



SOMATOTYPE OF THE BEST RANKED CROATIAN SUPERLEAGUE FEMALE VOLLEYBALL PLAYERS: DIFFERENCES BETWEEN PLAYING ROLES

SOMATOTIP NAJBOLJE RANGIRANIH ODBOJKAŠICA HRVATSKE SUPERLIGE: RAZLIKE IGRAČKIH ULOGA

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SUMMARY

The aim of this research is to determine significant differences in somatotype of playing roles among Croatian female volleyball players who compete in the highest-ranking national competition. The sample of examinees was constituted out of female volleyball players (n=52) from four top-seeded teams that competed in the Croatian Superliga in the 2018/2019 season. The players' somatotype was assessed based on ten anthropometric measurements for the following playing roles: setter, libero, opposite, receiver and centre. The significance of the differences between the playing roles in anthropometric indicators and somatotype components was determined by using the univariate analysis of variance (ANOVA), whereas the difference between pairs of individual playing roles was established by a series of post hoc Tukey tests. Significant differences were found between playing roles in the variables body height, body weight, humerus breadth diameter, mesomorphs and ectomorphs. It was determined that opposites and centres are taller than receivers, setters and liberos, whereas receivers are taller than liberos. Regarding to body weight, opposites are heavier than setters, liberos and receivers. According to humerus breadth diameter, opposites showed higher values than liberos and setters. In view of individual components of somatotype, liberos have a significantly higher mesomorph component than centres, while centres have a significantly higher ectomorph component than all other playing roles. The average somatotype of all the female volleyball players is endomorphic ectomorph (3.1-2.4-3.6). Setters and receivers belong to the endomorph-ectomorph category (3.0-2.7-3.3, 3.3-2.7-3.5). Liberos pertain to the mesomorph-endomorph category (3.1-3.3-2.7). Opposites fall into the endomorph-ectomorph category (3.4-1.9-3.6), whereas centres are in the endomorphic ectomorph category

SAŽETAK

Cilj ovog istraživanja bio je utvrđivanje značajnih razlika u somatotipu igračkih uloga hrvatskih odbojkašica koje se natječu u najvišem rangu nacionalnog natjecanja. Uzorak ispitanika formiran je od igračica (n=52) četiri prvoplasirane ekipe koje su se natjecale u sezoni 2018/2019 u hrvatskoj Superligi. Somatotip igračica procijenjen je na temelju deset antropometrijskih mjera za sljedeće igračke uloge: dizač, libero, dijagonala, primač i srednjak. Značajnost razlika između igračkih uloga u antropometrijskim pokazateljima i komponentama somatotipa utvrđena je univarijantnom analizom varijance (ANOVA), dok je razlika između parova pojedinih igračkih uloga utvrđena serijom post hoc Tukey testova. Između igračkih uloga utvrđene značajne razlike u varijablama tjelesna visina, tjelesna težina, dijametri lakta, mesomorfiji i ektomorfiji. Utvrđeno je da su dijagonale i srednjaci viši od primača, dizača i libera, dok su primači viši od libera. Obzirom na tjelesnu težinu dijagonale su teže od dizača, libera i primača. Kod dijametra lakta dijagonale su postigle više vrijednosti od libera i dizača. U odnosu na pojedine komponente somatotipa, libera imaju značajno veću mezomorfnu komponentu od srednjaka, a srednjaci imaju značajno veću ektomorfnu komponentu od svih ostalih igračkih uloga. Prosječni somatotip svih igračica je endomorfni ektomorf (3.1-2.4-3.6). Dizači i primači pripadaju kategoriji endomorfa-ektomorfa (3.0-2.7-3.3, 3.3-2.7-3.5). Libera pripadaju kategoriji mezomorf endomorf (3.1-3.3-2.7). Dijagonale pripadaju kategoriji endomorph-ektomorf (3.4-1.9-3.6), a srednjaci kategoriji endomorfni ektomorf (3.0-1.6-4.5). U ovom istraživanju po prvi put je utvrđen somatotip ponajboljih superligaških hrvatskih odbojkašica čime se proširuje svjetska baza podataka antropometrijskih karakteristika odbojkašica, a istovremeno osigurava vrijedne podatke za implementaciju

(3.0-1.6-4.5). The somatotype of some of the elite female Croatian Superliga volleyball players was determined for the first time in this research, which thus expands the global database of anthropometric characteristics for female volleyball players, as well as simultaneously provides valuable data for production and implementation of future training programs and a higher level of quality in the selection of playing roles in Croatia.

Key words: anthropometry, somatotype, volleyball, female players, playing roles, national league

i kreiranje budućih trenažnih programa, te kvalitetniju selekciju igračkih uloga u Hrvatskoj.

Ključne riječi: antropometrija, somatotip, odbojka, odbojkašice, igračke uloge, nacionalna liga

INTRODUCTION

Somatotype incorporates several anthropometric measurements and thus more comprehensively defines body shape, unlike individual analysis of separate measurements. Galdi and Zaccagni (2001) point out that results obtained by somatotype analysis cannot entirely account for success in volleyball, yet it is necessary to also consider other physiological characteristics and specific skills of volleyball players that likewise affect the overall performance. The structure of volleyball as a game requires players to accomplish different situational tasks and tackle difficulties while performing basic elements of the game, which consequently leads to the specialization of different playing roles. In modern volleyball, there are five standard playing roles that can be singled out within each team: setter, libero, opposite, receiver and centre. In accordance with the completion of different tasks during the game, each playing role thus also requires the players to have a distinct body composition, structure and shape. Data on individual anthropometric characteristics and somatotype of playing roles in volleyball on the highest level of competition allow coaches to properly select the mentioned roles, while comparison with a top-level model facilitates determining the potential for accomplishing maximum competitive results, as well as for potentially correcting the training programs. Upon examining previous research implemented with a sample of female volleyball players in national leagues (1,4,6,8,10), a certain inconsistency in the prevalence of anthropometric characteristics and somatotype can be observed. Generally, somatotype in athletes participating in national competitions indicates deviations in relation to the central somatotype which is characteristic for Olympic athletes with top-level results, which can ultimately be attributed to the differences in the available material resources, race and ethnicity, social-economic status, as well as selection methods and training process (9). So far, a somatotype analysis of female volleyball players in the highest level of the Croatian national league has not been conducted, and accordingly, the aim of this research is to analyse and determine significant differences in somatotype

of elite Croatian highest national league female volleyball players in accordance with their playing positions.

METHODS

The research was conducted with female volleyball players ($n=52$, 20.4 ± 3.2 years of age) who played for teams ranked between 1st and 4th place in the Croatian Superliga in the 2018/2019 season, which represents the highest level of competition in Croatian volleyball, and thus the mentioned sample is composed out of the most elite female volleyball players in the national championship. Furthermore, a sub-sample was formed based on five basic playing roles in volleyball: setters ($n=8$), liberos ($n=7$), opposites ($n=7$), receivers ($n=16$) and centres ($n=14$). All players (or parents for underage players) confirmed their informed consent in writing and were thoroughly introduced with the purpose of the research.

In purpose of determining the players' somatotype according to the method of Carter and Heath (1990), ten anthropometric measurements were utilised in this research: body height, body weight, triceps skinfold, subscapular skinfold, supraspinal skinfold, calf skinfold, humerus breadth diameter, femur breadth diameter, flexed arm girth circumference and flexed calf girth circumference. The measurements were conducted according to the ISAK protocol (7). All the above-mentioned measurements were estimated on the right side of the body and implemented by an individual (kinesiologist) with years of experience in taking measurements. An anthropometer was used for the purpose of measuring body height, while a digital scale as used for body weight. Skinfolds were measured with a skinfold calliper. Diameters were measured by using a spreading caliper and sliding caliper, whereas circumference was measured with a flexible metal band. Most of the used instruments was produced by a reputable manufacturer (GPM, Switzerland) and each measurement was estimated with the appropriate calibrated precision.

Upon completing the anthropometric measurements, the collected data was processed by using the appropriate corresponding equations in Microsoft Excel. Likewise,

the endomorph, mesomorph and ectomorph somatotype components were calculated, as well as two-dimensional somatocharts of playing role somatotypes for the observed female volleyball players. Descriptive statistics for all the measured variables were calculated by using the Statistica 13.5 (TIBCO Software Inc.), whereas for determining statistically significant differences between the groups of playing roles the univariate analysis of variance (ANOVA) was implemented, as well as the Tukey test for the purpose of post hoc analysis of the differences for each individual variable.

RESULTS

Descriptive statistics results (mean±SD) for the players' morphologic variables and somatotype components, as well as the effects of the univariate analysis of variance for determining the differences between the groups of playing roles are presented in Table 1. Significant differences for playing roles were established in variables of body height (p<.001), body weight (p<.001), humerus breadth diameter (p<.05), mesomorphs (p<.02) and ectomorphs (p<.001).

Furthermore, it was determined that opposites and centres are taller than receivers, setters and liberos, while receivers are taller than liberos. Regarding to body weight, opposites are heavier than setters, liberos and receivers. According to humerus breadth diameter, opposites showed higher values than liberos and setters. In view of individual components of somatotype, liberos have a significantly higher mesomorph component than centres, while centres have a significantly higher ectomorph component than all other playing roles.

According to the results in Table 1, the average somatotype of all players is endomorphic ectomorph (3.1-2.4-3.6). Setters and receivers belong to the endomorph-ectomorph category (3.0-2.7-3.3, 3.3-2.7-3.5) with tendency towards the central category. Liberos pertain to the mesomorph-endomorph category (3.1-3.3-2.7), while also with a tendency towards the central category. Opposites fall into the endomorph-ectomorph category (3.4-1.9-3.6), whereas centres are in the endomorphic ectomorph category (3.0-1.6-4.5).

The position of average results for somatotypes of all players, as well as for each individual playing role is demonstrated on the two-dimensional somatochart (Illustration 1).

Table 1. Descriptive statistics and somatotype of best ranked female volleyball players in the Croatian Superliga according to playing roles (mean±SD)

Tabela 1. Deskriptivna statistika i somatotip najbolje rangiranih odbojkašica hrvatske Superlige obzirom na igračke uloge (mean±SD)

Variable	Total (n=52)	Setters (n=8)	Liberos (n=7)	Opposites (n=7)	Receivers (n=16)	Centres (n=14)	P
Basic							
Height (cm)	180.6±7.1	176.2±4.5 ^{cc}	170.5±4.1 ^{cdc}	186.2±4.1 ^{abd}	179.7±4.6 ^{bcc}	186.2±5.4 ^{abd}	***
Weight (kg)	69.5±6.2	66.7±3.6	64.2±4.4	76.7±4.6 ^{abd}	69.4±5.6	70.2±6.2	***
Skinfolds (mm)							
Triceps	14.9±3.5	13.4±3.8	13.6±2.8	16.6±3.1	16.0±3.8	14.5±3.3	-
Subscapular	10.2±2.8	9.7±1.9	9.6±2.5	10.7±3.2	10.6±1.8	10.2±4.0	-
Supraspinale	8.2±2.4	7.6±2.1	7.9±2.7	9.6±2.1	7.9±1.8	8.2±3.2	-
Calf	12.5±3.9	14.0±5.0	13.6±4.6	13.2±2.8	12.4±3.6	10.9±3.5	-
Diameters (cm)							
Humerus breadth	6.6±0.3	6.5±0.2	6.4±0.3	6.9±0.2 ^{ab}	6.5±0.3	6.6±0.4	*
Femur breadth	9.2±0.5	9.4±0.7	9.2±0.5	9.4±0.4	9.0±0.4	9.2±0.5	-
Circumference (cm)							
Arm girth	28.7±1.5	28.1±1.1	28.9±1.1	29.5±1.6	29.1±1.4	28.1±1.7	-
Calf girth	33.8±5.3	33.0±5.8	31.8±7.0	32.4±6.9	35.6±3.1	34.0±5.2	-
Somatotype							
Endomorphy	3.1±0.6	3.0±0.7	3.1±0.5	3.4±0.6	3.3±0.5	3.0±0.8	-
Mesomorphy	2.4±1.3	2.7±1.3	3.3±1.1 ^c	1.9±1.6	2.7±1.0	1.6±1.0	**
Ectomorphy	3.6±0.9	3.3±0.6	2.7±0.8	3.6±0.8	3.5±0.7	4.5±0.7 ^{abcd}	***

*p < .05, **p < .02, ***p < .001; in Tukey test significantly different from ^a setters, ^b liberos, ^c opposites, ^d receivers, ^e centres

*p < .05, **p < .02, ***p < .001; u Tukey testu značajna razlika u odnosu na ^a dizače, ^b libera, ^c dijagonale, ^d primače, ^e srednjake

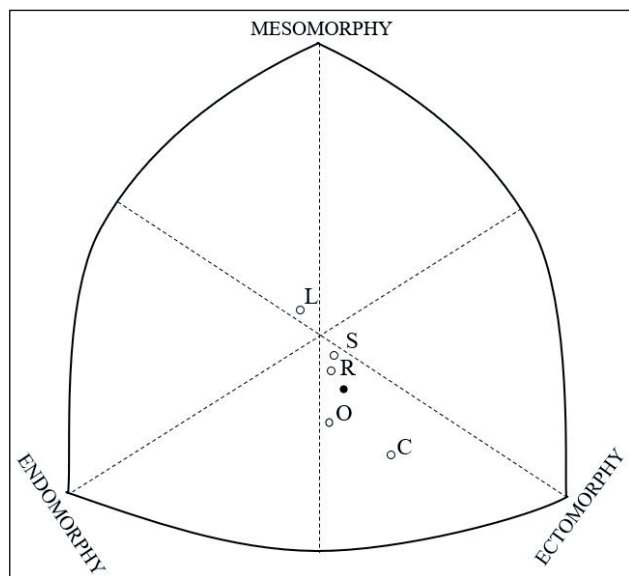


Illustration 1. Somatochart of players' somatotypes for individual playing roles (S=setters, L=liberos, O=opposites, R=receivers, C=centres, ● = total)

Prikaz 1. Somatograf somatotipa igračica za pojedinu igračku ulogu (S=dizači, L=libera, O=dijagonale, R=srednjaci, C=, ● = ukupno)

Table 2 demonstrates the distribution of different somatotype categories of elite Croatian female volleyball players in absolute and relative values. Out of the possible 13 somatotype categories, there is a total of 9 categories

recorded for all the players, while in relation to a specific playing role, 7 categories for setters, 5 for liberos, 4 for opposites, 8 for receivers and 5 for centres.

DISCUSSION AND CONCLUSION

The results of this research showed that Croatian female volleyball players from the elite national league differ in certain anthropometric characteristics and somatotype in relation to their playing role, namely in body height, body weight, humerus breadth diameter and in the mesomorph and ectomorph somatotype component. It should be noted that upon comparing body height and weight with female volleyball players in previous available studies, data was used from the research in which the sample was composed of elite players from the highest national competition rank and which included the playing role of the libero. It is notable that Croatian female volleyball players (20.4±3.2) are the youngest among all the previously observed athletes (Greece =25.7±5.1; China=22.3±3.65; Spain=24.8±4.4; Republic of North Macedonia=23.18±2.96; Portugal= data unavailable). Furthermore, elite female volleyball players in the Croatian Superliga are on average 1.0 cm taller and weigh 1.5 kg less than Greek A1 players, 3.0 cm shorter and weigh 1.0 kg less than Chinese A1 players, 0.8 cm taller and weigh 2.8 kg less than Spanish A1 players, 4.2 cm taller and weigh 0.68 kg more than North Macedonian A1 players and 4.3 cm taller and weigh 1.5 kg more than Portuguese A1 players (1,4,6,8).

Table 2. Distribution of somatotype categories for playing roles of best ranked female volleyball players in the Croatian Superliga
Tabela 2. Distribucija kategorija somatotipa igračkih uloga najbolje rangiranih odbojkašica hrvatske Superlige

Somatotype categories	Total (n=52)		Setters (n=8)		Liberos (n=7)		Opposites (n=7)		Receivers (n=16)		Centres (n=14)	
	n	%	n	%	n	%	n	%	n	%	n	%
Central	12	23,1	2	25	3	42,9	2	28,6	5	31,3	-	-
Balanced endomorph	1	1,9	-	-	-	-	-	-	1	6,3	-	-
Mesomorphic endomorph	2	3,8	1	12,5	-	-	-	-	1	6,3	-	-
Mesomorph-endomorph	2	3,8	-	-	1	14,3	1	14,3	-	-	-	-
Endomorphic mesomorph	4	7,7	1	12,5	1	14,3	-	-	2	12,5	-	-
Balanced mesomorph	1	1,9	-	-	1	14,3	-	-	-	-	-	-
Ectomorphic mesomorph	-	-	-	-	-	-	-	-	-	-	-	-
Mesomorph-ectomorph	1	1,9	1	12,5	-	-	-	-	-	-	-	-
Mesomorphic ectomorph	2	3,8	-	-	-	-	-	-	1	6,3	1	7,1
Balanced ectomorph	5	9,6	1	12,5	-	-	-	-	2	12,5	2	14,3
Endomorphic ectomorph	15	28,8	1	12,5	1	14,3	3	42,9	2	12,5	8	57,1
Endomorph-ectomorph	6	11,5	1	12,5	-	-	1	14,3	2	12,5	2	14,3
Ectomorphic endomorph	1	1,9	-	-	-	-	-	-	-	-	1	7,1

n=number of examinees, %= relative share
n=broj ispitanika, %= relativni udio

With regard to somatotype category, Croatian female volleyball players on average pertain to the endomorphic ectomorph category (3.1-2.4-3.6), whereas Greek and Chinese players are endomorph-ectomorphs (3.2-2.4-3.2; 3.7-2.9-4.0), Spanish players belong in the central category (3.1-3.4-3.1), North Macedonian players are balanced mesomorphs (3.27-4.11-3.09) and Portuguese players are balanced endomorphs (4.3-2.7-3.1). The afore-said allows for observing that Chinese volleyball players together with the Croatian players have the highest ectomorph component in relation to other players, while together with the Greek players they have the lowest mesomorph component, thus finally that the endomorph component is fairly even in all players but the Portuguese where it is noticeably higher. The low mesomorphy of Croatian female volleyball players indicates an insufficient development of the muscle system, which can partially be explained by the relatively low average age, and thus also by a shorter training age (playing period). In addition, one of the reasons for the insufficient development of mesomorphy according to Malousaris et al. (2008) is an insufficient presence of targeted developmental physical conditioning programs. At the same time, a high mesomorph component has shown to be a characteristic of top-level international female volleyball players (3), which refers to the necessity of further development of this somatotype component in Croatian players in order for them to ultimately possess the predisposition for playing at a higher level of competition than they are currently.

According to the obtained statistically significant differences in basic anthropometric characteristics of different playing roles, liberos (170.5 cm) are the lowest compared with other playing roles apart from setters (176.2 cm), whereas setters and receivers (179.7 cm) are identical, as well as lower than opposites (186.2 cm) and centres (186.2 cm). Centres and opposites are taller than other playing roles, as well as without any differences regarding their height. In previous research of Greek, Spanish, North Macedonian female volleyball players (1,6,8) which included the five standard playing roles into the game system, liberos [(171.0; 170.1; 175.7) cm] and setters [(176.9; 176.1; 169.6) cm] showed to be lower than receivers [(181.2; 181.5; 179.3) cm], centres [(182.0; 184.7; 181.3) cm] and opposites [(183.6; 183.2; 183.3) cm], while centres and opposites were taller than other playing roles. The latter comparison in body height between Croatian and previously mentioned elite female volleyball players allows for determining that elite Croatian players achieved fairly even values for the libero, setter and receiver positions, whereas they accomplished higher values for the opposite and centre positions. The height of playing roles for Chinese players (10) was not included due to a different classification of playing roles.

The conclusion can thus be made that the results of this research go in favour of previously determined theories that height is not key for liberos, as the mentioned playing role is specialized for serve reception and defence in the back court zone, and where a lower centre of gravity benefits the performance of actions played closer to the playing surface.

Although it was shown that setters are taller than liberos, but lower than other playing roles, it seems that height is not crucial for this playing role as well, as the main assignment of the setter is primarily to organize the play, which includes appropriate tactical thinking with emphasis on the precise performance of the setting action. Likewise, the domination in height among opposites and centres allows the mentioned playing roles to efficiently execute actions above the net, such as spiking and blocking.

Opposites show a statistically significant higher body weight than setters, liberos and receivers, which can also be explained by a proportionally bigger height than the mentioned playing roles. Even though there is no statistically significant difference in body weight ($p=0.076$), it is interesting that opposites are as much as 6.5 kg heavier than centres, while at the same time of identical height. Such a result can be based on the specificity of the tasks for these two playing roles, i.e. the lower weight in centres allows for an advantage in a higher number of block rebounds combined with lateral movements and the spiking tempo in a short period of time in terms of a more efficient performance and quicker recovery when performing the mentioned actions, while the higher weight of opposites enables a greater robustness and penetration when spiking the ball both from the front and back zone of the court. Out of the remaining anthropometric measurements, only the humerus breadth diameter showed to be a measurement that is significantly higher in opposites when compared to liberos and setters, which can also be accounted for by the proportionality in height of the mentioned playing roles.

Upon observing solely, the somatotype of the playing roles, significant differences emerged in the mesomorph and ectomorph component. Liberos have the highest (3.3), while centres have the lowest (1.6) mesomorph component, and these are the only ones with statistical difference. Greek and Spanish liberos (3.3; 4.3) have the highest, identically as did their centres (2.2; 3.0) have the lowest mesomorphy compared to the other playing roles. In the ectomorph somatotype component, centres showed a significant difference from the other playing roles, as they achieved the highest value (4.5). As opposed to Croatian female volleyball players, the highest ectomorphy in Greek players was achieved by opposites (3.9), while among Spanish players it was likewise centres (3.5). Such results for liberos and centres in comparison to other playing roles also go in favour of confirming their performance of specific situational tasks in volleyball.

Finally, the results obtained in this research present a contribution towards expanding the knowledge in determining somatotypes of female volleyball players on the highest level of top national competition ranks. In addition, upon comparison with other female volleyball players from similar ranks, it is possible to determine the advantages and shortcomings in somatotype characteristics of Croatian female volleyball players and thus suggest possible training programs and selection methods.

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