transportation to and from school. However, as in previous study (Leslie, Kremer, Toumbourou, & Williams, 2010), more students engaged in active commuting for the route from school to home than for the route from home to school. To understand this result we have to consider typical day of school and work. Whereas both have the same opening time (8 o'clock), they differ in the closing time (16 o'clock for school day and 18 o'clock for most work days). It is possible that parents find easier to leave their children in school than to take them home after school, due to work and school schedule.

Students from high SES significantly presented less probability to engage in active commuting. This might be related with money availability, increasing the likelihood of owning a car per family (Prentice & Jebb, 1995). Access to motorized vehicles was associated with passive commuting for university students (Molina-Garcia, Castillo, & Sallis, 2010) and among United Kingdom adults (Adams, 2010), what could affect children if they were taken to school by their parents or family members. Also, higher parental education was associated with reduced odds of walking to school (Evenson, Huston, McMillen, Bors, & Ward, 2003). As a result, the difference between higher and lower SES students, who actively commute to and from school, could be explained by the possibility for children among higher SES to be driven to school (passive commuting) by their parents or family members in the morning, and come back home by walking or cycling (active commuting), because their parents are still at work.

The present study found that girls were significantly more active than boys in their way of travel. However, this outcome was in contrast to the findings of Timperio (2006), Robertson-Wilson et al. (2008) and Larsen et al. (2009). The precocity of girls could explain their higher representation among active travellers.

Concerning the age, the adolescents using an active way of travel were significantly older than those using a passive way of travel, as being older were significantly associated with engagement in active commuting. These results are understandable and corroborative with the increasing autonomy that comes

with age increasing, which characterizes this period of life. Furthermore, this explanation can be strengthened by the results on the perception of competence, where students with higher perception of competence had higher odds to engage in active commuting. It is possible that perception of competence increases with age, and together with increasing autonomy this could lead to engagement in active commuting. The findings of physical perception of competence as a significant correlate of active transportation are in concordance with an Australian study of active transport to and from university (Shannon et al., 2006).

Most studies used as variable the distance between home and school (Panter, Jones, van Sluijs, & Griffin, 2010; Timperio et al., 2006). However, in this study the variable of interest was the travel duration. This variable was significantly correlated with active commuting. Indeed, students were more likely to actively travel to and from school if the travel duration was shorter. These results confirmed those of previous studies using the variable distance (Larsen et al., 2009; Robertson-Wilson et al., 2008).

A positive association between active commuting and participation in SS were found. Previous studies found a relationship between PA participation and engaging in active commuting (Larouche, Saunders, Faulkner, Colley, & Tremblay, 2014; Robertson-Wilson et al., 2008), which could be accordingly to these study findings, as SS is a form of organized PA.

Walking to school was associated with higher school-day steps in older children. The proportion of children who met recommended step thresholds was higher in those who actively commute compared with those who passively commute (Abbott, Macdonald, Nambiar, & Davies, 2009). Given that active commuting may be a simple and effective way to increase PA level among youth populations, it is important to promote, improve conditions and create strategies in order to increase the number of students that actively commute to and from school.

Some study limitations should be mentioned. Causal relationships cannot be inferred from this cross sectional data. Another limitation of the study is the reliance on self-report measures. However, we note that the main strength of this study is the large sample that achieves significant results. To the best of our knowledge it is the biggest study on this subject among Portuguese adolescents.

For future studies, in order to promote active travel to school, it is important to consider school and district policies as well as attitudes of school and district administrators. This is another area of research that would better understand school policies promoting active travelling. Combined with the results of this study, we could redirect campaigns to target people by adjusting the proposals.

Disclosure of conflicts of interest

The authors declare that there are no conflicts of interest. Moreover, authors have no relevant financial or nonfinancial relationships to disclose.

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Match Analysis in Volleyball: a systematic review

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ABSTRACT

The present article aims to review the available literature on match analysis in adult male Volleyball. Specific key words "performance analysis", "match analysis", "game analysis", "notational analysis", "tactical analysis", "technical analysis", "outcome" and "skills" were used to search relevant databases (PubMed, Web of Science, SportDiscus, Academic Search Complete and the International Journal of Performance Analysis in Sport). The research was conducted according to PRISMA (Preferred Reporting Items for Systematic reviews and Meta analyses) guidelines. Of 3407 studies initially identified, only 34 were fully reviewed, and their outcome measures extracted and analyzed. Studies that fit all inclusion criteria were organized into two levels of analysis, according to their research design (comparative or predictive) and depending on the type of variables analyzed (skills and their relationship with success, play position and match phase). Results show that from a methodological point of view, comparative studies were currently complemented with some predictive studies. This predictive approach emerged with the aim to identify the relationship between variables, considering their possible interactions and consequently its effect on team performance, contributing to a better understanding of Volleyball game performance through match analysis. Taking into account the limitations of the reviewed studies, future research should provide comprehensive operational definitions for the studied variables, using more recent samples, and consider integrating the player positions and match phase contexts into the analysis of Volleyball.

Key words: Teams sports, high performance, game analysis, Prisma, skills.

Introduction

Volleyball is probably one of the most popular sports in the world (Reeser & Bahr, 2003). Despite its universal nature and its official history dating back more than a hundred years, there are still some uncertainties about its techniques and tactics multidimensions (João, Leite, Mesquita, & Sampaio, 2010), physiological (Trajkovic, Milanovic, Sporis, Milic, & Stankovic, 2012), nutritional and psychological needs (Valliant, Emplainscourt, & Wenzel, 2012). Therefore, there are still some ambiguities in the planning of the training process to improve performance in the competition.

To better understand the constraints that promote sporting success, match analysis (MA) has assumed a very important role in sports games (Carling, Reilly, & Williams, 2009; McGarry, O'Donoghue & Sampaio, 2013; O'Donoghue, 2015; O'Donoghue, & Holmes, 2015). Coaches were always concerned with optimising the performances of their teams given this is part of the competition (Hughes & Franks, 2008; Lago-Ballesteros & Lago-Peñas, 2010). The theme of monitoring performance has also been subjected to a lot of scientific research (Carling & Dupont, 2011; Drikos, Kountouris, Laios, & Laios, 2009; McGarry et al., 2013) and the results highlighted a number of overwhelming questions on performance of a team facing its opponents (Drikos et al., 2009; Jones, James, & Mella-lieu, 2008; Liebermann et al., 2002; Marcelino et al., 2010; O'Donoghue, 2009; Palao, Santos, & Ureña, 2004).

Volleyball MA research has focused on the importance of the success and failure of the teams (Drikos et al., 2009). Usual methodology designs consist in descriptive, predictive or comparative analysis. Frequent comparisons occur between the different functional positions of the players (Alexandros & Atha-

nasios, 2011; Busca & Febrer, 2012; Laios & Kountouris, 2010; Silva, Lacerda, & João, 2013; Silva, Lacerda, & João, 2014b); between the different competitive levels and opposition quality (Marcelino, Mesquita, Andres, & Sampaio, 2009; Marcelino, Mesquita, & Sampaio, 2011; Marcelino, Sampaio, & Mesquita, 2012); between the different scoring systems (Fellingham, Collings, & McGown, 1994; Giatsis, 2003; Kovacs, 2009) and between gender (Bergeles, Barzouka, & Nikolaidou, 2009; Joao et al., 2010; Palao, Manzanares, & Ortega, 2009).

Recently there is an increase of research articles in scientific journals and specific books (Hughes & Franks, 2008; Carling et al., 2009) have been edited (McGarry et al., 2013; O'Donoghue 2015; O'Donoghue, & Holmes, 2015). However, although an increase in the amount of research, no systematic reviews are available concerning the Volleyball performance analysis.

Match Analysis scientific reviews are mostly done with distinct aims: reviews on specific methodological procedures used in MA articles (Barris & Button, 2008; Lees, 2002) and reviews that organize and systematize the scientific knowledge produced on about specific sport (Eom & Schutz, 1992; Gabbett, 2005; Lees, 2003; Karcher & Buchheit, 2014; Marcelino et al., 2011; Medeiros, Palao, Marcelino, & Mesquita, 2014; Moore, Bullough, Goldsmith, & Edmondson, 2014; Sarmiento et al., 2014).

Regarding the of Volleyball MA, the vast majority of published studies are supported by purely narrative reviews, which are difficult to replicate, serving as a framework for the subject matter being dealt with, and where no statistical methods are used in the review process aimed at analysing and summarising the results.

Considering the importance of conducting systematic review

ew of literature articles to produce scientifically based knowledge (Morin, 2007), it becomes urgent to conduct more studies of this nature in MA. This increase of producing studies that systematize through a critical assessment will greatly benefit MA, as a scientific area, research predicts (Marcelino et al., 2011).

Therefore the goal of this study is to verify, through a systematic revision of literature, the scientific production related with the match analysis in Volleyball from published articles in the main electronic databases.

Methods

A systematic review of the available literature on match analysis in adult male Volleyball was conducted according to PRISMA (Preferred Reporting Items for Systematic reviews and Meta-analyses) guidelines, aiming to identify and characterize study methodologies, samples, variables and the data collections software used. Three independent reviewers separately conducted the analysis performed on 10 November 2014.

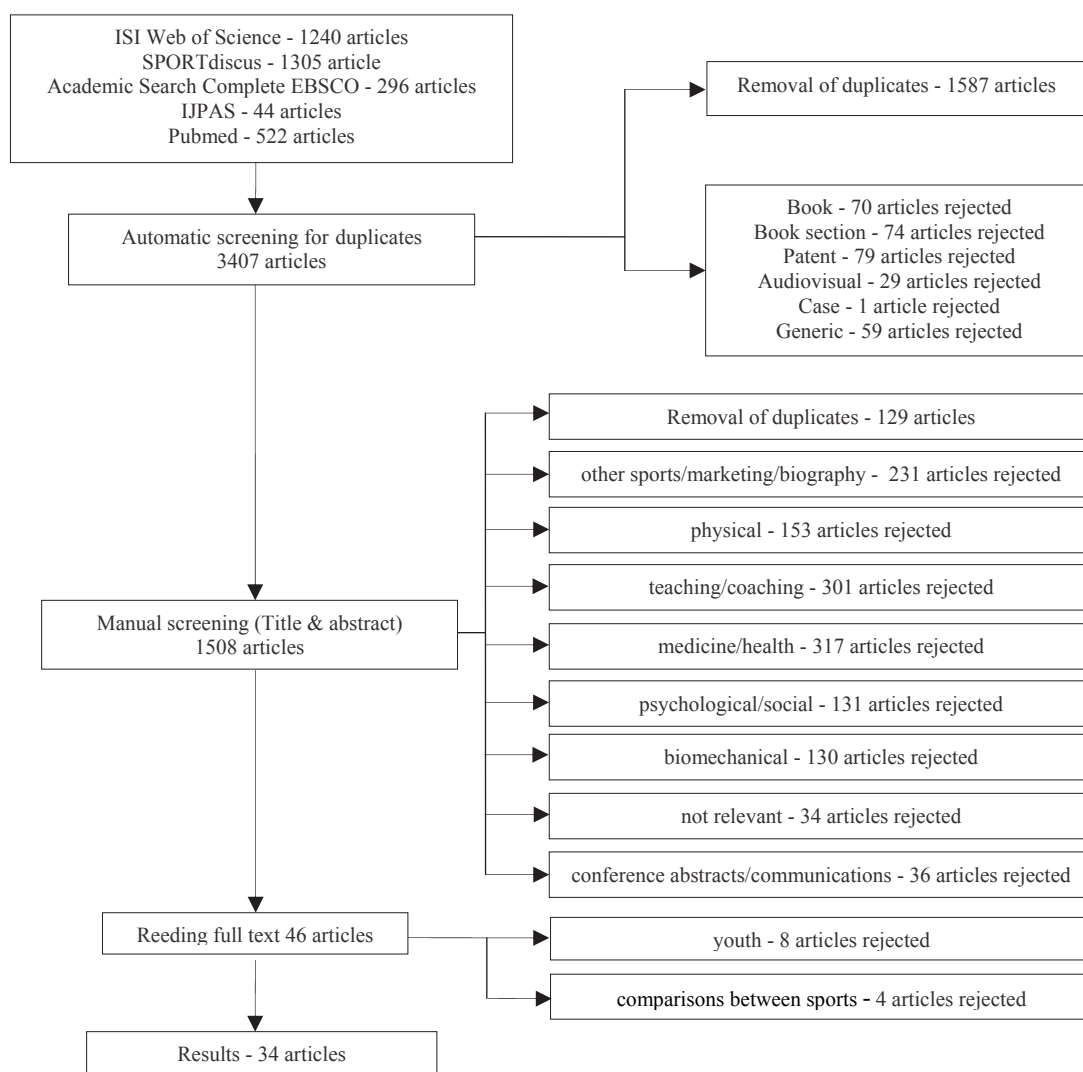


Figure 1. Flow chart of methodology used for the article search

The electronic databases used were *PubMed*, *Web of Science*, *SportDiscus* and *Academic Search Complete* since they are relevant, credible, representative and comprehensive (Bento, 2014; Harris, Quatman, Manring, Siston, & Flanigan, 2013). In addition to these databases, the *International Journal of Performance Analysis in Sport* was adopted as a data source as it is a key magazine in the field.

These databases were used to search for articles in peer-reviewed publications using the combinations of keyword "Volleyball" with the following terms: "performance analysis", "match analysis", "game analysis", "notational analysis", "tactical analysis", "technical analysis", "outcome" and "skills".

The inclusion criteria for these articles were: (1) relevant

data concerning technical and tactical evaluation or statistical compilation; (2) performed by amateur and/or professional adult male Volleyball; (3) written in English, French, Portuguese or Spanish language. Studies were excluded if they: (1) related to beach volleyball or other sports; (2) thematic related to medicine, health, biomechanical, physical, psychological or teaching; (3) did not include any relevant; (4) were conference abstracts, communications, proceedings' or news.

If there was disagreement amongst authors regarding the inclusion of certain articles, the final decision was left to the senior author due to greater experience on the matter.

To organize the results, the studies were grouped according to the major research topics of match analysis that emerged

from the detailed analysis, and to the methodological strategies used.

The initial search identified 3407 titles in the referred database. Then, a reference manager software (EndNote X7, Thomson Reuters, Philadelphia, PA, USA) was used to import all available references. The duplicate ones (1587 references) and papers from non-sport science-specific journals (312 references) were removed either automatically or manually. The remaining 1508 articles were then screened for relevance based on their title and abstract, resulting in another 1462 studies being eliminated from the database. The full text of the remaining 46 articles was then read and another 12 articles were rejected due to a lack of relevance to the purpose of this study. At the end of

the screening procedure, only 34 articles remained for the systematic review (Figure 1).

Results

The first Volleyball MA research paper dates to 1992 (Eom & Schutz, 1992). However, over the next few years the production of scientific works in this area was of a residual nature. Results show a pronounced increase in the production of Volleyball MA research after 2009. Most studies were conducted from 2009 to 2012 (65% from the total took place over this period) and again there has been a decrease in production since then.

Table 1. Studies with predominantly comparative analysis according to Skills and their relationship with success.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Palao et al. (61)	To analyze the effect of a team's level on the performance of skills in high level volleyball	33 male matches and 23 female matches from 2000 Olympic Games. <i>Service, reception, spike, block and dig.</i>	Chi-Square Test and likelihood ratio. <i>VIS</i>	- In males, the results show a significant difference between teams' levels for the skills of spiking and blocking. The block is the skill that differentiates the teams of level 1 with the teams of level 2.
Yiannis & Panagiotis (75)	To compare the effectiveness of principal skills in men's Volleyball	38 matches from the Men's 2000 and 2004 Olympic Games. <i>Service, reception, attack, block and dig.</i>	T-test. <i>Without software information</i>	- An universal tendency of the elite men's volleyball teams to enhance their defense by reducing their block and dig faults. - There was an increase of the reception faults as a result of the improvement of the service effectiveness. - Teams' shift of tactics to win more points from their own serve.
Araújo et al. (5)	To analyze some block constraints in Elite Male Volleyball.	4351 sequences, 97 sets, from Men's 2007 World Cup. <i>Blocking system, effectiveness, opposition and set outcome.</i>	Chi-Square Test. <i>VROS</i>	- A significant relationship between block effectiveness and blocking system. - Block effectiveness and set final outcome, showed an independent relationship.
Bergeles et al. (10)	Examination and comparison of performance in attack in relationship with performance in set.	Games (M=8, F=8) from final phase of the 2004 Olympic Games. <i>Set and attack.</i>	Chi-Square Test. <i>Without software information</i>	- The higher the performance of setters, the higher the performance of attackers in both genders.
Lirola & González (39)	To analyze the reception in elite-level men's volleyball.	15 matches from Men's 2003 World League and 2003 European Volleyball Championship. <i>Reception.</i>	Chi-Square Test and Pearson. <i>Excel</i>	- The libero player has a great importance in serve reception. There were no significant differences in the reception responding to power services, floating services or jump services between the libero and receivers.
Monteiro et al. (49)	To analyze the relationship between the set outcome and the dig and attack efficacy in side-out transition.	27 games of the Final Phase of the 2007 Men's World Cup. <i>Dig efficacy, attack efficacy, set outcome.</i>	Chi-Square Test. <i>VROS</i>	- A significant association between the attack efficacy and the set outcome since the teams that win the sets make fewer errors and have a higher efficacy in the counter-attack. - The dig efficacy is not significantly associated with the set outcome.
Araújo et al. (4)	To examine the relationship between the opponent block, compared to the hitter chosen by the setter to attack.	4531 sequences, 97 sets, from 2007 Men's World Cup. <i>Hitter and the block Opposition.</i>	Chi-Square Test. <i>VROS</i>	- A significant association between the blockers starting points and the hitter chosen by the setter to finalize the play set. A significant association between hitter and number of blockers was also verified.

In the current review, the articles were initially grouped chronologic, according to aims, variables, methods and results obtained. It was decided that the most appropriate way to pre-

sent the results would be to categorize them into two levels of analysis, depending on the type of analysis performed; comparative analysis (13 articles - 38%) and predictive analysis (21

Table 2. Studies with predominantly comparative analysis according to player position.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Papadimitrio et al. (62)	To evaluate the influence of the reception of the opponents' serve on the offensive actions and strategy.	36 matches from 98/99 Greek A1 Men's National Division (3 for each team). <i>Team; service, reception; type, time of set; set's area, effectiveness; type of attack, effectiveness; line-up of opponent's block</i>	Chi-Square Test. <i>Vicas analysis system</i>	- The quality of the reception of the opponents' serve formed the offensive strategy of the Greek setters of A1 National Division, though it did not affect the effectiveness of their sets to the attackers and the attacking strategy of the team.
Laos & Kountouris (33)	To study whether the six possible line-ups that appear during position rotations have the same efficiency for the serving team.	132 matches from A1 Men's 2005/2006 Greek Championship of Volleyball. <i>Won or lost the rally and position of the players.</i>	Chi-Square Test. <i>Data Volley</i>	- The teams performed two and a half full rotations per set and that the serving team had the disadvantage to win the rally. - With regards to the efficiency of the teams when serving, there are significant differences between the six line-ups.
Alexandros & Athanasios (2)	To analyse the action of the setter after a perfect reception.	4 matches from Men's 2009 C.E.V. CUP and 4 matches from Men's 2009 Champions League. <i>Service and reception.</i>	Chi-Square Test. <i>VirtualDub</i>	- The setters make the right choice only in half the cases and this has a significant impact on the team's attack efficiency, especially in the case of quick attacks.
Laos & Kountouris (34)	To examine whether receiving and serving team efficiency in Volleyball was dependent on the teams' line-up that emerges from the clockwise rotation of the players.	132 matches from A1 Men's 2005/2006 Greek Championship. <i>Point winner and line up.</i>	Chi-Square Test. <i>Data Volley</i>	- Rotations differ with regards to the teams' serving efficiency but not with regards to their receiving. - Most of the teams have one favored starting line-up position for the set with the setter at zone 1 when serving first and at zone 2 when receiving first. All teams utilized a maximum of two preferred starting line-ups.
Busca & Febrer (11)	To analyze the temporal fight of the volleyball Spanish high-level setter and the opponent middle-blocker to get advantage in the attack construction situations and blocking, respectively.	300 sequences of attack from 8 games of the Men's 2009 Spanish Cup volleyball. <i>Setter position in the rotation, placement area, according to the travel time of middle blocker and block effectiveness</i>	Chi-Square Test. <i>Without software information</i>	- There was some evidence that middle-blockers develop anticipated responses for 60,94% of the actions

articles - 62%); and a second-order level, depending on the type of variables analyzed (skills and their relationship with success (19 articles - 56%), player position (8 articles -24%) and match phase (7 articles -20%).

Comparative analysis

In this review the studies of comparative nature have an incidence of 38%, which followed three research lines: 1) skills and their relationship with success (Table 1); 2) player position (Table 2) and 3) match phase (Table 3).

Table 3. Studies with predominantly comparative analysis according to match phase.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Marcelino et al. (40)	To examine attack and serve performances in the beginning and end of the initial and final sets of volleyball matches according to the quality of opposition.	600 serves and 1,128 attacks from Men's 2007 World Cup. <i>Attack, service and match period.</i>	Cluster analysis and Double 2-point Moving Average. <i>VROS</i>	- Volleyball matches presented different profiles depending on the match period. - Considering the teams' level, a greater adaptation was found within the HIGH 3 HIGH matches according to the match period and a more strategic use of the serve and attack tactics taking into account the type of the set and the period.

Table 4 (Part 1). Studies with predominantly predictive analysis according to Skills and their relationship with success.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Eom & Schutz, (20)	To develop and test a method to analyze and evaluate sequential skill performances in a team sport.	72 matches from the third Federation of International Men's Volleyball Cup. <i>First-order (pass-to-set, set-to-spike) and second-order (pass-to-spike) transition plays</i>	Log-linear procedures. <i>On-line computerized system</i>	- There was a significant dependency in both the first-order and second-order transition plays, indicating that the outcome of a skill performance is highly influenced by the quality of a preceding skill performance.
Marcelino et al. (41)	To study performance levels in scoring skills, and to relate the results to the teams' final ranking in the tournament.	72 matches from Men's 2005 World League. <i>Spike, serve, and block.</i>	Pearson correlation coefficients <i>VIS</i>	- Spike is the best indicator of success in high level volleyball, but only when considering relative measures. - The number of block points per game proved to be a good indicator of success in volleyball.
Moras et al. (51)	Comparative analysis between serve mode and speed and its effectiveness.	377 serves from 2004 Men's Olympic Qualification Tournament. <i>Service.</i>	ANOVA and regression <i>Data Volley</i>	- No relationship was found between serve speed and its effectiveness outcome.
Asterios et al. (6)	To determine the technical elements that could lead to a prediction to winning or losing a match by taking into account the differences of the technical elements recorded.	15 matches from Men's 2006 Pool B World Volleyball Championship. <i>High, jump service; service reception and attack.</i>	Discriminant function analysis and Stepwise method. <i>Data Volley</i>	- "attack after reception" and "quick ball attack" emerged as the decisive factors for team qualification.
Drikos et al. (19)	To determine whether latent derivative parameters, can be better predictors than the original proportions of overall team's performance in Volleyball expressed as the ratio of sets won to the total number of sets played by the team.	132 matches from Greek Men's 2005-2006 Volleyball Championship. <i>Sets, service and attack.</i>	Pearson's and Spearman's correlation coefficients and multiple stepwise linear regression. <i>Data Volley</i>	- The findings lead to clear-cut definitions of norms both for the serving and attack efficiency ratio. The leading teams had a serving efficiency ratio of around two and an attack efficiency ratio of around three.
João et al. (28)	To identify sex differences in volleyball game-related statistics.	132 matches (M=66, F=66) from the 2007 World Championships. <i>Service, attack, block, set, dig and reception.</i>	Discriminant function analysis. <i>VIS</i>	-The fault serves, shot spikes, and reception digs were discriminating variables. - Men's volleyball games were better associated with terminal actions (errors of service), and women's volleyball games were characterized by continuous actions (in defense and attack).
Patsiaouras et al. (63)	To examine the technical skills that emerged as statistical important for volleyball men team's progress.	29 matches from 2008 Men's Olympic Games. <i>Attack, service, reception and block.</i>	Kruskal-Wallis nonparametric test and Mann - Whitney U test showed. <i>Data Volley</i>	- There were statistically significant differences among the teams concerning the "attack errors following bad receptions" factor. - Statistically important differences were also noticed in the "attack after bad reception" between qualification round teams and teams playing in the final (Brazil-USA).
Drikos & Vagenas (18)	To identify volleyball performance indicators that best discriminate between winning and losing teams in a set according to set final score differences.	350 sets played during the 2009 Men's European Volleyball Championship. <i>Serve, attack, block, set, dig and reception, set and result.</i>	Clusters analysis, MANOVA and Discriminant function analysis. <i>Without software information</i>	- The effectiveness of attack is the most important performance indicator for all types of sets, far more for the ambivalent ones. - The discriminant function correctly classified increasing percentage of cases with increase in score difference, especially for ambivalent sets 67.3% were correctly classified.
Marcelino et al. (42)	To assess the effects of quality of opposition and match status on technical and tactical volleyball performances.	25 matches from the Men's World Cup 2007. <i>Block, attack, serve, and set.</i>	Cluster analysis and Multinomial logistic regression. <i>VROS</i>	Strategic behaviour was affected by the interaction of quality of opposition and match status.

Table 4 (Part 2). Studies with predominantly predictive analysis according to Skills and their relationship with success.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Patsiaouras et al. (64)	To evaluate the importance of technical skills that led to the success of the national teams.	29 matches of the Men's 2008 Beijing Olympic Games. <i>Service, service reception, attack, and attack blocked.</i>	Parametric statistical analysis. <i>Data Volley</i>	The results showed that, service points, reception errors are the skills that can influence the game result. - The attacks blocked also emerged as important factor that were decisive for winning or losing a match.
Peña et al. (65)	To determine which skills and factors better predicted the outcomes.	125 matches from 2010/11 Spanish Men's First Division Volleyball Championship. <i>Service, reception, attack, block, result, team category, home/away court factors, and points obtained in the break point phase.</i>	Multinomial logistic regression. <i>Data Volley</i>	- The variables of team category, points obtained in the break point phase, number of reception errors, and number of blocked attacks by the opponent were significant predictors of winning or losing the matches. - Odds ratios indicated that the odds of winning a volleyball match were 6.7 times greater for the teams belonging to higher rankings and that every additional point in Complex II.
Silva et al. (71)	Identify the volleyball skills that discriminate in favor of victory.	24 matches from Men's 2010 Volleyball World Championship. <i>Serve, attack, block, set, dig and reception and outcome).</i>	Discriminant function analysis. <i>Data Volley</i>	- Service points, reception errors, and blocking errors were the discriminating variables that identify the final outcome of the match (victory/defeat). - Service points were the major variable most likely associated with match success (victory).

Predictive analysis

Studies with predictive nature (62% of total screening studies), were also organized into three different research lines: 1) skills and their relationship with success (Table 4); 2) player position (Table 5) and 3) match phase (Table 6).

Volleyball MA articles were published in 12 Sports Sciences Scientific journals (*International Journal of Performance Analysis in Sport* - 58.8%, *Journal of Sports Science and Medi-*

cine - 5.8%, *Journal of Strength and Conditioning Research* - 5.8%, *Perceptual and Motor Skills* - 5.8%, *International Journal of Medicine and Science of Physical Activity and Sport* - 2.9%, *International Journal of Sport Science* - 2.9%, *Journal of Human Kinetics* - 2.9%, *Journal of Physical Education & Sport / Citius Altius Fortius* - 2.9%, *Journal of Quantitative Analysis in Sports* - 2.9%, *Journal of Sports Sciences* - 2.9%, *Research Quarterly for Exercise & Sport* - 2.9%, *The Journal of Sports Medicine and Physical Fitness* - 2.9%).

Table 5. Studies with predominantly predictive analysis according to player position.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Afonso et al. (1)	To examine predictors of the setting zone in elite-level men's volleyball.	21 matches from the Men's 2007 World Cup. <i>Setting zone, server player (type, direction, depth), reception zone, receiver player and reception type.</i>	Multinomial logistic regression. <i>Excel</i>	- The tennis jump serve, serves from the middle player, deep serves, reception near the end line or sidelines, reception by the zone 4 attackers when in defensive zone, and low reception all proved to impair the quality of reception, demanding the setter to play more often in the not acceptable setting zone.
Silva et al. (70)	To analyze and understand what happens when the setter is in the attack zone, identifying the skills that best discriminate for victory or defeat.	24 matches from Men's 2010 Senior Volleyball World Championship. <i>Service, attack, block, set, dig and reception and outcome.</i>	Discriminant function analysis. <i>Data Volley</i>	- The serve point, service error, excellent set, set error, attack error, excellent dig and side-out error were discriminating variables that identify the final outcome of the match.
Silva et al. (72)	To analyze the discrimination skills according to the setter position in the defense zone (Zones 1, 6, and 5).	49 matches from the semi-finals of Men's senior volleyball competitions during the biennium 2010–2012. <i>Service, attack, block, set, dig and reception and outcome.</i>	Discriminant function analysis. <i>Data Volley</i>	- The reception error, counter attack point, set error, and attack point were discriminating variables that can identify the final outcome. - Success with the match skills of attack point and counter attack point often predict a winning outcome.

Table 6. Studies with predominantly predictive analysis according to match phase.

Author	Aim of study	Sample/ Variables	Statistic/ Software	Result
Zetou et al. (77)	To present the playing characteristics of the teams in complex II and to attempt to determine which of these characteristics led to victory and to the final ranking of the teams.	38 matches from Olympic Volleyball Men's Games. <i>Service, block, dig and Counter attack.</i>	Discriminant function analysis and Stepwise method. <i>Data Volley</i>	These results conclude that “ace” in service and in counterattack remain powerful aggressive tools for high level teams and were predictors to win.
Marcelino et al. (43)	To identify the probability of winning each Volleyball set according to game location.	275 sets in the 2005 Men's Senior World League. <i>Set result, game location, set number and performance indicators</i>	Student T-test, Binary logistic regression analysis. <i>VIS</i>	- Winning a set is significantly related to performance indicators. - Home teams always have more probability of winning the game than away teams, regardless of the set number.
Castro & Mesquita (15)	To analyze possible determinants that might predict the attack tempo in the Volleyball's complex II.	28 matches from Men's 2007 World Cup. <i>Attack tempo, dig type, dig zone, dig efficacy and setting zone.</i>	Multinomial logistic regression. <i>VROS</i>	- The dig type, dig efficacy and setting zone demonstrated predictive power of the attack tempo. - The higher frequency of the dig without all attack options is, perhaps, an explanation to the high values of the non acceptable setting zone, whose occurrence promotes a slower attack organization.
Castro et al. (16)	To identify performance indicators predicting attack efficacy in volleyball's game phase denominated Complex II.	28 matches from the Men's 2007 World Cup. <i>Attack efficacy, tempo, type; number of attackers available, dig efficacy, setting zone and number of blockers</i>	Multinomial logistic regression. <i>VROS</i>	- Power attack and Attack tempo 1 increased the probability of an Attack point. - The supremacy of Attack tempo 3 and the high frequency of two blockers and three blockers reflected the difficulty of efficient attack during Complex II.
Nikos & Elissavet (54)	To analyze the probabilistic relationships that might predict attack efficacy relating to setter's performance as a function of attack tempo in Complex I.	30 matches from 2004 Men's Olympic Games. <i>Set and attack.</i>	Chi-Square Test, ANOVA and Multinomial logistic regression. <i>Without software information</i>	- Results on odds ratios showed that when setter's performance was excellent so that attackers made first or second tempo attacks, the probabilities of gaining a direct point were strongly increased.
Alexandros et al. (3)	To investigate the existence, strength and consistency of the home advantage effect.	6681 matches from championships of the last decade in first division Italy and Greece for both men and women. <i>Home advantage, win and defeat.</i>	Chi-square test and Markov-chain. <i>Web sites.</i>	- Home wins in games (58.1%), in sets (55.6%) and in points (50.86%) were significantly greater than the theoretically expected 50%.

Discussion

The main goal of this paper was to review the available literature on match analysis in adult male Volleyball. Thirty- four studies published between 1992 and 2014 were included in this review. The discussion section is organized into two levels of analysis, according to their research design (comparative or predictive) and depending on the type of variables analyzed (skills and their relationship with success, player position and match phase), limitations are also discussed.

Comparative analysis

Comparative studies have an incidence of 38% (13 articles), organized in three research lines: 1) skills and their relationship with success; 2) player position and 3) match phase.

1) Skills and their relationship with success

In the seven comparative studies related to game actions and their relationship with success (Table 1), the authors tried several ways of analysing the performance of the teams.

There are studies that analyse or compare all the skills of the game simultaneously and relate them with success (Palao et al., 2004; Yiannis & Panagiotis, 2005) and studies that analyse

only one or two skills actions and relate them with success, pointing out how they interfere with the previous action and the game or contribute to the final result (Araújo, Castro, Marcelino, & Mesquita, 2010; Araújo, Mesquita, & Marcelino, 2009; Bergeles et al., 2009; Lirola & González, 2009).

The vast majority of analysed competitions were not recent, being the most recent in 2007 (Araújo et al., 2010; Araújo et al., 2009; Monteiro, Mesquita, & Marcelino, 2009). With the natural evolution of volleyball, these data may have changed (Drikos & Vagenas, 2011), i.e. due to changes in the physical (Trajkovic et al., 2010), technical/tactical (João et al. 2010) profile of the players and the increased speed of the game, the way on how to play the game skills may no longer be the same (Marcelino et al., 2012; Peña et al. 2013; Silva et al., 2014a), and the current values may be different from those of the period.

Analysis were performed on accumulated data of performance indicators, in order to identify and quantify the performance of players in all game skills (Palao et al., 2004; Yiannis & Panagiotis, 2005) or specifically in the block (Araújo et al., 2010; Araújo et al., 2009), attack (Bergeles et al., 2009; Monteiro et al., 2009), reception (Lirola & González, 2009) relating them, in some cases, with performance (Bergeles et al., 2009; Palao et al., 2004), efficiency (Moras, et al., 2008; Yiannis & Panagiotis, 2005), constraint (Araújo et al., 2010; Araújo et al., 2009) and result (Monteiro et al., 2009).

It is important to highlight that comparative studies enabled the identification, description and comparison of the structure and/or the game patterns, being based on more accurate methodologies, which represents a significant advance in research conducted so far.

Despite the relevance of such an approach, it was not possible for the authors to forecast the sport performance (Lames, 2006), because no reference values were found, which are essential for a better organisation of training and competition process. One of the limitations encountered was the fact that there is a need to complement this analysis with the use of stronger models, where the non-linearity of behaviours is considered (O'Donoghue, 2010).

The vast majority of studies used statistical technique as the *Chi-square test* with the exception of Yiannis and Panagiotis (2005) who used the T-test. Concerning to data collections strategies, two studies did not reference any software for data collection. The *VIS software* was used by Palao et al. (2004) and the *Volleyball Rally Observation System (VROS)* was used by Araújo et al. (2009; 2010) and by Monteiro et al. (2009).

2) Player Position

In this context five studies were performed (Table 2). Three of these studies have as common goal understanding the quality of the effect of preceding action in the execution of a certain action (Alexandros & Athanasios, 2011) or in the team offensive organization (Papadimitriou et al., 2004; Busca & Febrer, 2012). The other two studies analyzed one skill (service) (Laios & Kountouris, 2010) or two skills (service and reception) (Laios & Kountouris, 2011) according to the line-up (Laios & Kountouris, 2010; Laios & Kountouris, 2011).

With recourse to bivariate analyses, using the Chi-square test statistical technique in all these studies, these studies relate the different specific positions of the players with specific performance indicators, in terms of the effectiveness of the skills of game (Alexandros & Athanasios, 2011; Busca & Febrer, 2012; Papadimitrio et al. 2004), and in term of the line-up (Laios & Kountouris, 2010; Laios & Kountouris, 2011).

The results show that the requirements, both on a technical and tactical level (Papadimitrio et al., 2004), are distinct from player to player, according to the line-up (Laios & Kountouris,

2010; Laios & Kountouris, 2011) and the role that these play (Alexandros & Athanasios, 2011; Busca & Febrer, 2012; Papadimitrio et al., 2004), usually have a cause-effect relationship between game skills and the tactical organization of the teams, stressing the importance of the specificity of training in light of the peculiarities of the functional specialisation.

Although the first article compared the different positions of the players with specific performance indicators, it's about ten years old (Papadimitrio et al., 2004). This topic recently sparked the interest of some researches.

Of all the studies reviewed, apart from the study performed by (Papadimitrio et al., 2004) did not show significant associations between performance indicators (reception) and the efficiency of the skills (pass and attack). The meaning of these results, contrary to the majority of research, may be due to the characteristics of the sample of this study, which may be slightly out of date, given that it refers to the 1998/1999 season of the Greek A1 Men's National Division.

On the five studies reviewed, three different observation softwares for data collection and observation were used. *Data Volley* (Laios & Kountouris, 2010; Laios & Kountouris, 2011), *Vicas Analysis System* (Papadimitrio et al., 2004) and *Virtual-Dub* (Alexandros & Athanasios, 2011), and the study of (Busca & Febrer, 2012) does not provide any software information.

3) Match Phase

Currently, there is very little information about the variation of performance, whether on global performance or in efficiency in game skills, throughout the different phases or critical periods of the game (Bar-Eli & Tractinsky, 2000; Navarro, Lorenzo, Gómez, & Sampaio, 2009). Proof of this is the availability of a single comparative study (Table 3) in this review (Marcelino, Sampaio, & Mesquita, 2012) making it more difficult to characterise the lines of research both in methodologies and the results.

Marcelino et al., (2012), using the software *VROS* and analyzing games from Men's 2007 World Cup, concluded that volleyball matches presented different profiles depending on the match period and that the most important points occur at the end of the set, recommending to the players to manage their effort throughout the match attempting to reach this period in optimal condition.

Given that there are differences between the periods or phases of the game, these can provide important perspectives on, for example, a more appropriate design of specific programmes on how to prepare for competitions. This information may also be useful for coaches to manage the substitutions, because knowing the physical and psychological characteristics of their athletes they can take more assertive decisions, putting the athletes in play with the best profile during each particular phase of the game.

Comparative studies are currently based on more accurate methods, which represented a significant advance in MA (Marcelino et al., 2011). The understanding of the game has improved, to the extent that contemplates the possibility of detecting differential performances on the basis of certain characteristics of the game, players and respective match skills.

Predictive analysis

In a study of this nature, its added value lies in the possibilities that these represent in the strategic training and preparation of the game (Peters & O'Donoghue, 2013), being however, more susceptible to speculation (Heazlewood, 2006). The relationship between performance indicators and the match final results allows the identification of the sports performance in competition (James 2006; O'Shaughnessy, 2006).

The articles selected in this review showed that seventeen studies (62%) used predictive analysis to study performance, organized in three research lines: 1) skills and their relationship with success; 2) player position and 3) match phase.

1) Skills and their relationship with success

From the chronological analysis (Table 4) it was seen that twelve studies were conducted, and the first study was (Eom & Schutz, 1992), going on to predictive analytics, linking game skills to success, representing a gap of 16 years. From 2008 the production of studies with this type of analysis has become more systematic, investigations aiming know the relationship between the game skills and the final result (Asterios, Kostantinos, Athanasios, & Dimitrios, 2009; Moras et al., 2008; Patsiaouras, Moustakidis, Charitonidis, & Kokaridas, 2011; Pena, Rodriguez-Guerra, Busca, & Serra, 2013; Silva, Lacerda, & Joao, 2014a), differences between gender (Joao et al., 2010), ranking (Marcelino, Mesquita, & Afonso, 2008; Marcelino, Mesquita, & Sampaio, 2011; Patsiaouras, Moustakidis, Charitonidis, & Kokaridas, 2010) and sets (Drikos et al., 2009; Drikos & Vagenas, 2011).

The common goal of these studies was to understand and determine the most effective ways to play the game, through the use of multidimensional qualitative data rather than one-dimensional frequency data, therefore improving the ability to describe the game of volleyball.

The authors used statistical techniques that have gone through log-linear procedures (Eom & Schutz, 1992), Pearson correlation coefficients (Marcelino et al., 2008; Drikos et al., 2009), Discriminant analysis (Asterios et al., 2009; Joao et al., 2010; Drikos & Vagenas, 2011; Silva et al., 2014a), Kruskal-Wallis nonparametric test and Mann - Whitney U test showed (Patsiaouras et al., 2010); Parametric statistical analysis (Patsiaouras et al., 2011), Multinomial logistic regressions (Marcelino et al., 2011; Moras et al., 2008; Pena et al., 2013).

The competitive level of the teams is an indispensable factor for this kind of analysis and should be as representative as possible (Marcelino et al., 2011). Samples used were closed to the data of publications, being only one older than two years (Eom & Schutz, 1992). Two studies were related to national championships (Drikos et al., 2009; Pena, et al., 2013), with the others relating to national teams international competitions, which leads us to think that the results can be current and consistent with the standards of today's game.

In twelve studies analysed there is a notorious tendency towards the use with increasing frequency of observation *Data Volley software*, which was used in seven studies. This software is used by most teams worldwide and allowed the access to total and detailed qualitative statistics by set and offered a wealth of various data (Drikos et al., 2009; Rodríguez-Ruiz et al., 2011). These teams use scouts with vast experience in observation of the game thereby ensuring the quality in information collected.

Overall the results show that there is an effect on the quality of the playing skills in the performance of the teams (Eom & Schutz, 1992; Marcelino et al., 2011; Pena et al., 2013), pointing out that good levels of service effectiveness, attack (Asterios et al., 2009; Drikos & Vagenas, 2011; Drikos et al., 2009; Joao et al., 2010; Moras et al., 2008; Patsiaouras et al., 2010; Patsiaouras, et al., 2011; Silva et al., 2014a) and block (Marcelino et al., 2008; Silva et al., 2014b) can predict success in the final result.

2) Player position

Predictive analyses related to the positions of the players seem to be a recent research theme (Afonso, Esteves, Araujo, Thomas, & Mesquita, 2012; Silva et al., 2013; Silva et al., 2014b). The three studies included in this review (Table 5) have as their common denominator the fact that all of them do an analysis relating to setter player. Nowadays, the setter is considered essential

in a volleyball team (Matias & Greco, 2011), performing the fundamental function (Bergeles et al., 2009) of being responsible for the organization of the offensive skills of his team, either in complex I (KI) or in complex II (KII) (Castro & Mesquita, 2008; Zetou, Moustakidis, Tsigilis, & Komninakidou, 2007).

Through discriminant analysis, and using the *Data Volley software* two studies aimed to identify which game related statistics allow to predict winning and losing, when the setter is in the attack zone (Silva et al., 2013) and when the setter position in the defence zone (Silva et al., 2014b). The analysis of this variable (setter position) seems extremely important in the context of match analysis because this player is now seen as a key piece for the success of any volleyball team since his performance seems to interfere directly with the team's success (Buscà & Febrer, 2012), but surprisingly was not studied in any of the other reviewed studies.

The results show that the service, set, attack, dig and side-out were discriminating variables that identify the final outcome of the match when the setter is in the attack zone (Silva et al., 2013). When the setter was in defence zone, performance in reception, counter attack, set and attack, discriminate teams according to set final outcome (Silva et al., 2014b). Regarding the setting zone Afonso et al. (2012) using Multinomial logistic, concluded that the tennis jump serve, serves from the middle player, and low reception all proved to impair the quality of reception, demanding the setter to play more often in the not acceptable setting zone.

The above-mentioned studies present reference values of game statistics and demonstrate which skills of the game can interfere on the team organization or are discriminant on winning or losing the match. This profile can be of help to the coach when preparing training sessions and matches.

3) Match phase

Following research lines related to the phase of the game, six studies (Table 6) were found in this review, one of them related to Complex I (Nikos & Elissavet, 2011), three of them related to the Complex II (Castro & Mesquita, 2010; Castro, Souza, & Mesquita, 2011; Zetou, Tsigilis, Moustakidis, & Komninakidou, 2006) and two of them related to the probability of winning a set or the game depending on the game location (Alexandros, Panagiotis, & Miltiades, 2012; Marcelino, Mesquita, Andrés, & Sampaio, 2009).

Analysing the studies we can conclude that these focused on two objectives; analysing, in different complexes, the game location (Alexandros et al., 2012; Marcelino et al., 2009) and the game characteristics of the teams highlighting those taking us to victory (Zetou et al., 2006); and analysing the predictive factors of time (Castro & Mesquita, 2010) and effectiveness (Castro et al., 2011; Nikos & Elissavet, 2011) of the attack.

Regarding game location the results of the two studies performed show that home teams normally have more probability to win the points (Alexandros et al., 2012), sets and the games (Marcelino et al., 2009).

Using the same sample, methodology and observation software (*Volleyball Rally Observation System*) two studies assessed the efficacy (Castro et al., 2011) and attack time (Castro & Mesquita, 2010), in Complex II, and the conclusions presented are a reflection that the studies complement each other. Thus, the authors argue that quality of skills prior to attack interfere with the time of execution of the same (Castro & Mesquita, 2010) and that the faster and powerful the attacks are the higher the probability of getting a point (Castro et al., 2011). With an older sample of three years $n = 30$ matches from 2004 Men's Olympic Games (Nikos & Elissavet, 2011), but adding to the statistical calculation Chi-Square and ANOVA and only rela-

ting the attack with the action of the setter in Complex I, the authors also concluded that there is a relationship between the quality and speed of the attack and the performance of the setter, i.e. a good distribution provides faster and powerful attacks.

To present the playing characteristics of the teams in complex II and to attempt to determine which of these characteristics led to victory and to the final ranking of the teams in Olympic Volleyball men's games ($n=38$ matches) (Zetou et al., 2006) concluded that "ace" in service and the counterattack remain powerful aggressive tools for high level teams and were predictors to win.

The trend of the results suggests the need to clarify the relationship between performance indicators and overall performance levels (victory or defeat) calling for the use of more robust methodological designs, which can be reproduced.

At a conceptual level, studies focused on three lines of research skills and their relationship with success, play position and match phase. From a methodological point of view, there is a passage of comparative studies, where the cumulative statistics were the most commonly used analysis criteria, to predictive studies.

This recent more predictive approach came up with the objective of identifying the relationship between variables, considering their possible interactions and, consequently, their effect on the performance of the team, contributing to a better understanding of the performance of the game of Volleyball through MA.

Conclusion

This systematic review shows a light balance in the production of comparative and predictive studies, although there is a supremacy of predictive studies (62%) than comparative (38%). The trend is that last researches are of predictive nature.

Although the research has two types of studies, predictive and comparative, it is possible to infer that both are complied with the same research lines: skills and their relation with success; match phase and player position.

Regarding the samples, it's notorious that the data used in

comparative studies is older than the predictive studies. With the natural evolution of Volleyball, this data could have suffered changes, not providing essential reference values for a better organization of the training and competition process.

The game of volleyball has evolved over the years, along with the development of computer systems and software that enable knowledge and a deeper understanding of the performance phenomenon (Drikos et al., 2009, Silva et al., 2014a). A current challenge involves the creation of suitable video sequences that can clearly identify and categorise individuals and behaviours over time and regular patterns of play. Analysing the software used in the studies of this review it is possible to infer that currently the most frequently used software are *Data Volley* (35%), *VROS* (21%) and *VIS* (12%) being noted as a limitation to the analysis of some studies (12%) that this does not make reference to the type of software or technical observation they used.

Given that it is essential to identify and quantify the stability and current behavioural standardisation in the game, in order to provide substantive and relevant feedback about the irreducibly complex nature of sports performance in competition (Marcelino et al., 2011), we recommend the adoption of more robust methodologies, capable of replication without neglecting the reliability of data, instability and variability of the materials under study, thereby helping coaches in the optimising the training process of young athletes and the implementation of more effective training methodologies in elite athletes.

Apart from the suggestions described previously, it seems relevant to replicate, with actual samples, studies of the game related skills and start to point with skills are discriminants, regarding the setter position (defensive zone (zones 1, 6 and 5) or in the attack zone (zones 4, 3 and 2)) for a future comparison of the intervention in the game complexes (KI and KII) trying to identify which rotations a team has been more or less efficient.

It is hoped that this study will provide the opportunity to explore and learn from literature that is available in Volleyball and overall to encourage researchers to study the sport.

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Original scientific papers are the results of empirically- or theoretically-based scientific research, which employ scientific methods, and which report experimental or observational aspects of sports science and medicine, such as 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. Descriptive analyses or data inferences should include rigorous methodological structure as well as sound theory. Your manuscript should include the following sections: Introduction, Methods, Results, and Discussion.

☒Open Submissions

☒Indexed

☒Peer Reviewed

Original scientific papers should be:

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

Review papers should provide concise in-depth reviews of both established and new areas, based on a critical examination of the literature, analyzing the various approaches to a specific topic in all aspects of sports science and medicine, such as 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.

☒Open Submissions

☒Indexed

☒Peer Reviewed

Review papers should be:

- Up to 6000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 100.

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

☐Open Submissions

☒Indexed

☒Peer Reviewed

Editorials should be:

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

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

☒Open Submissions

☒Indexed

☒Peer Reviewed

Short reports should be:

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

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

☒Open Submissions

☒Indexed

☐Peer Reviewed

Peer review - fair review should be:

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

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

☐ Open Submissions

☒ Indexed

☐ Peer Reviewed

Invited papers and award papers should be:

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

1.3. Submission

MJSSM only accepts electronic submission to the e-mail of the Journal Office: office@mjssm.me.

Submitted material includes:

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

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

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

1.4. Peer Review Process

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

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

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

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

1.5. Publisher Copyright Policies

Copyright of published articles are the property of MJSSM, and under no circumstance will the Journal transfer rights of published work. Reproduction of portions of published articles in other publications, or for any other use, is subject to written permission by the editors-in-chief. Reproductions of published work by MJSSM, under a maximum of 500 words, are allowed with proper citation references and quotations.

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Upon acceptance of an article, authors will be asked to complete a "Journal Publishing Agreement". Acceptance of the agreement will ensure the widest possible dissemination of information. An email will be sent to the corresponding author confirming receipt of the manuscript together with a "Journal Publishing Agreement" form or a link to the online version of this agreement.

The editors of MJSSM consider plagiarism and self-plagiarism to be a serious breach of academic ethics. Any author who practices plagiarism and/or self-plagiarism (in part or totality) will be suspended for six years from submitting new submissions to MJSSM. If such a manuscript is approved and published, public exposure of the article with a printed mark ("plagiarized" or "retracted") on each page of the published file, as well as suspension for future publication for at least six years, or a period determined by the editorial board. Third party plagiarized authors or institutions will be notified, informing them about the faulty authors. Plagiarism and self-plagiarism will result in immediate rejection of the manuscript.

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

- ☒ Authors can archive pre-print (i.e., pre-refereeing)
- ☒ Authors can archive post-print (i.e., final draft post-refereeing)
- ☒ Authors can archive publisher's version/PDF

1.6. After Acceptance

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

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

1.7. Code of Conduct Ethics Committee of Publications



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

2. MANUSCRIPT STRUCTURE

2.1. Title Page

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

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 Akpınar¹, Stevo Popović^{1,2}, Sadettin Kirazci¹

¹Middle East Technical University, Physical Education and Sports Department, Ankara, Turkey

²University of Montenegro, Faculty for Sport and Physical Education, Niksic, Montenegro

Corresponding author:

S. Popovic

University of Montenegro

Faculty for Sport and Physical Education

Narodne omladine bb, 84000 Niksic, Montenegro

E-mail:

Word count: 2,980

Abstract word count: 236

Number of Tables: 3

Number of Figures: 3

2.1.1. Title

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

2.1.2. Type of publication

Authors should suggest the type of their submission.

2.1.3. Running head

Short running title should not exceed 50 characters including spaces.

2.1.4. Authors

The form of an author's name is first name, middle initial(s), and last name. In one line list all authors with full names separated by a comma (and space). Avoid any abbreviations of academic or professional titles. If authors belong to different institutions, following a family name of the author there should be a number in superscript designating affiliation.

2.1.5. Affiliations

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

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

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

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

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

2.1.6. Corresponding author

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

2.1.7. Manuscript information

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

2.2. Abstract

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

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

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

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

Abstract

Results of the analysis of...

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

2.3. Main Chapters

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

2.3.1. Headings

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

✓ **Methods**

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

✓ *Table position of the research football team*

2.3.2 Ethics

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

2.3.3 Statistics reporting

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

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

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

2.4. References

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

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

2.4.1. References style

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

2.4.2. Examples for Reference citations

One work by one author

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

Works by two authors

- ✓ Duffield and Marino (2007) studied...
- ✓ In one study (Duffield & Marino, 2007), soccer players...
- ✓ In 2007, Duffield and Marino's study of soccer players...

Works by three to five authors: cite all the author names the first time the reference occurs and then subsequently include only the first author followed by et al.

- ✓ First citation: Bangsbo, Iaia, and Krstrup (2008) stated that...
- ✓ Subsequent citation: Bangsbo et al. (2008) stated that...

Works by six or more authors: cite only the name of the first author followed by et al. and the year

- ✓ Krstrup et al. (2003) studied...
- ✓ In one study (Krstrup et al., 2003), soccer players...

Two or more works in the same parenthetical citation: Citation of two or more works in the same parentheses should be listed in the order they appear in the reference list (i.e., alphabetically, then chronologically)

- ✓ Several studies (Bangsbo et al., 2008; Duffield & Marino, 2007; Reilly, 1997) suggest that...

2.4.3. Examples for Reference list

Journal article (print):

- Bangsbo, J., Iaia, F. M., & Krstrup, P. (2008). The Yo-Yo intermittent recovery test: a useful tool for evaluation of physical performance in intermittent sports. *Sports Medicine*, 38(1), 37-51.
- Duffield, R., & Marino, F. E. (2007). Effects of pre-cooling procedures on intermittent-sprint exercise performance in warm conditions. *European Journal of Applied Physiology*, 100(6), 727-735.
- Krstrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., . . . Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine and Science in Sports and Exercise*, 35(4), 697-705.

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

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

Journal article (online; electronic only):

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

Conference paper:

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

Encyclopedia entry (print, with author):

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

Encyclopedia entry (online, no author):

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

Thesis and dissertation:

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

Book:

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

Chapter of a book:

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

Reference to an internet source:

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

2.5. Tables

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

Tables should be presented as standard MS Word tables.

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

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

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

2.5.1. Table heading

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

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

2.5.2. Table sub-heading

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

2.5.3. Table footnotes

Table footnotes should be written below the table.

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

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

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

✓ ^aOne participant was diagnosed with heat illness and n = 19. ^bn = 20.

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

✓ *P<0.05, †p<0.01.

2.5.4. Table citation

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

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

2.6. Figures

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

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

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

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

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

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 below the figure, in sentence case. *See* example:

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

2.6.2. Figure citation

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

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

2.6.3. Sub-figures

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

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

2.7. Scientific Terminology

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

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

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

Percentage	Degrees	All other units of measure	Ratios	Decimal numbers
✓ 10%	✓ 10°	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 °	× 10kg	× 12 : 2	× .056
Signs should be placed immediately preceding the relevant number.				
✓ 45±3.4	✓ p<0.01	✓ males >30 years of age		
× 45 ± 3.4	× p < 0.01	× males > 30 years of age		

2.8. Latin Names

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

✓ First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*

Authorship Statement

(Fill out the blank fields, in print and send on email: office@mjssm.me)

1. Manuscript title:

--

2. List all authors in order of appearance on the title page:

--

(Family name, initials)

3. Publication type:

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Number of authors :	
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Number of figures :	
Number of figures submitted separately :	
Total number of FILES submitted (including manuscript):	

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The authors herein signed, state that:

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- The authors agree that the manuscript will be under review for publication in the Montenegrin Journal of Sports Sciences and Medicine;
- If the study includes participation of human beings or animals, please fill out the compliance/assessment by an ethics committee:

This study complies with the ethics committee of (state the name of the institution):	
Approval date:	
Approval number:	

6. Authors' confirmation:

By signing, all authors confirm the agreement with the contents of the statement in the previous chapter and that the information they provided on these pages is true.

(Authors should be listed in the exact order as appearing on the title page of the manuscript. Feel free to copy and add more tables for additional authors if needed, likewise delete the excess if not used. ALL AUTHORS MUST SIGN THIS FORM).

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	Email		
	Corresponding author (YES/NO)		

No.	Name		Date and signature:
2	Institutional address		
	Email		
	Corresponding author (YES/NO)		

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	Email		
	Corresponding author (YES/NO)		

Declaration of Potential Conflict of Interest

(Fill out the blank fields, in print and send on email: office@mjssm.me)

Manuscript title:		
Authors (last name, initials):		
Number of authors		

ALL AUTHORS MUST SIGN THIS FORM and it must be uploaded as a supplementary document of the submitted manuscript in the Journal database.

When potential conflict of interest exists, descriptions of type of conflict must be stated for each of the listed authors.

The items listed below are some of the examples of conflict of interest that can be inserted in the form:

- Author participates in clinical and/or experimental study subsidized by an industry or business;
- Author is a speaker at events sponsored by an industry or business;
- Author is a member of a board or directors of an industry or business;
- Author participates in regulatory committees of scientific studies sponsored by an industry or business;
- Author receives institutional financial support of an industry or business;
- Author shares stocks in an industry or business;
- Author prepares/develops scientific papers for journals sponsored by industries or business.

Note:

All authors must sign this document disclosing potential conflict of interest.

Form must be scanned and converted to a PDF file.

The document must be uploaded as supplementary file of the submitted manuscript.

[] No potential conflict of interest exists for this study.

[] Yes, there is a potential conflict of interest relative to this study as detailed above (please explain):

--

AUTHORS

By signing, all authors confirm the agreement with the contents of the previous (first) page of the Conflict of Interest statement (of the Montenegrin Journal of Sports Science and Medicine) and that the information they provided on these pages is true.

(Authors should be listed in the exact order as appearing on the title page of the manuscript. Feel free to copy and add more tables for additional authors if needed, likewise delete the excess if not used. ALL AUTHORS MUST SIGN THIS FORM).

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1	Institutional address		
	Email		
	Corresponding author (YES/NO)		

No.	Name		Date and signature:
2	Institutional address		
	Email		
	Corresponding author (YES/NO)		

No.	Name		Date and signature:
3	Institutional address		
	Email		
	Corresponding author (YES/NO)		

No.	Name		Date and signature:
4	Institutional address		
	Email		
	Corresponding author (YES/NO)		

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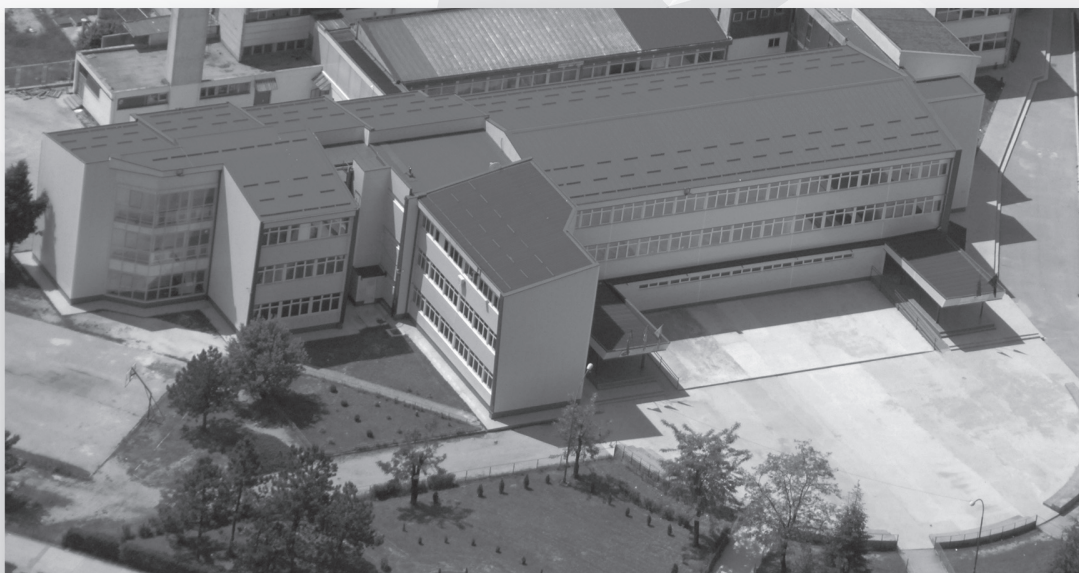
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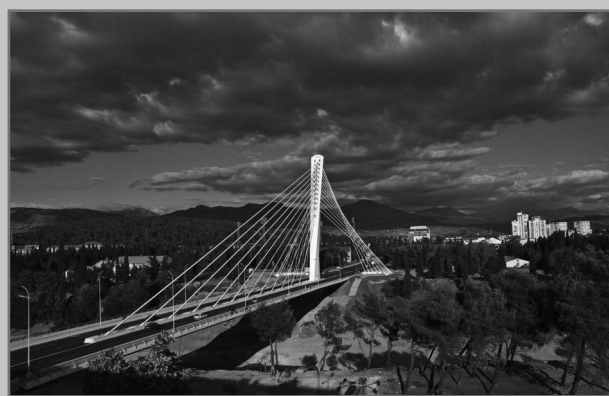
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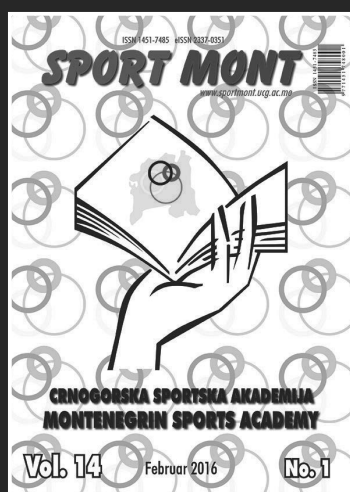
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