Coll. Antropol. **35** (2011) 4: 1089–1094
Original scientific paper

Are There any Differences in Power Performance and Morphological Characteristics of Croatian Adolescent Soccer Players according to the Team Position?

Goran Sporiš[1], Vlatko Vučetić[1], Mario Jovanović[1], Zoran Milanović[2], Marijan Ručević[1] and Dinko Vuleta[1]

[1] University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia
[2] University of Niš, Faculty of Sport and Physical Education, Niš, Serbia

A B S T R A C T

The aim of the study was to analyze differences in power performance and morphological characteristics of young Croatian soccer players with respect to their team positions and to establish correlations between the power performance variables. Anthropometric characteristics and jumping and sprint performances were analyzed for 45 soccer players (age 14–15; mean body height 175.4±6.61 cm; body weight 63.6±8.06 kg) according to their team positions (defender, midfielder, forward). Pearsons coefficient of correlation was used to determine the relationship between the power performance variables. There were no significant differences ($p>0.05$) in the power performance of players according to their team position. The only significant differences between players were in some of the anthropometric characteristics, such as height and weight linear relationship was determined between almost all the power performance variables. Since the players in this study were very young and their sports careers have not reached their peak performance, it is possible that their nominal team positions may change during their soccer careers.

Key words: *jumping, measurement, anthropometric characteristics, ability*

Introduction

A team position is highly important in the interpretation of morphological and power performance data because there are specific demands for a specific play position[1–10]. Because of this it should be possible to classify team positions based on these measures. One of the motor capabilities that is very important in game of soccer is power performance as when one player wants to achieve an advantage over the other he may need to jump higher or run faster.

A number of studies have investigated a variety of variables using different independent variables such as players, positions, levels and competitions[1–10]. It is a well known fact that most of the anthropometric characteristics are almost exclusively genetically determined[11]. According to Matković[1] only goalkeepers are significantly different from all the other top players in Croatia, in some of the anthropometric characteristics, such as body height and weight. Generally soccer players characterize their small morphological structure compared to other team sport[11]. However, significant differences in age, stature, body mass and body mass index have recently been identified between elite players in different positions suggesting that players of a particular size and shape may be suitable for the demands of the various playing positions[12]. In this respect, positional role appears to have an influence on total energy expenditure in a match, suggesting different physical, physiological and bioenergetic requirements are experienced by players of different positions[13]. Bangsbo[14] reported that elite defenders and forwards covered approximately the same mean distance (10–10.5 km) in a single match, but this was significantly less than that covered by the midfield players (11.5 km). Bloomfield[15] has also shown that less than half of »purposeful movement« (PM) is performed

Received for publication October 06, 2010

in a forward direction, players perform the different types of movement with a range of intensities and players perform frequent turns during movement patterns. Significant differences exist between striker, midfield and defending players in %PM time running, %PM time skipping and %PM time moving backwards.

Team positions are of great importance in the interpretation of adult soccer players morphological and power performance data because of a variety of demands each play may have[1,16–18]. Furthermore, there are differences in morphological and power performance among adolescent soccer players in regard to different play positions[19–21].

Results of Baldari's investigation[22] demonstrated that age, pubertal developmental stages, testicular volume, weight, height, fat free mass and salivary DHEAS concentrations are associated with standing long jump performance. In addition, salivary testosterone concentrations aren't related to explosive leg power. Fortunately, the relation between maximal strength and sprint and jumping performance has been studied thoroughly. One of these studies has shown that there is a strong correlation between maximal strength in half squats and sprint performance and jumping height[23]. Also, in another study[4] among young soccer players, maximal isometric force and vertical jump height were highly correlated.

In order to improve the knowledge of the subject, it is important to further investigate the differences between team positions of adolescent players and especially to investigate all the aspects of strength, as well as to provide a higher level of specific detail.

The aim of this present study was to provide a detailed analysis of young soccer players and to demonstrate any differences in the morphological characteristics and power performance parameters between them according to their team positions, as well as to establish the correlations between the power performance variables. Specifically, this research was conducted to determine which players are more explosive; defenders, midfielders or forwards.

Materials and Methods

Forty five young soccer players, (aged 14 or 15, mean body height 175.4±6.61 cm; body weight 63.6±8.06 kg), were selected from 3 positional groups (15 defenders, 15 midfielders, 15 forwards) representing various 1st Croatian Football League U-15 clubs.

Individual players were measured using 2 sets of variables (anthropometric variables and explosive strength variables).

Anthropometric variables:

- 3 variables of longitudinal dimensions of skeleton: body height (BH), leg length (LL), foot length (FL),
- 3 variables of transversal dimensions of skeleton: knee diameter (KD), ankle diameter (AD), foot width (FW),
- 5 variables of body volume and body mass: body mass (BM), chest girth (CG), abdomen girth (AG), upper leg girth (ULG), lower leg girth (LLG),
- 7 variables of under skin fat tissue: armpit skinfold (AS), back skinfold (BS), upper arm skinfold (UAS), upper leg skinfold (ULS), chest skinfold (CS), waist skinfold (WS), abdomen skinfold (ABS).

Explosive strength variables:

- Squat Jump (SJ). For each trial, the subjects were instructed to initially stand on a tensiometric platform (Kistler, Germany) and jump as high as possible from a semi squatting position without countermovement.
- Counter Movement Jump (CMJ). For each trial, the subjects were instructed to initially stand on the tensiometric platform and jump as high as possible. During the test the subjects were allowed to perform a countermovement using their lower limbs before jumping.
- Maximal Counter Movement Jump (CMJ max). For each trial, the subjects were instructed to initially stand on the tensiometric platform and jump as high as possible. They were allowed to perform a countermovement with the lower limbs before jumping and to swing hands.
- Continuous Jumps with Straight Legs (CJS). For a single trial, the subjects were instructed to initially stand on the tensiometric platform, jump as high as possible, and were also allowed to perform a countermovement with the lower limbs before jumping continued by five consecutive jumps with straight legs, without bending knees.
- Standing Long Jump (SLJ). For each trial, the subjects were instructed to initially stand on a long jump mat (Elan, Slovenia) and jump as far as possible. The distance from the starting point to the landing point at heel contact was used for statistical analysis.
- Split Time 5m (ST5). For each trial, the subjects were instructed to run on a sound mark as fast as possible. The time needed to get from a starting point to finish line was measured with photocells (Newtest, Finland).
- Split Time 10m (ST10). For each trial, the subjects were instructed to run on a sound mark as fast as possible. The time needed to get from a starting point to finish line was measured with photocells (Newtest, Finland).
- Sprint 20m (S20). For each trial, the subjects were instructed to run on a sound mark as fast as possible. The time needed to get from a starting point to finish line was measured with photocells (Newtest, Finland).

The above 3 tests were measured with 3 trials on 20m distance, and split times on 5 and 10m were taken by photocells.

Statistical analyses

Data processing was undertaken using the statistical package SPSS ver. 18.0. The data were presented using standard descriptive statistic methods. The analysis of

differences between the groups of players was carried out using the ANOVA (univariate analysis of variance) with the level of significance set at $p<0.05$. And finally, Pearsons coefficient of correlation was used to determine the relationship between the power performance variables.

Results

Table 1 shows basic descriptive parameters and the analysis of differences between the groups of players in morphological characteristics and Table 2 shows basic descriptive parameters and the analysis of differences between the groups of players in power performance variables. Post-hoc tests showed that in all those variables where significant differences were determined, defenders significantly differed from the other groups ($p<0.05$).

It is quite simple to demonstrate the differences (Tables 1 and 2) by using the charts. However, only some of the interesting results are presented below. Defenders were the tallest and heaviest, and they also had the biggest morphological measures. However, there were no significant differences between the groups in explosive strength variables. In Split Time 10m variable were very

TABLE 1
BASIC DESCRIPTIVE PARAMETERS AND ANALYSIS OF DIFFERENCES BETWEEN THE GROUPS OF PLAYERS (ANOVA) OF MORPHOLOGICAL VARIABLES

	All players	Defenders	Midfielders	Forwards
	$\overline{X}$±SD (min–max)	$\overline{X}$±SD (min–max)	$\overline{X}$±SD (min–max)	$\overline{X}$±SD (min–max)
Body height (cm)	175.40±6.61* (162.30–190.70)	179.99±6.83 (166.00–190.70)	172.37±5.10 (162.30–182.30)	173.83±5.43 (164.80–185.9)
Body mass (kg)	63.60±8.06* (48.80–83.50)	69.33±7.44 (53.80–83.50)	59.24±6.71 (48.80–71.40)	62.23±6.82 (52.70–73.80)
Leg length (cm)	99.59±4.52* (91.30–109.40)	102.33±4.89 (91.30–109.40)	98.11±4.01 (92.40–105.00)	98.33±3.50 (93.60–105.50)
Foot length (cm)	26.15±1.70 (20.60–28.70)	26.59±2.00 (20.60–28.50)	25.85±0.92 (24.20–27.30)	26.01±1.97 (20.60–28.70)
Armpit skinfold (mm)	5.65±1.40 (3.90–10.00)	6.32±1.62 (4.40–9.97)	5.21±0.88 (3.90–6.60)	5.42±1.41 (4.20–10.00)
Back skinfold (mm)	7.44±1.34* (5.13–10.50)	8.29±1.18 (6.00–10.50)	6.69±1.09 (5.13–8.53)	7.33±1.29 (5.20–10.40)
Upper arm skinfold (mm)	7.62±1.77 (5.13–13.73)	8.22±1.35 (5.80–10.10)	7.16±1.37 (5.40–9.63)	7.48±2.35 (5.13–13.73)
Upper leg skinfold (mm)	9.58±2.79 (5.53–18.70)	10.85±2.73 (5.77–16.10)	9.10±1.91 (7.40–13.20)	8.78±3.28 (5.53–18.70)
Chest skinfold (mm)	5.06±1.46* (2.67–8.73)	5.99±1.28 (4.53–8.73)	4.22±1.11 (2.67–6.37)	4.95±1.45 (3.50–8.13)
Waist skinfold (mm)	6.70±2.16 (3.53–14.73)	7.56±1.53 5.40–11.53)	6.44±2.95 (3.57–14.73)	6.08±1.54 (3.53–9.50)
Abdomen skinfold (mm)	8.33±2.82* (4.87–17.30)	9.92±3.14 (5.87–17.30)	7.23±1.94 (4.87–11.80)	7.84±2.65 (5.10–15.57)
Knee diameter (cm)	9.74±0.43 (9.00–10.90)	9.85±0.43 (9.10–10.90)	9.64±0.30 (9.30–10.50)	9.72±0.52 (9.00–10.80)
Ankle diameter (cm)	7.71±0.38 (6.90–8.60)	7.87±0.33 (7.40–8.50)	7.65±0.26 (7.30–8.30)	7.61±0.47 (6.90–8.60)
Foot width (cm)	10.02±0.60* (8.60–11.40)	10.43±0.66 (9.00–11.40)	9.59±0.38 (8.60–10.10)	10.04±0.42 (9.30–10.80)
Chest girth (cm)	86.85±5.71 (74.20–97.20)	89.58±4.75 (78.80–97.20)	85.59±5.15 (78.80–96.30)	85.38±6.43 (74.20–95.70)
Upper leg girth (cm)	53.25±3.45* (45.50–60.50)	55.92±2.75 (49.80–60.50)	51.03±2.83 (45.50–55.40)	52.79±2.97 (48.00–57.70)
Lower leg girth (cm)	35.81±2.05* (31.90–40.00)	36.94±1.71 (34.60–39.90)	34.99±2.49 (31.90–40.00)	35.51±1.38 (33.00–38.40)
Abdomen girth (cm)	74.26±4.28* (67.00–83.00)	76.56±4.38 (67.00–83.00)	72.53±3.66 (67.20–80.80)	73.70±3.98 (67.80–80.10)

*$p<0.05$

TABLE 2
BASIC DESCRIPTIVE PARAMETERS AND ANALYSIS OF DIFFERENCES BETWEEN THE GROUPS OF PLAYERS (ANOVA) OF POWER PERFORMANCE VARIABLES

	All players	Defenders	Midfielders	Forwards
	$\overline{X}$±SD (min–max)	$\overline{X}$±SD (min–max)	$\overline{X}$±SD (min–max)	$\overline{X}$±SD (min–max)
Split Time 5 m (s)	1.39±0.13 (1.14–1.67)	1.40±0.14 (1.18–1.67)	1.34±0.08 (1.20–1.47)	1.41±0.14 (1.14–1.65)
Split Time 10 m (s)	2.13±0.12 (1.86–2.40)	2.14±0.12 (1.89–2.31)	2.11±0.07 (1.98–2.20)	2.14±0.15 (1.86–2.40)
Sprint 20 m (s)	3.37±0.13 (3.15–3.63)	3.36±0.12 (3.15–3.52)	3.35±0.13 (3.16–3.61)	3.40±0.14 (3.20–3.63)
Standing Long Jump (cm)	219.0±15.2 (187.0–254.3)	215.6±15.1 (187.0–236.3)	220.9±18.1 (195.6–253.6)	220.4±12.5 (208.0–254.3)
Squat Jump (cm)	42.48±4.12 (35.97–49.40)	42.62±3.72 (35.97–48.40)	42.14±4.34 (36.17–49.40)	42.68±4.52 (36.40–49.00)
Counter Movement Jump (cm)	45.47±3.85 (38.83–53.50)	45.34±4.10 (38.83–51.17)	45.47±3.77 (40.10–53.50)	45.58±3.93 (39.00–51.30)
Maximal Counter Movement Jump (cm)	53.26±4.30 (42.63–62.77)	53.34±4.60 (45.40–62.77)	54.03±3.49 (48.80–62.57)	52.40±4.83 (42.63–58.60)
Continuous Jumps with Straight Legs (cm)	39.23±2.99 (32.30–46.20)	40.45±3.07 (36.00–46.20)	38.77±2.59 (33.70–43.00)	38.47±3.09 (32.30–43.10)

*$p<0.05$

similar results to those in Split Time 5m, although forwards were a little bit faster than defenders. The smallest differences between groups were in tests SJ ($p=0.93$) and CMJ ($p=0.99$).

Pearson's coefficient of correlation showed linear relationships between almost all the variables ($p<0.05$) with CJS test and ST5 sprint test less related to other variables (Table 3) than for example SLJ test.

Discussion

As found previously[1,7–10,12], the results indicated that players of a particular size and shape may be potentially more suitable for the demands of various playing positions than other players.

The reason has already been explained, but it is also important to note that in a single match defenders cover less distance than midfielders[18]. According to Bangsbo[14], elite defenders and forwards cover approximately the same mean distance (10–10.5 km) in a single match, but this is significantly less than covered by the midfield players (11.5 km). Defenders maintain the highest results in morphological measures (such as skinfolds and girths), as the results of some previous study show[1,18,20,21], and we can explain that as a result of selection process. Moreover, defenders are the highest and the heaviest of the players because of frequent jumping movements they are supposed to perform in the defense tactical tasks.

There was little difference between forwards and defenders and the forwards were slowest in 5m sprint, ap-

TABLE 3
CORRELATIONS BETWEEN THE POWER PERFORMANCE VARIABLES

	ST5	ST10	S20	SLJ	SJ	CMJ	CMJmax	CJS
ST5	1.00							
ST10	.84*	1.00						
S20	.51*	.65*	1.00					
SLJ	–.31*	–.33*	–.37*	1.00				
SJ	–.17	–.34*	–.55*	.53*	1.00			
CMJ	–.20	–.35*	–.52*	.62*	.82*	1.00		
CMJmax	–.23	–.36*	–.43*	.55*	.79*	.85*	1.00	
CJS	–.06	–.15	–.05	.32*	.26	.25	.31*	1.00

*$p<0.05$, SJ – Squat Jump, CMJ – Counter Movement Jump, CMJmax – Maximal Counter Movement Jump, CJS – Continuous Jumps with Straight Legs, SLJ – Standing Long Jump, ST5 – Split Time 5 m, ST10 – Split Time 10m, S20 – Sprint 20 m

ropos, they had the worst start reaction. As it was expected, the results in Split Time 10m variable are highly correlated to those in variable Split Time 5m (Table 3). The results in 20 m sprint test were perhaps unexpected but they are logical, considering the results in 5m and 10m sprint tests. Defenders needed a lot more time to gain a maximum speed and because of that their 20m sprint results were much better. In jumping tests forwards and midfielders achieved better results than defenders, probably because of their body weight.

Probably one of reasons of homogeneous achievements in variables SJ and CMJ (Table 2) lies in the fact that subjects had to keep their hands on the hips throughout the tests, and normally they do not jump in the same way during the match in ball heading situations. The results of this study in SJ, CMJ and CMJ max variables were little higher and more homogenous than in Sporiš[20] assessment of adolescent players (age 16–18), mostly because of a smaller sample and a higher quality of young players measured in this study.

The type of jump that has been used in the Maximal Counter Movement Jump test resembles the kind of jump that players use in a real game when heading, and that is why we have to pay special attention to these results. The best results in this test have been achieved by midfielders and the worst by forwards. Results of the Continuous Jumps with Straight Legs test, where defenders have the highest values, can be explained by the differences in tactical roles in the game[1].

Correlations between the explosive strength variables were determined between almost all the variables and these results are in accordance with Wisloff's study[23]. Wisloff[23] has shown that there was a strong correlation between maximal strength in half squats, sprint performance and jumping height. In accordance with this study, it should be mentioned that all the players were very young and their sports careers have not reached their peak, so their nominal team positions may change during their soccer careers.

Conclusion

In conclusion, this analysis has shown that there are no significant differences between the players in power performance, although midfielders have achieved the best results in sprint tests. Because the players were very young and their sports careers have not reached their tops, their nominal team positions will probably change during their soccer careers. Significant differences existed between forward, midfield and defending players in 10 anthropometric variables and defenders were always those who differ from the other positions. In addition, this study has shown that almost all the variables were linearly related which indicates that the tests which were made were very good indicators for measuring power performance.

Studies like this can produce a lot of useful information and help to diagnose and improve the performance of young athletes. In the future, it would be beneficial if a large number of athletes were tested in a wide range of performances.

REFERENCES

1.MATKOVIĆ BR, MIŠIGOJ-DURAKOVIĆ M, MATKOVIĆ B, JANKOVIĆ S, RUŽIĆ L, LEKO G, KONDRIĆ M, Coll Antropol, 27 (2003) 167. — 2. WHITE JE, EMERGY TM, KANE JL, GROVES R, RISMAN AB, Pre-season fitness profiles of professional soccer players. In: REILLY T, LEES A, DAVIDS K, MURPHY WJ (Eds) Science and football (E & FN Spon, London, 1988). — 3. TUMILTY D, Sports Medicine, 16 (1993) 80. — 4. GISSIS I, PAPADOPOULOS C, KALAPOTHARAKOS VI, SOTIROPOULOS A, KOMSIS G, MANOLOPOULOS E, Res Sports Med, 14 (2006) 205. — 5. STRØYER J, HANSEN L, KLAUSEN K, Med Sci Sports Exerc, 36 (2004) 168. — 6. CRONIN JB, HANSEN KT, J Strength Cond Res, 19 (2005) 349. — 7. SPORIŠ G, JUKIĆ I, MILANOVIĆ L, VUČETIĆ V, J Strength Cond Res, 24 (2010) 679. — 8. SPORIŠ G, JUKIĆ I, OSTOJIĆ SM, MILANOVIĆ D, J Strength Cond Res, 23 (2009) 1947. — 9. SPORIS G, VUCETIC V, JUKIC I, JOVANOVIĆ M, OMRČEN D, J Strength Cond Res, 25 (2010) 1168. — 10. SPORIŠ G, VULETA D, DINKO JR, MILANOVIĆ D, Coll Antropol, 34 (2010) 1009. — 11. PELIN C, KURKCUOGLU A, OZENER B, YAZICI AC, Coll Antropol, 33 (2009) 1057. — 12. BLOOMFIELD J, POLMAN RCJ, BUTTERLY R, O'DONOGHUE PG, J Sports Med Phys Fitness, 45 (2005) 58. — 13. DI SALVO V, PIGOZZI F, J Sports Med Phys Fitness, 38 (1998) 294. — 14. BANGSBO JJ, Sports Sci, 12S5 (1994) 12. — 15. BLOOMFIELD J, POLMAN RCJ, O'DONOGHUE PG, International J Perfom Analysis Sport, 4 (2004) 20. — 16. BANGSBO J, Acta Physiol Scand, 619 (1994) 1. — 17. BLOOMFIELD J, POLMAN RCJ, BUTTERLY R, O'DONOGHUE PG, J Sports Med Phys Fitness, 45 (2005) 58. — 18. BANGSBO J, NØRREGAARD L, THORSØ F, Can J Sport Sci, 16 (1991) 110. — 19. STRØYER J, HANSEN L, KLAUSEN K, Med Sci Sports Exerc, 36 (2004) 168. — 20. GIL SM, GIL J, RUIZ F, IRAZUSTA A, IRAZUSTA J, J Strength Cond Res 21 (2007) 438. — 21. REILLY T, BANGSBO J, FRANKS A, J Sport Sci, (2000) 669. — 22. BALDARI C, DI LUIGI L, EMERENZIANI GP, GALLOTTA MC, SGRÒ P, GUIDETTI L, Br J Sports Med, 43 (2009) 191. — 23. WISLØFF U, CASTAGNA C, HELGERUD J, JONES R, HOFF J, Br J Sports Med, 38 (2004) 285. — 24. SPORIŠ G, Influence Of Situational Polystructural Complex Training On Morphological, Motor, Situational – Motor And Physiological Characteristics, PhD Thesis, In Croat (University of Zagreb, Zagreb, 2007).

G. Sporiš

University of Zagreb, Faculty of Kinesiology, Horvaćanski zavoj 15, 10 000 Zagreb, Croatia
e-mail: g.sporis@kif.hr

POSTOJE LI RAZLIKE U EKSPLOZIVNIM I MORFOLOŠKIM KARAKTERISTIKAMA MLADIH HRVATSKIH NOGOMETAŠA U ODNOSU NA IGRAČKE POZICIJE?

S A Ž E T A K

Cilj ovoga rada je utvrditi razlike u eksplozivnim i morfološkim karakteristikama mladih hrvatskih nogometaša u odnosu na njihovu igračku poziciju i utvrditi povezanost između eksplozivnih karakteristika. Istraživanje je provedeno na uzorku od 45 nogometaša (14–15 godina) u skladu s njihovim igračkim pozicijama (obrambeni i vezni igrači i napadači). Na temelju dobivenih rezultata analizirane su morfološke karakteristike, skakačke i sprinterske sposobnosti. Rezultati su analizirani primjenom standardnih deskriptivnih parametara, a razlike između grupa su procijenjene ANOVOM (Univarijatna analiza varijance). Parsonov koeficijen korelacije je korišten za utvrđivanje povezanosti između eksplozivnih karakteristika. Dobiveni rezultati su pokazali kako nema statistički značajnih razlika u eksplozivnim karakteristikama u odnosu na igračke pozicije. Samo su utvrđene statistički značajne razlike u nekim morfološkim karakteristikama kao što su visina i težina, te je utvrđena linearna povezanost između skoro svih eksplozivnih karakteristika. S obzirom na dob igrača u ovome istraživanju može se zaključiti da ispitanici nisu dosegnuli vrhunac svojih sposobnosti. Stoga se mogu dogoditi određene promjene igračkih pozicija u daljnjem nastavku karijere.