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Dear Readers,

welcome to the inaugural issue of the Montenegrin Journal of Sports Science and Medicine (MJSSM). On behalf of my colleagues on the Advisory, Editorial and Review Board, allow me to introduce this new publication with few words about it. The first of all I would underline that the Montenegrin Journal of Sports Science and Medicine would provide a forum for research and dialogue about the many forms and values of sports science and medicine around the world. We also hope the Montenegrin Journal of Sports Science and Medicine will become a "space-and-place" where practitioners and thinkers feel free to engage colleagues' ideas and experiences on a wide range of topics in the area of sports science and medicine. Hence, the Montenegrin Journal of Sports Science and Medicine is similar to most academic journals as far as it is dedicated to the values of critical interchange and scholarly investigation. Therefore, we do hope the contents and formats of the Montenegrin Journal of Sports Science and Medicine will support and encourage your work and/or encourage you to contribute your ideas and experiences for the benefit of everyone in this fascinating field.

Thank you for taking your time to read the Montenegrin Journal of Sports Science and Medicine and wish you all the best in your further work.

Sincerely Yours,
Editor-in-Chief
Prof. Duško Bjelica, PhD

Dragi čitaoci,

dobrodošli u inauguraciono izdanje „Montenegrin Journal of Sports Science and Medicine" (MJSSM). U ime mojih dragih kolega iz savjetodavnog, uredničkog i recenzentskog odbora, dozvolite mi da prestavim ovu novu publikaciju u par riječi. Kao prvo, htio bih naglasiti da časopis „Montenegrin Journal of Sports Science and Medicine" ima namjeru da obezbijedi forum za istraživanje i dijalog o različitim formama i vrijednostima sportskih nauka i medicine širom svijeta. Mi se, takođe nadamo da će „Montenegrin Journal of Sports Science and Medicine" postati mjesto gdje će se praktičari i mislioci osjećati slobodno da razmjenjuju svoje ideje i iskustva na širokom spektru tema u oblasti sportskih nauka i medicine. Dakle, „Montenegrin Journal of Sports Science and Medicine" je sličan većini akademskih časopisa, budući da je posvećen vrijednostima kritičkog razmišljanja i naučnog istraživanja. Prema tome, iskreno se nadamo da će sadržaj i format „Montenegrin Journal of Sports Science and Medicine" podržati i ohrabriti Vaš rad i/ili ohrabriti Vas da doprinesete svojim idejama i iskustvom ovoj fascinantnoj oblasti za dobrobit svih nas.

Hvala Vam za odvojeno vrijeme u čitanju „Montenegrin Journal of Sports Science and Medicine" i želim Vam sve najbolje u daljem radu.

Iskreno Vaš,
Glavni urednik
Prof. dr Duško Bjelica

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Comparative Analysis of Morphological Characteristics of Goalkeepers in Football and Handball

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A B S T R A C T

The goal of this research was to determine differences between top football and handball goalkeepers in morphological characteristics. The sample consisted of 10-13 handball and 7-10 football top senior goalkeepers. Morphological characteristics were assessed using a battery of 12 anthropometrical variables – 4 variables for the assessment of longitudinal skeletal dimensionality, 4 for subcutaneous adipose tissue, and 4 for body voluminosity. The standard central and dispersion parameters were calculated for all the variables. The significance of differences between football and handball goalkeepers in the measured morphological characteristics were determined by t-test for independent samples. It was determined that the handball and football goalkeepers differ in the following variables: arm span (ALRR), back skinfold (ANL), upper arm skinfold (ANNAD), abdomen skinfold (ANT), right thigh circumference (AVONATD), waist circumference (AVOT), and body mass (AVTT). The football goalkeepers had lower values in longitudinal skeletal dimensionality, subcutaneous adipose tissue and body voluminosity.

Key words: *Football Goalkeepers, Handball Goalkeepers, Morphological Characteristics, Differences.*

Introduction

In the contemporary training experts increasingly use testing of relevant dimensions that can be quantified. With the view towards optimising training, the current state of athletes' relevant abilities, characteristics and skills as well as the specific demands of particular sport and different players' positions should be taken into consideration.

Top football and handball goalkeepers should master the goalkeeping technique and specific goalkeeping movements that are used during the training and the competition and that are performed in a fast, correct, explosive and accurate manner. Football and handball goalkeeping techniques consist of the technique with the ball and the technique without the ball.

Beside the specific goalkeeping technique, football goalkeepers often use and should therefore master the elementary technique of field players. The specific football goalkeeping technique and movements comprise: The basic stance of the football goalkeeper, positioning of the goalkeeper, saving low balls, saving medium height balls, saving high balls, saving by rolling down, rolling the ball out, kicking the ball from the hand, diving on low balls, single leg jump high balls saving, diverting high balls, punching the ball with both hands, drop-kicking the ball, diving on medium height and high balls, diverting high balls by diving sideways, punching the ball with one hand, throwing the ball out sideways and drop-kicking the ball, diving into opponent's legs, diverting low and medium height balls by rolling down, throwing the ball out overhead[1].

The coach should be familiar with the model values of top athletes in the given sport in order to conduct proper selection and to design and implement training plan and programme. To better understand and design the training plan and programme coaches should also know which movement structures the goalkeepers perform during the training and the competition.

Specific handball goalkeeping movements comprise: The basic stance of the handball goalkeeper, positioning of the goalkeeper in front of the goal line and within the goal perimeter (semicircle, parallel and vertical positioning), jumps of the handball goalkeeper, saving low balls by lunging and positioning of the leg and the arm in front of the ball flight path, saving the low balls by sliding step and positioning of the leg and the arm above the foot in front of the ball flight path, saving medium height balls by arm, saving medium height balls by arm and leg while standing on one leg, saving medium height balls by arm and leg with both legs in the air - split in the air, jump saving of high balls with both arms, jump saving of high balls with one arm, saving low angles from wing positions, saving medium height angles from wing positions, saving high angles from wing positions, saving shot angles from backcourt positions by catching, saving shot angles from backcourt positions by amortisation, saving shot angles from backcourt positions by bouncing the ball using the arm only, saving shot angles from backcourt positions by bouncing the ball using the leg only, saving shot angles from backcourt positions by bouncing the ball using the arm and the leg, saving the penalty line shot angles from the goal line in the basic stance, saving the penalty line shot angles by positioning in front of the goal line. In order to perform specific goalkeeping movements the flexibility and the speed of the movement of handball goalkeepers must be well-developed and their longitudinal skeletal dimensionality must be above the average in comparison to normal population.

Football and handball research has been primarily focused on field players, neglecting goalkeepers. Morphological characteristics and specific tasks of goalkeepers during the match vary and there are significantly fewer goalkeepers than the field players. This is why goalkeepers have usually been excluded from the sample of subjects. Data obtained by testing allows an educated coach to determine the level of different preparedness components for one goalkeeper or for the group of goalkeepers, which further helps to define the goals of the training process

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and to design the plan and programme of the training in each sports preparation cycle.

Verheijen[2] and Bangsbo[3] previous research studies have included insufficient analysis of football and handball goalkeepers' body build indicators. According to Drust Reilly and Rienzi[4] and Sporiš[5], football goalkeepers are on average taller and heavier than field players. When compared to field players, football goalkeepers on average cover less distance, mostly walking, skipping and sprinting and they perform specific goalkeeping movements, like rolling, jumping, saving balls with hands, throwing the ball out with the hand etc.

Barišić[6] studied the importance of several anthropometrical characteristics in football. According to football experts there are two types of players in football: the goalkeeper and the field player. Goalkeepers have a high level of simple movement speed, reaction speed, explosive power, flexibility, movement frequency, coordination, anaerobic alactate capacity, and longitudinal skeletal dimensionality. Gil, S., Gil, J. and Ruiz[7] studied physical and anthropometric characteristics of young football players in relation to their respective positions on the field. Players aged 17.31 (±2.64), in the range between 14 and 21 years of age, were classified in the following groups: goalkeepers (n=29), forwards, midfielders and defenders. The results indicate that the goalkeepers are the tallest and the heaviest players in the field. The goalkeepers also had the lowest values of skinfold measures and aerobic capacity. Šentija, Matković, Vuleta, Tomljanović and Džaja[8] defined morphological characteristics of top Croatian handball players (goalkeepers, wingmen, pivots, and backcourts) based on 6 anthropometrical parameters. In the sample of 20 members of the senior male national team the authors found the highest level of subcutaneous adipose tissue with goalkeepers, while the lowest level was found with the wingmen. Sporiš, Vuleta and Milanović[9] found different preparedness profiles with handball players playing different positions. Wingmen are the shortest players. Pivots are taller and heavier than backcourt players (0.01 significance level), while backcourt players are taller than wingmen (0.01 significance level). Goalkeepers have higher percentage of subcutaneous adipose tissue than backcourt players (0.01 significance level).

Material and Methods

The purpose of this study was to determine differences between top football and handball goalkeepers in several morphological characteristics. The basic hypothesis was set and tested at 5% significance level.

The sample of subjects comprised 7-10 football goalkeepers and 10-13 handball goalkeepers, depending on the tested anthropometrical variable. The age span was 17-40 for handball goalkeepers and 19-31 for football goalkeepers.

The sample of variables comprised 12 morphological tests that measured the following dimensions: 4 variables for the assessment of the longitudinal skeletal dimensionality (body height - ALVT, right leg length - ALDND, left leg length - ALDNL and arm span - ALRR), 4 variables for the subcutaneous adipose tissue (back skinfold - ANL, upper arm skinfold - ANNAD, thigh skinfold - ANNAT and abdomen skinfold - ANT) and 4 variables for the body voluminosity and mass (thigh circumference - AVONAT, calf circumference - AVOPOT, waist circumference - AVOT and body mass - AVTT). All the morphological variables were measured once, with the exception of the skinfolds, of which three subsequent measurements were taken.

TABLE 1
CENTRAL AND DISPERSION PARAMETERS OF VARIABLES FOR THE ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS OF FOOTBALL GOALKEEPERS (LONGITUDINAL SKELETAL DIMENSIONALITY, SUBCUTANEOUS ADIPOSE TISSUE AND BODY VOLUMINOSITY AND MASS)

Variables	N	M	Min	Max	Range	SD	Skew	Kurt
ALVT	10	188.87	181.60	195.70	14.10	4.36	0.08	-0.60
ALDND	10	107.66	99.10	112.60	13.50	3.69	-1.31	2.86
ALDNL	10	107.94	99.10	113.20	14.10	3.70	-1.44	3.71
ALRR	10	191.52	183.30	200.30	17.00	4.74	0.38	0.71
ANL	10	10.01	7.20	13.90	6.70	2.34	0.73	-0.73
ANNAD	10	8.74	5.67	11.73	6.06	1.83	-0.04	-0.30
ANNAT	10	13.87	7.67	23.57	15.90	5.08	0.65	-0.01
ANT	10	12.60	7.10	26.00	18.90	5.97	1.28	1.72
AVONATD	10	60.55	57.00	65.20	8.20	2.90	0.12	-1.47
AVOPOTD	10	39.73	34.60	43.60	9.00	2.70	-0.41	0.09
AVOT	7	82.98	61.25	93.00	31.75	10.10	-2.06	5.09
AVTT	10	87.39	75.80	96.50	20.70	7.44	-0.41	-1.24

Data was analysed using the software package Statistica, version 7.0. Standard central parameters (arithmetic mean - M) and dispersion parameters (standard deviation - SD; range - R; minimum - MIN; maximum - MAX; skewness - SKEW and kurtosis - KURT) were calculated for all the variables. T-test for independent samples with 0.05 statistical significance level was used to test differences between the two groups of goalkeepers.

Results and Discussion

Morphological characteristics of football and handball goalkeepers

Morphological characteristics of football goalkeepers

Table 1 shows central and dispersion parameters of variables for the assessment of football goalkeepers' morphological characteristics. All tests for longitudinal skeletal dimensionality and for body voluminosity and mass have adequate metric characteristics. All of the variables are normally distributed and

have adequate dispersion of results from the arithmetic means. The interval between the minimum and the maximum result in most cases includes more than three standard deviation values.

On the basis of the average values and minimum and maximum results in morphological measures a preliminary interpretation of the results suggests that football goalkeepers tend to be of the mesomorphic body type. They are tall athletes (M = 188.87 cm) with adequate body weight (M = 87.39 kg) and relatively low values of subcutaneous adipose tissue.

Morphological characteristics of handball goalkeepers

Table 2 shows central and dispersion parameters of variables for the assessment of handball goalkeepers' morphological characteristics. All tests for longitudinal skeletal dimensionality and for body voluminosity and mass have acceptable metric characteristics and are normally distributed. The interval between the minimum and the maximum result in most cases includes more than three standard deviation values, ranging between 3 and 3.37, which means that the dispersion of results from the arithmetic means is slightly higher than with the football goalkeepers.

TABLE 2
CENTRAL AND DISPERSION PARAMETERS OF VARIABLES FOR THE ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS OF HANDBALL GOALKEEPERS (LONGITUDINAL SKELETAL DIMENSIONALITY, SUBCUTANEOUS ADIPOSE TISSUE AND BODY VOLUMINOSITY AND MASS)

Variables	N	M	Min	Max	Range	SD	Skew	Kurt
ALVT	13	192.32	181.70	201.30	19.60	5.26	-0.51	0.48
ALDND	10	110.15	106.10	117.20	11.10	3.55	0.85	0.01
ALDNL	10	110.27	106.10	117.10	11.00	3.38	0.86	0.22
ALRR	10	196.73	187.80	206.80	19.00	6.34	0.43	-0.80
ANL	13	14.66	10.07	30.33	20.26	5.80	1.87	3.81
ANNAD	13	11.80	6.00	17.00	11.00	2.73	-0.13	1.23
ANNAT	13	17.61	9.47	26.93	17.46	5.78	0.50	-0.76
ANT	13	26.98	5.30	47.00	41.70	10.48	-0.16	0.72
AVONATD	12	65.44	59.90	71.80	11.90	4.30	0.19	-1.27
AVOPOTD	12	41.12	38.00	45.70	7.70	2.63	0.17	-1.35
AVOT	12	95.45	86.20	103.40	17.20	5.69	-0.26	-0.76
AVTT	13	98.39	82.11	111.80	29.69	9.88	-0.48	-1.06

Handball goalkeepers are very tall athletes (M = 192.32 cm). Their average body weight is 98.39 kg and they have relatively high percentage of the subcutaneous adipose tissue. Handball goalkeepers are corpulent athletes of the mesomorphic somatotype with a slight tendency towards the endomorphic body type. A preliminary interpretation of the results in the Table 1 and Table 2 suggests that the football goalkeepers are slightly shorter, weigh less and have lower percentage of subcutaneous adipose tissue than the handball goalkeepers. Further data analysis will show statistical significance of the differences.

Comparative analysis of variables for the assessment of morphological characteristics of football and handball goalkeepers

T-test for small independent samples at 99% significance level was used to test the null hypothesis regarding differences in several morphological characteristics between top football and handball goalkeepers. Specific differences between football and handball goalkeepers with respect to body build indicators were determined.

The data showed in Table 3 suggest that in longitudinal skeletal dimensionality measures there are practically no statistically significant differences between football and handball goalkeepers. Out of four variables, a statistically significant difference was determined only in the variable *arm span* (ALRR) at the 95% significance level. Table shows that the average height of handball goalkeepers is 192.32 cm and that they are taller than football goalkeepers by approximately 4 cm, which could indirectly affect statistically significant differences in the variable *arm span*.

Football goalkeepers have a significantly lower percentage of subcutaneous adipose tissue than handball goalkeepers. Statistically significant differences were found in 3 out of 4 measured skinfold variables: upper arm (ANNAD), abdomen (ANT) and back (ANL). Football goalkeepers have a lower percentage of subcutaneous adipose tissue due to the fact that they need to be more explosive (faster and of better jumping ability) than handball goalkeepers and that they need to have better aerobic capacity. They cover significantly longer distances on the field during trainings and matches than handball goalkeepers.

Furthermore, the results suggest that football goalkeepers have lower body circumference values than handball goalkeepers. These differences are statistically significant at the 99% significance level in 3 out of 4 measured variables. Statistically significant differences were calculated in the following variables: right thigh circumference (AVONATD), waist circumference (AVOT) and body weight (mass) (AVTT). In conclusion, the results indicate that handball goalkeepers are more corpulent than football goalkeepers.

In order to guard the space in front of the handball goal (300 x 200 cm), which is, when compared to the football goal (7.32 x 2.44 m) much smaller, and to close that space to prevent the opponent attackers from scoring, handball goalkeepers must have higher measures of the longitudinal skeletal dimensionality and body voluminosity than their team mates in the field. This paper has proven that they have, when compared to football goalkeepers, higher values of the body mass, which is partly due to the higher percentage of the subcutaneous adipose tissue. When compared to football goalkeepers, handball goalkeepers more frequently utilise actions in a confined space, anticipate the situation and react by proper positioning.

TABLE 3
DATA SHOWING DIFFERENCES BETWEEN TOP FOOTBALL AND HANDBALL GOALKEEPERS IN VARIABLES FOR THE ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS.

Variables	goalkeepers	N	M	SD	df	p-
ALVT	F	10	188.87	4.36	21	0.11
	H	13	192.32	5.26		
ALDND	F	10	107.66	3.69	18	0.14
	H	10	110.15	3.55		
ALDNL	F	10	107.94	3.70	18	0.16
	H	10	110.27	3.38		
*ALRR	F	10	191.52	4.74	18	0.05
	H	10	196.73	6.34		
*ANL	F	10	10.01	2.34	21	0.03
	H	13	14.66	5.80		
**ANNAD	F	10	8.74	1.83	21	0.01
	H	13	11.80	2.73		
ANNAT	F	10	13.87	5.08	21	0.12
	H	13	17.61	5.78		
**ANT	F	10	12.60	5.97	21	0.00
	H	13	26.98	10.48		
**AVONATD	F	10	60.55	2.90	20	0.01
	H	12	65.44	4.30		
AVOPOTD	F	10	39.73	2.70	20	0.24
	H	12	41.12	2.63		
**AVOT	F	7	82.98	10.10	17	0.00
	H	12	95.45	5.69		
**AVTT	F	10	87.39	7.44	21	0.01
	H	13	98.39	9.88		

F - football goalkeepers H - handball goalkeepers
* indicates p-value lower than 0.05 **indicates p-value lower than 0.01

On the other hand, when compared to handball goalkeepers, football goalkeepers move more frequently in front of the goal and cover longer distances. Increased body weight would slow them down in their saving actions, such as jumping, running out, punching or catching the ball, and especially landing after diving.

Conclusion

The purpose of this research was to determine differences between top football and handball goalkeepers in morphological characteristics. The sample of subjects comprised 10-13 handball goalkeepers and 7-10 football goalkeepers. T-test for independent samples was used to determine statistically significant differences between handball and football goalkeepers in the following variables: arm span (ALRR), back skinfold (ANL), upper arm skinfold (ANNAD), abdomen skinfold (ANT), right thigh circumference (AVONATD), waist circumference (AVOT), and body weight (mass) (AVTT). Results suggest that top handball goalkeepers are taller (longitudinal skeletal dimensionality) and more corpulent (body voluminosity and mass) and that they have a higher percentage of the subcutaneous adipose tissue. The reason for this can be found in selection procedures for the position of a goalkeeper and specific TE-TA actions of top football and handball goalkeepers during trainings and matches.

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RAZLIKE IZMEĐU FUDBALSKIH I RUKOMETNIH GOLMANA U MORFOLOŠKIM KARAKTERISTIKAMA

S A Ž E T A K

Cilj je ovog istraživanja utvrditi razlike među vrhunskim fudbalskim i rukometnim golmanima u morfološkim karakteristikama. Uzorak ispitanika čini 10-13 rukometnih i 7-10 fudbalskih seniorskih golmana hrvatskih nacionalnih selekcija ili prvoligaških klubova. Morfološke karakteristike procjenjivane su baterijom od 12 antropometrijskih varijabla – 4 varijable za procjenu longitudinalne dimenzionalnosti skeleta, 4 varijable za procjenu potkožnog masnog tkiva te 4 mjere za procjenu voluminoznosti tijela. Izračunati su standardni centralni i disperzivni parametri morfoloških varijabla. Značajnost razlika između fudbalskih i rukometnih golmana u mjerenim morfološkim karakteristikama utvrđena je t – testom za nezavisne uzorke. Utvrđeno je kako se rukometni i nogometni vratari razlikuju u sljedećim varijablama: raspon ruku (ALRR), kožni nabor leđa (ANL), kožni nabor nadlaktice (ANNAD), kožni nabor na trbuhu (ANT), opseg natkoljenice desne (AVONATD), opseg trbuha (AVOT) i težina tijela (AVTT). Vrhunski fudbalski golmani imaju manju longitudinalnu dimenzionalnost skeleta, imaju manje potkožnog masnog tkiva te manju voluminoznost tijela od rukometnih golmana.

Ključne riječi: Nogometni vratari, rukometni vratari, morfološka obilježja, razlike.

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Predictors Affecting the Ranking in Women Armwrestling Competition

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A B S T R A C T

The purpose of this study was to investigate the predictors contributing to be in the first three places with right dominant arm in women armwrestling. Thirty-one female senior armwrestlers competed in Turkish National Championship voluntarily participated in this study. The data were collected from six different weight classes. Handgrip strength, auditory reaction time, forearm length, and forearm circumference were determined as the predictors. All the measurements were taken after weigh-ins was completed and before the first day of national championship competition. Logistic regression analysis was conducted to predict whether a competitor in women armwrestling would be in the first three places with right arm, to be a winner or non-winner. Relative handgrip strength and forearm length were found significant predictors ($p < .05$). This result suggests that strength can be viewed as the main predictor in right arm ranking for women competitors; however, in order to apply different techniques during the match, forearm length also found to be an effective factor to be a winner. Thus, this anthropometric measurement can be used for the talent identification for women armwrestlers.

Key words: *Handgrip Strength, Auditory Reaction Time, Forearm Length, Forearm Circumference.*

Introduction

Female participation in sports can be seen in both amateur and professional level. This participation especially rose sharply in the twentieth century. This increased participation can be also observed in armwrestling. Armwrestling is accepted to be one of the oldest sports. Researchers stated that armwrestling can be traced all the way back to ancient Egypt. This is based on a painting depicting a type of armwrestling found in an Egyptian tomb dating to about 2000 B.C. It has started to be very popular in the last century because it does not require many equipments and not have many rules. The first rules for armwrestling was set up and the first organized competition carried out almost 60 years ago in California, USA[1]. Nowadays, it is a genuinely international sport and spread out all over the world.

In armwrestling, the competitors are facing one another. They lock their hands with their elbows firmly planted on the flat surface, and each attempts to force the others arm down to the table. Armwrestling involves primary (medial rotation of the upper arm, pronation of the forearm and hand, flexion of the wrist) and secondary (flexion of the arm and forearm) movements, which recruit the participation of some muscles, such as Pectoralis Major (PM), Biceps Brachii (BB), Pronator Teres (PT) and Flexor Carpi Ulnaris (FCU) muscles. In fact, the PM and FCU muscles participate as agonists in the simulated armwrestling whereas the BB and PT muscles seem to perform secondary functions[2]. Besides the muscle strength, armwrestlers also use different techniques like top-roll and hook. In top-rolling, competitor tries to put his or her hand up opponent's palm. The main aim of the hook technique is to force the opponent's hand back and expose his or her wrist by twisting your wrist towards you[3].

In armwrestling competition, the referee starting the match will be deemed head referee of that particular match. Assistant referee will watch for elbow fouls at start of match and assist in assuring a fair start. In a regular match, assistant referee properly aligns the competitors' hands. Then, head referee starts the match with a "Ready...Go!" signal in an unspecified cadence[4].

One may think that arm strength is the main factor for winning an armwrestling match. However, arm wrestling is not only a "strength" sport, but also a sport with technique and speed5. In fact, studies with armwrestling are very limited in the literature. This draws our attention to search for parameters contributing to winning in armwrestling. Therefore, the purpose of this study was to investigate the factors contributing to be in the first three places with right arm in women armwrestling. For this purpose, we have determined some physiological and perceptual predictors that can be thought as factors affecting to be a winner or non-winner. Handgrip strength, forearm circumference, and forearm length were determined as physiological predictors whereas auditory reaction time was determined as a perceptual predictor. Handgrip strength was taken as the first predictor to win the match. Handgrip strength is often used in many sports, since hand dynamometry is simple, not expensive, and a well-established method for assessing the strength of wrist and digits flexor muscles. Some researchers reported high test - retest reliability of handgrip strength in children and adolescent males[6,7].

As the head referee starts the match with a "Go"signal, it is important for a competitor to react very fast5 to this stimulus to force the others arm down to the table. Thus, we took auditory

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reaction time as the second predictor. Some limb measurements, e.g. forearm length, and forearm circumference, are also used for the talent identification[1], thus, we took these two parameters as the third and fourth predictors.

Materials and Methods

Participants

The total number of 31 female senior armwrestlers ($M_{(age)}$ = 27.8 ± 4.41) voluntarily participated in this study. All armwrestlers participated in this study competed in Turkish National Championship. However, we could not reach all participants in the championship. Please note that we have searched the possible predictors for being a winner or non-winner in armwrestling competition for only right ranking. All participants were right handed which was determined using a modified version of the Edinburgh Handedness Inventory. The participants computed in 6 different weight classes (0-50 kg, 55 kg, 60 kg, 65 kg, 70 kg, and 80 kg). The Ethics Committee of Nevşehir University, Turkey approved this study.

Measurements and Procedures

The aim of this study was to investigate the factors contributing to be in the first three places with right arm in women armwrestling. For this purpose, we have determined four predictors; handgrip strength, auditory reaction time, forearm length, and forearm circumference. All the measurements were taken after weigh-ins had been done and before the first day of competition start time. The measurements were taken by two researchers and done in a silent and fresh room so that each participant felt very comfortable. All the measurements for one arm took approximately 5 min. The measurements were started with forearm length and forearm circumference and then continued with auditory reaction time. Finally, the measurement of handgrip strength was applied to the participants.

Forearm length measurement was taken as length of radius, from radiale (proximal point on the lateral side of the head of the radius) to stylion (most distal point on the styloid process of the radius).

Forearm circumference was measured in supination at a point 12 cm distal to the tip of the olecranon in a flexed elbow at 90° and using a flexible tape measure. This was applied closely to the skin, but without causing compression[8].

Simple auditory reaction time was obtained using a multi-choice reaction timer (Lafayette Instruments Company). Participants put their index finger on the key and were instructed to press the key as rapidly as possible when they heard the auditory stimulus.

Handgrip strength measurements were taken with a portable digital hand dynamometer (Jamar, EN ‑ 120604). Each participant performed a standardized warm-up that included one or two preliminary trials for familiarization with the recording procedure and instrumentation. The participants were seated on a chair with the shoulder adducted and neutrally rotated. Whereas the forearm and wrist were set in neutral position, the elbow was flexed at 90° [7,9]. The testing protocol consisted of three maximal isometric contractions for 3 - 5 s, on competed hand. As Ridan et al. (2000) stated the fatigue influence on grip measurement during successive squeezes, a rest period of at least 60 s was provided to the participants between trials[10]. The participants were told to put maximal force on the dynamometer. The result of handgrip strength was provided to the participants after each trial. The maximal strength value (kg) of three trials was used for the analysis. As the participants were from six different weight classes, relative handgrip strength (handgrip strength / body mass) value was used for the statistical analysis.

Statistical Analysis

Data were analyzed using SPSS 18 statistical software. Logistic regression analysis was performed to predict whether a competitor in women armwrestling would be in the first three places with right arm, to be a winner or non-winner. We defined the winners as the competitors who were in the first three places in the armwrestling competition and non-winners as the competitors who were in the fourth or upper places in the armwrestling competition. We also tested collinearity following logistic regression analysis. As SPSS does not have an option for producing collinearity diagnostics in logistic regression, we obtained statistics such as the tolerance and VIF by simply running a linear regression analysis using the same outcome and predictors. The level of significance was set to $p < .05$.

Results

The average and standard deviation of the predictors were provided in Table 1. A logistic regression analysis was conducted for the statistical analysis with relative handgrip strength, auditory reaction time, forearm circumference, and forearm length being as predictors for the analysis.

TABLE 1
PARTICIPANTS' AVERAGE AUDITORY REACTION TIME, RELATIVE HANDGRIP STRENGTH, FOREARM CIRCUMFERENCE, AND FOREARM LENGTH IN RIGHT ARM RANKING

	Winner (n = 18) *M* ± *SD*	Non-winner (n = 13) *M* ± *SD*
Auditory Reaction Time (ms)	139 ± 15.1	148.57 ± 25.7
Relative Handgrip Strength	0.71 ± 0.13	0.60 ± 0.11
Forearm Circumference (cm)	26.81 ± 2.7	25.19 ± 1.78
Forearm Length (cm)	24.92 ± 1.27	23.15 ± 1.34

A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between winners and non-winners (chi square = 29.09, $p < .000$ with df = 4). Nagelkerke's R^2 is the most-reported of the R-squared estimates. In our case, it was .82, indicating a high relationship of 82% between the predictors and the prediction. Hosmer and Lemeshow goodness-of-fit statistic was greater than .05, implying that the model's estimates fit the data at an acceptable level[11].

In the Classification table, the columns are the two predicted values of the dependent, while the rows are the two observed (actual) values of the dependent. In a perfect model,

all cases will be on the diagonal and the overall percent correct will be 100%. In this study, 94.4% were correctly classified for the winner group and 92.3% for non-winner group (Table 2). Overall 93.5% (step 1 in Table 2) were correctly predicted. This is a considerable improvement on the 58.1% (step 0 in Table 2) correct classification with the constant model so we know that the model with predictors is a significantly better mode.

TABLE 2
CLASSIFICATION TABLES FOR RIGHT ARM RANKING; STEP 0: BEFORE THE ANALYSIS, STEP 1: AFTER THE ANALYSIS

	Observed		*Predicted*		
			Right Ranking		Percentage Correct
			Winner	Non-winner	
Step 0	Right Arm Ranking	Winner	0	18	100.0
		Non-winner	0	13	0
	Overall Percentage				58.1
Step 1	Right Arm Ranking	Winner	17	1	94.4
		Non-winner	1	12	92.3
	Overall Percentage				93.5

The Wald statistic and associated probabilities provide an index of the significance of each predictor in the equation. The Wald statistic has a chi-square distribution. The simplest way to assess Wald is to take the significance values and if less than .05 reject the null hypothesis as the variable does make a significant contribution. In our case, we note that relative handgrip strength and forearm length contributed significantly to the prediction (p = .03 and p = .04, respectively) but auditory reaction time and forearm circumference did not (p = .19 and p = .62, respectively).

TABLE 3
THE RESULT OF WALD STATISTICS IN LOGISTIC REGRESSION ANALYSIS FOR RIGHT ARM RANKING

	B	*S.E.*	*Wald*	*df*	*Sig.*	*Exp(B)*
Auditory Reaction Time	-.94	.72	1.72	1	.110	.390
Relative Handgrip Strength	-34.13	16.26	4.40	1	.036	.000
Forearm Circumference	-.23	.46	.24	1	.622	.795
Forearm Length	-3.75	1.85	4.06	1	.044*	.24
Constant	132.07	66.17	3.98	1	.046*	2.274

* indicates p-value lower than 0.05

For the assumption of logistic regression, collinearity statistics was also checked with linear regression analysis[11]. The result of the linear regression analysis showed tolerance and VIF values as .92 and 1.32 for auditory reaction time, .87 and 1.72 for relative handgrip strength and forearm circumference, and .94 and 1.12 for forearm length, respectively. For the collinearity statistics, a tolerance values less than .1[12] and a VIF value greater than 10[13] are cause for concern for the parameters of a regression model. In our case, therefore, it is safe to indicate that our logistic regression model is reliable to predict winner or non-winner in an armwrestling competition.

Discussion

Female athletic participation has been increasing in all sports. This increased female participation can be also seen in armwrestling. Armwrestling has become a popular sport in all over the world not only for men but also for women. Even though one may consider arm strength as the main contributing factor for winning, strength is not seen the only factor for winning[5]. Speed and technique are also thought to be effective in this sport. In this study, we tried to find the possible predictors for winning a match in women armwrestling competition. For this purpose, we determined four predictor; relative handgrip strength, forearm circumference, forearm length, and auditory reaction time. Logistic regression analysis displayed that handgrip strength and forearm length were significant predictors for right arm ranking.

In armwrestling, it is very crucial to react fast to the head referee "go" signal to start the match in order to force the others arm down to the table before the opponent attempt. Thus, auditory reaction time plays may play an important role. Interestingly, auditory reaction time was not found a significant predictor although competitors in winner group had faster auditory reaction time (M = 138 ± 15.1 ms) than that of non-winner group (M = 148.57 ± 25.7 ms). It can be still recommended for women armwrestlers to improve this perceptual skill.

Handgrip strength is generally used to measure the maximum isometric strength of the hand and forearm muscles. It is important for any sport in which the hands are used. Strength is also thought to be one of the important factors to win a match in armwrestling[14]. In fact, relative handgrip strength was found to be a significant predictor for being a winner or non-winner in armwrestling competition for right arm ranking in this study. This is not a surprising result as the women competitors aims are to force the others arm down to the table. Thus, being stronger than the opponent can give an advantage to win the match if both competitors have the same auditory reaction time and techniques.

The other dependent variable used in this study predicting to be a winner or non-winner in armwrestling was forearm circumference. Forearm circumference was found to be a predictor of maximum handgrip strength in many studies[8,15,16]. In this study, forearm circumference was not found a significant predictor although forearm circumference value in winner group

(M = 26.81 ± 2.7 cm) was more than that of non-winner group (M = 25.19 ± 1.78 cm).

In some countries, forearm length is used as a criterion to select talented armwrestlers[1]. It was previously stated that forearm length had a positive correlation with the maximum handgrip strength[16]. In this study, we have found forearm length together with relative handgrip strength a significant predictor to be a winner or non-winner. Thus, the result of this study supports Nicolay and Walker (2005) research[16]. Forearm length may be effective to apply different techniques (the top-roll or the hook) during the match as it may give an advantage to put hand over the opponent's palm. Even though we did not aim to search the effect of forearm length on applying techniques, having a longer forearm predicts to win the match for women armwrestlers.

Conclusion

Armwrestling has been increasing its popularity for the last two decades. However, scientific studies about armwrestling are very limited in the literature, especially for women. This study aimed to investigate possible predictors to be a winner or non-winner in women armwrestling competition. Overall, relative handgrip strength and forearm length were found to be significant predictors for right arm ranking. Competitors in this sport mostly perform strength training in their practice regime[14]. Even though auditory reaction time was not found to be a significant predictor, women wrestlers in the winner group had the faster reaction time than the reaction time of the non-winners. Therefore, it is also suggested that women wrestlers should also allocate some time to improve their auditory reaction time. Speedy response in order to set muscles into motion will definitely give an advantage to apply appropriate technique and win the match. Forearm circumference was not found as a significant predictor in this study. Therefore, this anthropometric measurement does not need to be used for the talent identification. In order to apply different techniques during the match, having longer forearm length increases the probability of winning the match. Thus, this anthropometric measurement should be used for the talent identification for women wrestlers. In conclusion, the predictors to be a winner or non-winner in women armwrestling were found to be relative handgrip strength and forearm length. Even though forearm length is genetically determined anthropometric measurement, women armwrestlers can focus on to improve their handgrip strength.

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PREDIKTORI KOJI DOPRINOSE BOLJEM RANGIRANJU KOD TAKMIČENJA U OBARANJU RUKU U ŽENSKOJ KONKURENCIJI

S A Ž E T A K

Cilj ovog istraživanja je bio da se utvrde prediktori koji doprinose da se takmičarke koje koriste desnu ruku nađu među prva tri mjesta na tabeli. Uzorak je sačinjavala 31 odrasla takmičarka u Turskom nacionalnom šampionatu u obaranju ruku dok su sirovi podaci prikupljeni iz šest različitih težinskih kategorija. Snaga stiska ruke, vrijeme reakcije na zvuk, dužina i obim podlaktice su predviđeni da budu prediktori u ovom istraživanju. Testiranje je sprovedeno nakon zvaničnog mjerenja takmičarki, kao i prije prvog zvaničnog takmičarskog dana. Logistička regresivna analiza je primjenjena kako bi se utvrdilo da li će takmičarke u obaranju ruku osvojiti jedno od prva tri mjesta desnom rukom, biti pobjednica ili poražena. Utvrđeno je da su relativna snaga stiska ruke i dužina podlaktice značajni prediktori ($p < .05$). Ovi rezultati ukazuju na to da snaga može biti posmatrana kao glavni prediktor koji doprinosi boljem rangiranju kod takmičenja u obaranju ruku u ženskoj konkurenciji; međutim, u cilju primjene različitih tehnika tokom meča, utvrđeno je da je i dužina podlaktice, takođe značajan faktor za ostvarivanje pobjede. Dakle, primjenjena antropometrijska mjerenja mogu biti korišćena za identifikaciju talenata kod obaranja ruku u ženskoj konkurenciji.

Ključne riječi: Snaga stiska ruke, vrijeme reakcije na zvuk, dužina podlaktice, obim podlaktice.

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The Influence of Basketball on the Asymmetry in the Use of Limbs

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A B S T R A C T

The purpose of this study was to determine how basketball affects the uneven use of the limbs in relation to non-basketball population. Participants were compared by multiple motoric and situational tests, and for each participant tested the relationship between all limbs, both upper and lower. Before the motoric and situational tests participants completed a questionnaire on preference in limb use in everyday life and during sports activities. Participants belong to two groups, one group of young players with the rank of at least four years experience in basketball training, while the second group consisted of members of the healthy school population, but with no experience in the continuous training of basketball. The study tested the explosive power of the lower and upper limbs, and the reaction time and agility in the lower limbs. Statistical analysis of results showed significant differences in certain tests between groups and within groups, both among the upper and lower extremities. It can be concluded that basketball has positive influence on the development of the tested variables, while the level of asymmetry at basketball players is less than the level of asymmetry in the non-basketball population.

Key words: *Asymmetry, Basketball, Preferred Limbs, Non-Preferred Limbs.*

Introduction

Uneven use of the limb was present as the world is divided conditionally speaking into right and left. With the evolution of the sport as a social phenomenon and in striving to achieve the best results there has been interest in the exploration of uneven use of the limbs in the sport, while in the past, this problem was investigated in the general population and is usually referred to the upper extremities.

In the mid 20th the concept of lateral dominance was defined by Harris[1], that the lateral dominance is bigger ability of one body part over another to perform some motor tasks. The reasons that lead to the occurrence of lateral dominance lies in the phenomenon of CNS to one side of the brain play a greater role in specific functions[2]. Increasing interest has developed a number of theoretical discussions about the causes and reasons of the lateralization[3,4,5,6,7,8,9], course for this article mentioned terms are informative, no intention to discuss about them.

In sport, the problem of inconsistent use of limbs starts to engage researchers in the field of medicine because of the frequent occurrence of anterior cruciate ligament injury ACL[10,11,12,13].

Some sports require constant improvement of one side of the body or one limb, for example sports with use of racket (tennis, squash, etc.), while in other sports, for example sports games (basketball, football, handball, volleyball, hockey etc.), require a greater degree of bimanual dexterity[14], or simultaneous use of the lower limbs, or all the limbs together. The level of players and their mastery of sports has an impact on the degree of bimanual dexterity[15]. Based on these assumptions, Stöckel and Weigelt[16] have carried out a research conducted w ith the video analysis of dribbling the ball, catching, passing and shooting, between preferred and non-preferred arm on a sample of 126 male basketball players (mean age 24.3 years). Basketball players have competed at various levels: (1) international level (n=43), (2) national professional level (n=20), (3) non-professional (n=43) and (4) juniors and amateurs (n = 20). The results showed a significant difference in use between dominant and non-dominant hand and the level of competition in which players participate (r=0.496, p <.001). Specifically it was found that the use of non-preffered hand increases as the level at which the athletes compete. At junior and recreational groups the percentage of non-preferred arm use was 10.3%, with 17.4% of non-professional players, the players of the national professional level of 31.2% and the players who compete at international level 26.1%. An interesting finding of this study is that the various technical elements that were studied (dribbling, trapping, passing, kicking, etc.), occurring in almost the same proportion as in the previously mentioned data.

Dauty and associates[17] have dealt with the identification of mechanical consequence of Jumper's knee injury in elite basketball players. The study was conducted on 15 basketball players with a history of Jumper's knee injury and a control group of 42 subjects without history of mentioned injury. Subjects were tested using a dynamometer and it was found the basketball related to asymmetry between the knee extensor muscle force was at a level of about 10%. An interesting fact in this study is that one in 7 patients in the control group has an asymmetry of about 10%, although none of them had a history of injuries.

Schiltz et al.[18] conducted a study examined the imbalances in an explosive force in professional basketball players and compared junior basketball players with the controls that are not actively involved in basketball. The study included 15 professional basketball players, 10 junior basketball players and 20 healthy men. Research has shown that the asymmetry occurs and to the professional basketball and is 12% and to the jumps in depth with a height of 20 cm, an asymmetry arises in favor of

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the dominant limb. There was also a difference in the height of the jump on one foot and it is a significant difference was also with professional players and it was 10.5%, while the juniors and the control group no significant difference.

Čvorović, Berić & Kocić[19,20,21] examined the asymmetry of the dominant and non-dominant limbs in the expression of muscular force, explosive strength and frequency of movement in basketball players of the younger age groups. They came to the conclusion that a significant asymmetry occurs in explosive strength of upper extremities and in the frequency of movement occurs with the upper and lower extremities and to the benefit of the dominant limb.

The literature often use the terms preferred leg, the preferred arm, preferred and non- preferred leg and arm, some authors the real disparities in relation to the concept of dominant non-dominant leg or arm, in this research these concepts will be treated as synonyms, as the case in most studies of this or similar type.

The aim of this study was to determine differences in the use of limbs as among the participants, and among the groups to which they belong, and thereby obtain information on how basketball affects the uneven use of the limbs compared to participants who are not engaged in active basketball training.

Materials and Metods

Participants

Participants in this study were members of a healthy male population aged 15 years, divided into two groups: first group consists of 15 players from the Basketball Club Flash from Belgrade (M_{age}=15±0.5 years, M_{BW}=71.73±9.17kg, M_{BH}=182.87 ±6.71cm), while the second group consists of 15 members of the healthy school population, but without a history of serious basketball training, from Elementary School Ivo Andric from Belgrade (M_{age}=15±0.5 years, M_{BW}=74.93±15.01kg, M_{BH}= 177.67±7.89cm).

Variables and Testing Procedures

Prior to testing participants completed a questionnaire on preference in the use of limbs. The questionnaire consists of six questions, three questions relating to the arms, and three on the legs, a limb that is mentioned in at least two options is the preferred or dominant limb. Questions were related to writing, shooting, and passing for the hands, and kicking, step on the stair and a take-off for of the legs. The questionnaire in research was taken from Čvorović[21], and it is only informative type in order to determine the subjective answer of preference in use of limbs in daily life, and certain sports activities.

Tested variables from the anthropometry are body height (BH), body weight (BW) and height of the reach of the extended arm above head (AR).

Motoric skills and variables that were tested are explosive strength of leg extensors, explosive strength of arm extensors, agility and reaction time to light signals.

Explosive leg extensor strength was measured with two tests. One test included in the horizontal jump with each leg separately, and the second test included the vertical jump after a running start with take-off from one foot, of course, was carried out for both legs separately. For the horizontal component of the explosive leg extensor strength (HJD - horizontal jump dominant and HJN - horizontal jump non-dominant) was used Hop for Distance Test[22]. The subjects stood on the test leg and then hopped as far as possible and landed on the same leg. Free leg swing was allowed. The hands were placed behind the back. The subjects were instructed to perform a controlled, balanced landing and to keep the landing foot in place (i.e. no extra hops were allowed) until (2–3s) the test leader had registered the landing position. Failure to do so resulted in a disqualified hop. Participant performed a jump with one leg and then with the other when it is ready, the rest interval between next two jumps is at least 2 minutes. The distance was measured in centimetres from the toe at the push-off to the heel where the subject landed. The vertical component of the explosive leg extensor (VJD - vertical jump dominant and VJN - vertical jump non-dominant) strength was measured with a Vertec Jump Testing System after run-up jump from single leg take-off[23], with the difference that the vertical jump is not measured after a certain number of steps, but the running start was with the three point line (6.75 m). Measured is the difference between the reach of the extended arm and reach after the jump. Subject conducted three jumps each leg separately, and recorded the best results achieved for each leg separately. Participant performed a jump with one leg and then with the other when it is ready, the rest interval between next two jumps is at least 2 minutes. The precision of measurement is 1 cm.

Arm extensor explosive strength (TBD - throwing the ball dominant and TBN - throwing the ball non-dominant) is measured by the modified Throwing Gate Test[24], with a platform for testing Newtest Powertimer 300 a portable system for field tests of Finland production. System consists of rubber mat with sensors, photocells set, the console to connect to the transmission computer that has installed software to track test results on the monitor. Difference from original Throwing Gate Test is that participants toss medicine ball with one hand at the level of the shoulders, not with two hands above his head. The subject stands in a parallel stance 1 m away from the first set of photocells, that are placed on the supports vertically one above the other to create an infrared curtain. From that position participants throwing a medicine ball a weight of 1 kg with one hand in the level of the shoulders and without moving the body and feet. After ejection the ball need to pass through the infrared curtain and hit the mat with sensors that hung on the wall at a distance 2 m from the curtain. The measurement started when the ball cut the beam from the infrared curtains, and ends when it hit the mat with sensors. Two results were obtained in the measurements, the flight time, expressed in milliseconds (ms) and speed of the ball in meters per second (m/s). This study analyzed data related to the speed. Subjects were allowed to do three attempts for each hand, and recorded the best results achieved for each hand separately. Participant performed a throwing with one hand and then with the other when it is ready, the rest interval between next two throwing is at least 2 minutes.

Agility (AGD - agility dominant, and AGN - agility non-dominant) was measured using the 505 Test on platform with Newtest Powertimer 300. The subject was on the start line on the track length of 15 m, the end of the path was line twist. Photocell is located 10 m from the starting line. Participants run from to the starting line and accelerates as possible, run by a photocell and cross the turning line where turn around with left or right leg and running quickly is possible by photocell. The movement was tested with three attempts of changing direction with dominant as well as with non-dominant leg, and recorded the best results achieved for each leg separately, precision of measurement is one 1 ms.

Reaction time (RTD – reaction time dominant, and RTN – reaction time non- dominant) was measured also using the platform for testing Newtest Powertimer 300 and with Take-Off Reaction Time Test. This test is performed by the participant on

rubber mat with sensors versus the command console, which is only two meters from mat on which the participant is, on the left and right at a distance of 5m of the mat where the participant is located two photocells. The subject is facing towards the control panel with slightly bent knees and hands on the hips in the ready position, a command console comes with a buzzer and light for the start signal for the direction of movement. Following this signal, the participant raised leg toward the direction of movement, and the other leg pushes up quickly and set up motion in a given direction is determined by measuring the response time of giving the signal to start the movement and speed of a given signal to pass through the photocell. The console provides random signals for both directions of movement 3-5 times for each direction, and recorded the best results achieved for each direction separately and the difference between left and right sides. For the purposes of this study are treated only data related to the response time to a given light signal. Rest interval between attempts is one minute. The precision of measurement is 1 ms.

TABLE 1
DESCRIPTIVE STATISTICS FOR ALL TESTED VARIABLES

	Non-Basketball Group		Basketball Group	
VARIABLES	Mean	Std. Dev.	Mean	Std. Dev.
BW(kg)	74.93	15.01	71.73	9.17
BH(cm)	177.67	7.88	182.86	6.71
AR(cm)	233.27	10.19	241.33	9.41
VJD(cm)	32.87	9.32	56.33	5.65
VJN(cm)	42.06	7.54	62.13	6.21
HJD(cm)	138.06	17.20	163.60	10.81
HJN(cm)	137.53	15.46	162.33	9.20
AGD(ms)	3216.13	301.52	2525.20	127.98
AGN(ms)	3225.40	388.66	2515.06	123.11
RTD(ms)	810.20	91.19	780.80	71.99
RTN(ms)	822.06	91.14	749.46	65.73
TBD(m/s)	7.89	0.50	8.72	0.89
TBN(m/s)	6.67	0.38	8.14	0.84

Explanation of abbreviations for Table 1: BW - body weight, BH-body height, AR-arm reach, VJD – vertical jump dominant, VJN – vertical jump nondominant, HJD – horizontal jump dominant, HJN – horizontal jump non-dominant, AGD- agillity dominant, AGD- agillity non-dominant, RTD - reaction time dominant, RTD - reaction time non-dominant, TBD – throwing the ball dominant, TBN – throwing the ball non-dominant.

Design and Analysis

The statistical procedures that are used in the field of descriptive statistics were treated with variables related to body height and body weight and for all motoric variables. The difference between the extremities in motoric tests was treated with the coefficient of asymmetry, which is expressed in per- centage and is calculated by the formula AS=D-ND/Dx10025 where is: AS - asymmetry coefficient, D - dominant side; ND - non-dominant side. Significant results are considered to be above 5%. The difference between groups and within the subjects was tested by mixed design ANOVA with dominant and non- dominant measurements as repeated factors (*dnmf – dominant and non-dominant measurements factor*) for significance level at $p<0.05$. Statistical analysis was carried out using SPSS 19 software forWindows.

Results

Results of the questionnaire in a group of basketball players showed that the number of participants with dominant or preferred right hand is 15 or 100%. As for the legs 10 participants stated right leg as the preferred or 66.67%, while the left leg as a dominant participant listed in 5 or 33.33%.

In the group of non-basketball as the dominant right hand led the 14 participants or 93.33%, while one participant stated his left hand as dominant, or 6.67%. The dominant right leg led 14 participants or 93.33%, while the dominant left leg was obserwed in one participant or 6.67%.

Results related to the asymmetry coefficient for non-basketball group (NVJ/AS), showed that are statistically significant NVJ / AS =-26.63%, and values are negative, which means that the non-dominant leg is stronger than the dominant one in this test. For the same test within a group of basketball players asymmetry coefficient (BVJ/AS), results showed that are also statistically significant BVJ/AS=-10.37%, and also values are with a negative sign indicating that the non-dominant limb exhibited greater strength.

For horizontal component of explosive leg strength in non-basketball group coefficient of asymmetry (NHJ/AS), results shown that difference between limbs was statistically insignificant NHJ/AS=0.05%. For the same variable, but within a group of basketball players asymmetry coefficient (BHJ/AS), results was also statistically insignificant BHJ/AS=0.67%.

The variable explosive strength of arm extensor in the group of non-basketball for results of coefficient of asymmetry (NTB/AS), showed a statistically significant difference between the upper limbs and to the benefit of the dominant limb NTB/AS=15.36%. For the same variable in a basketball group coefficient of asymmetry (BTB/AS), results also showed a statistically significant difference between the upper limbs and to the benefit of the dominant limb BTB/AS=6.42%.

Results of the coefficient of asymmetry within the group of non-basketball players related to agility (NAG/AS), showed statistically insignificant difference between the limbs of the

variables NAG/AS=-0.24%. Also in the group of basketball players were no significant differences between the extremities for agillity variables, which is confirmed by the results of coefficient of asymmetry BAG/AS=0.35%.

The results for variable reaction time in non-basketball group for coefficient of asymmetry (NRT/AS), have shown that was not statistically significant difference between the extremities in this group NRT/AC=-1.90%. For the same variable in the group of basketball players coefficient of asymmetry (BRT/AS), also not determined statistically significant difference between the extremities BRT/AS=3.19%.

Results obtained by mixed design ANOVA showed significant differences within subjects for variables related to vertical jump abillity (VJD and VJN), F=36.468, p<0.05, and between groups of subjects, F=85.382, p<0.05. For horizontal jump variables (HJD and HJN), results showed there were no significant differences within subjects, F=0.496, p>0.05, for the same variables but between groups results showed significant differences, F=28.030, p<0.05.

Results for mixed design ANOVA showed for agillity variables (AGD and AGN), there were no significant differences within subjects, F=0.000, p>0.05, for the same variables but between groups results showed significant differences, F=60.126, p<0.05.

Results obtained by mixed design ANOVA showed significant differences within subjects for variables related to explosive strength of uper limbs (TBD and TBN), F=82.398, p<0.05, and also between groups of subjects results showed significant differences, F=24.327, p<0.05.

For reaction time variables (RTD and RTN), results from mixed design ANOVA showed there were no significant differences within subjects, F=0.360, p>0.05, for the same variables but between groups results showed significant differences, F=4.281, p<0.05.

Discusion

The main objective of this study was to determine the presence of asymmetry in the limbs of young basketball players as compared with peers who are not actively involved in basketball training and belong mainly to sedentary population. From results of statistical analysis are isolated two variables that are statistically different within the groups they belong to and among groups, and these variables are related to the explosive strenght of the extensors of the hand and the explosive strenght of leg extensors with pronounced vertical component.

Results of the research for upper limbs asymmetry are in agreement with several studies conducted so far[26,19]. Certainly the results and any agreement should be interpreted with caution, because in this area is insufficient number of research to make a set of variables and testing standards, and research methodology and measurement instruments differ.

In the lower extremity the results are quite different from each other, because they are tested with two tests, one with a pronounced horizontal component, but without the arm swing and another with a pronounced vertical component, but with arm swing during the jump, where statistically significant differences to the benefit of the non-dominant lower limb. In basketball this movement is one of the basic technical movements in attack and is directly related to achievement points with very small distance from the rim and usually ends with the dominant hand, and take-off foot is non-dominant, and that's probably the reason for the asymmetry determined. The results obtained in this test, mainly referring to the basketball group are in agreement with the results of research from Young, Wilson & Byrne[22], with the difference that in above mentioned study measured only the vertical jumping ability of the dominant side of the body. The results for the horizontal jumping ability, where there were no significant differences between the lower limbs is consistent with the research from Čvorović, Berić & Kocić[19,21], which also showed no statistically significant differences between the lower limbs.

As for agility were no statistically significant differences among the groups tested in the lower limbs, while there is a difference between groups and statistically significant in favor of basketball players. Results obtained by testing with a 505 test for basketball players group are fairly consistent with the results released by Gore[27], course in terms of asymmetry, while the results of his research are little better, because these are the players of senior age, and national levels.

As for the reaction time results are tentatively quite high compared to say a sprinter and reaction time related to the upper limbs, but it should be noted that the movement in the test which was performed quite differently from the aforementioned and reason for this probably lies in the Hick's Law, which states that the amount of time it takes to prepare a response is dependant upon the number of stimulus-response (SR) alternatives that are present[28] , but they are quite consistent with the results of research from Pradas, Carrasco & Izaguerri[29] because they use the same testing procedure with Newtest, with the difference that there were no statistically significant differences within the groups in terms of reaction time.

Conclusion

In conclusion of this study can be stated that basketball as a sport positively influence on the variables that were tested in comparison to a healthy school population, and more importantly what results from this study is the fact that basketball have a positive transfer to reduce the level of asymmetry between the limbs. The reason for this is probably the nature of competitive activity and the technical demands of the sport which requires solving the bimanual movement tasks, as the same may be said for the lower limbs. Future research should include more participants of all ages and levels and to examine some other variables, and it would certainly be interesting to conduct a training program aimed at reducing the level of asymmetry that would result in more complete player and would reduce the possibility of injuries that occur as a result of functional imbalances between limbs.

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UTICAJ KOŠARKE NA NEUJEDNAČENU UPOTREBU EKSTREMITETA

S A Ž E T A K

Svrha sprovedenog istraživanja je bila da se utvrdi kako košarka utiče na neujednačenu upotrebu ekstremiteta u odnosu na ispitanike koji se ne bave košarkom. Učesnici su upoređivani kroz više motoričkih i situacionih testova i kod svih učesnika su testitrani međusobni odnosi kod ekstremiteta, kako kod gornjih tako i kod donjih. Prije sprovodjenja testiranja učesnici su popunjavali upitnik koji se odnosi na preferiranost u upotrebi ekstremiteta u svakodnevnom životu i u okviru sportskih aktivnosti. Učesnici su svrstani u dvije grupe, jednu su činili mladi košarkaši sa najmanje četiri godine kontinuiranog košarkaškog treninga, dok su drugu grupu sačinjavali pripadnici zdrave školske populacije, ali bez iskustva u kontinuiranom košarkaškom treningu. Testovi koji su korišćeni u okviru istraživanje odnose se na eksplozivnu snagu gornjih i donjih ekstremiteta i na agilnost i vrijeme reakcije kod donjih ekstremiteta. Rezultati statističke analize dobijenih podataka su pokazali značajne razlike u pojedinim testovima, kako medju ispitanicima, tako i među grupama i to i kod gornjih i kod donjih ekstremiteta. U zaključku je navedeno da košarka kao specifična sportska aktivnost ima pozitivan uticaj na sve testirane motoričke sposobnosti, a što se tiče nivoa asimetrije među ekstremitetima utvrđeno je da je niži kod košarkaša nego kod vršnjaka koji se ne bave košarkom.

Ključne riječi: Asimetrija, košarka, preferirani ekstremiteti, nepreferirani ekstremiteti.

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Effects of Internal, External and Preference of Attentional Focus Feedback Instructions on Learning Soccer "Head Kick"

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A B S T R A C T

The aim of this study was to investigate the effects of different types of feedback on learning soccer "head kick" of female adolescent. Novices performed head kick during two practice days [one week apart) for two weeks using either internal or external preference attentional focusing instructions. There was also a preference group who choosen their feedback type themselves. Internal focus feedback related with body movements, whereas external focus feedback related with movement effects. The subjects (N=64) were randomly assigned to three groups internal focus feedback group (IFF) (N=15), external focus feedback group (EFF) (N=15) and preference group (PF) (N=34). To promote learning two skill acquisition days for two weeks and one retention day was applied at initial day of third week. Technique of the skill was measured in acquisition days and targeting was measured in retention day. In technique measuring part, EFF group was significantly more accurate than IFF group, PF group was better than those two groups (PF>EFF>IFF). Similar to acquisition phase, EFF group was significantly more successfull than IFF group, PF group was better than those two groups (PF>EFF>IFF)in retention phase. Acquisition and retention phase results indicated significant main effect for attentional focus feedback groups. This study results' indicated that external focus feedback was more effective than internal focus feedback in terms of acquisition and retention of learning soccer head kick for students with limited amount of knowledge about this skill. This study also indicated that not only the source of attention but also control over to source of attention of preference was an important factor in the amount of retention.

Key words: *Attentional Focus, Internal Focus, External Focus, Feedback, Motor Skill, Soccer, Head Kick.*

Introduction

Attention in human performance relates to the characteristics associated with consciousness, awareness, and cognitive effort as they relate to the performance of skills. Attention can be influenced in many ways. Focus is a related term and can be thought of as the direction of one's attention to the performance environment or to the activity[1].

"Smart" motor system supported by Wulf et al. states that motor system optimizes the control processes based on environmental outcomes and movement effects[2]. Regarding this suggestion, Wulf and colleagues[3,4,5] propose the *constrained action hypo-thesis* suggesting that an internal focus of attention directs individuals consciously to control their movements. This approach directly constrains the motor system by disrupting normally automatic control processes. Furthermore, an external focus, states more effective movements through more automatic control of movement processes. Several lines of evidence provide support for this theory. For example, in the study by Wulf participants balancing on a stabilometer with an external focus not only showed more effective balance performance but also faster probe reaction times, compared to participants with an internal focus[6]. Faster probe reaction times are seen as an indication of reduced attentional demands of the primary (balance) task, or greater automaticity[7]. Thus, an ex- ternal focus appears to speed the learning process, resulting in higher performance levels and automatic control sooner[8].

Some studies have previously shown that the type of information emphasized in the verbal instructions provided to individuals can significantly affect learning and following movement performance as a function of the direction of attentional focus. Particularly, it has been consistently shown that instructions with external focus of attention result with better movement execution and also better learning when it is compared to instructions with internal focus of attention[8,9]. Such findings have been observed in sport skills[10,11,12,13,14,15,16].

Essentially there are two types of feedback in motor skill learning, knowledge of performance (KP) and knowledge of results (KR). KP is similar to internal-focus feedback in that statements are given to the learner such as "feet should be shoulder width apart" and "weight on the balls of your back" as in soccer. KR is similar to external-focus feedback in which the learner is given statements that refers to the result produced by the motor skill as in a head kick. Too much KP encourages the learner to focus on his/her own movements and can lead to detriments in motor skill learning. However, it is possible that frequent KR could be used to enhance motor performance if it induces an external focus of attention. Results of the study have shown that if learners receive knowledge of results feedback relative to their movement effects rather than to knowledge of performance they may learn a motor skill more effectively [3].

The generalizability of the external focus advantage is further demonstrated by the fact that the effects have not only been shown for young, healthy adults, but also for children[17].

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In her study Thorn[17] aimed to examine balance performance and learning in 9-12 year old children using internal and external focus of attention strategies. Results introduced that subjects who had chosen external focus feedback performed better in balance performance and learning than subjects who used internal focus feedback[17].

The advantages of an external focus over an internal focus have been demonstrated in every sport context tested, thus it seems logical for instructions and feedback in any sport to direct the performer's attention to the environment or effects of the movement and not the body itself.

The studies reported demonstrate that it is important for coaches, instructors, and athletes to understand the significant effect that instructions and feedback can have on performance and learning. Also important to realize is that this effect is not only seen in more simple and basic skills such as balance but in more complex skills requiring the control of multiple muscles and several degrees of freedom. This has been specifically shown in some of the more popular sports of golf, basketball, soccer, and volleyball[6].

The present study adds to this discussion by assessing instructional preference of novices, and the influence of such preferences on subsequent learning and performance. If Preference for specific types of attentional instruction found, this may interfere with the effectiveness of a teaching way being used and may also reflect the type of information novices are presently comfortable with. In addition, it is also very important to use specific strategies which is most useful for novices in terms of instructional information.

This study investigated effects of external focus, internal focus and preference of attention source on young girls on a novel task. Main aim was to analyze those effects on preference group which had not been analyzed yet on this special age group.

Based upon previous researches results', it is hypothesised that an external focus will be beneficial to novice's head kick performance, regardless of preference. In addition, participants will be more likely to prefer the external rather than the internal attentional focusing instructions.

Method

Sixty-four participants (64 females) took part in the present study. The mean age was 14.10 (SD = 3.78, range = 12-15). Participants were all secondary school students and they were not educated about soccer. Researcher informed the participants about procedure and aim of the study.

Apparatus and Task

The head kick in soccer was used as a task. The experiment was conducted in a garden of schools. The video camera was used to record all of the practices and retention kicks. The ball, which was used during the practices and retention test was size 4 regular ball. This size of ball's weight is 384 gram.

To examine the technique "Criteria for Movement form Evaluation" sheet which included nine criteria, was used. This form was adapted from Wulf et al., 2002 study and statements converted to soccer according to features of head kick. Two experiment trainers supported and approved the criterias of evaluation form.

Procedure and Design

There were two days of practice to teach performing the head kick in soccer. Moreover, participants' learning levels were evaluated after three weeks of the first practice day which is called retention day. To evaluate effects of the internal (n=15) – external (n=15) focus attention feedback, two groups formed. Also to determine effects of preference (n=34) of attentional focus feedbacks, an additional group was formed.

Instructions were given the participants before each practice day and the environment was adapted to warm up sufficiently. Criteria sheet has nine items. The suitable points were marked every second trial of 12 trials by. So there were six criteria sheets for each participant for each day.

The experiment was conducted in a garden of schools, which was suitable for soccer players, or sport saloons of school. The distinct of the line between instructor and participant was 3 meters due to participants' age and their physical features.

For the retention day measurement, the place was marked with colored tape, within 4 meter distance between instructor and participant. To measure kicking ability of participants 1x1 meter cardboard was designed. This cardboard had circles that they drawed by the multiple of soccer ball's radius.

Statistical Analysis

The acquisition data were analyzed using a 3 (group) x 6 (Blocks) mixed design repeated measure analysis of variance with repeated measures on trial block factor. Each acquisition block was consisted of 2 individual trials. Retention trial data were analyzed using a 3 (group) x 2 (Blocks) mixed analysis of variance with repeated measures on trial block factor. Paired sample t-test was used as a follow up test to the mixed design repeated measure ANOVA. Significance level of $p < .05$ was set for all statistical tests.

Results

Acquisition Scores

The scores achieved by each of the three groups during the practice days can be seen in figure 1. IFF group was performed the lowest score at the first block and highest score at the 5th block. EFF group was performed the lowest score at the first block and highest score at the 6th block. PFF group was performed the lowest at the first block highest score at the 4th block.

Acquisition phase 3 (Group) x 6 (Blocks) mixed design repeated measure analysis of variance results produced significant main effect for block, Wilks' Lambda = .131, $F_{(5, 295)} = 77.022$, $p < .05$, $\eta^2 = .538$ which is a moderate effect according to the Cohen[18], the amount of 54 % variance accounted for block effect. Block x group interaction also produced significant effect, Wilks' Lambda = .36, $F_{(10, 295)} = 13.245$, $p < .05$, $\eta^2 = .362$ which is a moderate effect according to the Cohen, the amount of 36 % variance accounted for block x group effect. The results also showed significant main effect for groups, Wilks' Lambda = .131, $F_{(1, 62)} = 32.93$, $p < .05$, $\eta^2 = .765$ which is a large effect according to the Cohen, the amount of 77 % variance accounted for groups effect.

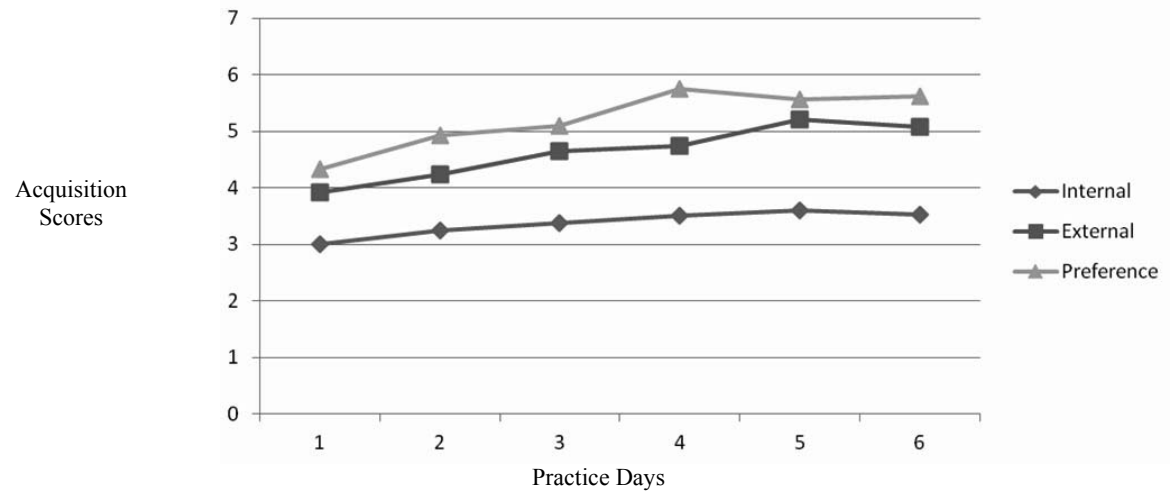

FIGURE 1
AVERAGE ACQUISITION SCORES OF THE INTERNAL, EXTERNAL AND PREFERENCE GROUPS DURING THE PRACTICE DAYS

Paired sample t-test follow up procedure showed that some of the blocks had significant differences. IFF group's score in the first block was significantly lower than scores in the 2nd, 3th, 4th, 5th, and 6th blocks. There was no significant difference between first block of IFF group and second, third and fourth block ($p > .05$). However, there was a significant difeerence between first block and fifth and last blocks ($p < .05$). There was no significant difference between residual blocks of IFF group ($p > .05$).

EFF group's score in the first block was significantly lower than scores in the 2nd, 3th, 4th, 5th, and 6th blocks. There was a significant difference between first block of EFF group fourth, fifth and last block ($p < .05$). Also, there was a significant difeerence between second block and fourth, fifth and last blocks ($p < .05$). There was no significant difference between residual blocks of EFF group ($p > .05$).

TABLE 1
MIXED ANOVA TECHNIQUE MEASUREMENT IN ACQUISITION PHASE

Source of Variation	*SS*	*Df*	*MS*	*F*	*Sig of F*
Between Subjects					
Groups	223.889	1	223.889	32.93	.036
Error Between	1429.239	62	23.052		
Within Subjects					
Blocks	810.982	5	162.196	77.022	.001
Blocks by Groups	184.071	10	18.407	13.245	.001
Error Within	756.159	295	2.563		

PFF group's score in the first block was significantly lower than scores in the 2nd, 3th, 4th, 5th, and 6th blocks. There was a significant difference between first block of PFF group third, fourth, fifth and last block ($p < .05$). Also, there was a significant difeerence between second block and fourth, fifth and last blocks ($p < .05$). There was a significant difference between third block of PFF group fourth, fifth and last block ($p < .05$). There was no significant difference between fourth, fifth and last blocks of EFF group ($p > .05$).

Block x group interaction's follow up analysis results indicated that; all groups in first block showed similar performance. In the second block IFF and EFF groups revealed slightly increased performance but PFF group increased sharply. All groups results are increased slightly in the third block. In the fourth block IFF and EFF groups results are contunied to increase slightly but PFF group results are increased sharply. In the fifth block IFF group results did not change. EFF group results increased and PFF group results decreased. In the last block IFF group and EFF group results decreased. PFF group results slightly increased.

Retention Scores

On the retention test, there was a general trend for further improvements in the accuracy of the head kicks. All groups had increase from first block to second one. PFF group had the highest mean in both first and second block. IFF group had lowest scores in first and last block. EFF group had moderate scores in the first and the last block.

Retention phase 3 (Group) x 2 (Blocks) mixed design repeated measure analysis of variance results produced significant main effect for block, Wilks' Lambda = .284, $F_{(1,61)} = 54.658$, $p < .05$, $\eta^2 = .462$ which is a moderate effect according to the Cohen [19], the amount of 46 % variance accounted for block effect. Scheffe test results revealed that EFF group was more successful than IFF group. Also, PFF group was more successful than EFF group. Block x group interaction also produced significant effect, Wilks' Lambda = .982, $F_{(2,61)} = 2.857$, $p < .05$, $\eta^2 = .362$ which is a moderate effect according to the Cohen, the amount of 36 % variance accounted for block x group effect. The results also showed significant main effect for groups, Wilks' Lambda = .131, $F_{(1, 62)} = 6.39$, $p < .05$, $\eta^2 = .914$ which is a large effect according to the Cohen, the amount of 91 % variance accounted for groups effect.

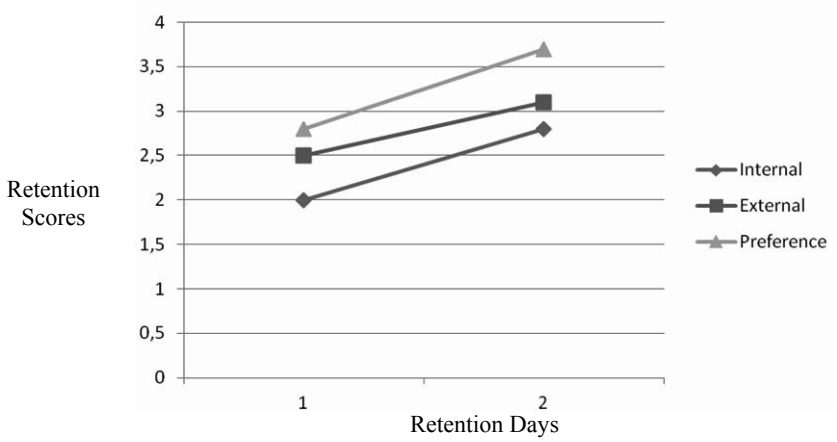

FIGURE 2
RETENTION SCORES OF THE INTERNAL, EXTERNAL AND PREFERENCE GROUPS DURING THE RETENTION DAY

Paired sample t-test follow up procedure showed that most of the blocks had significant differences. IFF – EFF and PFF groups' scores in the first block were significantly lower than scores in the last blocks. There was significant difference between first and second blocks for all groups ($p < .05$).

Block x group interaction's follow up analysis results indicated that; all groups in first block showed similar performance. In the second block EFF group revealed slightly increased performance but IFF and PFF group increased sharply ($p < .05$).

TABLE 2
MIXED ANOVA PRODUCT MEASUREMENT IN RETENTION PHASE

Source of Variation	*SS*	*Df*	*MS*	*F*	*Sig of F*
Between Subjects					
Groups	159.236	1	159.236	6.39	.001
Error Between	1639.392	62	26.442		
Within Subjects					
Blocks	127.651	1	127.651	54.658	.001
Blocks by Groups	16.350	2	8.175	2.857	.001
Error Within	156.184	62	2.082		

Discussion

In almost any training situation where motor skills are to be learned, performers are given instructions about the correct movement pattern, or technique. Those instructions typically refer to the coordination of the performers' body movements, including the order, form, and timing of various limb movements. Instructions that direct individuals' attention to their own movements induce an internal focus of attention. Other type of instructions which is called as external focus of attention can be defined as directing individuals' attention to the effect of his or her movements on the environment such as an apparatus or implement[19].

In this study we tried to investigate effects of external focus, internal focus and preference of attention source on young girls on a novel task. Therefore our main aim was to analyze those effects on preference group which has not been analyzed much on this special age (12 -15) group. In addition, we asked whether there would be differential effects of type of feedback depending on the performers' learning level.

The results showed that external focus feedback resulted in more effective performance than internal focus feedback did in terms of the acquisition of the head kick for 12 – 15 age group females. More important, findings show that the attentional focus induced by the feedback can indeed have an effect on learning.

Metaphors or analogies could be used for the external-focus conditions. As it has pointed out earlier, one advantage of metaphors might be that they detract the performer's attention from his or her body movements and at the same time provide a mental image of the movement goal – which presumably serves a function similar to instructions or feedback directing attention to the movement effects[8].

The constrained action hypothesis provides a plausible explanation for our present findings, when individuals try to consciously control their movements (adopt an internal attentional focus), they tend to constrain the motor system by intervening in the processes that would "normally" regulate the coordination of their movements. Thereby, automic control processes that have the capacity to control movements effectively and efficiently are disrupted. Likewise, conscious attempts to control movements may have interfered with novice's kicking movements (e.g., inappropriate meeting point with the ball during kicking, insufficient force production) when an internal focus was used, leading to poorer accuracy.

According to this view, focusing attention on the movement effect promotes an automatic mode of movement control. Adopting an external focus allow unconscious, fast and reflexive processes to control the movement, with the result that the desired outcome is achieved almost as a by-product. Using the

external focus may have promoted more efficient back movements, eye following, and force production, and, therefore, superior accuracy[3].

Despite soccer's widespread popularity, there seems to be a lack of investigation on the effect of attentional focus on soccer skills. There are few studies in the within literature related with this subject. Within those studies Wulf and colleagues[14] had aimed to find learning effect of attentional feedback types on lofted kick in soccer.

The participants in this study were university students with some experience in soccer. Participants were required to shoot lofted soccer passes at a target 15 meters away. Accuracy points were awarded based on the center of the target and the surrounding areas. Participants were randomly assigned to one of four groups: internal-focus with 100% feedback frequency, external-focus with 100% feedback frequency, internal-focus with 33% feedback frequency, external-focus with 33% feedback frequency. All participants performed 30 practiced trials and returned one week later to perform the retention test. During the retention test no feedback was provided to any of the groups. The main finding of that study was participants who got external focus feedback were more accurate in their skill performing than participants who got internal focus feedback[12].

Ford et al., experimented with relevant and irrelevant internal focus of attention on soccer dribbling at different expertise level. From the detrimental effects that internal relevant and internal irrelevant focus of attention had on skilled players, it can be deduced that instructions inducing an internal focus of attention on features of performance interfere with automatic processes. This interference occurs irrespective of whether those features are directly related to the task or not[20].

Conclusion

The findings from the present study have led to the following conclusions. Firstly; there are benefits of adopting an external focus of attention for children (12-15 years old). Afterthat, participants who were "given an external focus cue and said they used it" were better in kicking performance and learning than those participants who were "given an internal cue and said they used it". All participants who said they used an external focus cue were better in kicking performance and learning than participants who used an internal focus cue.

Additionally; Preference feedback group had better scores than Internal – External feedback group. This study also indicated that not only the source of attention but also control over to source of attention of preference is an important factor in the amount of retention. This result also confirms superior effect of external focus of feedback on learning a novel skill even under the preference condition. This information can be useful to design of learning environment (needs of learners). Giving a chance to learner about making decisons him/herself can cause differences in learning.

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EFEKTI UNUTRAŠNJEG, SPOLJAŠNJEG I PRIORITETNOG FOKUSA PAŽNJE KOD RAZLIČITIH POVRATNIH INFORMACIJA TOKOM UČENJA UDARCA PO LOPTI GLAVOM U FUDBALU

S A Ž E T A K

Cilj ove studije je bio da se ispitaju efekti različitih povratnih informacija tokom učenja udarca po lopti glavom u fudbalu kod adolescentkinja. Početnici su izvodili udarac po lopti glavom tokom dvije nedjelje (dva trenažna dana u svakoj) koristeći unutrašnji, spoljašnji ili prioritetni fokus pažnje kod povratnih informacija. Postojala je, takođe i grupa koja je birala tip povratnih informacija po svom nahođenju. Unutrašnji fokus pažnje kod povratnih informacija je bio u vezi sa tjelesnim pokretima, dok je spoljašnji fokus pažnje kod povratnih informacija bio u vezi sa efektima kretanja. Ispitanici (N=64) su nasumično podijeljeni u tri grupe sa unutrašnjim fokusom pažnje (IFF) (N=15), spoljašnjim fokusom pažnje (EFF) (N=15) i prioritetnim fokusom pažnje (PF) (N=34). Bilo je predviđeno da se u prve dvije nedjelje stiče znanje, dok je prvi dan treće nedjelje predstavljao dan za zadržavanje znanja. Tehnika je mjerena tokom dana kada se sticalo znanje, dok je završno mjerenje sprovedeno na dan predviđen za zadržavanje znanja. U dijelu koji se odnosio na tehniku, EFF grupa je bila mnogo preciznija nego IFF grupa, dok je PF grupa pokazala bolje rezultate od obije preostale grupe (PF>EFF>IFF). Slično dijelu koji se odnosio na tehniku, i u drugom dijelu mjerenja EFF grupa je bila značajno uspješnija od IFF grupe, dok je PF grupa pokazala bolje rezultate od obije preostale grupe (PF>EFF>IFF). I u dijelu za sticanje, kao i u dijelu za zadržavanje znanja, rezultati su pokazali značajan uticaj kada su u pitanju grupe sa prioritetnim fokusom pažnje kod različitih povratnih informacija. Ova studija je ukazala da je spoljašnji fokus pažnje bio mnogo efektivniji od unutrašnjeg fokusa pažnje u pogledu sticanja i zadržavanja znanja tokom udarca po lopti glavom u fudbalu kod studenata sa ograničenim znanjem kada je ova vještina u pitanju. Ova studija je, takođe ukazala da nije samo izvor pažnje, već i kontrola nad izvorom pažnje, važan faktor zadržavanja znanja.

Ključne riječi: Prioritetni fokus, unutrašnji fokus, spoljašnji fokus, povratna informacija, motorne vještine, fudbal, udarac po lopti glavom.

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Short Communication
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Report of the 9th International Scientific Conference on Transformation Processes in Sport "Sports Performance"

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On behalf of the Montenegrin Sports Academy, it is our great pleasure, to present to you the report of the 9th International Scientific Conference on Transformation Processes in Sport "Sports Performance", which was held in Herceg Novi, Montenegro from April 5-8, 2012, in the Hotel Plaza. These serious of conferences represent a milestone in the discussion on the transformation processes in sport and present the impact of the research on sports performance. It was once again organized by the Montenegrin Sports Academy, in cooperation with the Faculty of Sport and Physical Education, University of Montenegro and Montenegrin Olympic Committee. The conference was, as all the previous ones, organized under the traditional patronage of the Ministry of Education and Sports and International Olympic Committee, and, in difference to all the previous ones, the Ministry of Science also recognized this year's conference.

The conference comprised three sessions: Top Level Performance, Theory and Practice in the School Sports, and Science of Various Sports Disciplines. More than 300 people from 18 Universities and 38 University Units as well as 30 Institutions from 9 European and 2 overseas countries participated in the work of the conference which treat sport from the various interdisciplinary and multidisciplinary aspects. Within the plenary speeches and three mentioned sessions 114 full text contributions, written by 222 authors, were presented during the three workdays. Most of contributions were also printed in the national journal with the international contribution "Sport Mont", while the best of them were directed to the peer review process and possible publishing in the Montenegrin Journal of Sports Science and Medicine. The Scientific Committee consisted of 15 members from 9 countries and 2 continents. Plenary speeches were presented by 6 invited lecturers from 4 countries.

PICTURE 1
THE OPENING CEREMONY

The conference officially started on April 5, 2012, at 6:00 p.m. with the Registration of the Participants held on the Desk in front of the Reception in the Hotel Plaza in Herceg Novi. The Opening Ceremony started on April 6, 2012, at 4:00 p.m. with the opening speeches that were given by Prof. Sanja Vlahović, Minister of Science in Montenegro, Prof. Predrag Miranović, Rector of University of Montenegro, and Dušan Simonvić, president of Montenegrin Olympic Committee held in the Congress Hall of the same Hotel. The opening speeches were followed by handing out Montenegrin Sports Academy

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Awards and six plenary lectures that were given by several distinguish lecturers. Prof. Duško Bjelica, president of Montenegrin Sports Academy awarded Water Polo Clubs "Primorac" and "Jadran", Karate Club "Budućnost" and Women Handball Club "Budućnost" by Montenegrin Sports Academy Award as well as Prof. Dragan Milanović from the Faculty of Kinesiology at University of Zagreb who has been internationally recognized for his outstanding contribution in sports science. Prof. Pavel Opavsky from Faculty of Sport and Physical Education, University of Belgrade, Serbia, opened with the vivid presentation entitled "Flagellum – effect in sport" and Prof. Dragan Milanović from the Faculty of Kinesiology, University of Zagreb, Croatia followed up with the very interesting lecture entitled "Comparative Analysis of Morphological Characteristics of Goalkeepers in Football and Handball" as well as Prof. Čoh from the Faculty of Sport, University of Ljubljana, Slovenia with also the interesting lecture entitled "Differences in reactive power in elite and sub-elite sprinters". In chronological order of their appearance at the conference three more plenary lectures were presented by Prof. Grujo Bjeković from Faculty of Sport and Physical Education, University of East Sarajevo, Bosnia and Herzegovina, Assist. Prof. Jovica Petković from Faculty for Sport and Physical Education, University of Montenegro, and Prof. Branimir Mikić from Faculty of Sport and Physical Education, University of Tuzla, Bosnia and Herzegovina, all of them also with the very interesting topics. Right after these respective speeches given by the invited speakers, the floor was open for discussion, which was made use of extensively.

PICTURE 2
MONTENEGRIN SPORTS ACADEMY AWARDS HANDED OUT

SESSION A: Top Level Performance

The first session addressed the issue of the top-level performance. It was chaired by Prof. Pavel Opavsky, the legendary professor from the Faculty of Sport and Physical Education at University of Belgrade, Serbia who earn the first PhD degree in the Former Yugoslavia. This interesting field of research succeeded in attracting more than 60 researchers who had contributed as authors to the session. At the beginning of the programme Slobodan Stojiljković, primarius doctor of sports medicine, who works as a specialist introduced the audience to the always-interesting issue of a heart rhythm disorder in athletes. After that, researchers from various scientific institutions presented 25 diverse topics related to the field of sport and exercise medicine. Following a brief, but stimulating discussion, the session was closed.

SESSION B: Theory and Practice in the School Sports

The second session addressed the issue of the theory and practice in the school sports was held on Saturday, 6th April, and Sunday, 7th April, in the morning conference. It was chaired by Assist. Prof. Rašid Hadžić from the Faculty for Sport and Physical Education, University of Montenegro. The introductory lecture, entitled "Body Posture in Sixth-Grade Students", was given by Elvira Beganović, PhD, with the Faculty of Education, University of Sarajevo, Bosnia and Herzegovina. Work in the section continued with 23 more lectures, accepted for oral presentation by the review committee. Within this section, more than 50 authors presented their current researches and published 24 papers accordingly. All the papers had been internationally peer reviewed by recognized reviewers and will be placed in the national journal with the international contribution "Sport Mont". After the last lecture, a short discussion took place.

SESSION C: Science of Various Sports Disciplines

As was the case at previous conferences, the session Science of Various Sports Disciplines was the biggest session and welcomed papers regarding all scientific activities in the numerous sports disciplines. It was chaired by Assist. Prof. Jovica Petković from the Faculty for Sport and Physical Education, University of Montenegro and 58 papers were received. All the papers had been also internationally peer

reviewed by recognized reviewers. Due to the large number of papers, the work and papers in this session were separated into three parts; Part One was being the morning session started on April 6, 2012, at 9:30 a.m., while Part Two and Three were being the morning and afternoon sessions started on April 7, 2012, at 9:30 a.m. and 4:00 p.m. respectively. All the presentations provoked a number of questions from the public so the discussion was very interesting and productive. We wish to thank all the authors for their participation in the work of this session.

On Sunday, April 8, 2012 was the last day of the conference that established itself as a major event in discussing the link between the academic activities and the actual practice of sports science delivery. Prof. Duško Bjelica, the president of the Montenegrin Sports Academy and the Dean of the Faculty for Sport and Physical Education, University of Montenegro had the task of summarizing the meeting. He noted that the conference had not only focused on measuring the impact of science, but also wanted to address whether there was a positive impact of science. He thanked all the authors for their participation in the work of the sessions, invited speakers and special guests. He has also introduced the plans of Montenegrin Sports Academy and welcomed all participants to the following 2013 Conference that will be held at the same place during the first week of April 2013.

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Guidelines for authors*

When preparing the final version of the manuscript, either NEW or REVISED authors should strictly follow these guidelines. Manuscripts departing substantially from the guidelines will be returned to the authors for revision.

For more detailed information on the uniform requirements of the manuscript elements please visit the web site of the International Committee of the Medical Journal Editors.

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1. Manuscript layout

1.1. General remarks

Authors should submit their manuscript as one Microsoft Word (.doc) file strictly following specified layout of manuscript structural elements. Main manuscript file should be carefully checked to contain all needed structural elements. Do not add any additional elements or data in your main manuscript file except the ones specified in guidelines! Do not break your main manuscript file in more files!

In text, avoid "one sentence – one paragraph" writing. Integrate your sentences in continuous text and sensible paragraphs.

Type the whole manuscript double-spaced!

Apart from chapter titles and subtitles avoid any kind of formatting (bold, underline) in the main text of the manuscript or table contents.

1.1.1. Length of the manuscript

The manuscript should not exceed the maximum length of 8 pages as printed in Montenegrin Journal of Sports Science and Medicine, which are roughly 30 A4 pages of double-spaced text. Additional pages are extra charged (See **Costs and payments**)

1.1.2. Printing in color

If your manuscript contains pictures in color note that printing in color is extra charged. For prices see **Costs and Payments**.

1.2. Overview and position of structural elements of the main manuscript file

First or title page contains: 1. title, 2. type of publication, 3. running head, 4. authors, and 5. affiliations.

Second page contains: 6. abstract, and 7. key words.

Starting on a third page follow: 8. chapters of the manuscript, 9. references 10. corresponding author's address, and 11. corresponding author's e-mail.

A separate page, following corresponding author's address, contains: 12. naslov na crnogorskom jeziku (title in Montenegrin, only for Montenegrin authors), and 13. sažetak na crnogorskom jeziku (abstract in Montenegrin, only for Montenegrin authors).

Tables (14. Tables) with headings and footnotes should be put each on a separate page.

As for 15. Figures, **ONLY** graphs and other Microsoft Office graphics should be included in the main manuscript file, each on a separate page with appropriate heading below. All other graphic material should be submitted separately, in

* Modified from guidelines for authors of the Collegium Antropologicum

properly named files to avoid any confusion. The last, separate page of the manuscript should contain 16. Figure headings of figures submitted **separately**.

You can download a **Short overview of the main manuscript file structure** (MS Word .doc file).

Following are two examples of the first (or title) page:

Example 1:

Transfer of learning on a spatial memory task between the blind and sighted people

Spatial Memory among Blind and Sighted

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

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Example 2:

Comparison of instep kicking between preferred and non-preferred leg in young football players

Instep kicking between preferred and non-preferred leg

Dusko Bjelica, Stevo Popovic

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

---

1.3. Title

Authors should include all information in the title that will make electronic retrieval of the article both sensitive and specific.

Check spelling and language of your title. The title should be in Titlecase, 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 in caps. Exceptions are words like: articles, and, or, between etc. The word following a colon (:) or a hyphen (-) in the title is always capitalized.

Example:

Effects of Socio-Economic and Behavioral Characteristics in Explaining Central Obesity – A Study of Adult Asian Americans in San Diego, USA

1.4. Type of publication

Authors should suggest the type of their submission. Montenegrin Journal of Sports Science and Medicine publishes original scientific papers, notes, preliminary communications, reviews and conference papers.

Original scientific papers – report hitherto unpublished results of original research. The acceptance of the paper obliges the author not to publish the same material elsewhere without the permission of the Editorial Board.

Notes (short communications) – reports on shorter but completed research.

Preliminary communications – include preliminary results of greater importance requiring rapid publication.

Reviews – original, concise and critical surveys of a current research area in which the author himself (authors themselves are) is active. In the review the role of the author's contribution in this field in relation to other published reports, as well as original views should be given.

Conference papers – previously reported at congress, symposium or summer school, etc., should be submitted by the Organizing Committee in the form of a complete manuscript of the Proceedings

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1.5. Running head

Short running title should not exceed 50 characters including spaces.

Example:

Attitudes toward advertising through sport

(Title: Attitudes toward advertising through sport among the frequency of watching sports events)

1.6. Authors

In one line list all authors with full names separated by a comma (and space). Last author should be separated with the word "and". Only the first name, initial of a middle and family name of authors should be given. **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 (see the next section 1.7. Affiliations).

Example:

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

1.7. Affiliations

Affiliation consists of the name of a department(s) and institution(s), city and country 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. Do not translate yourself – check the information since Editorial Board does not have any way of checking these.

Affiliations should be written as follows:

name of institution(s), name of department(s), town, state

Only if there is more then 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 (see example).

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.

Example:

Selcuk Akpinar[1], Stevo Popovic[1,2] and Sadettin Kirazci[1]

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1.8. Abstract

The abstract should provide the context or background for the study and should state the study's purposes, basic procedures (selection of study subjects or laboratory animals, observational and analytical methods), main findings (giving specific effect sizes and their statistical significance, if possible), and principal conclusions. It should emphasize new and important aspects of the study or observations.

It is recommended that abstract should not exceed one typed double-spaced page, written in English. It should be placed, **in italics**, on second page of your document after the standard title written in caps (**abstract**).

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 (Aim, Results…). Abstract should be written as a continuous text and consists of **one paragraph only**!

Citing literature in abstract is done in the same way as in the rest of the text.

1.9. Key words

Authors should provide 3 to 10 key words or short phrases that capture the main topics of the article. These will assist indexers in cross-indexing the article and may be published with the abstract. Terms from the **Medical Subject Headings (MeSH)** list of **Index Medicus** should be used. There are other subject headings lists available on the Internet like **Sociology and Anthropology Subject Headings**.

Key words should be placed on the second page of the manuscript right below the abstract in English, written in italic as shown in the following example.

Example:

ABSTRACT

Results of the analysis of……..

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

1.10. Chapters of the manuscript

Style of the journal prescribes only 2 types of titles:

Main chapter titles – written **in bold** and **in titlecase** (initial uppercase for all word except articles, conjunctions, short prepositions etc.). The word following a colon (:) or a hyphen (-) in the title is always capitalized.

Example:

Methods of Analysis – An Overview

Subtitles – all other titles within one chapter. They are written **in italic** and in normal **sentence case** (only the starting word of a title begins with first letter in caps).

Example:

Table position of the research football team
Note that titles but NOT the subtitles are written in titlecase.

Do not put a full stop or any other sign at the end of the title.

Depending on the type of publication main manuscript chapters may vary. The general outline is: Introduction, Materials, Methods, Results, Discussion, Conclusion, Acknowledgements. If not needed, acknowledgements may be omitted. Conclusion can be part of Discussion. Materials and Methods can be (if authors want to) united in one chapter and titled "Materials and Methods". Results and Discussion can be united in one chapter and titled accordingly. Subjects and Methods or Patients and Methods can also be used as a chapter title. For example, a case report might have the following titles: Introduction – Case Report – Discussion – Conclusion – Acknowledgements.

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.

1.10.1. Introduction

Introduction provides a context or background for the study (i.e. the nature of the problem and its significance). It states the specific purpose or research objective of, or hypothesis tested by the study or observation; e.g. keep in mind that the research objective is often more sharply focused when stated as a question. Both the main and secondary objectives should be made clear, and any pre-specified subgroup analyses should be described. Only strictly pertinent references should be given without data or conclusions from the work being reported.

1.10.2. Materials (subjects, patients etc.) and Methods

The Materials and Methods section should include only information that was available at the time the plan or protocol for the study was written. All information obtained during the conduct of the study belongs to the Results section.

Statistics

Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Avoid relying solely on statistical hypothesis testing, such as the use of p-values, which fails to convey important information about effective size. References for the design of the study and statistical methods should comply with standard works when possible (with pages stated). Define statistical terms, abbreviations, and most particularly symbols. Specify the computer software used.

1.10.3. Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations. Restrict tables and figures to those needed to explain the argument of the paper and to assess its support. Use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables. Avoid non-technical uses of technical terms in statistics, such as "random" (which implies a randomizing device), "normal", "significant", "correlations", and "sample".

1.10.4. Discussion and Conclusion

Emphasize the new and important aspects of the study and the conclusions that follow from them. Do not repeat in detail data or other material given in the Introduction or the Results section. For experimental studies it is useful to begin the discussion by summarizing briefly the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast the results with other relevant studies, state the limitations of the study, and explore the implications of the findings for future research and for clinical practice.

Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not adequately supported by the data. In particular, authors should avoid making statements on economic costs and benefits unless their manuscript includes appropriate economic data and analyses. Avoid claiming priority and alluding to work that has not been completed. State new hypotheses when warranted, but clearly label them as such.

Authors can also separate Conclusion chapter from Discussion.

1.10.5. Acknowledgements

Authors should acknowledge help and support (financial, advisory etc.) from an institution, organization, group or an individual who have contributed to the production of the article.

1.11. References

References should be numbered consecutively in the order in which they are **first mentioned** in the text.

All information needed for each type of reference (journal article, book, book chapter, internet source etc.) **MUST** be present as specified in guidelines. If you omit any of the specified data you will surely be contacted to rectify it.

Authors are responsible for accuracy of each reference. Use authoritative source for information such as databases Current contents, Web of Science, Medline or PubMed (see **Links**) to check the validity of journal article citation.

1.11.1. Reference list

Reference list is a highly structured part of the text where each comma, space, colon, etc. counts. Authors are kindly asked to be very careful and strict when editing this part of the text. Following are some general rules and examples that should help authors.

In the reference list, references should be listed one after another (**without line break**) separated with a **dash** (see an example of a reference list).

All authors of the cited source should be quoted (*et. al*. cannot be used in the reference list). Accuracy and content of the references are **author's responsibility**, so make sure you provide correct references.

The following conventions are used for references:

Journal article
2. BARAK O, JAKOVLJEVIC DJ, POPADIC-GACESA J, OVCIN Z, BRODIE D, GRUJIC N, J. Heart rate variability before and after cycle exercise in relation to different body positions. Journal of Sports Science and Medicine, 9 (2010) 176. –

Book
5. FRANCE RC, Introduction to sports medicine and athletic training (Thomson Delmar Learning, Clifton Park, 2004). -

Book chapter
11. Stotlar DK, Facility management. In: Parks JB, Zanger BK (Eds) Sport and fitness management: career strategies and professional content (Human Kinetics Books, Champaign, 1990). –

Congress report
13. POPOVIC S, RADOVANOVIC R, Primary school pupils' views on extra-curricular Sport and recreational activities. In: Proceedings (Theoretical, methodology and methodical aspects of physical education, Faculty of Sport and Physical Education, Belgrade, 2008). -

M.S., PhD Thesis, etc.
16. Pyun DY, The proposed model of attitude toward advertising through sport. PhD Thesis. In Engl. (The Florida State University, Tallahassee, 2006). -

Reference to an internet source
17. HABIBZADEH N, The effect of short-term weight-bearing exercise on bone mass density in obese and thin young girls, Sport scientific and practical aspects, accessed 2.1.2011. Available from: URL: www.sportspa.com.ba/html/ dec2010/rad2.html. -

Personal communication - avoid citing a "personal communication" unless it provides essential information not available from a public source, in which **case the name of the person and date of communication** should be cited in parentheses in the text. For scientific articles, authors should obtain written permission and confirmation of accuracy from the source of a personal communication.

Example for the reference list:

(please note how references are separated with a dash and NOT a line break)

REFERENCES

1. Pyun DY, The proposed model of attitude toward advertising through sport. PhD Thesis. In Engl. (The Florida State University, Tallahassee, 2006). – 2. HABIBZADEH N, The effect of short-term weight-bearing exercise on bone mass density in obese and thin young girls, Sport scientific and practical aspects, accessed 2.1.2011. Available from: URL: www.sportspa.com.ba/html/dec2010/rad2.html. – 3. POPOVIC S, RADOVANOVIC R, Primary school pupils' views on extra-curricular Sport and recreational activities. In: Proceedings (Theoretical, methodology and methodical aspects of physical education, Faculty of Sport and Physical Education, Belgrade, 2008). – 4. Stotlar DK, Facility management. In: Parks JB, Zanger BK (Eds) Sport and fitness management: career strategies and professional content (Human Kinetics Books, Champaign, 1990). – 5. FRANCE RC, Introduction to sports medicine and athletic training (Thomson Delmar Learning, Clifton Park, 2004). 6. BARAK O, JAKOVLJEVIC DJ, POPADIC-GACESA J, OVCIN Z, BRODIE D, GRUJIC N, J. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine*, 9 (2010) 176. –

Additional comments and examples:

Initials of authors' names should NOT be followed by a full stop:
BARAK O, JAKOVLJEVIC DJ, POPADIC-GACESA J, OVCIN Z, BRODIE D, GRUJIC N, J. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine*, 9 (2010) 176.
but not:
BARAK, O., JAKOVLJEVIC, DJ., POPADIC-GACESA, J., OVCIN, Z., BRODIE, D., GRUJIC, N. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine*, 9 (2010), 176.

Initials of authors' first and middle names should NOT be separated with a space:
Pyun DY, The proposed model of attitude toward advertising through sport. PhD Thesis. In Engl. (The Florida State University, Tallahassee, 2006).
but not:
Pyun D Y, The proposed model of attitude toward advertising through sport. PhD Thesis. In Engl. (The Florida State University, Tallahassee, 2006).

There should be a comma after a journal name:
BARAK O, JAKOVLJEVIC DJ, POPADIC-GACESA J, OVCIN Z, BRODIE D, GRUJIC N, J. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine*, 9 (2010) 176.

but not:
BARAK O, JAKOVLJEVIC DJ, POPADIC-GACESA J, OVCIN Z, BRODIE D, GRUJIC N, J. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine* 9 (2010) 176.

All parts of authors' names should be written in uppercase:
BARAK O, JAKOVLJEVIC DJ, POPADIC-GACESA J, OVCIN Z, BRODIE D, GRUJIC N, J. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine*, 9 (2010) 176.
but not:
Barak O, Jakovljevic DJ, Popadic-Gacesa J, Ovcin Z, Brodie D, Grujic N, J. Heart rate variability before and after cycle exercise in relation to different body positions. *Journal of Sports Science and Medicine*, 9 (2010) 176.

There should be a space after a reference number and before the first author's surname.

When citing journal articles, ONLY the first page of the article in the journal should be given.

1.11.2. Reference citation

References should be numbered in the order in which they appear in the text. **Number** of the reference should be written in **superscript** after the text **without spacing and without brackets**. If the reference number is at the end of a line/sentence, put full stop **after** the reference. More than two references are not to be spaced. If more than two consecutive references are encountered, please separate them with a **dash**.

Examples for references in the text:

….learn places of body parts are among the topics that spatial memory covers[4,9]…..

….bandwidth KR feedback on movement performance in retention[18-21]. Therefore……

…among young football player in Montenegro[2,8-11].

There should be no space between numbers in superscript:
SHOULD BE: .....of each person[11]. They have.....
NOT: .....of each person.[11] They have.....

1.12. Corresponding author's address

Corresponding author's name with **full postal address in English** and, if possible, **e-mail** address should be placed, *in italics*, at the end of the manuscript between reference list and abstract in Montenegrin. It is preferred that submitted **address is institutional** and not private.

Author's name should include only initials of the first and middle names separated by a full stop (and a space) and the full surname. 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.

Example:

J. Petkovic

University of Montenegro, Faculty for Sport and Physical Education, Narodne omladine bb, 84000 Niksic, Podgorica

e-mail: ***jpetkovic@ac.me***

1.13. Corresponding author's e-mail

E-mail (if possible) should be placed in the line following the postal address.

Author should clearly state weather or not his e-mail should be published.

1.14. Title in Montenegrin (only for Montenegrin authors)

Title in Montenegrin, together with an abstract in Montenegrin should be placed on a separate page following the author's address and e-mail.

Title in Montenegrin should be written in bold capital letters.

1.15. Abstract in Montenegrin (only for Montenegrin authors)

Only Montenegrin authors should provide the **title of the paper** and **abstract** in the Montenegrin language, which must correspond to the title and abstract in English. They should be placed at the end of the manuscript, after the author's corresponding address.

There should be no subtitles in Montenegrin abstract (Aim, Results etc.). Abstract in Montenegrin just as in English should be written as in one paragraph.

Montenegrin authors should check the language and do the spell-check for Montenegrin.

Key words in Montenegrin are not needed.

Example:

RAZLIKE U MORFOLOSKOM STATUS MLADIH FUDBALERA I NESPORTISTA

SAŽETAK

Prikazani su rezultati……..

1.16. Tables

All tables should be included in the main manuscript file, each on a separate page right after the abstract in Montenegrin. Number tables consecutively in the order of their first citation in the text and supply a brief title for each.

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 (see **Abbreviations**).

Tables should be presented as standard MS Word tables, NOT as pictures or other graphic material. Do not use simple text editing to create a table, but the table option instead. If you are not familiar with using MS Word please find a colleague to help you.

All text appearing in tables should be written beginning only with first letter of the first word in caps (only the initial word of all text should be capitalized), i.e. all words for variable names, column headings etc. in tables should start with the first letter in caps.

Avoid any formatting (bold, italic, underline) in your tables and their headings. Avoid any shading or coloring in your tables. Avoid any border formatting in your tables. Put plain borders, no additional graphic editing is necessary.

Be sure that each table is cited in the text.
If you use data from another published or unpublished source, obtain permission and acknowledge them fully.

The format of tables should not exceed A4. Only exceptionally the format A3 will be accepted.

Example:

TABLE 5
PRESENTATION OF INSTEP FOOTBALL KICK
BETWEEN PREFERRED AND NON-PREFERRED
LEG IN YOUNG FOOTBALL PLAYER

INTENSITY	STATE	t	p
OPT	SR	21	.04
	SF	22	.03
MAX	SR	44	.55
	SF	55	1.22

OPT – optimal intensity, MAX – maximal intensity,
SR – resting state, SF – state of fatigue

Example for table citation:

….exhibit greater variance than three years before (Table 6). Therefore….

1.16.1. Table heading

Table heading should be written above the table, in caps and without a full stop at the end of the heading.

Example:

TABLE 5
PRESENTATION OF INSTEP FOOTBALL KICK
BETWEEN PREFERRED AND NON-PREFERRED
LEG IN YOUNG FOOTBALL PLAYER

1.16.2. Table footnote

Footnotes should be written below the table.

Examples:

$^{*}p>0.01$, $^{**}p>0.05$, OPT – optimal intensity, MAX – maximal intensity, SR – resting state, SF – state of fatigue

SHOULD BE: OPT – optimal intensity, MAX – maximal intensity
NOT: OPT = optimal intensity, MAX = maximal intensity

1.16.3. Table citation

In the text, tables should be cited as full words. Some examples are given below:

Examples:

SHOULD BE: Table 1
NOT: table 1 (first letter in caps)

SHOULD BE: Table 1
NOT: Table 1. (no full stop)

SHOULD BE: …($p<0.05$, Table 1).
NOT: ...($p<0.05$). (Table 1)

SHOULD BE: ...as shown in Tables 1 and 3. (citing more tables at once)

SHOULD BE: ...result has shown (Tables 1-3) that... (citing more tables at once)

SHOULD BE: ....in our results (Tables 1, 2 and 5)... (citing more tables at once)

1.16.4. Subtables

Use this only if there is no other solution. It is preferred that you brake subtables in two independent tables or merge them into one.

Examples:

heading for a subtable: TABLE 1a

citation of a subtable: ....(Table 1a)

1.17. Figures

The only figures allowed in the main manuscript file are graphs and other Microsoft Office graphics. All other graphic material (pictures, photographs, drawings etc.) should be submitted separately in digitalized form. When submitting separate figure file s make sure that they are named properly to avoid any loss or confusion (See **Naming files**). On the last separate page of the main manuscript file, authors should place the headings of all the figures submitted separately.

All graphic material should be digitalized first. Avoid sending photographs or similar. All graphic materials should be of sufficient quality for print (300 dpi, or more if necessary).

Important!
When submitting manuscript for the first time it is not necessary to send very high quality pictures. We are contacting all our reviewers via e-mail so if it is not extremely necessary, please resize your pictures. Complete submission package with all other files should not exceed 2 MB.

Figures should be numbered consecutively according to the order in which they appear in the text. 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 headings should be completely intelligible without reference to the text. All abbreviations appearing in a figure or its heading not considered standard **MUST** be explained in a figure heading (see **Abbreviations**).

The format of figures should not exceed A4. Only exceptionally the format A3 will be accepted.

Avoid using any formatting (bold, underline) in figures or figure headings.

Be sure that each figure is cited in the text.

1.17.1. Graphs

All graphs and other Microsoft Office material should be placed in the main manuscript file each on a separate page and are accompanied by a corresponding figure heading.

All words for variable names should be capitalized.

All abbreviation s are to be explained in the footing of the figure. If you have "Number of…." then put the whole word NOT "No. of……".

Axis titles in your figures should have no formatting (bold, italic etc.). After the title of the axis there should be a unit of measure in parentheses for example Age (years). While the first letter of the axis title is capitalized, unit of measure is not. Whenever possible, all axis titles should be put below the middle of the axis.

Take care about the **colors** on your graphs. The graphs shall be printed in gray unless otherwise specified in the new submission form and paid for accordingly.

Decimal numbers on your axis should have a decimal full stop, NOT a comma.

1.17.2. Figure heading

Figures should not contain footnotes. All information, including explanations of abbreviations must be present in figure heading. Headings of the figures like graphs and other MS Office material submitted in the main manuscript file should be presented together with their corresponding figures. Headings of the figures submitted separately should be presented on the last separate page of the main manuscript file.

Figure heading should be written bellow the figure, in caps and without a full stop at the end of the heading.

Examples for figure heading:

FIGURE 1
CHANGES IN ACCURACY OF INSTEP FOOTBALL KICK MEASURED BEFORE AND AFTER FATIGUED. SR – resting state, SF – state of fatigue, $^{*}p>0.01$, $^{**}p>0.05$.

FIGURE 7
ATTITUDES TOWARD ADVERTISING THROUGH SPORT. X – mean, SD – standard deviation.

1.17.3. Figure citation

All graphic material (graphs, pictures, drawings etc.) should be referred to as Figures in the text. Figures are cited in the text as full words.

Examples for figure citation:

….exhibit greater variance than the year before (Figure 2). Therefore…

SHOULD BE: Figure 1
NOT: figure 1 (first letter in caps)

SHOULD BE: Figure 1
NOT: Figure 1. (no full stop)

SHOULD BE: ….($p<0.05$, Figure 1).
NOT: ...($p<0.05$). (Figure 1)

SHOULD BE: ....as shown in Figures 1 and 3. (citing more figures at once)

SHOULD BE: ...result has shown (Figures 1-3) that... (citing more figures at once)

SHOULD BE: ....in our results (Figures 1, 2 and 5)... (citing more figures at once)

1.17.4. Subfigures

If there is a figure divided in several subfigures, each subfigure should be marked with a small letter followed by parenthesis, starting with a), b), c) etc. The letter and parenthesis should be marked for each subfigure in a logical and consistent way.
If a figure consists of several subfigures, all of them should be referred to in the main figure heading (see example).

Example:

Fig. 1. a) Morphologic characteristics of the..... b) Sources of the.... c) The last segment...

Subfigures should be cited in the text as follows:

Examples:

SHOULD BE: Figure 1c
NOT: Fig. 1 C

SHOULD BE: ...in Figures 1a and b we can...

SHOULD BE: ...data represent (Figures 1a-d)...

---

2. Additional requirements

2.1. Language

Language quality is author's responsibility. Therefore authors should let a native speaker or fluent English speaker check their manuscript. There are professional lectors who can help with that. Please make spell and language check before sending back your manuscript or find a competent person to do that. Montenegrin authors should also do spell check for additional summary in the Montenegrin language.

2.2. Numbers, units of measurement, variables and values

In Montenegrin Journal of Sports Science and Medicine all units of measures should conform to the International System of Units (SI).

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

Temperatures should be expressed in degrees Celsius. Blood pressures should be expressed in millimeters of mercury, unless other units are specifically required by the journal.

Examples:

Percentages and degrees:
SHOULD BE: 10%
NOT: 10 % (NO space in between)

SHOULD BE: 10º
NOT: 10 º (NO space in between)

All other units of measure:
SHOULD BE: 10 kg
NOT: 10kg (a space in between)

Ratios:
SHOULD BE: 12:2
NOT: 12 : 2 (NO space in between)

Decimal numbers:
SHOULD BE: 0.056
NOT: .056 (there should be a zero in front of decimal full stop)

SHOULD BE: SD=3.5
NOT: SD = 3.5 (NO space in between)

SHOULD BE: X=45±3.4
NOT: X=45 ± 3.4 (NO space in between)

SHOULD BE: 45±3.4
NOT: 45 ± 3.4 (NO space in between)

SHOULD BE: X±SD (use standard abbreviation)
NOT: Mean±SD

SHOULD BE: $p<0.005$
NOT: $p < 0.005$ (NO space in between)

SHOULD BE: $0.001<P$
NOT: $0.001 < p < 0.005$ (NO space in between)

SHOULD BE: χ^2
NOT: chi square or X2 or X^2 (use the Greek letter)
SHOULD BE: $\chi^2=2345$
NOT: $\chi^2 = 2345$ (no space between)

SHOULD BE: p
NOT: P (not capitalized)

2.3. Abbreviations

Use only standard abbreviations; the use of non-standard abbreviations can be extremely confusing to readers. Avoid abbreviations in the title. The full term for which an abbreviation stands should precede its first use in the text unless it is a standard unit of measurement.

All abbreviations should be explained ONLY the first time they appear in text in the following way:

Example:

…. following the main sample (MS). Therefore…….
Note that **abstract, each figure and table** is considered a separate and independent part of the text and all abbreviations should be also explained there despite the fact that you may have already explained it text. If you have abbreviations that are repeated through tables and figures they should be explained in each figure and in each table (in heading or in footnote).

2.4. 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.

Example:

First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*

3. Naming and submitting files

Name your files according to the family name of the first author (see example). Authors submitting revised versions of the manuscript can use the identification number of their manuscript as provided by the Journal Office.

Example:

Jordan-form.doc – (submission form)
Jordan-manuscript.doc – (main manuscript file)
Jordan-fig3.jpg – (Figure 3)
Jordan-fig4.tiff – (Figure 4)
Authors should submit the files to the e-mail of the Journal Office: **office@mjssm.me**

If you want to send your main manuscript file in formats other than Microsoft Word, please contact the Journal Office first.

DO NOT SEND us hard (paper) copy of your manuscript through regular mail. Those submissions **WILL NOT BE** considered at all. **DO NOT USE FLOPPY DISKS!**

3.1. NEW manuscript submission

Authors who want to submit a new manuscript to Montenegrin Journal of Sports Science and Medicine should send an e-mail to **office@mjssm.me** with the following files attached:

a) Submission form file – filled IMPORTANT!
b) Main manuscript file – with all structural elements, according to guidelines
c) Figure file(s) – if needed

It is extremely important that new submission form is provided with all necessary information and that the main manuscript file is organized as specified in the guidelines for authors.

d) Authorship statement form should be filled and signed by ALL coauthors and then send in regular mail to our office.

Office will not consider new submissions that do not comply with those requests!

When submitting manuscript for the first time it is not necessary to send very high quality pictures. We are contacting all our reviewers through e-mail so if it is not extremely necessary, please resize your pictures. Complete submission package with all other files should not exceed 2 MB.

For help in preparing the documents for new submission see **Checklist NEW**.

3.2. REVISED manuscript submission

Authors returning their manuscript after revision or additional corrections should do so by sending an e-mail to **office@mjssm.me** with the following files attached:

a) Response to reviewers' comments – it is extremely important that authors write an letter explaining how each of the revivers' comments was included in the new version of the manuscript
b) Main manuscript file - with all structural elements, according to guidelines
c) Figure file(s) – if needed

Incomplete submission will be returned to author for additional correction!

If all your files exceed 2 MB please send us all your files on a CD-ROM. Do not forget to send a short accompanying letter and to properly mark CD.

For help in preparing the documents for revised manuscript submission see **Checklist REVISED.**

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4. Authorization of the final version of the manuscript

After the manuscript has been accepted, authors will receive a PDF version of their manuscript for authorization, as it should look in printed version of the journal. 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.

5. Costs and payments

Do not make any payments prior to contact with Journal Office.

All payments should be made to:

Crnogorska komercijalna banka, Podgorica, Montenegro

If you pay outside Montenegro, the account is IBAN ME25510000000002219012

If you pay inside Montenegro, the account is 510-22190-12

5.1. Fees and Reprints

Authors of the article (altogether not each) are expected to pay the fee of 100 EUR for the publication of the article. The notification for the payment will be sent to the author when the paper is accepted.
10 reprints of the paper as well as one copy of the journal issue will be sent to the specified corresponding address.

5.2. Printing additional pages

The manuscript should not exceed the maximum length of 8 pages as printed in Montenegrin Journal of Sports Science and Medicine, which are roughly 30 A4 pages of double-spaced text. Additional pages are extra charged.

Printing of an additional page in Montenegrin Journal of Sports Science and Medicine is 50 EUR per page as printed in an issue of the journal.

5.3. Printing in color

If your manuscript contains pictures in color note that printing in color is extra charged.
The price of printing in color is 50 EUR per page as printed in an issue of the journal.

AUTHORSHIP STATEMENT

(Fill out the blank fields, in print)

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

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*(Please check **ONLY ONE** appropriate box below.)*

- ❑ We have no relevant financial interests in this manuscript
- ❑ We certify that all financial and material support for this research and work are clearly identified in the manuscript
- ❑ We certify that all our affiliations with or financial involvement (e.g. employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, royalties) with any organization or entity with a financial interest in or financial conflict with the subject or materials discussed in the manuscript are **disclosed completely here**:

  (Use a separate sheet of paper if necessary)

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