

DIFFERENCES IN SPRINT ABILITY, AGILITY AND VERTICAL JUMP BETWEEN PROFESSIONAL AND AMATEUR SOCCER PLAYERS IN BOSNIA AND HERZEGOVINA

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ABSTRACT: The aim of investigation was to determine the differences in linear speed (SPRINT30), agility (TT), and the explosive power of vertical jump (CMJ) between adult professional and amateur soccer players in Bosnia and Herzegovina. Forty-seven (47) soccer players were included in the research and were divided in two sample groups: professional soccer players of CSC Zrinjski Mostar who play at the elite level of competition - BiH Premier League (n = 22) and amateur soccer players of FC Velež Mostar who play at the second level of competition - First League of FBiH (n = 25). The study was conducted in February 2019, at the beginning of the second part of 2018/19 soccer season in BiH. The results of descriptive statistics show that professional soccer players are, on average, older (24.59 ± 4.15 vs 22.00 ± 2.95), taller (185.04 ± 6.33 vs 182.44 ± 6.99), and have a larger body mass (80.77 ± 6.92 vs 76.96 ± 8.64). The values of lower-limb explosive power, flight time CMJTIME ($.63 \pm .56$ s vs $.65 \pm .57$ s) and jump height CMJHIGH (40.95 ± 4.70 cm vs 39.70 ± 4.15 cm) show that, on average, professional soccer players have better results. The values of the ability to change the direction quickly (TT) are higher in professional soccer players ($9.43 \pm .33$ s vs $10.07 \pm .43$ s), and it is the case with the linear speed tested by the test SPRINT30 ($4.15 \pm .12$ s vs $4.33 \pm .15$ s). As for the variables defining lower-limb explosive power, the average values of CMJTIME and CMJHIGH are again slightly on the side of professionals as compared to amateurs (0.57 ± 0.03 s vs 0.56 ± 0.03 s) and (40.95 ± 4.70 cm vs 39.70 ± 4.15 cm). T test for independent samples determined the differences in arithmetic mean between professional and amateur soccer players in Bosnia and Herzegovina in the treated variables. We noted here a statistically significant age difference between these two groups at the level of .95% ($p \leq 0.05$) (sig. 0.017) and the difference between the variables defining the linear speed in SPRINT30 and TT agility at the level of .99% ($p \leq 0.01$) (sig.0.000). In the variables defining lower-limb explosive power, the groups did not differ statistically in jump height and flight time.

Based on the analysis of the results obtained, we may conclude that professional and amateur soccer players in BiH differ statistically significantly by age, linear speed and agility, and that there is no statistically significant difference in terms of lower-limb power/strength and the ability to jump vertically. We may conclude that professional teams rely more on more experienced players, while the second-level teams rely on young players who are eager to prove themselves, and that in training selection and technology, professional teams pay more attention to sprint speed and agility ability compared to amateur soccer players and second-level players. The soccer players do not differ statistically in their ability to jump vertically, so we can say that training technology, selection and programs in that domain are the same at both competition levels.

Keywords: *soccer, speed, agility, explosive power.*

INTRODUCTION

We are witnessing the rapid development of modern soccer in all components of the game, but particularly in terms of players' physical quality (Bangsbo, 2014). Many authors have found out that top soccer players run 8-12 km on average during a match. It depends on their position in the team (Bangsbo, Nørregaard and Thorsøe, 1991; Reilly, Thomas, 1976; Reilly, 1996; Čolakhodžić et al., 2017), their energy status, and aerobic fitness (Jacobs, Westlin, Karlsson, Rasmusson and Houghton, 1982; Smaros, 1980; Helgerud, Engen, Wisløff and Hoff, 2001). It is also evident that the amount of running at higher speed during a soccer match constantly increases with the high level of performance (Mohr, Krustup and Bangsbo, 2003). General opinion is that sprinting skills in all their forms are becoming increasingly important in modern soccer (Haugen, Tonnessen, Hisdal and Seiler, 2014). According to Reilly and Thomas (1976), the sprint in a football match occurs approximately every 90 seconds and each lasts 2-4 seconds on average (Bangsbo, Nørregaard, Thorsøe, 1991).

The sprint counts for 1%-11% of the total running distance in a match, and it is equal to 0.5%-3.0% of the effective playing time, i.e. when the ball is in play (Bangsbo, Nørregaard, Thorsøe, 1991; Reilly, Thomas, 1976; O'Donoghue, 2001; Ali, Farrally, 1991; Bangsbo, 1992). Top players perform about 50 turns in a match, including strong contractions to maintain the balance and to control the ball because of the opponent's pressure. In all these actions, the strength, agility and explosive power, together with endurance, are of quintessential importance for a top soccer performance. The ability to create the level of maximum strength in players' lower limbs in the shortest period is the foundation for achieving the best performance in soccer (Haugen, Tonnessen, Hisdal and Seiler, 2014; McFarland, Dawes, Elder and Lockie, 2016). A significant relationship was also observed between one repetition maximum (1RM), acceleration and movement speed. The relationship between maximum strength, explosive power and soccer performance is supported by jumping results and 30 m sprint tests. The results show that the increase in the available muscle contraction force in respective muscles or muscle groups leads to the increase in acceleration and speed in the skills,

which are crucial for a soccer match, such as turning, sprinting, changing of direction and pace (Buhrle, Schmidbleicher, 1977; Schmidbleicher, 1992; Hoff, Berdahl, Braten, 2001). The results of the study by Wisloff, Castagna, Helgerud, Jones and Hoff (2004) also confirmed the existence of the strong relationship between maximum strength, sprint, and jumping ability in the performance of elite soccer players.

The ability to maintain and control the position of the body while rapidly changing the direction in a series of movements is called agility (Twist, Benicky, 1995; Sheppard, Young, 2006). Agility is also defined as the combination of strength, speed, balance, and coordination (Draper and Lancaster 1985). Agility, therefore, is not defined precisely, but it is most often defined as the ability to rapidly change direction, to react, and to stop (Gambetta, 1996; Sheppard, Young, 2006). In addition to the data we referred to earlier, the importance of sprint, agility and vertical jump in soccer is evidenced by the fact that the players make 30 sprints on average, about 600 changes of direction, and 10-15 jumps (Čolakhodžić, Rađo, Alić, 2016) in a match. One way to examine the relationship between these abilities and top performance in soccer, and their impact on the performance is to determine the degree of their correlation. The results obtained by Pauole, Madole, Garhammer, Lacourse, and Rozenek (2000) show a significant degree of correlation between the agility T-test and the 40-yard dash test in male and female athletes. Buttifant, Graham, and Cross (1999) and Young, Hawken, and McDonald (1996) did not prove significant correlation between sprint and agility tests in soccer players and Australian football players. Young, McDowell, and Scarlett (2001) proved that linear sprint and agility are specific abilities having limited impact on each other. Some authors have defined agility as a skill or simply the ability to change the direction rapidly (Mathews, 1973), and some as the ability to change the direction rapidly and accurately (Barrow & McGee, 1971; Johnson & Nelson, 1969).

Some authors have defined agility in more recent publications as including a whole-body change of direction as well as a rapid movement and direction change of limbs (Baechle, 1994; Draper & Lancaster, 1985). We also need to emphasize the results of some studies that highlight the advantages of high aerobic fitness in soccer and its association with the quality of match performance. It has also been proved that improving the aerobic fitness of elite junior soccer players leads to an increase in the running distance, match intensity, number of sprints and contacts with the ball in a match (Helgerud, Engen, Wisloff and Hoff, 2001). Although such relationships and results are also expected in top soccer players in Bosnia and Herzegovina, this study is a little empirical support to such assumption. The aim of this study was to investigate the abilities of sprint, agility and vertical jump and to determine the differences between professional and amateur soccer players in Bosnia and Herzegovina who represent two competition levels (first competition

level is the Premier League of BiH and second competition level is the First League of FBiH).

METHODS

Research Subjects

The sample comprised 47 senior soccer players. They were divided into two groups. The first group were professional soccer players of HFC Zrinjski Mostar who play at the elite competition level - BiH Premier League ($n = 22$; age: 24.59 ± 4.15 years, height: 185.4 ± 6.33 cm, weight: 80.77 ± 6.92 kg). The second group were amateur football players of FK Velež Mostar who play at the second competition level – the First League of FBiH ($n = 25$; age: 22.00 ± 2.95 years, height: 182.44 ± 6.99 cm, weight: 76.96 ± 8.64 kg). The research was conducted in February 2019, at the beginning of the second part of the 2018/19 football season in BiH.

Assessment Methods

The assessment and testing of anthropological characteristics and vertical jump (CMJ) took place indoors in a gym, and the testing of sprint (SPRINT30) and agility (TT) in the open fields of the clubs tested, on the same day and under the same conditions. Prior to assessment and testing, a ten-minute warm-up drill was applied. The drill comprised activation and mobilization exercises, light running, stretching, skipping, and acceleration drills. The break between individual assessments lasted 10-15 minutes. The testing was conducted by the experienced researchers of the Institute of Kinesiology of the Faculty of Teacher Education, at Džemal Bijedić University of Mostar.

Lower-Limb Power Ability Test: CMJ (Counter Movement Jump)

The lower-limb power ability was evaluated by the evaluation of vertical jump height. The jump height during CMJ was evaluated by using an infrared photocell connected to a digital computer (Optojump System, Microgate R, Bolzano, Italy). This made it possible to measure flight time (tf) with 1/1000 s accuracy. For CMJ testing, the subjects started from standing position with the hands on the hips. After a verbal signal, downward movement to a 90-degree knee angle was made, and the subjects then jumped upward as quickly as possible. Three attempts were made for the evaluation of CMJ and the average used for the analysis was taken.

Change of Direction Speed Ability: T-test

For testing the change of direction ability (Change Of Direction Performance - CODP) we used the effective, reliable, and sensitive soccer T-test (Sporiš i sar., 2010). The T-test was applied under the protocol as described by Semenick (1990). One cone was placed at the distance of 9.14m in front of the first cone and the other two cones were placed at the distance of 4.57m on either side of the second cone. Times were recorded by an electronic timer (Photocells, Microgate R, Bolzano, Italy). Photoelectric cells were placed at the height of 0.7 m above the floor. The subjects were running in T-

shape, running forward 9.14m to the first touching its top with the right hand. Then they were running 4.57m left to the second cone touching its top with the left hand. Then they were running to the opposite side 9.14m right to the third cone touching its top with the right hand. Then they returned 4.57m left to the middle cone touching its top with the left hand, before finally running backwards to 2 meters wide starting line. The testing failed if the participants failed to touch a particular cone, if they crossed over a leg while migning or if they failed to face forward all the time. Prior to performance, all the participants had tests to familiarize themselves with three final assessment tests with one-minute recovery intervals before performance. The average of three measurements was used for the analysis.

Linear Speed Ability: 30 m Sprint

The assessment of S30m linear sprint test was performed by Witty Gate Training System photocells (Microgate R, Bolzano, Italy). Two photocells were located at the starting point at the distance of 30m. The sprint started from the starting position. Each participant started sprinting when he was ready. The time was recorded from the passing by the first photocell until the participants crossed the 30-meter line, on which the other photocells were placed. All the participants performed 2 runs with 5-minute break to recover between runs. The fastest test time S30m was used for further statistical analyzes.

Statistical Analysis

SPSS (version 26.0; SPSS, Inc., Chicago, IL, SAD) was used for statistical analysis. Standard statistical paarmeters (arithmetic mean, SD and minimum and

maximum results) were calculated for each experimental agility test.

Kolmogorov-Smirnov test was used for examining distribution, while variance homogeneity was tested by Levene's test.

Ethical Approval

The study included adults only in accordance with the applicable domestic legislation and institutional policies, and it followed the principles of the Declaration of Helsinki and the ethical code of conduct in human research of Džemal Bijedić University of Mostar.

RESULTS AND DISCUSSION

The results of the descriptive statistics of this study can be seen in Table 1. A review of the table shows that professional soccer players were, on average, older (24.59 ± 4.15 vs 22.00 ± 2.95), taller (185.04 ± 6.33 vs 182.44 ± 6.99) and that they had higher body weight (80.77 ± 6.92 vs 76.96 ± 8.64). If we look at the values of lower-limb explosive power, flight time CMJTIME ($.63 \pm .56$ s vs $.65 \pm .57$ s) and jump height CMJHIGH (40.95 ± 4.70 cm vs $39.70 \pm .4.15$ cm), we can see that professional soccer players had better results. The values of the ability to quickly change the direction of movement (CODP), which was examined by the T-test, also showed better results in professional soccer players, as did the linear speed SPRINT30 ($4.15 \pm .12$ s vs $4.33 \pm .15$ s) test. As for the variables defining lower-limb power, the average CMJTIME and CMJHIGH values were again slightly on the side of the professionals as compared to the amateurs (0.57 ± 0.03 s vs 0.56 ± 0.03 s) and (40.95 ± 4.70 cm vs $39, 70 \pm 4.15$ cm).

Table 1. Descriptive statistics of the sample

Variable	Professionals (HFC Zrinjski)					Amateurs (FK Velež)				
	n	Min	Max	Mean	SD	n	Min	Max	Mean	SD
Age (year)	22	18.00	31.00	24.59	4.15	25	17.00	31.00	22.00	2.95
High (cm)	22	172.00	195.00	185.04	6.33	25	168.00	198.00	182.44	6.99
Mass (kg)	22	65.00	92.00	80.77	6.92	25	63.40	91.90	76.96	8.64
SPRINT30 (s)	22	3.95	4.41	4.15	.12	25	3.94	4.62	4.33	.15
TT (s)	22	8.85	10.05	9.43	.33	25	9.41	11.00	10.07	.43
CMJTIME (s)	22	.52	.65	.57	.03	25	.50	.63	.56	.03
CMJHIGH (cm)	22	33.10	52.00	40.95	4.70	25	31.10	49.00	39.70	4.15

The T test for independent samples (Table 2) determined the differences in arithmetic means between professional and amateur soccer players in Bosnia and Herzegovina in the treated variables. Based on the T test, we can see that these two groups of soccer players differ statistically

significantly by age at the level of .95% ($p \leq 0.05$) (sig. 0.017) and in the variables defining linear speed SPRINT30 and TT agility at the level of .99 % ($p \leq 0.01$) (sig.0,000). In the variables defining lower-limb power, the groups do not statistically differ in jump height and flight time.

Table 2. Independent Sample Test

		Levene's Test for Equality of Variances		T-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Age (year)	Equal variances assumed	4,088	.049	2,483	45	.017	2.59091	1.04342	.48935	4.69246
	Equal variances not assumed			2,430	37.375	.020	2.59091	1.06602	.43167	4.75014
High (cm)	Equal variances assumed	.031	.861	1.331	45	.190	2.60545	1.95716	-1.33647	6.54738
	Equal variances not assumed			1.340	44.955	.187	2.60545	1.94461	-1.31130	6.52221
AMAS (kg)	Equal variances assumed	2.340	.133	1.650	45	.106	3.80473	2.30635	-.84050	8.44996
	Equal variances not assumed			1.673	44.629	.101	3.80473	2.27360	-.77559	8.38504
SPRINT30 (s)	Equal variances assumed	.821	.370	-4,418	45	.000	-.18067	.04090	-.26304	-.09830
	Equal variances not assumed			-4,477	44.735	.000	-.18067	.04035	-.26196	-.09939
TT (s)	Equal variances assumed	1.195	.280	-5.555	45	.000	-.63045	.11350	-.85906	-.40185
	Equal variances not assumed			-5,649	44.239	.000	-.63045	.11161	-.85535	-.40556
CMJTF (s)	Equal variances assumed	.272	.605	.786	45	.436	.00725	.00922	-.01133	.02583
	Equal variances not assumed			.781	42.827	.439	.00725	.00928	-.01147	.02597
CMJH (cm)	Equal variances assumed	.373	.545	.971	45	.337	1.25509	1.29264	-1.34843	3.85861
	Equal variances not assumed			.963	42.275	.341	1.25509	1.30317	-1.37431	3.88449

CONCLUSION

The aim of this study was to determine the differences in linear running speed (SPRINT30), agility (TT), and the lower-limb explosive power in vertical jump (CMJ) between adult professional and amateur soccer players in Bosnia and Herzegovina. We assumed that there was statistically significant difference at the level of physical performance taken between the two groups of soccer players, who represent the two largest ranks of competition in Bosnia and Herzegovina. Based on the analysis of the results obtained, we can conclude that professional and amateur soccer players in Bosnia and Herzegovina differ statistically significantly by age, linear speed ability and agility, and that there are no statistically significant differences in lower-limb

explosive power in vertical jump. These the two teams represent in the best way the first and the second level of competition in BiH. We may conclude that professional teams rely more on more experienced players, while the teams at the second level of competition rely more on young players who are eager to prove themselves. We also concluded that in training selection and technology they pay more attention to the speed of movement-sprint and the agility than do amateur soccer players or the second competition level players. In the ability to jump vertically, soccer players do not differ statistically, so, based on these results, we can say that training technology, selection and programs in this domain are the same at both competition levels.

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