Morphological Characteristics and Somatotype Of Elite Female Volleyball Players. A Review

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Abstract:
This review aimed to review a series of articles (n = 21) to determine morphological characteristics of women volleyball players. These studies included relevant information on morphological variables, such as height, weight, body fat %, LBM, somatotype.
The results of the study showed that height is an important factor to play at the highest level (elite level), The results, also, Indicated that elite women players have a morphological characteristics more suitable in high performance volleyball, since They have a lower fat percentage, higher lean body mass and somatotype more muscular and less adipose that's allows the female players to perform with high capacities.
Keywords: Morphological characteristics, somatotype, elite female volleyball players.

1. INTRODUCTION

Volleyball is a team sport. Each match lasts an indeterminate amount of time; it has a set scoring structure, little player interaction with the ball, and positional rotations. It is an interval game, a technical game, and in terms of its motoric characteristics, it is a member of the group of sports that emphasize strength and speed. Specific physiological, kinesiological, and psychological variables, together with the necessary anthropometric traits, determine high-level performance in volleyball. While certain morphological traits are largely determined by genetics, others are also influenced by the environment. If players possess the necessary somatometric qualities required by the sport they participate in as a requirement, then some of these attributes may be improved through training (Papadopoulos et al., 2002).

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The morphological features of a female athlete play a highly decisive role in achieving a successful athletic career of high level performance and, thus, constitute a basic criterion for selecting female volleyball athletes (Papadopoulos et al, 2003).

The determination of the special characteristics of an athlete's build in various sports has been an area of interest for sports scientists to investigate athletes' orientation and training. The quantification of the morphological characteristics of high-level female athletes could become a basic point that concerns body build relative to athletic performance. The recognition of real talent is a very complex process that requires a good knowledge of anthropometrics that are related to high performances. Certain anthropometric characteristics have been referred to as significant discriminatory parameters between top and low-level athletes (Konstantinos et al., 2019).

Over recent decades, due to the secular acceleration that occurs in different countries, the morphological profile of volleyball player has changed significantly. In a cross-sectional study carried out in Cuba, the variation of some parameters of the body composition (BC) of the volleyball players is observed throughout the Olympic cycles between 1976 and 2008.

The size, for example, went from 175.12 cm to 182.20 cm, the percentage of fat mass went from 25% to 22% and the somatotype changed from meso-endomorph to meso-ectomorph (Carvajal et al., 2008). This same phenomenon was observed in the studies of Gao (2006) and Zhang (1998) which reported an increase in the average size and weight of the elite players between the 26 and 28 Olympic Games. Height went from 181 cm to 184 cm and a body mass from 71kg to 73.4 kg. Ferris, Signorille and Caruso (1995) identified an average size of 176 cm in their study, which is similar to other studies at that time (Fernández et al., 2017).

Various researchers suggested that different body size, shape and proportions are beneficial in different physical activities (Gaurav et al., 2011). The present study, therefore, has been conducted to identify the morphological characteristics of the highest-level women volleyball players by reviewing a series of studies collected.

What are the results of the morphological characteristics of high level women volleyball players?

2. Objectives and significance of the study

The purpose of this article is to identify the morphological characteristics and Somatotype of the volleyball players of high-performance women (without distinguishing elite or pre-elite) by reviewing a series of studies collected. This study is one of the few studies in which a review on the topic is conducted and therefore it provides the necessary information that allows approaching the

morphological profile that a high-achieving volleyball player must have. Also, this study, contributes knowledge useful for athletic talent selection in volleyball and training program development.

3. Research Terms and Definitions

3.1. Morphological characteristics

Morphology is those anthropometric measurements, and measurements of body composition and the proportions of its different composition in terms of lengths, Circumferences, percentage of body fat, muscle mass, etc.

In our study, Includes measurements of length, weight, fat percentage and lean body mass of high-level female volleyball players.

3.2. Somatotype

A somatotype is understood as the description of the current morphological condition of an individual, expressed through 3 numbers, where each of them represents one of the 3 basic components of body composition (Tóth et al., 2014).

3.3. Volleyball

Volleyball is a team game played by two teams on a playing court divided by a net. There are different versions existing for specific situations in order to offer the versatility of the game to everyone. The object of the game is to send the ball over the net control to ground it on the opponent's court, and to prevent the same attempt by the opponent. The team has three hits for returning the ball (in addition to the block contact). The ball is set in play with a service: hit by the server over the net to the opponents. The rally continues until the ball is grounded on the playing court, goes "out" or a team fails to return it properly (Pandey et al., 2016).

3.4. Elite female volleyball players: The elite female volleyball players, participating in the 1st (Super League) divisions, female national team players and the female professional players. The sub-elite female players performing at the 2nd (Serie A2) division.

4. Methods and materials

Literature was collected by searching the Internet as well as searching for papers available in Google Scholar, Research Gate. Our search was limited to the papers in Spanish and English, and those that have been published since 2000 until 2020 (in the last twenty years), the following keywords were defined in order to search for information: body composition, somatotype and volleyball, the morphological profile of the female volleyball players. After the search.

The studies were included if they comprised (1) elite female volleyball players; (2) sub-elite players; (3) female national team players and the female professional players; only full-text and articles written in English and Spanish

were considered for this review.

Studies were excluded were carried out in junior, children or college categories. Also, Excluded were books, book chapters, and congress abstracts, as well as studies for which only the abstract was available.

5. Results

5.1. Anthropometric characteristics

Table1. Summary of the anthropometric characteristics of high-level female volleyball players

Study	Subjects	Age (Years)	Height (Cm)	Weight (Kg)	BF%	LBM
Gualdi-Russo, Zaccagni, 2001	Italian A1 (n=129) and A2 (n=115) league players	23.1±4.4	A1 league: 178.4 ±5.8 A2 league: 176.7±4.9	A1 league: 71.2 ± 7.0 A2 league: 70.9 ± 6.9	NA	NA
Papadopoulou, 2003	Greek woman volleyball athletes participating in the national team (NT, n=29) and the A1 national division (AD, n=63)	NT: 20.7±3.5 AD: 25.3±5.1	NT:180.5 ± 6.2 AD:178.9 ±6.2	NT:72.7± 8.1 AD:69.8± 7.5	NT:22.4 ± 4.7 AD:21.3 ± 5.5	NA
Papadopoulos et al., 2002	Greek female volleyball athletes NT (N=18) A1(N=73) A2(N=52)	22.4±4.9	NT:182.5 ±6.3 A1:178.2 ±5.3 A2:175.6 ±5.6	NT:74.8± 7. 4 A1:68.8 ±7.3 A2:69.2 ±7.8	NA	NA
Grgantov et al., 2006	female volleyball players (n=17)	18-19	175,9± 7,3	66,8 ± 7,3	NA	NA
Aytek, 2007	Turkish volleyball players (NT, n=60)	Youth : 13-15 Junior : 15-18 (Adult)	183.2±6.1	67.4±4.8	15.8±3. 1	NA
Malousaris et al., 2008	Greek first national league divisions	23.8±4.7	Division A1: 179.6	Division A1: 71.0	Division A1: 22.7	NA

	A1 (n=79) and A2 (n=84)		±5.8 Division A2: 174.7 ± 6.2	± 8.2 Division A2: 68.2 ± 6.3	± 2.9 Division A2: 24.1 ± 2.6	
Marques et al., 2008	Professional players of national first division of Portugal and the European cup (n=10)	25 years old	187 ± 5,4	74,6 ± 8,1	NA	NA
Toledo et al., 2008	female volleyball athletes from Brazil (n=11)	not mentioned	182,6±6,7	70,9 ±6,5	NA	NA
Carvajal et al., 2008	Cuban women's volleyball players (n=25)	not mentioned	182,2 ± 4,2	74,3 ± 5,1	22,3 ± 2,7	NA
Carvajal et al., 2009	Cuban women's volleyball players(n=43)	22.8±3.6	180,5 ± 4,2	73,6 ± 6,9	NA	NA
Dopsaj et al., 2010	Serbian Volleyball Players: Olympic team (OS) (n=16) Super League (SL) (N=12)	OS: 22.7±3.2 SL: 20±2.1	Os:185,4 ± 7,8 SL:180.8 ± 3.0	Os: 71,6 ± 6,5 SL: 69.4 ± 7.1	Os: 14,3 ± 2,9 SL: 17.1 ± 2.8	Os: 61,2 ± 4,9 SL: 57.4 ± 5.3
Zhang, 2010	elite Chinese players (n=100)	22.3±3.6	183,6 ± 5,7	70,5± 7,6		
Malá et al., 2010	female national volleyball team of the Slovak Republic: SNT – senior team(n=12)	24.3±2.67	179,4 ± 7,3	67,7 ± 5,9	13,7 ± 2,4	58,4 ± 4,7
Maly et al., 2011	women volleyball players of two teams which were participants in the European Champions League (T1, n=12)	T1: 24.3±2.67 T2: 20.78±2.05	T1: 182.79 ±5.6 T2: 184,2 ± 7,9	T1: 72.9 ± 6.34 T2:71,2 ± 6,2	T1: 16.1± 3.1 T2: 14,7 ± 3,1	T1: 61.0 ± 4.22 T2: 61,8 ± 6,2
Carvajal et al., 2012	Cuban Women Olympic	Centers: 21.8±4	181,6 ±3,9	75,2 ±5,8	NA	NA

	Volleyball players (n=41)	Setters: 23.6±4.2 Spikers: 23.2±4.2				
Zapolska et al., 2014	professional volleyball players (n=17)	24.8±5	180.0 ± 10	74.33	18.49±5.0	NA
Abazi et al., 2017	best clubs of the first Macedonian league (n=86)	23.18±2.96	176,5 ± 7,0	68,82 ± 11,1	12,8 ± 5,3	59,7 ± 8,7
Valleser et al., 2018	elite Filipino women's volleyball players (n=36)	23.9+3	168 ± 9	64 ± 7	16 ± 5	NA
Bankovic et al.,2018	top elite women volleyball players, Rio 2016 Olympic medal winners (n=12)	26.8±3.9	188. 9 ±6.4	75.5±6.9	13.4± 2.7	NA
Selimi et al., 2019	women volleyball players from nine clubs of Kosovo Volleyball Super League (n=116)	19.91±3.59	172.2 ± 6.1	60.5 ± 7.6	NA	NA
Carvalho et al., 2020	elite female volleyball players competing in the 1st and 2nd divisions in Portugal GA (n=20, A1 division, ranked first) GB (n=21, A1 division, ranked last) and GC (n = 18, A2 division)	not mentioned	GA: 176.3 ± 6.1 GB: 174.9 ± 8.3 GC: 168.1 ± 7.4	GA: 68.0 ± 6.6 GB: 64.4 ± 7.5 GC: 66.3 ± 8.4	GA: 21.3 ± 2.6 GB: 21.8 ± 2.3 GC: 27.2 ± 2.7	NA

Weight (Kg). Height (Cm). BF%: body fat percentage. LBM: lean body mass.
NA: data not available

5.2. Somatotype

Table 2. Summary of the somatotype of elite female Volleyball player

study	Subjects	Endo	Meso	Ecto
Gualdi-Russo and Zaccagni, 2001	Italian A1 (n=129) and A2 (n=115) league players	A1 league: 2.9±0.8 A2league: 3.1 ±0.8	A1 league: 3.1±1.0 A2 league: 3.5± 0.9	A1 league: 3.0±0.9 A2 league: 2.7± 0.8
Papadopoulos et al., 2002	Greek female volleyball athletes NT5 (n=18) A1(n=73) A2(n=52)	NT: 4.2±1.0 A1: 4.3±1.1 A2: 4.4±1.2	NT: 2.2±1.1 A1: 2.1±1.2 A2: 2.81±1.2	NT: 2.2±0.9 A1: 2.3±0.9 A2: 1.9±0.8
Toledo et al., 2008	female volleyball athletes from Brazil (n=11)	3.5 ± 1.0	3.0 ±1.3	3.5 ±1.1
Carvajal et al., 2008	Cuban women's volleyball players (n=25)	2.6	3.5	3.0
Malousaris et al., 2008	Greek first national league divisions A1 (n=79) and A2 (n=84)	A1:3.2± 0.8 A2:3.6± 0.7	A1:2.4± 1.1 A2:2.9± 1.0	A1:3.2± 0.9 A2:2.7± 1.0
Carvajal et al., 2009	Cuban women's volleyball players(n=43)	2.6 ± 0.8	3.5± 0.8	3.5 ±0.9
Zhang, 2010	Elite Chinese players (n=100)	3.7 ± 0.9	2.9 ± 1.0	4.0 ± 1.1
Carvajal et al., 2012	Cuban high-performance volleyball player (n=43)	2.7 ± 0.8	3.6 ± 0.8	2.9 ± 0.8
Abazi et al., 2017	best clubs of the first Macedonian league (n=86)	3.2±1.0	4.1±1.0	3.0±1.0
Carvalho et al., 2020	Portuguese female volleyball	GA 4.26 ±0.8	GA 2.7 ± 1.0	GA 3.0 ± 0.8

	players GA (n=20,A1 division, ranked first) GB (n=21, A1 division, ranked last) and GC (n=18, A2 division)	GB 4.5 ± 0.9 GC 7.2± 1.6	GB 2.2 ± 0.9 GC 3.3 ±1.2	GB 3.2 ± 1.0 GC 1.90 ±1.3

ENDO: Endomorphy. MESO: Mesomorphy. ECTO: Ectomorphy

6. Discussion

6.1. Anthropometric characteristics

The reviewed data reveal several noteworthy findings. Height and body mass values vary between 168 ± 9 cm and 60.59±7.62 kg to 188.93±6.49 cm and 75.56±6.97 kg, respectively. These variables in the data can be because of a number of factors, such as the genetic profile of the players, their level of Play, and the selection process they underwent.

Anthropometric characteristics can differentiate among players of different levels. Although the 1 study (Maly et al., 2011) indicated no differences in the screened samples, height and body mass, other studies showed that players of higher levels are taller and somewhat heavier than players playing at lower levels (Gualdi-Russo and Zaccagni, 2001; Dopsaj et al., 2010;Carvalho et al., 2020). In one study (Malousaris et al., 2008), the differences between players of different positions in divisions A1 and A2 in the Greek first national league were examined. Hitters, centers, and setters were significantly taller in division A1 (181.2±4.5, 182.0 ± 4.6, and 176.9 ± 4.1 cm, respectively) compared to the division A2 (173.4 ± 6.2, 178.7 ± 4.9, and 170.9 ± 4.2 cm, respectively). No differences in body mass were found between players of the 2 divisions. Differences in percent body fat were found only in opposites (A1: 20.5 ± 3.0% vs. A2: 25.7 ± 3.4%). In this study (Malousaris et al., 2008), the anthropometrical characteristics between players playing various positions were also compared, and it was found that liberos appear to be smaller than players in other positions (except for setters). In addition, centers and opposites were taller compared to hitters, liberos, and setters.

In relation to the body fat component, the opinions of professional literature concerning its optimum percentage vary. Essential fat, which is a component part of organs (marrow, heart, lungs, kidney, brain, etc.) is inevitable for the normal functioning of the organism. Fat also constitutes one of the major components of membranes (in the form of phospholipids), and in combination with proteins it constitutes the “skeleton” of membranes. Reserve or subcutaneous fatty tissue has its role, too – it provides the protection of organs

serving as a body heat preserver. However, its excessive amount limits the level of the player's motion (Malá et al., 2010).

The percentage of body fat among female volleyball players varies in different studies from 12,8 % to 27.2%. While Fleck and Wilmore suggest that female players body fat percentage should be 16-25% (Aytek et al., 2007).

In study of Carvalho and others, with Portuguese female volleyball players the body fat percentages for A1 players (GA: 21.3 ± 2.61% and GB: 21.80 ± 2.32%) were similar to the values reported by Papadopoulos et al. In a study with Greek female volleyball players from the national team (22.4 ± 4.7%) and the A1 (21.3 ± 5.5%) division. Another study by Malousaris and al, also with female volleyball players in the A1 Greek National League, presented similar results (22.7 ± 2.9%). However, in general, the A2 Portuguese female players had higher body fat percentages compared to other volleyball players of different ages and competition levels.

But if we are interested in anything, it is to relate anthropometric values to performance. In several studies (4.14) of body composition of volleyball players of various levels of sports competition, several indices are found that are related to sports performance and key physiological parameters in physical activity. Among these values, the LBM (Lean Body Mass) stands out, which is revealed, Among other values, as the determining measure in establishing the significance of Body Composition studies, according to several studies (Maly et al., 2011;Dopsaj et al.,2010;Malá et al., 2010) and specifically two of them, (Dopsaj et al., 2010; Mala et al., 2010), the LBM, including all body tissues except for fat deposits, is considered a major precondition for a good performance in volleyball. In both articles, this parameter represents one of the key characteristics of physical performance of female volleyball players.

6.2. Somatotype

In study of Papadopoulos and others, no particular differences per competition level were observed, as all the divisions of female athletes were characterised as endomorphic, On the contrary, in the study of Carvalho et al. (2020) others Significant differences were found between groups (GA/GB from A1 and GC from A2). Both groups (GA and GB) the A1 division were identified as endomorph-ectomorphs (4.3-2.7-3.1 and 4.5-2.3- 3.3, respectively), while players from the A2 division (GC) were characterized as endomorph mesomorphs (7.3-3.3-1.9). Nevertheless, the first component (endomorph) of A2 division players presented higher values than A1 players. Compared to the A2, the morphology of A1 players was characterized by higher ectomorphy and lower endomorphy. These results are similar to those found by Malousaris et al (2008) in a study with Greek female players that were characterized as endomorph-ectomorphs (3.2-2.4- 3.2) and balanced endomorphs (3.6-2.9-2.7)

in the A1 and A2 divisions, respectively. Also, in a study with Italian A1 and A2 volleyball leagues (Gualdi- Russo and Zaccagni, 2001) differences were observed between the two somatotypes (2.9-3.1- 3.0 and 3.1-3.5-2.7), with A1 players having lower endomorphy and higher ectomorphy than A2 players, whereas the mesomorph was the main component. This trend was also confirmed in a study involving elite Chinese female volleyball players (3.7-2.9-4.0), whose main component was ectomorphy.

In the study of Abazi and al. (2017) with players the first Macedonian league, we observed that volleyball players have a mostly a mesomorphic somatotype. This somatotype, also, we find in the study of carvajal and al. (2012) with Cuban women's volleyball players and a study of Kautzner. These results are similar to this asserted by international reports, where the high level female volleyball athletes' somatotype was recorded as being mostly mesomorphic. The mesomorphic somatotype prevails in sports requiring strength and explosiveness such as volleyball. This is probably explained by the fact that mesomorph is positively related to the athletic performance, in contrast to endomorphy, which is negatively related to performance. The mesomorphic somatotype provides a better jumping ability, flexibility and movement speed into the court, as well as strength and explosiveness (Papadopoulos et al., 2002).

7. Conclusion

This article reviews a series of studies (n=21) examining morphological characteristics of high-level players (elite and sub-elite players).The data showed that height is a requirement of modern volleyball, becomes more relevant at elite level, the results of this review also, indicate that elite women players have a morphological characteristics more suitable for high performance volleyball, since they had lower fat content and higher lean body mass, somatotype more muscular and less adipose.

The determination of the morphological characteristic of high-achieving volleyball players is crucial to support decision-making in the processes of detection and selection of talents.

Moreover, the determination of the profile must be continually reviewed and adjusted to the dynamics of secular growth and to the new sport dynamics.

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