



## MORPHOLOGICAL DIFFERENCES OF ELITE CROATIAN FEMALE SOCCER PLAYERS ACCORDING TO TEAM POSITION

### RAZLIKE U MORFOLOŠKIM KARAKTERISTIKAMA IZMEĐU VRHUNSKIH HRVATSKIH NOGOMETAŠICA S OBZIROM NA IGRAČKU POZICIJU

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#### SUMMARY

The research regarding the influence of morphological characteristics on soccer performance is particularly complex because the success in soccer in part depends upon the individual characteristics and team position of every player. It is necessary to have knowledge of these characteristics in order to establish their importance as key factors of success in competitive sports such as soccer. This is one reason why the authors decided to determine the morphological differences of elite Croatian female soccer players according to their respective team positions, a logical extension of an earlier article focusing on male soccer players. The sample consisted of soccer players who were current members of first league clubs in Croatia (n=24) and who were tested at the end of the 2005/06 competition season (prior to the European championship). According to the instructions issued by the International Biological Program, the following anthropometrical variables were measured: body height, body mass, leg length, arm length, biacromial and bicristal diameters, knee and elbow diameters, upper arm girth, forearm girth, thigh girth and calf girth. The body fat percentage and relative body fat mass in female soccer players were determined using the Sloan and Siri equations. The differences in team position (goalkeepers, defenders, forwards and midfielders) were analyzed using a multivariate analysis of variance (MANOVA). The statistical significance was set at  $p < 0.05$ . The goalkeepers proved to be the tallest and the heaviest players on the team, with longest legs and arms, and the largest thigh girth. The MANOVA revealed no statistically significant differences in any of the selected parameters among female soccer players according to their team positions. An analysis of the female soccer players' team positions demonstrated no significant differences in morphological variables. The players' values (average height and body mass) fell within the range of normal values recorded in the general population and other elite European female soccer players. Therefore, we can conclude that Croatian female soccer players are morphologically similar to their counterparts on other elite European soccer teams. These findings are useful because a consideration of morphological characteristics is important in the selection of players, especially goalkeepers, for team positions.

*Keywords:* soccer, morphological characteristics, team position

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#### SAŽETAK

Istraživanja morfoloških karakteristika u nogometu osobito su složena, jer uspjeh u nogometu ovisi o individualnim karakteristikama igrača i specifičnostima pozicije na kojoj igraju. Spoznaje o navedenim morfološkim karakteristikama važne su u kompleksnim sportskim igrama kao što je nogomet. Ovaj rad logičan je nastavak prethodnog istraživanja provedenog na vrhunskim hrvatskim nogometašima. Uzorak ispitanika sačinjen je od nogometašica Prve hrvatske ženske nogometne lige (n=24). Nogometašice su testirane na kraju natjecateljske sezone 2005/06 (neposredno prije kvalifikacija za Europsko prvenstvo). Mjerenje morfoloških mjera izvršeno je prema napucima Međunarodnog Biološkog Programa. Za potrebe ovog istraživanja izmjereno je 14 morfoloških mjera: visina tijela, tjelesna masa, dužina noge, dužina ruke, širina ramena i kukova, dijametar lakti i koljena, opseg nadlaktice, opseg podlaktice, te opseg natkoljenice i potkoljenice. Postotak potkožnog masnog tkiva i relativna masa potkožnog masnog tkiva kod nogometašica određene su jednadžbama Sloan-a i Siri-ja. Razlike u morfološkim karakteristikama s obzirom na igračku poziciju (vratari, obrambeni igrači, napadači i vezni igrači) analizirani su Multivarijantnom analizom varijance MANOV-om, s statističkom značajnošću od  $p < 0.05$ .

U skladu s njihovim građom tijela utvrđeno je da su igračice na голу više i teže od igračice u polju. Multivarijantna analiza varijance nije pokazala postojanje statistički značajnih razlika između igračkih pozicija nogometašica. Dobiveni rezultati nogometašica u skladu su sa rezultatima prosječne populacije (vrijednosti visine tijela i mase tijela). Rezultati vrhunskih hrvatskih nogometašica slični su rezultatima koji su dobiveni na uzorcima vrhunskih europskih nogometašica. Možemo zaključiti da su hrvatske nogometašice u morfološkim karakteristikama slične vrhunskim europskim nogometašicama. Dobiveni podaci o morfološkim karakteristikama mogu koristiti trenerima u procesu selekcije igračica za određene igračke pozicije, a posebice za igračice na голу.

*Ključne riječi:* nogomet, morfološke karakteristike, pozicije igračica

## INTRODUCTION

Soccer is the most popular team sport worldwide, with approximately 40 million amateur participants<sup>16-18</sup>. Female soccer is very popular in Nordic countries, in 1997 a total of 200,000 players were registered in Sweden, and 40,000 (20%) of them were women, making female soccer the second largest sport in the country. The popularity of soccer continues to increase worldwide. In the last 10 years, the number of females participating in soccer has also risen among collegiate institutions in the United States<sup>19</sup>. But, in general, a female athlete remains less well-understood and less well-studied than male athletes. The logical reasons for this include: (a) limited two-generation span of the high-profile elite female; (b) fewer females involved in coaching, research, and sport medicine; and (c) limited areas of female youth sports historically (gymnastics, swimming, dance). Notwithstanding these reasons, science is in need of articles with female athletes. A significant amount of information has been obtained about the physical capacity of elite female soccer players<sup>9,18,29,33-35</sup>. These studies have shown that the aerobic power, sprinting ability, and intermittent exercise performance vary significantly between the levels of competition<sup>34</sup> and the playing position<sup>9,18,29,35</sup> but also between players at the same playing position and playing standard<sup>9</sup>. The authors have come across a small number of articles dealing with morphological differences among female athletes<sup>22,24,30,31</sup>, whereas numerous articles deal with the morphological characteristics of male athletes<sup>7-8, 12-13, 23,32</sup>. The knowledge of these characteristics is necessary to establish their importance for the success in competitive sports such as soccer.

The research on the influence of these characteristics in soccer is of particular complexity, because the success in soccer depends, among other things, on individual characteristics of players and their team position. Goalkeepers are the heaviest players; they also have the higher % fat, and are the tallest players in the team. On the other hand, forwards are the lightest and have the lowest % fat. Midfielders are the shortest players in the team<sup>13</sup>. Goalkeepers and defenders are taller and heavier than midfielders, wings and forwards<sup>8</sup>. This is one of the reasons why the authors have decided to determine the morphological differences of elite Croatian female soccer players according to their team position, which is a logical extension of the earlier articles done on male soccer players<sup>22</sup>.

## MATERIALS AND METHODS

The sample was comprised of soccer players who were members of a few first league clubs in Croatian (n=24), and who were tested at the end of 2005/06 competitive season (before the European Championship classification). The subjects were the following: 3 goalkeepers, 5 forwards, 12 midfield players and 5 defenders, all of the average age  $18.13 \pm 0.85$  years with an

average playing experience of  $10.12 \pm 2.44$  years.

All the players had more than 3 years of experience in the best Croatian league and were regular first-team members. The players were fully-informed of all the experimental procedures before giving their written informed consent to participate. The study was approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb, Croatia.

The percentage of body fat and relative body fat mass in female soccer players was determined from Sloan and Siri equations. According to the instructions of the International Biological Program<sup>24</sup>, the following anthropometrical variables were measured: body height, body mass, length of the legs, length of the arms, biacromial and bicristal diameters, knee and elbow diameters, upper arm girth, forearm girth, thigh girth and calf girth. The statistical Package for Social Sciences SPSS (v11.5, SPSS Inc., Chicago, IL) was used for the statistical analysis. The descriptive statistics mean (X), standard deviation (SD) and the minimal and maximal values (Min., Max.) were calculated for all the experimental data. The Kolmogorov-Smirnov test was used to test if the data are normally distributed. The differences between the team positions (goalkeepers, defenders, forward and midfielders) were analyzed by MANOVA. The statistical significant was set at  $p < 0.05$ .

## RESULTS

The average values presented in Table 1 indicate the average age of the female soccer players, 18.1 years, and the average playing experience, 10.1 years (Table 1).

Table 1. Average age and playing experience of soccer players

Tablica 1. Prosječna starost igračica i igrački staž

	<i>X</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
Age (years)	18.1	0.85	17	19
Playing experience (years)	10.1	2.44	9	13

The goalkeepers were the oldest and with longest playing experience, whereas the forwards were the youngest (Table 2).

Table 2. Average age and playing experience according to the team position

Tablica 2. Prosječna starost igračica i igračkog iskustva prema pozicijama u igri

	<i>Goalkeepers</i>	<i>Forward</i>	<i>Midfield</i>	<i>Defender</i>
Age (years)	19.1	17.4	18.3	18.5
Playing experience (years)	11.2	10.2	9.8	10.5

The average values presented in Table 3 indicate the parameters in the morphological characteristics.

Table 3. Descriptive statistics of morphological characteristics of soccer players  
 Tablica 3. Deskriptivni parametri morfoloških karakteristika nogometašica

	<i>X</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
Body mass (kg)	58.6	9.0	44.0	81.7
Body height	165.6	5.8	155.6	180.0
Fat tissue (%)	13.6	4.2	8.2	26.1
Lean body mass (kg)	48.9	5.2	40.0	60.0
Leg length (cm)	93.9	4.5	84.9	103.9
Arm length (cm)	71.3	2.8	66.5	77.6
Biacromial diameter (cm)	36.2	2.5	26.9	40.4
Bicristal diameter (cm)	25.7	36.6	28.3	2.1
Elbow diameter (cm)	6.1	1.2	4.9	6.7
Knee diameter (cm)	8.9	.3	8.3	9.8
Upper arm girth (cm)	15.0	3.6	10.0	24.3
Forearm girth (cm)	6.7	1.8	4.4	11.3
Thigh girth (cm)	24.8	5.9	14.7	35.0
Calf girth (cm)	13.5	3.6	9.0	24.2

In Table 4 the presented average values indicate the differences in morphological characteristics according to the team position.

Table 4. Average values of morphological characteristics in soccer players according to the there position in the team  
 Tablica 4. Prosječne vrijednosti morfoloških karakteristika nogometašica prema pozicijama u igri

	<i>Goalkeeper</i>	<i>Forward</i>	<i>Midfield</i>	<i>Defender</i>
Body mass (kg)	64.4	63.6	56.0	56.3
Body height	172.5	165.0	164.0	165.8
Fat tissue (%)	13.7	14.3	12.6	16.8
Lean body mass (kg)	47.6	50.6	48.3	51.7
Leg length (cm)	100.1	93.2	92.6	93.8
Arm length (cm)	74.6	71.4	70.7	70.6
Biacromial diameter (cm)	38.9	37.0	35.1	36.4
Bicristal diameter (cm)	29.5	27.8	28.1	27.8
Elbow diameter (cm)	6.6	5.8	5.5	5.7
Knee diameter (cm)	9.1	9.0	8.9	8.8
Upper arm girth (cm)	28.0	27.5	25.2	25.6
Forearm girth (cm)	23.2	23.0	22.8	22.9
Thigh girth (cm)	59.0	57.0	55.5	55.1
Calf girth (cm)	34.3	35.8	35.9	35.8

The goalkeepers were the tallest and the heaviest players in the team, with longest legs, arms and thigh girth. The multivariate analysis of variance showed no

statistically significant differences in any of the selected parameters in female soccer players according to their team positions (Table 5).

Table 5. Results of multivariate analysis of variance  
 Tablica 5. Rezultati multivarijatne analize varijance

	<i>F</i>	<i>p</i>
Body mass (kg)	2.0426	0.1402
Body height	0.8746	0.4707
Fat tissue (%)	0.8347	0.4906
Lean body mass (kg)	0.5908	0.6282
Leg length (cm)	1.1341	0.3592
Arm length (cm)	2.1255	0.1290
Biacromial diameter (cm)	2.8444	0.0636
Bicristal diameter (cm)	2.6371	0.0857
Elbow diameter (cm)	2.7543	0.0976
Knee diameter (cm)	2.5371	0.0957
Upper arm girth (cm)	2.9427	0.0579
Forearm girth (cm)	2.9702	0.0564
Thigh girth (cm)	2.3799	0.1000
Calf girth (cm)	2.9231	0.0590
Wilks'	Rao	
$\lambda=0.0388$	$R=1.2506$	
$p=0.2488$		

## DISCUSSION

Similarity was noted when the results of our study were compared with the results of the previous study<sup>36</sup>. The goalkeepers were, on the average, older than the players in the field; they were also the tallest players in the team. Owing to their height the goalkeepers had larger values of body mass, longer arms and legs, and a bigger thigh girth than the forwards, midfielders and defenders (Table 4). Although they are equally important for the team as the field players, (but) they have special tasks in team (keeping the goal). They covered 4km<sup>19</sup> during a game, compared to the field female soccer players who covered on average ~10.3km<sup>19</sup> during a game, and had on average ~1400 activity changes during a game. These values are similar to or slightly lower than the values reported for the elite male soccer<sup>2-3,6,10-11</sup>. On the other hand, the average distance of 1.3 km covered by the high-intensity running amounts to nearly two thirds of the distance in elite male soccer (1.9-2.4 km)<sup>2-3</sup>. This evidence indicates that female soccer players manifest a lower amount of strength and power than the male soccer players.

Body height is one of the crucial factors in the selection process in soccer. Therefore, not only is it important when directing a player towards specific, position-related or tactical roles in the game<sup>22</sup>, it is also favorable for the goalkeepers when defending a goal.

Naturally, such a body type contributes to the self-confidence of goalkeepers when trying to cover the broad area between the goalposts<sup>22</sup>. The average values of the height and body mass of elite Croatian female soccer players are similar to the results of Danish elite female soccer players<sup>19</sup>. The average values of the knee and elbow diameter, bicristal range and biacromial range, responded to the average values recorded in normal population<sup>24</sup>. The average of thigh circumferences was greater in female soccer players compared to that of the normal population<sup>24</sup>. This is probably due to bigger muscle mass versus a smaller amount of fat. During a soccer game, every player performs several dynamic movements (headers, cuttings, tackling, sprint, kicks), which require a very high level of muscle strength<sup>1</sup>. Soccer practice suggests that a soccer player needs to develop a level of maximum strength and power, which is utilized effectively within the game<sup>5,20</sup>. We can conclude that, strength is equally important for male and female soccer players. Body composition in soccer players is also an important factor in determining their success. The average values of elite Croatian female soccer players indicate 13.7% of fat tissue, which is within the range of values determined by Mišigoj-Duraković et al. in 1996. Female soccer players have the same percentage of fat tissue as Danish female soccer players<sup>19</sup>. However, these values are lower than the values recorded in normal female population<sup>24</sup>.

The lowest values of body fat percentage and body height were found in midfielder players, which could be explained by specific tasks that midfielders have to accomplish connecting two lines of a soccer game: the defense and attack. This is also the reason why a midfielder covers a larger distance during a soccer game than a defender or a forward<sup>1,4-5,7,15,25-29,35,31-37</sup>.

## CONCLUSIONS

The morphological variables of female soccer players do not significantly differ depending on their team positions. The values of the studied female soccer players are within the range of values recorded in normal population (average height and body mass), and other elite European female soccer players. The goalkeepers are the oldest and the tallest players in the team, with the largest thigh girth. This is due to their specific role in the team (which is that of defending the goal). Thus, we can conclude that the morphological characteristics of Croatian female soccer players are quite similar to their elite European soccer colleagues'. Morphological characteristics are important in the selection process for team position, especially that of a goalkeepers. However, the importance of other motor and physiological abilities in specific team positions has not been fully investigated. Further study is required to determine how these parameters influence the selection process.

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