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BODY COMPOSITION AND MORPHOLOGICAL CHARACTERISTICS OF SOCCER PLAYERS IN BOSNIA AND HERZEGOVINA

TELESNA SESTAVA IN MORFOLOŠKE ZNAČILNOSTI NOGOMETAŠEV V BOSNI IN HERCEGOVINI

ABSTRACT

The aim of this research was to determine the differences among the top soccer players of the two clubs in Bosnia and Herzegovina, FC Sarajevo and FC Zeljeznicar, both from Sarajevo in the body composition and morphological characteristics. A sample of 51 subjects was divided into two sub-samples. The first sub-sample of the subjects consisted of 25 players FC Sarajevo of the average age 23.60±4.66, who occupied the first position on the table after the semi-season 2018/19, while the other sub-sample consisted of 26 players of FC Zeljeznicar of the average age of 23.58±4.93, who occupied the fourth position on the table after the semi-season 2018/19. Soccer players were tested between the two semi seasons of the championship 2018/19. Body composition and morphological characteristics in the were evaluated by a battery of 11 variables: body height, body weight, body mass index, fat percentage, muscle mass, upper leg skinfold, lower leg skinfold, triceps skinfold, biceps skinfold, skinfold of the back and abdominal skinfold. The standard central and dispersion parameters of all variables were calculated. The significance of the differences between the players of the top two soccer clubs in the variables for assessing body composition and morphological characteristics was determined by a t-test for independent samples. It was found that the soccer players of the two mentioned clubs have statistically significant differences by the two variables that estimate the upper leg skinfold and triceps skinfold, in favor of FC Sarajevo.

Key words: football, body composition, anthropometric measurement, fat percentage, muscle mass

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IZVLEČEK

Cilj raziskave je bil ugotoviti razlike med vrhunskimi nogometaši dveh klubov v Bosni in Hercegovini, FK Sarajevo in FK Željezničar iz Sarajeva, glede telesne sestave in morfoloških značilnosti. Vzorec 51 merjencev smo razdelili v dva podvzorca. V prvem podvzorcu merjencev je bilo 25 igralcev iz FK Sarajevo, s povprečno starostjo 23,60 ± 4,66 let, ki so zasedli prvo mesto ob koncu prve polsezone 2018/19, v drugem podvzorcu pa je bilo 26 igralcev FK Željezničar, s povprečno starostjo 23,58 ± 4,93 let, ki so bili na koncu prve polsezone 2018/19 četrti. Nogometaši so bili vključeni v raziskavo v času med obema polsezonama prvenstva 2018/19. Telesno sestavo in morfološke značilnosti smo ocenjevali z baterijo testov z 11 spremenljivkami: telesna višina, telesna teža, indeks telesne mase, odstotek maščobnega tkiva, mišična masa, stegenska in mečna kožna guba, tricepsova in bicepsova kožna guba ter hrbtna in abdominalna kožna guba. Za vse spremenljivke smo izračunali standardne parametre centralne tendence in disperzije. Statistično značilnost razlik med igralci najboljših dveh nogometnih klubov glede spremenljivk za ocenjevanje telesne sestave in morfoloških značilnosti smo ugotavljali s t-testom za neodvisne vzorce. Ugotovili smo, da so med nogometaši obeh omenjenih klubov statistično značilne razlike v spremenljivkah, povezanih s stegensko in tricepsovo kožno gubo, ki govorijo v prid FK Sarajevo.

Ključne besede: nogomet, telesna sestava, antropometrične meritve, odstotek maščobnega tkiva, mišična masa

INTRODUCTION

Soccer is the most popular sport in the world, with close to 270 million participants (Akbari, Sahebozamani, Daneshjoo, & Amiri-Khorasani, 2018). A soccer game is said to be the most important secondary thing in the world, it gathers huge masses at stadiums and in front of TVs (Gardasevic, Bjelica, & Vasiljevic, 2017). It is a highly dynamic and fast team game which, with its richness of movement, falls under category of polystructural sports games. Soccer is a sport that is characterized by numerous and various complex and dynamic kinesiological activities which are then characterized by either cyclical or acyclical movement (Gardasevic, & Bjelica, 2018). Ability to run more for players or at the other hand distance cover during each full time competition significantly influenced by aerobic capacity and endurance performance (Amani, Sadeghi, & Afsharnezhad, 2018). The soccer is contact sport characterized by different running intensities, jumps, acceleration and deceleration (Krespi, Sporis, & Popovic, 2019). In soccer, top score can be achieved only under conditions of well-programmed training process (Gardasevic, & Vasiljevic, 2017). High quality management of the training process depends on the knowing of the structure of certain anthropological capabilities and player's characteristics, as well as their development. Various researches are to be done in order to establish certain principles and norms for the transformational processes of the anthropological characteristics important for soccer; with morphological characteristics and body composition among them as expected. Findings regarding morphological characteristics and body composition are of crucial importance for complex sports games such as soccer. The morphological space is defined by the longitudinal dimension of the skeleton, the transversal dimensionality of the skeleton, the mass and volume of the body. The purpose of knowing morphological characteristics is to improve skills in many sports (Carter & Heath, 1990). The morphological status of top level athletes is relatively homogeneous, depending on the sport, and it can be defined as a model of athletic achievement (Mišigoj-Duraković, Matković, & Medved, 1995). Research on morphological characteristics and body composition among athletes of different sports indicates that athletes of different sports have their own specific characteristics. Muscle mass improves performance in activities that require muscular strength and endurance, but also in those that require enviable aerobic ability (Rico-Sanz, 1998).

Today, soccer is certainly the number one sport in the world for its view and popularity, and the same applies to Bosnia and Herzegovina. The two clubs that are at the top of the Telecom Premier League of Bosnia and Herzegovina and are fighting for trophies almost every year are FC Sarajevo and FC Zeljeznicar, both from Sarajevo. These are two soccer clubs that have the biggest tradition in Bosnia and Herzegovina and have played for years in the first league of former Yugoslavia. Based on these positions that they have won at the end of the semi season 2018/19 and their tradition, it is expected that both clubs will continue with good results and get right to play on the international soccer scene within the framework of UEFA's competitions. It became as interesting for researchers to determine the models of body composition and anthropometric characteristics of the players who play for these clubs as to determine the differences among them.

The aim of this research was to determine morphological characteristics and body composition of top soccer players, players of FC Sarajevo and FC Zeljeznicar, who compete in the Telecom Premier League of Bosnia and Herzegovina. Afterwhich, compare the variables between these players and determine the possible differences between them.

MATERIALS AND METHODS

The data obtained in the study of body composition and morphological characteristics are checked and prepared for processing according to the set goal. Data bases are arranged according to the features and prepared for planned statistical processing. The results obtained by statistical analysis are presented in the tables and analyzed by the corresponding logical units. In general, the results of the research, through gradualness in the explanation of individual relationships, allow seeing differences in the observed morphological measures and body composition in accordance with the aim of the research, that is, they contribute to a clearer application of the obtained results in practice. In terms of time constraint, the research is of transversal character, and it consists of a one-off measurement of the corresponding morphological characteristics and body composition of top-level senior players.

Sample of subjects

A sample of the subjects consists of a total of 51 top-level senior players who performed in the Telecom Premier League of Bosnia and Herzegovina, divided into two sub-samples. The first one consists of 25 players of FC Sarajevo, the average age of 23.60±4.66, who occupied the first position on the Table Telecom Premier League after the semi-season 2018/19, and the second one that consists of 26 players FC Zeljeznicar, the average age of 23.58±4.93, who occupied the fourth position on the Table Telecom Premier League after the semi-season 2018/19 (Table 1). Soccer players were tested between the two semi seasons of the championship of Bosnia and Herzegovina 2018/19.

Table 1. Table Telecom Premier League of Bosnia and Herzegovina after semi season 2018/19

Teams	Points
FC Sarajevo	43
HSC Zrinjski	38
NC Siroki Brijeg	30
FC Zeljezničar	28
FC Sloboda	28
FC Mladost Doboj Kakanj	26
FC Radnik Bijeljina	22
FC Zvijezda - 09	21
NC Celik	21
FC Tuzla City	20
NC GOSK	18
FC Krupa	15

Sample of measures

Anthropometric research has been carried out with respect to the basic rules and principles related to the selection of measuring instruments and measurement techniques standardized in accordance with the International Biological Program guidelines. For the purpose of this study, 8 morphological measures have been taken: body height (ABH), body weight (ABW), upper leg skinfold (AUS), lower leg skinfold (ALS), triceps skinfold (ATS), biceps skinfold (ABS), skinfold

of the back (ASB) and abdominal skinfold (AAS), and 3 body composition assessment variables: body mass index (BMI), fat percentage (AFP) and muscle mass (AMM). Anthropometer, caliper, and measuring tape were used for morphological measurements. To evaluate the body composition, Tanita body fat scale - model BC-418MA, was used. The principle of this scale is based on indirect measurement of the body composition; a safe electrical signal is transmitted through the body via electrodes located in the standalone unit. The Tanita Scale, thanks to its athletics mode, enables athletes to closely monitor their body weight, health condition and form with all relevant parameters.

Method of data processing

The data obtained through the research are processed by descriptive and comparative statistical procedures. For each variable, central and dispersion parameters, as well as asymmetry and flattening measures are processed. Differences in morphological characteristics and the composition of the body of the players of these two clubs were determined by using a discriminatory parametric procedure with t-test for small independent samples, with statistical significance of $p < 0.05$.

RESULTS AND DISCUSSION

In tables 2 and 3, basic descriptive statistical parameters of anthropometric variables and body composition of the players of the two clubs, where the values of central measurements and dispersion tendencies are calculated, are shown: Arithmetic mean (Mean), Standard deviation (Std.D.),Variance (Variance), Minimal (Min) i Maximal (Max) values, coefficient of Curvature (Skewness) and Elongation (Kurtosis). First, the central and dispersion parameters of the variables were analyzed to evaluate the body composition and morphological characteristics of the players of FC Sarajevo (Table 2).

Table 2. Central and dispersion parameters of variables for assessment of body composition and morphological characteristics of players of FC Sarajevo (N=25)

Variable	Min	Max	Mean±S.D.	Variance	Skewness	Kurtosis
ABH	171.0	191.7	182.77±5.85	34.229	-.321	-.758
ABW	68.1	93.5	78.39±6.44	41.485	.265	-.193
BMI	21.5	26.1	23.49±1.26	1.590	.034	-.720
AFP	3.8	15.6	9.54±3.14	9.854	-.203	-.439
AMM	35.3	44.7	40.15±2.96	8.788	-.038	-1.316
AUS	4.2	14.6	6.95±2.53	6.431	1.425	2.104
ALS	3.0	14.8	5.08±2.48	6.145	2.808	9.672
ATS	3.4	12.2	6.10±2.36	5.595	1.439	1.534
ABS	3.2	6.4	4.39±.89	.804	.727	-.592
ASB	6.2	14.4	9.10±1.93	3.722	.818	.887
AAS	3.8	18.0	11.02±4.25	18.069	.239	-1.148

Legend: ABH - body height; ABW - body weight; BMI - body mass index; AFP - fat percentage; AMM - muscle mass; AUS - upper leg skinfold; ALS - lower leg skinfold; ATS - triceps skinfold; ABS - biceps skinfold; ASB - skinfold of the back; AAS - abdominal skinfold

Based on the central and dispersion parameters, the values of the skewness and the kurtosis, it can be noted that almost all the variables are placed within the normal distribution boundaries. It can be seen based on the value of skewness as well, that the three variables: upper leg skinfold (AUS), lower leg skinfold (ALS) and triceps skinfold (ATS) have mild asymmetry, and though not statistically significant on behalf of better results, they are a positive sign, since it is essential for soccer players to have lower values of subcutaneous fat tissue. By the value of the kurtosis, it can be seen that the lower leg skinfold (ALS) has a statistically significant leptokurticity, which indicates that a greater number of results in this variable are arranged around the arithmetic mean. Generally, according to all statistical parameters, it can be concluded that here we have some top soccer players; that there is a normal distribution in almost all variables and that the results that prevail are superior to the arithmetic mean, which is not statistically significant because it is to be expected that regarding players of a professional soccer club, there is no too large a span between the results of analyzed variables.

Based on the central and dispersion parameters, the values of skewness and kurtosis of the players of FC Zeljeznicar (Table 3), it can be stated that almost all the variables are within the normal distribution boundaries and that the values are very similar to those of the players of FC Sarajevo.

Table 3. Central and dispersion parameters of variables for assessment of body composition and morphological characteristics of players of FC Zeljeznicar (N=26)

Variable	Min	Max	Mean±S.D.	Variance	Skewness	Kurtosis
ABH	171.5	193.5	183.50±5.81	33.809	-.116	-.641
ABW	71.3	92.4	80.85±6.35	40.314	.455	-1.007
BMI	20.5	26.5	23.85±1.36	1.856	-.480	.087
AFP	4.5	15.0	9.45±3.41	11.635	-.056	-1.225
AMM	36.3	48.8	41.49±3.29	10.803	.453	-.177
AUS	4.6	15.8	8.61±2.58	6.654	.990	.995
ALS	3.5	10.6	5.30±1.56	2.438	1.983	4.986
ATS	4.6	11.8	7.41±2.24	5.043	.616	-.613
ABS	2.9	7.0	4.64±.97	.938	.840	1.165
ASB	6.8	16.8	9.85±2.09	4.379	1.450	3.612
AAS	5.6	22.0	11.58±4.70	22.114	.842	-.397

By the value of the skewness, it can be noticed that in the variables of the lower leg skinfold (ALS) and skinfold of the back (ASB), there was a slight inclination on the side of the lower results, which is good because subcutaneous fat is a disrupting factor for professional athletes. The values of the kurtosis of variables of the skinfold of lower leg skinfold (ALS) and skinfold of the back (ASB) form a slight leptokurtic curve.

In order to determine whether there are statistically significant differences in the analyzed variables in the top soccer players of these two clubs, the statistical procedure t-test (Table 4) was applied.

Table 4. T-test values between the arithmetic mean of variables for the evaluation of body composition and morphological characteristics of soccer players of FC Sarajevo (N=25) and FC Zeljeznicar (N=26)

Variable	Club	Mean±S.D.	t-test	Sig.	Mean Difference
ABH	SAR	182.77±5.85	-.446	.658	-.7280
	ZEL	183.50±5.81			
ABW	SAR	78.39±6.44	-1.377	.175	-2.4658
	ZEL	80.85±6.35			
BMI	SAR	23.49±1.26	-.983	.330	-.3618
	ZEL	23.85±1.36			
AFP	SAR	9.54±3.14	.098	.922	.0902
	ZEL	9.45±3.41			
AMM	SAR	40.15±2.96	-1.527	.133	-1.3405
	ZEL	41.49±3.29			
AUS	SAR	6.95±2.53	-2.316	.025*	-1.6597
	ZEL	8.61±2.58			
ALS	SAR	5.08±2.48	-.381	.705	-.2200
	ZEL	5.30±1.56			
ATS	SAR	6.10±2.36	-2.025	.048*	-1.3077
	ZEL	7.41±2.24			
ABS	SAR	4.39±.89	-.957	.343	-.2505
	ZEL	4.64±.97			
ASB	SAR	9.10±1.93	-1.336	.188	-.7540
	ZEL	9.85±2.09			
AAS	SAR	11.02±4.25	-.449	.655	-.5646
	ZEL	11.58±4.70			

Legend: SAR – FC Sarajevo; ZEL – FC Zeljeznicar; *p<.05

Based on the obtained values of t-test results, it can be noted that there are statistically significant differences in two variables at $p < 0.05$. It is two morphological measures upper leg skinfold (AUS) and triceps skinfold (ATS). It can be stated that the soccer players of FC Zeljeznicar have statistically significantly higher upper leg skinfold (AUS) and triceps skinfold (ATS) than the players of FC Sarajevo (Figure 1). In all other variables the differences are negligible and not statistically significant.

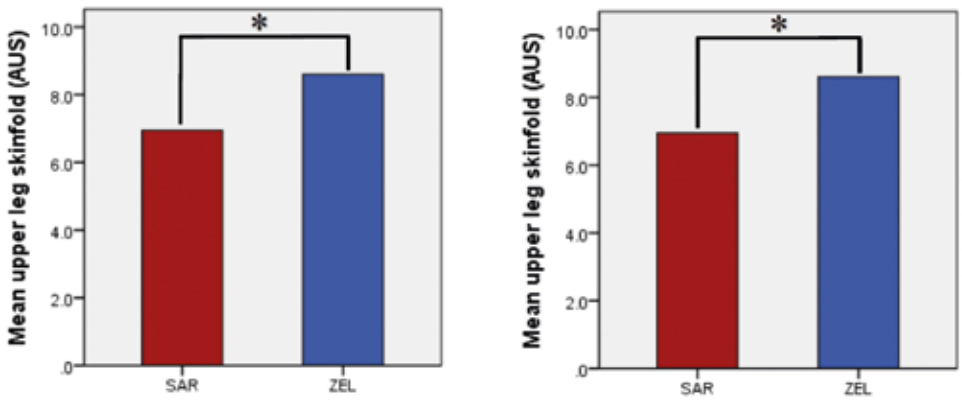

Figure 1. Statistically significant differences between soccer players FC Sarajevo and FC Zeljeznicar in two variables (*p<.05)

In all other variables the differences are negligible and not statistically significant.

CONCLUSIONS

The aim of this study was to determine the difference in the body composition and morphological characteristics of the top players of the two soccer clubs in Bosnia and Herzegovina, FC Sarajevo who occupied the first position on the table after the semi-season 2018/19, and FC Zeljeznicar who occupied the fourth position on the table after the semi-season 2018/19. A sample of 51 respondents was divided into two sub-samples. The first sub-sample consisted of the 25 players of FC Sarajevo of 23.60±4.66 age on average, and second sub-sample consisted of the 26 players of FC Zeljeznicar of 23.58±4.93 age on average. The results were obtained by using a battery of 11 tests in the area of body composition and morphological characteristics. By looking into the basic descriptive statistical parameters, it can be concluded that we have examined professional sportsmen indeed. It can be noticed that the players of both clubs are of the approximately similar mean values of the variables analyzed, which is not surprising because these are the top two clubs in Bosnia and Herzegovina, a state where there is also a great concentration of good players. Gardasevic, Bjelica and Vasiljevic (2019) found similar results on a sample of soccer players from Montenegro. The t-test results showed a statistically significant difference only in two variables. The first variable in which a statistically significant difference has been found is a variable that estimates upper leg skinfold (AUS), where the playmates of FC Zeljeznicar have a statistically higher value than the players of FC Sarajevo. Also, at the variable of triceps skinfold (ANT), players of FC Sarajevo have shown statistically better values because a smaller number means a better result when the disrupting factor of subcutaneous fat on playing soccer is taken into account. Similar results have been obtained in a recent study of Corluka et al (2018). It was found that the soccer players of the HSC Zrinjski Mostar and FC Siroki Brijeg have statistically significant differences by the three variables that estimate the bone mass, waist circumference and triceps skinfold, in favor of FC Siroki Brijeg. Also similar results have been obtained in a recent study of Bjelica, Gardasevic and Vasiljevic (2018), where the soccer players of FC Sutjeska, winners of the Cup of Montenegro, had significantly lower skinfold value than the soccer players

of FC Mladost, runner-up in the league of Montenegro. Also, they have shown that soccer players of FC Sutjeska, were dominant in these parameters in Montenegro, and that they had significantly lower values of skinfolds than the soccer players of FC Buducnost Podgorica, winners of the Championship of Montenegro.

For other variables, some values are better for players of FC Sarajevo and some for players of FC Zeljeznicar, although, insignificantly for statistics, which indicates that these players have very similar body composition and anthropometric parameters. That not surprising, considering that these two clubs have the best soccer players, have the biggest tradition in Bosnia and Herzegovina and occupides places at the top of the Table Telecom Premier League of Bosnia and Herzegovina after semi season 2018/19.

The values obtained in this research can be useful for coaches of these clubs for making a comparison of their players with others and formulate their work in a way that enables reduction of those parameters that are not good, and raise those that are good to a higher level. That will surely make their soccer players even better and more successful. Also, both clubs should turn to other researches and check the functional-motoric status, psychological preparation as well as tactical training of their players and analyze whether there is room for their improvement. The results obtained in this research can serve as model parameters for the estimated variables for players of all other soccer clubs in Bosnia and Herzegovina, because the players that have been analyzed here, were among the best and the most successful soccer players in Bosnia and Herzegovina at the end of the competitive semi season of the Telecom Premier League of Bosnia and Herzegovina 2018/19.

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CONFLICTS OF INTEREST

All authors confirm - no potential conflict of interest exists for this study.

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