INTER-POSITIONAL DIFFERENCES IN SOMATOTYPE AMONG YOUNG SOCCER PLAYERS

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SUMMARY

Introduction: The aim of this study was to determine if there were significant differences in somatotype components among young soccer players according to player position.

Methods: The study was carried out on a sample of 147 young Croatian soccer players, of mean chronological age of 14.25 years, mean body height of 167.92 cm and body mass of 56.65 kg.

The participants were divided into 4 groups according to player position: *goalkeepers*, *defenders*, *midfielders* and *forwards*. According to age category, young soccer players were divided into 3 groups: *young pioneers (U-13)*, *pioneers (U-15)* and *cadets (U-17).*

Ten measures of anthropometric characteristics were used based on which the *Body Mass Index* and *Somatotype* according to the Heath-Carter method were then calculated. By univariate analysis of variance (ANOVA) the differences between somatotypes, morphological characteristics and Body mass indices according to player positions in different age categories of young soccer players were calculated.Data analysis was done by *Somatotype 1.2.5.* and *Statistica Ver.11.00*. computer programmes.

Results: The obtained results show that in these age categories there were no significant differences in somatotype according to the criterion of player role. Also, there were significant differences in *body height* and *body mass* variables between the *goalkeeper* position and other positions, as well as in the *elbow diameter* variable.

Conclusion: The set hypothesis about the lack of significant differences in somatotype between player positions among young soccer players is fully accepted.

In future studies it would be desirable to expand the sample by including soccer players from other Croatian regions and to divide young players according to the criterion of efficacy. In this way correlation between body build and situational efficacy of young soccer players at competitions could be determined.

Keywords: anthropometry, body build, BMI, soccer, ANOVA.

INTRODUCTION

Today, soccer is considered one of the most developed, most visited and most popular sports games in the world. From a simple and attractive game soccer has become “the most important secondary thing in the world” in a very short time period. Soccer is played on almost every court surface (grass, clay, asphalt, concrete, parquet, sand), open or closed (Dujmović, 2000).

To achieve top results in sport, one must be familiar with scientific knowledge about the characteristics of the sport and the influence of certain factors on success in that sport. Scientific approach includes systematic and successive monitoring and testing of athlete’s overall anthropological status through all stages of his sports career. The most frequently tested components of anthropological status are athlete’s motor-functional abilities and morphological characteristics. This is due to the fact that measuring instruments for assessing those characteristics have satisfactory metric characteristics, so the obtained results are exact and interpretable, and are of great importance for success in almost every sport (Krstulović, 2006).

Somatotype is a convenient shorthand descriptor of overall physique in terms of body shape and composition independent of body size. Somatotyping is one of the most frequently used techniques for analysing body build. Because of its uniqueness, somatotyping has been used to study many aspects

of exercise, sports sciences and human biology, which may be important in identifying talented young athletes for particular sports (Carter, Ackland, Kerr and Stapff, 2005).

The application of new Somatotype Ver.1.2.5. software package according to Carter & Goulding (2010) has caused investigations on somatotype of different athletes and populations to evoke greater interest and become more attractive to many scientists because the programme uses certain age and gender coefficients in addition to basic morphological measures necessary for somatotype calculation (Milić, Grgantov and Katić, 2012).

Results of previous studies (Janssens, Renterghem and Vrijens, 2002; Matković et al. 2003; Gil, J. Gil, Ruiz, Irazusta, and Irazusta, 2010; Lago-Penas, Casais, Dellal, Rey, and Dominguez, 2011; Polat et al., 2011; Russell and Tooley, 2011) show that goalkeepers are generally the tallest and have the highest body mass value, skinfold values and body fat percentage. Wide midfielders were the shortest and had the lowest body mass. In soccer players mostly the mesomorphic type of somatotype has been established, and in relation to the general population, the soccer players are taller and have greater body mass. The basic problem of investigating inter-positional differences is including a larger number of participants because of the division into 3-5 smaller subsamples according to player positions, which would represent a homogenous sample.

The main aim of this study was to determine if there were significant differences in somatotype components among young soccer players according to player position.

METHODS

Sample of examinees

The study was carried out on a sample of 147 young Croatian soccer players of mean chronological age (MCA) of 14.25 years, mean body height of 167.92 cm and body mass of 56.65 kg.

The participants were divided into 4 groups according to player position: goalkeepers (N=14), defenders (N=46), midfielders (N=44) and forwards (N=43).

According to age category, young soccer players were divided into 3 groups: U-13 - young pioneers (N=51, MCA=12,32 years), U-15 - pioneers (N=52, MCA=14,30 years) and U-17 - cadets (N=44, MCA=16,30 years).

Sample of measuring instruments

Ten anthropometric characteristics were measured: body height, body mass, triceps skinfold, back skinfold, abdominal skinfold, calf skinfold, upper arm circumference flexed, calf circumference, elbow diameter and knee diameter. From these characteristics, the following values were then calculated: *Body mass index* (BMI) by dividing body mass (kg) and body height squared (m^2), and *somatotype* according to the Heath-Carter method (Carter & Goulding, 2010). The measurements were made according to the ISAK protocol (Stewart, 2011) on the dominant side of the body, as was originally suggested by the original description of using the Heath-Carter method of somatotype calculation (Heath and Carter, 1967; Carter and Heath, 1990).

The measurements were taken twice, and mean value was taken as the final result.

The exception was made in case of possible great variability in skinfolds and the necessity of taking a third measurement.

Statistical procedures

Methods of data analysis included calculation of descriptive statistical indicators of ten morphological measures: mean (M) and standard deviation (SD).

By univariate analysis of variance (ANOVA) it was determined if there were significant differences between somatotypes, morphological characteristics and Body mass index according to player position in different age categories among young soccer players.

Data analysis was done by *Somatotype 1.2.5.* and *Statistica Ver.11.00.* computer programmes.

RESULTS

The results of one-way analysis of variance (ANOVA) of morphological characteristics, *Body mass indices* and *somatotype components* (*endomorphic*, *mesomorphic* and *ectomorphic*

component) according to player position among young pioneers (N=51) are presented in Table 1.

Table 1 Differences of morphological characteristics, *Body mass indices* and *somatotypes* according to player position among U-13 (N=51)

	Goalkeepers (N=4)		Defenders (N=17)		Midfielder (N=19)		Forwards (N=11)		
Variables	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Body height	165.80	5.32	154.14	7.95	150.87	7.02	151.40	6.38	5.17*
Body mass	50.88	5.02	45.72	7.43	41.00	6.68	40.70	5.44	3.83*
Upper arm circumference flexed	25.25	1.29	24.07	2.82	22.75	2.28	22.80	1.17	2.19
Calf circumference	27.66	10.83	32.15	3.06	29.88	4.03	30.84	2.09	1.60
Elbow diameter	6.14	0.21	5.91	0.50	5.82	0.43	5.90	0.35	0.61
Knee diameter	9.53	0.17	9.13	0.46	8.96	0.57	8.82	0.38	2.43
Triceps skinfold	10.68	4.47	10.97	4.67	9.71	3.61	8.86	1.85	0.78
Back skinfold	7.90	4.04	8.00	3.38	7.73	3.69	6.00	0.84	0.99
Abdominal skinfold	9.85	5.80	8.06	3.78	6.44	3.38	5.69	1.62	2.11
Calf skinfold	12.75	3.91	12.77	4.65	10.88	4.54	9.40	2.43	1.68
Body mass index	18.43	2.06	19.09	2.07	17.94	2.04	17.64	1.30	1.63
Endomorphic component	2.90	1.54	2.95	1.22	2.66	1.19	2.26	0.44	0.91
Mesomorphic component	3.53	0.81	4.16	1.16	3.94	0.88	3.96	0.49	0.55
Ectomorphic component	4.23	1.30	3.08	1.18	3.54	1.01	3.69	0.81	1.64

LEGEND: mean (**M**), standard deviation (**SD**), coefficient of F-test (**F**), significant difference at the level of p≤0.05 (*****)

By analysing the results from Table 1 it can be noticed that the goalkeepers in the U-13 category had significantly the highest values of body height and body mass, and the midfielders were the shortest, whereas the forwards had the lowest body mass. The defenders had the highest and the forwards had the lowest values of BMI.

Mean values of somatotype components showed no significant differences between player positions among U-13 and indicate that the goalkeepers fit the mesomorphic ectomorph somatotype category, whereas all other player positions displayed mean somatotype of ectomorphic mesomorph.

The results of one-way analysis of variance (ANOVA) of morphological characteristics, *Body mass indices* and *somatotype components* (*endomorphic, mesomorphic* and *ectomorphic component*) according to player position among U-15 (N=52) are presented in Table 2.

By analysing the results from Table 2 it can be seen that the goalkeepers in the U-15 category had significantly the highest values of body height and body mass, whereas the forwards were the shortest and had the lowest body mass. The forwards also had the lowest values of BMI, whereas the goalkeepers and the defenders had the highest values of BMI.

Mean values of somatotype components showed no significant differences between player positions in the U-15 category and indicate that the goalkeepers fit the ectomorphic mesomorph somatotype category, the midfielders fit the ectomorph-mesomorph category, whereas the defenders and the forwards displayed mean somatotype of mesomorph-ectomorph.

The results of one-way analysis of variance (ANOVA) of morphological characteristics, *Body mass indices* and *somatotype components* (*endomorphic*, *mesomorphic* and *ectomorphic component*) according to player position among cadets (N=44) are presented in Table 3.

Table 2 Differences of morphological characteristics, Body mass indices and somatotypes according to player position among U-15 (N=52)

	Goalkeepers (N=4)		Defenders (N=16)		Midfielders (N=11)		Forwards (N=21)		
Variables	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Body height	176.47	8.01	169.43	8.80	169.21	7.08	168.65	9.91	2.67*
Body mass	64.03	8.66	59.13	11.48	56.09	7.33	55.82	10.53	2.27*
Upper arm circumference flexed	27.08	2.06	27.75	3.50	26.29	2.03	26.39	2.58	0.92
Calf circumference	34.78	3.08	35.83	3.01	34.74	2.20	33.93	2.69	1.46
Elbow diameter	6.46	0.38	6.74	0.57	6.58	0.33	6.52	0.47	0.79
Knee diameter	9.74	0.44	9.81	0.56	9.52	0.29	9.54	0.51	1.24
Triceps skinfold	10.49	4.74	10.09	4.57	9.01	1.72	8.73	2.09	0.75
Back skinfold	8.63	3.09	8.45	2.50	7.46	1.36	7.12	1.57	1.69
Abdominal skinfold	7.35	1.27	7.85	3.13	6.49	1.66	6.92	2.44	0.75
Calf skinfold	11.45	3.72	11.31	4.40	10.09	3.08	9.98	3.75	0.49
Body mass index	20.43	1.20	20.42	2.73	19.50	2.02	19.43	1.96	0.79
Endomorphic component	2.68	1.04	2.52	1.00	2.29	0.49	2.25	0.51	0.68
Mesomorphic component	4.00	0.51	3.69	1.16	3.91	1.03	3.83	0.82	0.17
Ectomorphic component	3.33	0.33	3.87	1.17	3.85	1.21	3.86	0.83	0.35

LEGEND: mean (**M**), standard deviation (**SD**), coefficient of F-test (**F**), significant difference at the level of p≤0.05 (*****)

Table 3 Differences of morphological characteristics, Body mass indices and somatotypes according to player position among U-17 (N=44)

	Goalkeepers (N=6)		Defenders (N=14)		Midfielders (N=14)		Forwards (N=10)		
Variables	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Body height	185.13	5.69	181.24	5.13	181.07	4.36	176.48	6.61	3.51*
Body mass	75.75	8.99	68.96	5.17	68.13	9.14	67.50	5.12	1.95
Upper arm circumference flexed	31.41	2.86	29.78	1.87	29.33	2.26	29.08	1.02	1.92
Calf circumference	38.41	2.23	36.29	1.03	36.60	1.90	36.51	1.66	2.46
Elbow diameter	7.28	0.37	6.81	0.31	6.94	0.29	6.70	0.19	5.49*
Knee diameter	10.13	0.27	9.79	0.42	9.71	0.54	9.82	0.42	1.21
Triceps skinfold	8.98	2.79	8.76	2.16	9.04	4.97	9.95	3.43	0.22
Back skinfold	8.79	1.83	8.99	1.36	9.08	3.44	9.28	1.57	0.06
Abdominal skinfold	8.21	2.22	6.97	1.94	8.52	6.16	9.08	4.31	0.54
Calf skinfold	10.47	2.69	8.42	2.19	10.02	4.26	9.74	2.93	0.85
Body mass index	22.13	2.53	20.96	1.21	20.70	2.11	21.68	0.87	1.36
Endomorphic component	2.37	0.68	2.31	0.44	2.42	1.28	2.73	0.88	0.45
Mesomorphic component	4.33	1.44	3.62	0.78	3.64	0.76	4.05	0.69	1.39
Ectomorphic component	3.52	1.31	3.79	0.76	3.95	0.90	3.15	0.64	1.81

LEGEND: mean (**M**), standard deviation (**SD**), coefficient of F-test (**F**), significant difference at the level of p≤0.05 (*****).

By analysing the results from Table 3 it can be seen that the goalkeepers in the U-17 category had significantly the highest values of body height and elbow diameter. Values of body mass and knee diameter were also the highest among the goalkeepers, but with no significant inter-positional difference. The forwards were the shortest and had the lowest body mass in this category as well. The midfielders had the lowest values of BMI, whereas the goalkeepers showed the highest values.

Mean values of somatotype components showed no significant differences between player positions

in the U-17 category and indicate that the goalkeepers and the forwards fit the ectomorphic mesomorph somatotype category, whereas players in other positions, the defenders and the midfielders, fit the mesomorph-ectomorph mean somatotype.

Frequencies and relative values of somatotype categories according to age groups are presented in table 4.

Table 4 Frequency and percentage of somatotype categories among young soccer players (N=147)

	U-13 (N=51)		U-15 (N=52)		U-17 (N=44)	
Somatotype category	N	%	N	%	N	%
Endomorph- ectomorph	3	5.88	-	-	1	2.27
Balanced endomorph	1	1.96	-	-	-	-
Mesomorphic endomorph	8	15.69	4	7.69	3	6.82
Mesomorph - endomorph	5	9.80	5	9.62	3	6.82
Endomorphic mesomorph	5	9.80	5	9.62	9	20.45
Balanced mesomorph	3	5.88	4	7.69	6	13.64
Ectomorphic mesomorph	11	21.57	15	28.85	11	25.00
Mesomorphic ectomorph	10	19.61	16	30.77	6	13.64
Balanced ectomorph	-	-	1	1.92	1	2.27
Central	5	9.80	2	3.85	4	9.09

LEGEND: frequency of participants (**N**), relative values (**%**).

In the U-13 category, out of the 13 somatotype categories, 9 categories were recorded. The majority of young soccer players in this age group fit the ectomorphic mesomorph and mesomorphic ectomorph somatotype category with the overall percentage of 42%. At the same time, 16% of U-13 fit the mesomorphic endomorph category.

In the U-15 category, there were 8 different somatotype categories, only two of which, the mesomorphic ectomorph and the ectomorphic mesomorph, exceeded 59% or the total of 31 participants.

U-17 also defined 9 somatotype categories. The ectomorphic mesomorph had the highest percentage as it included 11 participants or 25%, followed by the endomorphic mesomorph with 20.54% or 9 young soccer players. The balanced mesomorph and the mesomorphic ectomorph categories fit around 27% of the total percentage in the age group of cadets.

The somatoplot of the overall sample of young soccer players (N=147) is presented in Figure 1.

DISCUSSION

The main aim of the study was to determine if there were significant differences in somatotype components among young soccer players according to player position. The study showed that there were no significant differences between young soccer players at different player positions, which is congruent with previous findings (Janssens et al.,2002; Sporiš, Čanaki and Barišić, 2007; Russell and Tooley, 2011; Salgado et al.,2009; Rogan, Hilfiker, Clarys, Clijsen and Taeymansa, 2011; Cossio-Bollanoso, Portella, Hespanhol, Fraserr and de Arruda, 2012; Orahn, Sagir and Zorba, 2013).

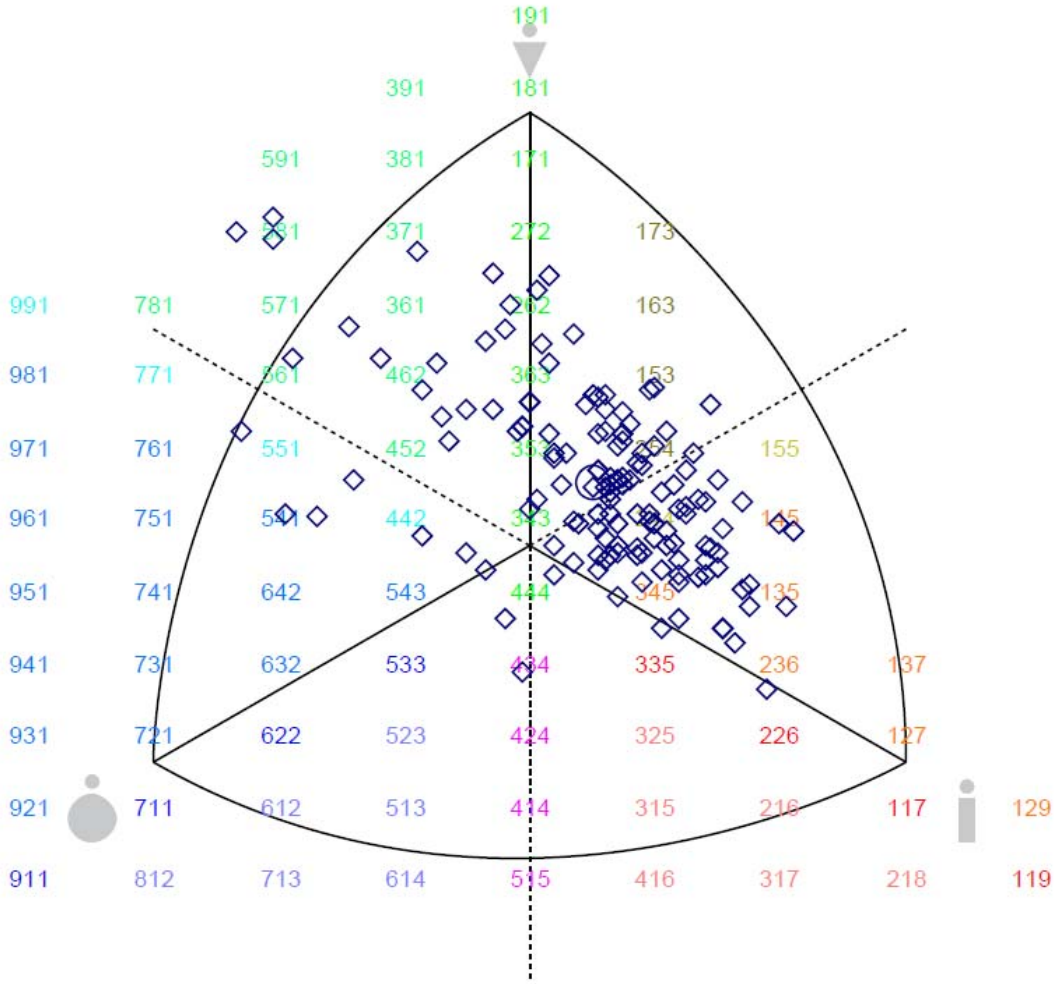

Figure 1 Somatoplot of the overall sample of young soccer players (N=147)

The soccer players that were measured were averagely 3 cm shorter and had 6.5 kg lower body mass than the participants in a study carried out by Russel and Tooley (2011) in which 43 young soccer players of mean age of 15±2 years were tested. Given that the participants in the current study were somewhat chronologically younger, these differences were expected. The same conclusion can be drawn by comparing the current study with a study carried out by Polat et al. (2011) in which soccer player at the age of 16 had mean body height of 174.38 cm and body mass of 57 kg. The mean values of somatotype components indicate that all age groups fit the ectomorph-mesomorph somatotype category (U-13 2.69-3.99-3.47; U-15 2.37-3.82-3.82; U-17 2.45-3.82-3.66), whereas in a study carried out by Gil et al. (2010) on soccer players of mean age of 16.48±2.63 years, the mesomorph component was prevalent in all age groups, with the exception of fourteen-year-olds who were mostly ectomorphic.

Dominance of two somatotype categories, balanced mesomorph and ectomorphic type, was determined in a study carried out by Martirovsov, Skomorokhov, Farmochi and Varga (1987) on 254 young soccer players. In a study carried out by Salgada et al. (2009), dominance of the mesomorphic component was also determined among young soccer players aged 17 to 18 years.

In studies among senior soccer players (Janssens et al., 2002; Castanhede, Filho and Dantas, 2003; Hazir, 2010; Orahn et al., 2013), the results indicated dominance of the mesomorphic component, with the emphasised somatotype component of balanced mesomorph.

All the aforementioned studies that were carried out on young soccer players and senior soccer

players indicated the prevalence of the mesomorphic component, whereas in the current study, besides the mesomorphic component, the ectomorphic component stood out as well. It can be assumed that the reason for this was the participants' younger chronological age in the current study. Namely, a study carried out by Nikolaidis and Vassilios Karydis (2011), investigating body composition of young soccer players through adolescence (from 12.01 to 20.98 years), showed that somatotype components change during adolescence so that the endomorphic and ectomorphic component are decreased, while the mesomorphic component is increased.

Significant differences in morphological characteristics, body mass index and somatotype according to player position among U-13 and U-15 were found only in morphological variables of body height (p=0.00; p=0.05) and body mass (p=0.02; p=0.05). Among U-17, significant difference was found only in the body height variable (p=0.02) and the elbow diameter variable (p=0.00). Among U-13 and U-15, the goalkeepers were significantly different from the other three positions by being taller and having higher body mass. Among U-17, the goalkeepers were also taller and significantly different from the other three positions in the elbow diameter variable. The results of previous studies on young soccer players (Gil, S. M., Gil, J., Ruiz, Irazusta, A. and Irazusta, J., 2007; Lago-Penas et al., 2011) are congruent with those results. In studies carried out among senior soccer players, it was also determined that goalkeepers were significantly taller and had higher body mass than their teammates playing other positions (Bloomfield, Polman, Butterly and O'Donoghue, 2005; Hazir, 2010).

Therefore, it can be concluded that many young soccer players were selected for the goalkeeper position at the very beginning of their training because of their dominant height in comparison to their teammates.

CONCLUSION

The set hypothesis about the lack of significant differences in somatotype between player positions among young soccer players is fully accepted. In future studies it would be desirable to expand the sample by including soccer players from other Croatian regions and to divide young players according to the criterion of efficacy. In this way correlation between body build and situational efficacy of young soccer players at competitions could be determined.

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