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ARE THE SOMATOTYPE STILL A USEFUL METHOD FOR SELECTION IN VOLLEYBALL? ANALYSIS OF THE SOMATOTYPE OF CROATIAN FEMALE VOLLEYBALL NATIONAL TEAMS (U16 AND U18)

JE LI SOMATOTIP JOŠ UVIJEK KORISNA METODA ZA PROVEDBU SELEKCIJE U ODBOJCI? ANALIZA SOMATOTIPA HRVATSKIH ODBOJKAŠICA NACIONALNE VRSTE (U16 I U18)

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SUMMARY

The goal of this research was to determine whether the somatotype is still a useful method that can be used to confirm the selection of young and promising volleyball players. For this purpose, groups of volleyball players of different age (U16 and U18) and status affiliation (starters and substitutes) were compared by means of calculated somatotypes. The sample of examinees was formed by top-level young Croatian female volleyball players (n=28, age=15.7±1.0 years, body height=179.6±7.2 cm body weight=64.8±7.0 kg), which was further then divided into subsamples regarding age category (U16 and U18) and team status (starters, non-starters). Players' somatotype was calculated according to the Heath-Carter method, whereas the significance of differences between the groups was determined with the t-test for independent samples. The average somatotype of all players was calculated as a balanced ectomorph, and accordingly also for subsamples U16 balanced ectomorph and U18 endomorphic-ectomorph, while for starters endomorphic-ectomorph and for non-starters central somatotype. In addition, upon analysis of the somatotype of all players, it was determined there was a total of 10 categories out of the possible 13 somatotypes, and that among those the most represented were endomorphic-ectomorphs (39.3%) and central somatotypes (17.9%). Among players in the U16 and U18 age categories there were no differences determined in none of the somatotype components, whereas among starters and non-starters differences occurred only in the ectomorph somatotype component.

Keywords: volleyball, morphology, body composition, performance, female players

SAŽETAK

Cilj ovog istraživanja bio je utvrditi je li somatotip još uvijek korisna metoda kojom se može potvrditi provedena selekcija mladih i perspektivnih odbojkašica. U tu svrhu su putem izračunatih somatotipova uspoređene skupine odbojkašica različite dobne (U16 i U18) i statusne pripadnosti (starteri i zamjene). Uzorak ispitanica činile su vrhunske mlade hrvatske odbojkašice (n=28, dob=15,7±1,0 godina, tjelesna visina=179,6±7,2 cm tjelesna masa=64,8±7,0 kg), koji je potom podijeljen na podskupine s obzirom na dobnu kategoriju (U16 i U18) i igrački status (starteri i zamjene). Somatotip igračica izračunat je prema Heath-Carter metodi, dok je značajnost razlika između skupina utvrđena t-testom za nezavisne uzorke. Prosječni somatotip svih odbojkašica je balansirani ektomorf, podskupine U16 balansirani ektomorf, a podskupine U18 endomorf-ektomorf. Prosječni somatotip startera je endomorfno-ektomorf, a za zamjene centralni somatotip. Analizom somatotipa svih odbojkašica, utvrđeno je da od mogućih 13 somatotipova u ovom uzorku egzistira 10, a među njima su najzastupljeniji endomorfno-ektomorfni (39,3%) i centralni somatotipovi (17,9%). Između podskupina U16 i U18 nisu utvrđene razlike ni u jednoj komponenti somatotipa, dok je među starterima i zamjenama razlika prisutna samo u komponenti somatotipa ektomorfa.

Ključne riječi: odbojka, morfologija, sastav tijela, performanse, odbojkašice

INTRODUCTION

Successful performance in a certain sport, including volleyball, is conditioned by the specific anthropological profile of a player, which also includes the player's morphological characteristics, such as dimensions, composition, and constitution, i.e., body somatotype. Certain morphological characteristics are conditioned by heritage (dimensionality of skeleton), whereas others can be conditioned by environmental factors (training process). The somatotype of athletes represents one of the relevant factors for performance in sport (17). Upon determining key morphological characteristics connected with successful performance, it is also required to establish their modal or normative values, which will ultimately allow for an effective identification and development process, and further on also for selection of talented players. Efficiency of all the above mentioned depends on the availability of comprehensive and current normative values obtained from a sample of elite athletes in the population of the observed sport (3). The most relevant sample of elite athletes is represented by members of the world's best senior national teams. During the process of creating a top-level model related to morphological status, further additional criteria are also possible for differentiating successful and less successful players, such as playing status on the team (9,12), competition rank (7,16) and team placement (2,14). Following the process of identification and selection, the somatotype of young perspective female volleyball players, which is like that of senior players, can be monitored during certain younger competitive age categories (e.g., U14, U16, U18), as well as further developed to the desired optimal somatotype by creating and modifying an appropriate training process and diet plan (15). More recent somatotype studies were conducted on a sample of top-level senior female players (6,11), while a smaller number was carried out on a sample of various younger age categories, particularly in Croatia, where until now the somatotype of top-level female players at the national team level was not determined, identically as for any other age category. The aims of this research are as follows: 1. To deter-mine the somatotype of young female players; 2. To determine if there are differences in the somatotype between U16 and U18 players; 3. To determine if there are differences in the somatotype between young starter and non-starter players.

MATERIALS AND METHODS

Participants

The research was conducted on young Croatian female volleyball players (n=28; age=15.7±1.0 years; body height=179.6±7.2 cm; body weight=64.8±7.0 kg) who were selected for the Croatian national youth and junior teams. In keeping with the aims of the research, the overall sample was stratified as follows (Table 1), in one part of the analysis in relation to the competitive age category under 16 years of age (U16) and under 18 years old (U18), whereas in the other part of the analysis in relation to the team status on the between starters (S) and non-starters (NS), i.e., players who are in the starting line-up at the beginning of a match/set and players who are on the bench as substitutes.

All examinees in this research joined the study in healthy condition and voluntarily (written consent) and were previously informed about the measurement procedures. As all examinees were minors at the time of measurement, consent for each individual player was provided by the coach and parent. The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb (97/2023).

Variables and Equipment

According to the Heath-Carter method (5), determining the endomorph, mesomorph and ectomorph somatotype component was completed by using ten anthropometric measurements (body height, body weight, upper arm skinfold, back skinfold, abdominal skinfold, lower leg skinfold, elbow diameter, knee diameter, flexed upper arm circumference and lower leg circumference), which also constitute the research variables.

Data Collection

The procedure of anthropometric measurements was conducted at the Faculty of Kinesiology University of Zagreb by educated measurers (kinesiologists) with many years of experience, in morning hours without previous physical activity and under standard atmospheric conditions.

Table 1. Basic demographic data for young Croatian volleyball players (AM±SD)
Tablica 1. Osnovni demografski podaci mladih hrvatskih odbojkašica (AM±SD)

	Total (n=28)	Age category		Playing status	
		U16 (n=14)	U18 (n=14)	S (n=14)	NS (n=14)
Age (years)	15.7±1.0	14.8±0.4	16.6±0.6	15.6±1.2	15.8±0.8
Body height (cm)	179.6±7.2	178.1±7.0	181.0±7.3	182.1±7.2	177.0±6.5
Body weight (kg)	64.8±7.0	63.2±4.9	66.4±8.4	65.5±7.8	64.1±6.2

Legend: U16=category under 16 years of age, U18=category under 18 years of age, S=starters, NS=non-starters

The measurements were conducted according to the ISAK protocol (13). In the process of determining the above-mentioned anthropometric measurements, the following instruments were used: body height anthropometer (GPM, Switzerland), digital weight scale (Tanita, Japan), skinfold caliper (Harpenden, UK), sliding caliper for diameters (GPM, Switzerland), and flexible metal band for measuring circumference.

Statistical Analysis

The collected data for 10 anthropometric measurements were entered and edited in MS Excel, all three somatotype components were calculated by using ad hoc defined parameters and equations (4), and a graphic representation was created by using a two-dimensional coordinate system, i.e., a somatochart. After calculating somatotype components for each individual player, further statistical analysis was conducted. The assessment of normality of distribution for the observed variables was completed with the Shapiro-Wilk test, and it was determined that the measured variables do not deviate statistically from the normal distribution. In addition, arithmetic mean (AM) and standard deviation (SD), as basic descriptive parameters, were calculated for all the variables. The Student t-test for independent samples (level of significance set at p=0.05) was used both times for determining differences between the two age groups of young selected Croatian volleyball players. Statistical analysis (normality of distribution, descriptive parameters and analysis of differences) was calculated by using the Statistica 14.0 programme (TIBCO Software Inc., USA). For calculating the impact size of the t-test, the Cohen's d was used (8), so that the obtained significant differences according to conventionally set values are considered as follows: trivial (0.00-0.19), small (0.20-0.49), moderate (0.50-0.79) and large (>0.79). The impact size of Cohen's d was calculated by using MS Excel.

RESULTS

The results of basic descriptive parameters (AM±SD) of the endomorph, mesomorph, and ectomorph somatotype component in young selected Croatian volleyball players, as well as the results of the t-test for independent samples between various groups of competitive age categories and different groups of playing status are presented in Table 2.

The results of the t-test for independent samples did not show significant differences in neither of the somatotype components between U16 and U18 groups, as well as in the endomorph and mesomorph somatotype component between the groups of starters and non-starters among young Croatian volleyball players who are members of the national team. Furthermore, the t-test for independent samples determined in the ectomorph somatotype component of young Croatian national team players significantly higher values among starter players (AM=4.6 SD=0.8) by comparison with non-starters (AM=3.9 SD=0.5; t(26)=2.82 p=.009), with an impact size interpreted as large (d=1.07; 95% CI=.20-1.24).

The average somatochart of young selected Croatian volleyball players, as well as the individual somatochart of all players is presented in a two-dimensional somatograph in Figure 1.

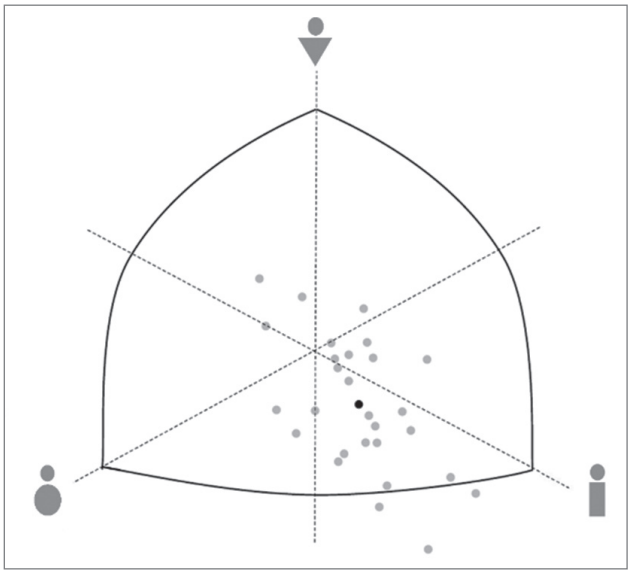

Figure 1. Somatograph of young selected Croatian volleyball players (●=average somatotype, ●=individual somatotype)

Graf 1. Somatograf mladih hrvatskih odbojkašica (●=prosječni somatotip, ●=individualni somatotip)

Table 2. Descriptive parameters and results of t-test between groups of different age categories and team status for somatotype of young Croatian volleyball players (AM±SD)

Tablica 2. Deskriptivni pokazatelji i rezultati t-testa između različitih dobnih skupina i različitog igračkog statusa somatotipa odbojkašica (AM±SD)

Somatotype	Total	Age category			Team status		
		U16	vs	U18	S	vs	NS
Endomorph	3,2±0,6	3,2±0,6		3,1±0,6	3,0±0,5		3,3±0,6
Mesomorph	2,7±1,2	3,0±1 ,1		2,3±1,4	2,4±1,2		3,0±1,2
Ectomorph	4,2±0,8	4,2±0,8		4,3±0,8	4,6±0,8	*	3,9±0,5

Legend: *p < .01, U16=category under 16 years of age, U18=category under 18 years of age, S=starters, NS=non-starters

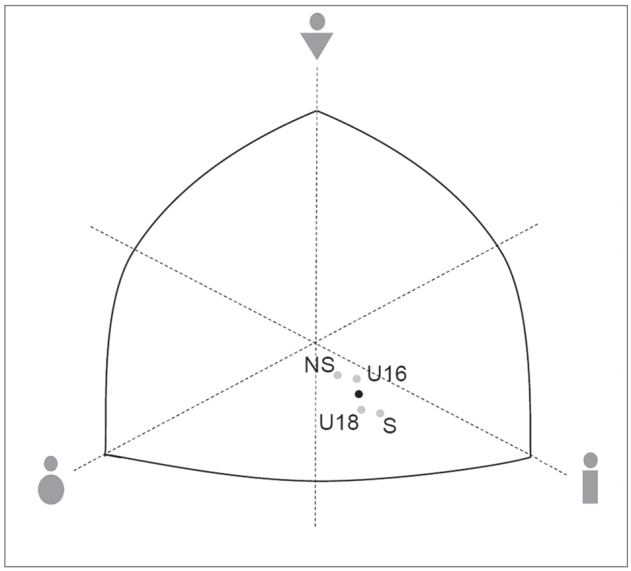

Figure 2. Somatograph of young selected Croatian volleyball players regarding competitive age category and team status (●=average somatotype, U16=under 16 years of age, U18=under 18 years of age, S=starters, NS=non-starters)

Graf 2. Somatograf mladih hrvatskih odbojkašica s obzirom na dobnu kategoriju i igrački status (●=prosječni somatotip, U16=kategorija do 16 godina, U18= kategorija do 18 godina, S=starteri, NS=zamjene)

Furthermore, in Figure 2 the somatochart of different competitive age categories (U16 and U18) and the somatochart of different playing status (starters and non-starters) is presented in a two-dimensional somatograph.

By analysis of the results in Table 2, the overall somatotype of all players is balanced ectomorph (3.2-2.7-4.2). Regarding the competitive age category, U16 volleyball players were determined the somatotype of balanced ectomorph (3.2-3.0-4.2), while U18 players of endomorphic ectomorph (3.1-2.3-4.2). Regarding team status, starter players were determined the somatotype of endomorphic ectomorph (3.0-2.4-4.6), whereas non-starters of central somatotype (3.3-3.0-3.9).

Table 3 presents the distribution of somatotypes of the observed young Croatian national team players within 13 possible categories (12), and it was determined that there was a total of 10 recorded categories. According to the analyzed data, the most represented somatotypes are endomorphic ectomorphs (39.3%) and central somatotypes (17.9%), while less represented were mesomorph-ectomorphs (7.1%), mesomorphic ectomorphs (7.1%), balanced ectomorphs (7.1%), endomorph-ectomorphs (7.1%), mesomorph-endomorphs (3.6%), endomorphic mesomorphs (3.6%), balanced mesomorphs (3.6%) and ectomorphic endomorphs (3.6%).

Table 3. Distribution of somatotype categories among young selected Croatian players

Tablica 3. Distribucija kategorija somatotipa mladih hrvatskih odbojkašica

Somatotype categories	Total (n=28)	
	n	%
Centrale	5	17,9
Mesomorph-endomorph	1	3,6
Endomorphic mesomorph	1	3,6
Balanced mesomorph	1	3,6
Mesomorph-ectomorph	2	7,1
Mesomorphic ectomorph	2	7,1
Balanced ectomorph	2	7,1
Endomorphic ectomorph	11	39,3
Endomorph-ectomorph	2	7,1
Ectomorphic endomorph	1	3,6

Legend: n=number of examinees, %= relative share

DISCUSSION

The main findings of this research are that the somatotype of young Croatian national team players is balanced ectomorph, then that different age categories U16 and U18 do not significantly differ in any of the somatotype components, while players of different team status are different only in the ectomorph somatotype component.

Table 4 shows data for the somatotype of young Croatian volleyball players in national teams, and according to the available research, the values are for a top-level sample of selected national team players on an international level, both for senior age categories as among younger groups of players. For comparison with other national teams, the values of somatotypes for Croatian players are not separately presented, but in total, due to a more simplified interpretation. In addition, as it was previously mentioned, it was determined there are no significant differences in any of the somatotype components between the two observed age groups.

For comparison with a top-level senior model, national team players of Cuba (6) and Brazil (10) shall be used, while for comparison with a top-level somatotype model for younger players, national team players from Peru (18) and Brazil (1) shall be used. At the moment of collecting research data, all previously mentioned teams in major intercontinental competitions (Olympic Games or World Championship) achieved ranking among the top ten teams.

The somatotype of Cuban senior players is balanced mesomorph (2.7-3.6-2.9), for Brazilian senior/junior players central, then for Peru younger players ectomorphic endomorph (4.0-2.8-3.5), and for Brazilian U17 players endomorphic ectomorph (3.1-2.2-4.5).

Table 4. Somatotype across national teams of different age categories
Tablica 4. Somatotip odbojkašica različitih reprezentacija i dobnih kategorija

National team	n	Age	Category*	Component		
				Endo	Meso	Ecto
Croatia (present research)	28	15.7±1.0	U16, U18	3.2	2.7	4.2
Cuba (Carvajal et al., 2012)	41	22.2±3.9	S	2.7	3.6	2.9
Brazil (Fonesca et al., 2008)	28	17.6±0.5; 25.2±4.6	J, S	3.5	3. 0	3.5
Peru (Rosas et al., 2013)	20	17.3±NA	J	4. 0	2.8	3.5
Brazil (Cabral et al., 2008)	14	15.9±0.4	U17	3.1	2.2	3.9

Legend: n=number of examinees, NA=not available, U16=under 16 years of age, U17=under 17 years of age, U18=under 18 years of age, J=junior players, S=senior players, Endo=endomorph, Meso=mesomorph, Ecto=ectomorph, * the listed competition categories are stated as in the original research

Upon comparison of Croatian young national team players with a top-level senior somatotype model, Cuban and Brazilian players achieved higher values in the mesomorph component (2.7 vs 3.6; 3.0), and lower values in the ectomorph component (4.2 vs 2.9; 3.5), while Cuban players had lower, and Brazilian players similar values in the endomorph component (3.2 vs 2.7; 3.5).

Upon comparison of Croatian national team players with the model sample of top-level world-class young players, players from Peru have a higher, while Brazilian players have a similar endomorph component (3.2 vs 4.0; 3.1; 3.4). Considering that Peru junior players achieved a high placement (6th place) at the 2011 World Championship, it is interesting to notice a relatively high value in the endomorph component among young players from Peru, which is associated with their amount of body fat and negatively correlates with successful performance. However, at the same time, junior players of Peru achieved higher values in the ectomorph and mesomorph somatotype component, which indicates the probability of this high endomorphic value being within an acceptable range and that still allows for achieving relatively good results in the junior competitive age group. Furthermore, Croatian young national team players achieved a similar value as Peru juniors in the mesomorph component, whereas a somewhat higher value than Brazilian U17 players (2.7 vs 2.8; 2.2). Finally, Croatian young players achieved a higher value than Peru juniors and Brazilian U17 players in the ectomorph component (4.2 vs 3.5; 3.9).

Generally, upon comparing the somatotype of observed top-level national team players, it can be said that senior (or older) players achieve higher values in the mesomorph component, whereas lower or similar values in the ectomorph component. A higher mesomorph component among senior players can be interpreted by the longer overall training experience and training/competition modality, which allows for development of larger volume quality muscle mass, while at the same time reducing body ballast mass (fat tissue), which is also manifested in the lower endomorph component. In terms of player selection, members of the senior national team represent top-level quality players in the whole country, and not only the best players in a certain age group (generation). Likewise, quality muscle mass enables higher-level performance of motor abilities, for which the manifestation of force is essential, such as explosive strength for jumping and hitting, speed and agility, which are key factors in volleyball for an efficient technical-tactical high-level performance.

In line with all previously mentioned, and in the development path of young talented players, it is essential to include them in a targeted and monitored training programme (primarily physical conditioning training) and diet plan, that aims at reaching approximate values of the optimal somatotype among top-level senior players, and which is particularly programmed for increasing its mesomorph component. The presumption can be made that only such an approach, which is also planned for a long term, can enable for talented young players to achieve their maximum playing potentials, and consequently high results, in their senior years.

This research determined on a sample of young selected national team players that successful players differ from less successful ones by the criterion of team status in the ectomorph somatotype component, and similar results were also confirmed on a sample of senior players in the criterion of competition rank (7,16,11), as well as in the criterion of team placement (14), where even players of higher competition ranks/better placement achieved higher values in the ectomorph component when compared with players of lower competition rank/lower placement. The ectomorph component represents a ratio of body height and weight, thus essentially players with a higher ectomorph component are also the players that are highest. In this way, a higher ectomorph component in volleyball can play an important role, especially as it allows players to have an advantage while performing elements that are executed above net height.

CONCLUSIONS

The results obtained in this research provide critical information on the somatotype of selected young volleyball players which can serve coaches (national team selectors) in preparing adequate training interventions, as well as in monitoring them, however also in the selection process of talented young players, both at club, as well as at national team level.

It is important to emphasize that the somatotype determination method is only one of the tools that can be used to support us during the selection process of young and promising volleyball players. Serious selection processes in volleyball should not be carried out without the obtained results of assessment of functional mobility and motor and functional abilities.

Finally, due to a limited smaller number of available young national team players, which can also be identified as a shortcoming of this research, there was an inability of determining the somatotype according to different playing roles, which should certainly be one of the aims for further research of this type. Even though it is a smaller sample, it is extremely representative because the players tested represented Croatia at the European and World Championships.

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