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REVISIÓN / REVIEW

MORPHOLOGICAL PROFILE OF ELITE WOMEN VOLLEYBALL PLAYERS. REVIEW ARTICLE

PERFIL MORFOLÓGICO DE VOLEIBOLISTAS DE ALTOS LOGROS. REVISIÓN

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ABSTRACT

OBJECTIVES: The purpose of this article is identify the morphological profile of the volleyball players of elite women. **METHOD**: Search was made and the various specialized databases was developed to identify studies published on this topic since 2000. We analyzed the variables of body composition (CC), materials, methods and techniques used in each of the studies **RESULTS**: A total of 65 papers and 76 different variables were identified. **CONCLUSIONS**: the variables most used in the measurement of body composition and the morphological profile of the elite women volleyball players were identified.

KEYWORDS: Body composition, anthropometry, somatotype, Volleyball, High performance in sports.

RESUMEN

OBJETIVOS: El propósito de este estudio fue identificar el perfil morfológico de las voleibolistas de altos logros. **MÉTODO**: Se realizó una revisión sistemática con el objetivo de identificar los estudios publicados sobre este tema a partir del año 2000. Se analizaron las variables de composición corporal (CC), materiales métodos y técnicas utilizados en cada uno de los estudios. **RESULTADOS**: Se identificó un total de 65 documentos que reportaron 67 diferentes variables de (CC). **CONCLUSIONES**: Se identificaron las variables más utilizadas en la valoración de la (CC) y se determinó el perfil morfológico ideal de las voleibolistas de altos logros.

PALABRAS CLAVES: Composición corporal, Antropometría, Somatotipo, Voleibol, Alto rendimiento deportivo.

INTRODUCTION

Body composition is considered one of the key components for performance in modern sport, especially in sports where this plays a major role (Hakkinen, 1993; Sands et al., 2005; Gabbett & Georgieff, 2007; Svantesson, Zander, Klingberg, & Slinde, 2008; Maly, Mala, Zahalka, Balas, & Cada, 2011). For example, body weight and somatotype are identified as important factors in athletic performance (Gualdi–Russo & L. Zaccani, 2001; Bandyopadhyay, 2007; Malosaouris et al., 2008) or as predictors for talent selection. That is the reason why they have been monitored for several years (Dostálová, Riegerová, & Přidalová, 2007; Fleck, Case, Puhl, & Van Handle, 1985; Tsunawake et al., 2003; Bandyopadhyay, 2007; Mala, Maly, Zahalka, & Bunc, 2010; Malosaouris, Bergeles,Barzouka,Bayos,Nassis & Koskolou et al., 2008; Riegerová & Ryšavý, 2001; Gualdi – Russo & Zaccani, 2001).

New technologies to improve the evaluation of CC have been developed during the last two decades and the studies that attempt to identify the importance of the ideal morphological profile in various sports have multiplied (Araujo, Araujo, Ferreira, Silva, & Machado, 2011; Carter, Ackland, Kerr, & Stapff, 2005; Sampaio, Janeira, Ibanez, & Lorenzo, 2006; Gabbett, Georgieff, & Domrow, 2007).

Volleyball is a technical and tactical sport where the the morphological characteristics of the athletes in terms of efficiency in blocking and shooting may present an incidence that fluctuate between 71% and 83% (Bandyopadhyay, 2007; Gualdi–Russo & Zaccani, 2001 ; Malosaouris et al., 2008; Gao, 2006 ; Hakkinen, 1993 ; Chen, 2005 ;Rocha & Barbanti, 2007). For example, a high percentage of body fat can have a negative effect on the speed, jump height, acceleration capability and, additionally, lead to an increase the use of energy (Svantesson, Zander, Klingberg,& Slinde, 2008; Zhang, 1998).

Having the control over the net has become an essential action that leads to master the game due to the increase in height and jumping ability of the players. Any team will lose its ability to earn points if they do not have control over the net (Stamm et al., 2003).

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, Rios, Echavarria, Martinez, & Castillo, 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 body mass from 71kg to 73.4 kg. Ferris, Signorille & Caruso (1995) identified an average size of 176 cm in their study, which is similar to other studies at that time.

Different studies on the body structure of high-achieving volleyball players state that these athletes have specific morphological characteristics (Zhang, 1998). However, despite this evidence, the fundamental variables of BC and their reference values in volleyball players of elite teams (UEFA Champions League, Olympic Games, World Championships, Europe Championship and prestigious club league winners) have not been defined clearly (Maly et al., 2011).

The aim of this study is to describe the morphological profile of high -achieving volleyball players of the thirteen best teams in the world, as ranked by the International Volleyball Federation 2013, by means of the reports found in the literature.

METHODOLOGY

A systematic review of the different studies published in the last fourteen years on the body composition (BC) of high-achieving volleyball players was developed. For the selection of the studies the following inclusion criteria were established: Studies evaluating the (BC) in high-achieving female volleyball players (players of the thirteen best countries in the world ranking of the International Volleyball Federation 2013), that clearly indicate the evaluation methods of each of the variables and describe the materials used for the evaluation of the variables.

No language restrictions were applied. Exclusion criteria: studies that only took weight and height as (BC) variables or were carried out in junior, children or college categories.

The following keywords were defined in order to search for information: body composition, anthropometric, somatotype, volleyball and elite sport; Also, various search methods were used: We first searched for the specialized databases of Medline, PubMed, Ebsco host, Science direct, Embase, Amed y Cinahl, Current Contents, Best evidence, Ovid, Jstor, Oxford Journals, Springerlink, Taylor & Francis Group, Wiley Online Library, Scisearch o Science, Citation Index, ProQuest, PEDro, SportDiscus, along with two other European databases, Ciscom and OpenSIGLE, which include unpublished works. Secondly, we did a search in full text journals that were available electronically on the International Network of Scientific Publications (INASP), BioMed central, and free medical journals. Thirdly, a manual review of indexes such as Index Medicus, Social Science Citation Index, Scopus and tables of contents of specialized journals was conducted: J Sports Sci Med, J Sports Med Phys Fitness, European J Sports Sci, Journal of Science and Medicine in Sport, Journal of Strength & Conditioning Research.

Fourthly, we reviewed the bibliographies of the various studies identified. Fifthly, we searched for doctoral thesis in the DissOnline thesis index of Great Britain and Ireland and in the system of university libraries in Spain. We also searched for papers presented at conferences in the BIOSIS data base and the Direct Plus British Library.

Sixthly, we contacted authors or research groups specialized in this topic and experts in the field in order to detect additional unpublished studies. The lists obtained were combined by means of the EndNote bibliographic software and the duplicates were deleted.

RESULTS

A total of 65 papers (61 articles and four doctoral theses) relevant by title and abstract, which were reviewed by the team of experts, was identified. Twenty-nine of them met the inclusion criteria and were examined thoroughly to assess the scientific quality. Finally, thirteen (12 articles and a doctoral thesis) were chosen for study. A literature review (Lidor & Ziv, 2010) was identified among them.

The most frequent exclusion criteria were the level in which the players competed, the age of the players (college players, or in junior or children categories) or the fact that the study was conducted in teams from countries that were not in the world ranking at the time of the review.

We used a total of 67 different variables to assess the (BC) of the volleyball players throughout the thirteen studies and we identified that 48 of them were not common. The most usual variables in the research were: height and body weight (thirteen studies); age (twelve studies); somatotype (seven studies); percentage of fat mass (five studies) and lean mass and triceps skinfold (four studies).

Only Zhang's work (2010) suggests the use of the International Working Group of Kinanthropometry (ISAK) in opposition to the anthropometric assessment technique used in each study. The other studies do not mention the technique used. Table 1 shows the characteristics of each of the studies that were included for the determination of the profile of high-achieving volleyball players.

Table 1, Identified studies that determine body composition in high performance volleyball players.

Author	Population n=	Country	Variables	Evaluation method	Instruments	Results
Maly et al., 2011	9	Russia	Age (years)	Bioimpedance		20,7 ± 2,0
			Size (cm)		SECA 242 Stadiometer	184,2 ± 7,9
			Weight (Kg)		SECA 769 Digital scale	71,2 ± 6,2
			Total body water (L)		BIA 2000 M Analyzer	40,1 ± 2,8
			Lean mass (Kg)			61,8 ± 6,2
			Extracellular mass (Kg)			25,7± 2,7
			Body cellular mass (Kg)			29,1 ± 1,8
			Ratio of the two previous (Kg)			0,8 ± 0,0
			Extracellular water (L)			17,0 ±2,1
			Intracellular water (L)			23,0±0,7
			(%) Body fat			14,7± 3,1
			Cellular body mass per kilo of body weight (rel)			0,4 ± 0,0
Maly, 2010,	12	European Champions League	Age (years)	Anthropometry	N/R	24,4 ± 2,8
			Size (cm)			184,0 ± 4,2
			Weight (Kg)			73,0 ± 5,9
			Total body water (L)	Bioimpedance	BIA 2000 M Analyzer	40,6 ± 2,4
			Lean mass (Kg)			55,7 ± 3,6
			Extracellular mass (Kg)			25,3 ± 2,3
			Body cellular mass (Kg)			30,4± 2,0
			Ratio of the two previous (Kg)			0,8 ± 0,0
			Extracellular water (L)			17,0 ± 1,8
			Intracellular water (L)			23,3 ± 0,6
			(%) Body fat			15,9 ± 1,8
Marques,et al, 2008	10	Serbia	Age (years)	Anthropometry	N/R	25,3 ± 1,3
			Size (cm)			187 ± 5,4
			Weight (Kg)			74,6 ± 8,1
			Size (m,)			1,88 ± 3,0
Toledo et al., 2008	11	Brasil	Age (years)	Anthropometry		25,2 ± 4,6
			Size (cm)		Sanny pachymeter,	182,6± 6,7
			Weight (Kg)		Filizola scale,	70,9 ± 6,5
			Endomorphy	Dermatoglyphics		3,5 ± 1,0

Author	Population n=	Country	Variables	Evaluation method	Instruments	Results
			Mesomorphy		Collector Impress ® ID of Cummins & Midllo 2005	3,0 ± 1,3
			Ectomorphy			3,5 ± 1,1

Author	Population n=	Country	Variables	Evaluation method	Instruments	Results
Dopsaj et al., 2010	16	Serbia	Age (years)	Anthropometry		22,7 ± 3,2
			Size (cm)			185,4± 7,8
			Weight (Kg)		SECA – CAS digital scale	71,6 ± 6,5
			Lean mass (Kg)		Don Howley -Franks, 1997	61,2 ± 4,9
			(%) Body fat			14,3 ± 2,9
			Fat-free mass ratio- % fat mass Lbm/Fat		Calliper TM Co, Inc,Nevada, EE,UU,	6,27 ± 1,6
			Triceps skinfold(mm)			10,0± 2,9
			Suprailiac skinfold (mm)			7,6 ± 2,3
			Quadriceps skinfold (mm)			15,5± 4,4
Carvajal, et al, 2008	25	Cuba	Size (cm)	Anthropometry	Holtain stadiometer	182,2± 4,2
			Weight (Kg)		Detecto Medic. scale	74,3 ± 5,1
			(%) Body fat		Holtain compass	22,3±2,7
			Active body mass index		Holtain calliper	0,9±0,0
			Endomorphy		Holtain calliper	2,6
			Mesomorphy			3,5
			Ectomorphy			3,0
Carvajal, et al 2009	43	Cuba	Age (years)	Anthropometry	*N/R*	22,8± 3,6
			Size (cm)			180,5± 4,2
			Weight (Kg)			73,6 ± 6,9
			Endomorphy			2,6 ± 0,8
			Mesomorphy			3,5± 0,8
			Ectomorphy			3 ±0,9
Araujo et al., 2011	16	Brasil	Age (years)	Anthropometry	Filizola stadiometer	25,6± 5,2
			Size (cm)			182,8± 7,0
			Weight (Kg)			72,5 ± 6,4
			Endomorphy			2,2± 0,5
			Mesomorphy			3,1 ± 1,0
			Ectomorphy			3,5 ± 1,0

Author	Population n=	Country	Variables	Evaluation method	Instruments	Results
Zhang, 2010	100	China	Age (years)	Anthropometry	Anthropometry equipment Rosscraft - Campbell 20, Campbell 10	22,3± 3,6
			Size (cm)			183,6± 5,7
			Weight (Kg)			70,5± 7,6
			Endomorphy			3,7 ± 0,9
			Mesomorphy			2,9 ± 1,0
			Ectomorphy			4,0 ± 1,1
			Height when sitting down (cm)			95,7 ± 3,5
			Reach when extending the arm (cm)			236,7± 7,8
			Acromion-Radial length (cm)			25,7± 1,4
			Radio-styloids length (cm)			43,1 ± 2,0
			Acromion-digital length (cm)			79,8 ± 3,6
			Ilioespinal height (cm)			103,9± 4,7
			Lateral tibial length (cm)			47,8 ± 2,2
			Achilles tendon length (cm)			27,9 ± 2,8
			Biacromial amplitude (cm)			38,7± 1,9
			Biliocristal amplitude (cm)			29,8± 1,6
			Transversal chest amplitude (cm)			27,9± 1,4
			Amplitude of the humeral condyle (cm)			6,5±0,3
			Amplitude of the femoral condyle (cm)			9,8 ± 0,4
			Hand amplitude (cm)			7,9 ± 0,3
			Flexed and contracted arm perimeter (cm)			28,7± 1,9
			Relaxed biceps perimeter (cm)			27,1 ± 1,9
			Corrected relaxed biceps perimeter (cm)			25,6± 1,5
			Flexed and contracted arm perimeter less relaxed arm perimeter (cm)			1,7± 0,7
			Forearm perimeter (cm)			24,6 ± 1,5
			Wrist perimeter (cm)			15,7 ± 0,8
			Waist perimeter (cm)			72,2 ± 5,7
			Gluteal perimeter (cm)			97,3 ± 4,9
			Half muscle perimeter (cm)			53,1 ± 3,4
			Calf perimeter (cm)			36,7± 2,2
			Corrected calf perimeter (cm)			35,7±1,9
			Ankle perimeter (cm)			21,5± 1,7
			Triceps skinfold (mm)			14,6 ± 3,9
			Subscapular fold (mm)			12,5 ± 3,7
			Supraspinal skinfold (mm)			11,8 ± 4,2
			Gastrocnemius fold (mm)			10,4 ± 3,3
			sum of the four folds (triceps, subscapularis, supraspinatus, gastrocnemius) (mm)			49,6 ±13,4

Autor	Población n=	País	Variables	Evaluation method	Instruments	Results
Grgantov, et al. 2006	17	Russia	Age (years)	Anthropometry	N/R	18,5± 0,5
			Size (cm)			175,9 ± 7,3
			Weight (Kg)			66,8 ± 7,3
			Subscapular fold (mm)			11,0 ± 2,2
			Triceps skinfold (mm)			14,7 ± 2,5
			Elbow diameter (cm)			6,4 ± 0,2
			Ankle Diameter (cm)			6,7 ± 0,5
			Foot reach (cm)			231 ± 10,8
			Foot length (cm)			25,7 ± 1,4
			Upper arm perimeter (cm)			26,8 ± 1,7
			Abdominal perimeter (cm)			80,2 ± 5,4
			Thigh perimeter (cm)			58,2 ± 2,5
			Wrist diameter (cm)			5,3 ± 0,2
			Supra-Iliocrestal skinfold (mm)			10,7 ± 3,4
Mala et al., 2010	12	Serbia	Age (years)	Bioimpedance	BIA 2000 M	24,0 ± 1,1
			Size (cm)			179,1 ± 6,7
			Weight (Kg)			66,8 ± 6,9
			Total body water (L)			21,8 ± 0,6
			Lean mass (Kg)			55,2 ± 4,4
			Extracellular mass(Kg)			23,9 ± 2,4
			Cellular mass (Kg)			25,6 ± 1,7
			Ratio of the two previos (Kg)			0,9 ± 0,1
			Extracellular water (L)			14,2 ± 1,6
			Intracellular water (L)			21,8 ± 0,6
			(%) Body fat			18,0 ± 2,2
Kautzner, 2010	20	Brasil	Age (years)	Anthropometry	NR	23,5 ± 3,2
			Size (cm)			180 ± 0,1
			Weight (Kg)			71,0 ± 9,5
			Endomorphy			2,8 ± 2,0
			Mesomorphy			3,6 ± 1,4
			Ectomorphy			2,8 ± 0,6

Author	Population n=	Country	Variables	Evaluation method	Instruments	Results
Carvajal et al., 2012	41	Cuba	Age (years)	Anthropometry	N/R	23,1 ± 4,0
			Size (cm)			181,6 ± 3,9
			Weight (Kg)			75,2 ± 5,8
			Abdominal skinfold (mm)			11,6 ± 4,5
			Thigh skinfold (mm)			14,2 ± 4,7
			Triceps skinfold (mm)			10,5 ± 2,1
			Subscapular fold (mm)			10,5 ± 3,1
			Gastrocnemius fold (mm)			12 ± 5,6
			Supraspinal skinfold (mm)			8,5 ± 3,8
			Leg perimeter (cm)			36,8 ± 1,7
			Waist perimeter (cm)			75,6 ± 4,8
			Forearm perimeter (cm)			25,5 ± 1,0
			Head perimeter (cm)			53,5 ± 4,8
			Extended arm perimeter (cm)			27,5 ± 1,7
			Flexed arm perimeter (cm)			29,5 ± 1,7
			Chest perimeter cm)			89,4 ± 3,6
			Thigh perimeter (cm)			57,2 ± 3,7
			Femoral diameter (cm)			9,8 ± 0,4
			Biacromial diameter (cm)			39,8 ± 1,2
			Bi-iliocrestal diameter (cm)			27,8 ± 1,5
			Antero-posterior diameter of the chest (cm)			26,4 ± 1,2
			Transverse diameter of the chest (cm)			18,2 ± 1,0
			Humeral diameter (cm)			6,9 ± 0,3
			Height when sitting down (cm)			90,4 ± 2,3

Table 2 shows the frequency of occurrence, the average value and standard deviation of each of the variables addressed by the various investigations in table 3 shows the number of variables per study.

Table 2. Variables used in the different studies

Variables	Studies*	Fr	%	Average results DS	Average DS
Size (cm)	1, 2, 3, 4,5, 6, 7, 8, 9, 10, 11, 12,13	13	100	(184,2± 7,9),(184± 4,2),(187± 5,4), (182,6±,6,7), (185,4± 7,8),(182,2± 4,2), (180,5± 4,2),(182,8± 7,0) (183,6± 5,7), (175,9± 7,3),(179,1± 6,7),(180±0,1), (181,6± 3,9)	182,6±2,5
Age (years)	1, 2, 3, 4,5, 7, 8, 9, 10, 11, 12,13	12	92	(20,7± 2),(24,4± 2,8),(25,3±1,3), (25,2±4,6),(22,7± 3,2), (22,8± 3,6), (25,6± 5,2), (22,3± 3,6), (18,5± 0,5), (24± 1,1),(23,5± 3,2),(23,1± 4,0)	21,3± 2,1
Weight (Kg)	1, 2, 3, 4,5, 6, 7, 8, 9, 10, 11, 12,13	13	100	(71,2± 6,2),(73± 5,9),(74,6± 8,1), (70,9± 6,5), (71,6± 6,5),(74,3±5,1), (73,6± 6,9),(72,5± 6,4),(70,5±7,6), (66,8±7,3), (66,8±6,9), (71±9,5), (75,2±5,8)	71,7± 2,1
(%) body fat	1, 2, 5, 6, 11,	5	38	(14,7±3,1),(15,9±1,8),(14,3±2,9), (22,3± 2,7),(18± 2,2)	17,1± 3,3
Active body mass index	6	1	8	0,95± 0,0	0,95±0,0

Lean mass (Kg)	1, 2, 5, 11	4	31	(61,8±6,2),(55,7±3,6),(61,2±4,9),(55,2±4,4)	58,5±3,5
Cellular mass (Kg)	1, 2, 11	3	23	(29,1±1,8),(30,4±2),(25,6±1,7)	28,4± 2,5
Extracellular mass (Kg)	1, 2, 11	3	23	(25,7±2,7), (25,3±2,3),(23,9±2,4)	25,01±0,9
Extracellular mass / cellular mass (Kg)	1, 2, 11	3	23	(0,8±0,09),(0,8±0,08),(0,9±0,1)	0,9± 0,1
Total body water L)	1, 2, 11	3	23	(40,1±2,8),(40,6±2,4),(21,8±0,6)	34,23±10,7
Extracellular water (L)	1, 2, 11	3	23	(17±2,1),(17±1,8),(14,2±1,6)	16,16±1,6
Intracellular water (L)	1, 2, 11	3	23	(23±0,7),(23,3±0,6),(21,8±0,6)	22,77±0,7
Body cellular mass per Kg of body weight (kg)	1	1	8	0,4± 0,0	0,4±0,0

***** 1 (Maly et al., 2011), 2 (Maly, 2010), 3 (Marques et al., 2008), 4 (Toledo et al., 2008), 5 (Dopsaj et al., 2010), 6 (Carvajal et al., 2008), 7 (Carvajal et al., 2009), 8 (Araujo et al., 2011), 9 (Zhang, 2010), 10 (Grgantov et al., 2006), 11 (Mala et al., 2010), 12 (Kautzner, 2010), 13 (Carvajal et al., 2012) .
(cm) centímetros, (Kg) kilogramos, (L) litros

Variables	Studies*	Fr	%	Results	Average D/S
Triceps fold (mm)	5, 9, 10, 13	4	31	(10±2,9),(14,6±3,9),(14,7±2,5),(10,5±2,1)	13,4±3,0
Subscapular fold (mm)	9, 10, 13	3	23	(12,5±3,7), (11±2,2),(10,5±3,1)	11,46±3
Quadriceps fold (mm)	5, 13	2	15	(15,5±4,4), (14,2±4,7)	14,52±4,4
Suprailiac fold (mm)	5, 10	2	15	(7,6±2,3), (10,7±3,4)	8,64± 2,8
Gastrocnemius fold (mm)	9, 13	2	15	(10,4±3,3),(12±5,6)	10,4± 3,3
Supraspinal fold (mm)	9, 13	2	15	(11,8±4,2),(8,5±3,8)	10,15±2,3
Sum of four skinfolds (triceps, subscapularis, supraspinatus, gastrocnemius) (mm)	9	1	8	49,6±13,4	49,6± 13,4
Abdominal fold (mm)	13	1	8	11,6±4,5	11,6± 4,
Endomorphy	4, 6, 7, 8, 9, 12	6	46	(3,5±1),(2,6±NR),(2,6± 0,8),(2,2±0,5),(3,7±0,9), (2,8±2)	2,9±0,5
Mesomorphy	4, 6, 7, 8, 9, 12	6	46	(3,0±1,3),(3,5± NR),(3,5±0.8),(3,1±1),(2,9± 1), (3,6±1,4)	3,3±0,3
Ectomorphy	4, 6, 7, 8, 9, 12	6	46	(3,5±1,1),(3,0± NR) (3±0,9),(3,5±1), (4±1,1), (2,8±0,6)	3,3±0,4
Calf perimeter cm)	9, 13	2	15	(36,7±2,2), (36,8±1,7)	36,8±0,1
Corrected calf perimeter (cm)	9	1	8	35,7±1,9	35,7± 1,9
Relaxed biceps perimeter (cm)	9, 10, 13	3	23	(27,1± 1,9),(26,8±1,7),(27,5±1,7)	26,6± 1,8
Corrected relaxed biceps perimeter (cm)	9	1	8	25,6±1,5	25,6±1,5
Waist perimeter (cm)	9, 13	2	15	(72,2±5,7), (75,6±4,8)	76±4,0
Flexed and contracted arm perimeter (cm)	9	1	8	(28,7±1,9), (29,5±1,7)	28,9±1,8

Flexed and contracted arm perimeter less relaxed arm perimeter (cm)	9	1	8	1,7± 0,7	1,7±0,7
Forearm perimeter (cm)	9, 13	2	15	(24,6±1,5), (25,5±1,0)	25,1±0,6
Wrist perimeter (cm)	9	1	8	15,7± 0,8	15,7±0,8
Gluteal perimeter (cm)	9	1	8	97,3±4,9	97,3±4,9
Half-muscle perimeter (cm)	9, 10,13	3	23	(53,1±3,4), (58,2±2,5), (57,2±3,7)	56,1±3,4
Ankle perimeter (cm)	9	1	8	21,5±1,7	21,5±1,7
Head perimeter (cm)	13	1	8	53,5±4,8	53,5±4,8
Chest perimeter (cm)	13	1	8	89,4±3,6	89,4±3,6

*4 (Toledo et al., 2008), 5 (Dopsaj et al., 2010), 6 (Carvajal et al., 2008), 7 (Carvajal et al., 2009), 8 (Araujo et al., 2011), 9 (Zhang, 2010), 10 (Grgantov et al., 2006), 12 (Kautzner, 2010), 13 (Carvajal et al., 2012).
(cm) centímetros, (mm) milímetros

Variables	Studies*	Fr	%	Results	Average D/S
Bi-iliocrestal diameter (cm)	13	8	7%	27,8±1,5	27,8±1,5
Antero-posterior chest diameter (cm)	13	8	7%	26,4±1,2	26,4± 1,2
Chest transversal diameter (cm)	13	8	7%	18,2±1	18,2± 1
Radial-styloids length (cm)	13	8	7%	43,1±2,0	43,1±2
Acromion-Radial lentgh (cm)	13	8	7%	25,7±1,4	25,7±1,4
Acromion-digital lentgh (cm)	13	8	7%	79,8±3,6	79,8±3,6
Iliospinal height (cm)	13	8	7%	103,9± 4,7	103,9±4,7
Lateral tibial length(cm)	13	8	7%	47,8± 2,2	47,8±2,2
Achilles tendon length (cm)	13	8	7%	27,9±2,8	27,9±2,8
Biacromial amplitude (cm)	13	8	7%	38,7±1,9	38,7±1,9
Biiliocrestal amplitude (cm)	13	8	7%	29,8±1,6	29,8±1,6
Transversal amplitude of the chest (cm)	13	8	7%	27,9±,4	27,9±,4
Amplitude of the humeral condyle (cm)	13	8	7%	6,5±0,3	6,5±0,3
Amplitude of the femoral condyle (cm)	13	8	7%	9,8±0,4	9,8±0,4
Hand amplitude (cm)	13	8	7%	7,9±0,3	7,9±0,3
Foot length (cm)	10	8	7%	25,7±1,4	25,7±1,4
Size (m)	3	8	7%	1,8±3,0	1,8±3,0
Lbm/fat (kg)	5	8	7%	6,27±1,6	6,27±1,6
Height when sitting down (cm)	9, 13	16	14%	(95,7±3,5),(90,4±2,3)	93,1±3,7
Reach when extending the arm (cm)	9, 10	16	14%	(236,7± 7,8), (231±10,8)	233,85±4

*3 (Marques et al., 2008), 5 (Dopsaj et al., 2010), 9 (Zhang, 2010), 10 (Grgantov et al., 2006, 13 (Carvajal et al., 2012)
(cm) centímetros, (m) metros, (Kg) kilogramos

Table 3 Number of variables per study

<table>
<tr><th>Study</th><th>Method</th><th>Technique</th><th>Number of studied variables</th><th>%</th></tr>
<tr><td>Zhang, 2010</td><td>Anthropometry</td><td>ISAK</td><td>43</td><td>64,1</td></tr>
<tr><td>Carvajal 2012</td><td>Anthropometry</td><td>NR</td><td>24</td><td>35,8</td></tr>
<tr><td>Grgantov, 2006</td><td>Anthropometry</td><td>NR</td><td>14</td><td>20,8</td></tr>
<tr><td>Malý, 2011</td><td>Bioimpedance</td><td></td><td>13</td><td>19,4</td></tr>
<tr><td>Malá, 2010</td><td>Anthropometry / Bioimedance</td><td></td><td rowspan="2">12</td><td rowspan="2">19,9</td></tr>
<tr><td>Maly, 2010,</td><td>Anthropometry</td><td>NR</td></tr>
<tr><td>Dopsaj, 2010</td><td>Anthropometry</td><td>NR</td><td>11</td><td>16,4</td></tr>
<tr><td>Carvajal-Veitia, 2008</td><td>Anthropometry</td><td>NR</td><td rowspan="5">6</td><td rowspan="5">8,9</td></tr>
<tr><td>Carvajal, 2009</td><td>Anthropometry</td><td>NR</td></tr>
<tr><td>Araujo, 2011</td><td>Anthropometry</td><td>NR</td></tr>
<tr><td>Kautzner, 2010</td><td>Anthropometry</td><td>NR</td></tr>
<tr><td>Toledo, 2008</td><td>Anthropometry/ Dematoglyphics</td><td></td></tr>
<tr><td>Marques, 2008</td><td>Anthropometry</td><td>NR</td><td>4</td><td>5,9</td></tr>
</table>

When looking at the nationality of the volleyball players of the studies we can see that four studies were conducted in Cuba; three in Brazil, three in Serbia, two in Russia, one in the European League and one in China.

The studies with the largest population are: Italy with 129 and China with 100, followed by three Cuban studies with 44 athletes. The other nine studies have an average population of 15 players. Table three shows the number of indexes used in each study and we can see that 93% of the studies addresses less than 25% of all variables. Eleven studies used anthropometry as a method for assessing body composition, three used bioimpedance and one anthropometry and dermatoglyphics and only one study (Zhang, 2010) indicates the anthropometry method used.

Table 4 shows a comparative study between the countries and the three morphological variables common to all of them.

Table 4 Comparison of anthropometric variables between countries

Variable	Cuba [1] 2012	Brasil [2] 2011	China [3] 2010	Serbia [4] 2010	Russia [5] 2011	European Champions League 2010 [6]
Age	23,1 ± 4,0	25,6± 5,2	22,3± 3,6	22,7 ± 3,2	20,7 ± 2,0	24,4 ± 2,8
Size	181,6 ± 3,9	182,8± 7,0	183,6± 5,7	185,4± 7,8	184,2 ± 7,9	184±4,2
Weight	75,2 ± 5,8	72,5 ± 6,4	70,5± 7,6	71,6 ± 6,5	71,2 ± 6,2	73±5,9

1 Carvajal 2012; 2 Araujo, 2011; 3 Zhang, 2010; 4 Malá, 2010; 5 Malý, 2011; 6 Maly, 2010,

Table five shows the morphological variables according to the player position. Only the studies by Zhang, (2010) and Carvajal et al., (2012) provide this information.

Table 5 Morphological characteristics according to the position of game

Variables	Hitter	Opposite	Middle	Setter
	Average	Average	Average	Average
Age (years)	23,0±0,0	23,0±0,0	24,0±4,1	23,0±0,0
Size (cm)	185±1,4	181±2,8	188±4,6	179±0,7
Weight (kg)	74,5±4,9	72±2,8	75±8,6	73±5,7
Endomorphy	2,8±0	3±0,3	2,8±0,9	3,3±0,1
Mesomorphy	3,0±0,4	3,25±0,2	2,4±0,9	3,65±0,4
Ectomorphy	3,8±0,4	2,85±0,8	3,7±1,3	2,75±0,6
% Body fat	13,6± 2,4	13,6± 2,4	13,6± 3,4	14,6 ±1,8

DISCUSSION

The evaluation of the (BC) in the context of high-achieving women's volleyball has been greatly developed during the recent decades because of the importance that this in terms of performance and achievement, which has led to the high number of studies that attempt to determine the ideal morphological profile. However, we could not find a consensus in the reviewed studies on what would be the most relevant variables of the (BC) to women's volleyball.

We noted that only the variables of size and weight were addressed by all studies. For several decades, the correlation between height and athletic performance in volleyball (Chen, 1999; Gao, 2006; Gladden & Colacino,1978; Morrow, Jackson, Hosler, & Kachurik, 1979; Wang & Yang, 2009) had been observed due to the fact that the efficiency in blocking and attacking actions does not only depend on the jumping ability of the athletes. Blocking and attacking represent the 45% of the game actions and are responsible for 80% of the points obtained during an international match (Voigt, 2003). Performance in these actions and the service depends largely on the height of the athletes (Stanganelli, Dourado, Oncken, Mançan, & Da Costa, 2008).

This phenomenon of the importance of size on performance in women's volleyball is noticeable when observing its evolution in the last decade. For example, the average height of the Chinese players went from 178.5 cm in the XXVI Olympic Games to 184cm. at the XXIX Olympic Games (Zhang, 2010). This trend of greater than 180cm. size observed in China is ratified in the studies analyzed and the results obtained from the World Volleyball Games of 2002 in which the average size of the players of the top three teams (Italy, Russia and the United States) was 186,2cm era. (Li, 2004).

In recent decades, the importance of size became a conditional factor in volleyball due to the change in the hopping training strategies, the chronic long-term injuries that this type of training can generate and the amount of time that was necessary to carry it out. Therefore, we might think that this size profile in volleyball may be due to the requirements of the new training methods rather than the secular evolution.

The second most studied variable of the (BC) was the somatotype. We observed that volleyball players have a meso-ectomorphic profile (Toledo et al., 2008; Carvajal et al., 2008; Carvajal et al., 2009; Zhang, 2010; Kautzner, 2010; Araujo et al., 2011). These results are consistent with those observed in the study by Papdopoulou, Gallos, George, Tspakidou, & Fachantidou, (2002). This means that the increase in size is not concomitant with the increase in body weight. Similarly, it could be assumed, according to the somatotype result, that an increase in body weight is due to an increase in muscle mass and not fat mass. However, this can not be stated due to the few studies that address the assessment of muscle mass percentage.

According to the studies by Sheppard (2008) and Piucco (2009), players with certain morph-structural features like higher height and lower fat mass can block higher and have a greater relative power in their lower limbs which improves their mechanical efficiency. This is confirmed by the study on the European Champions League players, who showed a high proportion of lean mass and low fat mass. This could mean some changes in the relationship between the intracellular and extracellular mass, the percentage of body cell mass ratio, and the intracellular and extracellular fluid. (Maly et al., 2011). With regard to the other (BC) variables used in the studies, it is not possible to come up with an analysis to identify its importance in terms of performance in volleyball because they were only addressed in a few studies. This fact indicates the need for analytical studies from different perspectives that allow us to define clearly what would be the different morphological and body composition aspects that are crucial to the performance of high-achieving volleyball players.

For example, to some experts in the field, the size of the body or the size of the hand are really important but they were only approached in one study (Marques et al., 2008). The diversity of methods used to evaluate the (BC) makes difficult to make comparisons or relations between the results obtained in each of the studies.

By observing the methods used to assess body composition in each of the studies, we can see that they present a high utilization of anthropometry, which is a doubly indirect method. This leads to measurement errors because almost all anthropometric variables include a great variety of tissues and their effect on the recorded values is not always very clear. For example, the variation of the skin thickness affects the value of the skinfold as a measurement of the subcutaneous fat. Measurements of bone lengths and widths are affected by the soft tissue covering these bony landmarks. In spite of the existence of a correlation between the values obtained through anthropometric perimeters and radiology, the values of the latter tend to be lower (Heymsfield, Lohman, Wang, & B, 2007).

Additionally, most of the studies, with the exception of Zhang´s (2010), do not mention the technique used for anthropometric assessment. The other method used was bioimpedance, which is based on the relationship between the water content of the body and the (BC) with its electrical properties (composition, hydration, density) as well as age, gender, race and fitness (Heymsfield et al ., 2007).

These factors coupled with the frequency and type of equipment used may change the results. Multifrequency BIA measurement uses standardized formulas to calculate the lean mass on the assumption that the water content of lean mass is 73% (Mika, Herpertz-Dahlmann, Heer, & Holt-kamp, 2004). In female athletes, this assumption can be influenced by insufficient hydration, training load, poor nutrition, menstruation, etc., which could lead to an underestimation or overestimation of lean mass. This divergence in methods does not allow to establish actual reference values for the variables studied and could partly explain the difference in some results. For example, the percentage of fat mass in the study of Carvajal (2008) reports a value of 22% which is much higher than those observed in other studies (around 14%). Maly (2011) reported values of fat mass percentage in high-achieving volleyball players high that are ranged from 11.7% to 27.1%.

No studies using more reliable methods for determining the (BC) such as plethysmography, DEXA or MRI, that allow to establish a benchmark of high reliability, were identified.

With regard to methodology, only one study described the process used for the measurement of anthropometric variables in detail. Other studies do not present this methodology rigorously.

As for the instruments used for the evaluation, the studies did not specify the technical characteristics of each of them and in some cases they are not mentioned.

CONCLUSIONS

La revisión de la literatura reveló que aunque la mayoría de los investigadores realizaron una descripción de las características morfológicas básicas de las jugadoras de voleibol. The literature review revealed that although most researchers conducted a description of the basic morphological characteristics of volleyball players, the studies were limited to a few typical variables which does not allow to ensure a complete and thorough analysis. Therefore, the number of studies of volleyball players from the top ten countries in the world must be increased with methodological designs for rigorous assessment and a higher level of reliability which include a greater number of variables such as the size of the hand and the length of the Achilles tendon which have an important relation on performance in this sport.

In this study, a first approach to the morphological profile of high-achieving volleyball players is performed. We also identified some of the key variables that could be the following: height, 182.6 (cm), body weight, 71.7 (kg), percentage of fat mass, 17.1%, somatotype (2.9)-(3.3)-(3.3), size 185 (cm), height when sitting down 93.1 (cm), reach when extending the arm, 233 (cm) and Ilioespinal height, 103 (cm).

The determination of the morphological profile 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.

This is one of the few studies in which a systematic review on the topic is conducted and therefore it provides the necessary information that allows to approach the morphological profile that a high-achieving volleyball player must have.

REFERENCES

1. Araujo, B. G., Araujo, S., Ferreira, H., Silva, P., & Machado, V. 2011. Discriminant effect of morphology and range of attack on the performance level of volleyball players Rev Bras Cineamtropom 2. Desempenho Hum, 13(3), 223-229. Doi: 10.5007/1980-0037.2011v13n3p223
2. Bandyopadhyay, A. 2007. Anthropometry and Body Composition in Soccer and Volleyball Players in West Bengal India. *JPA, 26*(4), 501-505. Doi.org/10.2114/jpa2.26.501.
3. Bortoluzzi, V., Diefenthaeler, F., & Vaz, V. 2009. Comparative study of anthropometric variables in female classical ballet dancers, volleyball players and physically active subjects. *Rev. Bras. Cineantropo. Desempehno. Hum., 11*(1), 8-13. Doi org/10.5007/1980-0037.2009v11n1p8
4. Carter, J., Ackland, T., Kerr, D., & Stapff, A. 2005. Somatotype and size of elite female basketball players. *J Sports Sci, 23*(10), 1057-1063. doi.org/10.1080/02640410400023233
5. Carvajal, V. W., Ríos, H. A., Echevarria, G. I., Martínez, A. M., & Eugenia, C. M. 2008. Tendencia secular en deportistas cubanos de alto rendimiento: periodo 1976-2008. *Rev. Esp. Antrop. Fís., 28*, 71-79.
6. Carvajal, W., Betancourt, H., León, S., Deturnel, Y., Martínez, M., Echevarría, I., Serviat, N. 2012. Kinanthropometric Profile of Cuban Women Olympic Volleyball Champions. *MEDICC Review, 14*(2). doi.org/10.1590/S1555-79602012000200006.
7. Carvajal, W., Diaz, I., Leon, S., & Echavarria , I. 2009. El somatotip de les jugadores de voleibol cubanes d'alt nivell: període 1992-2000. *a p u n t s m e d e s p o r t., 163*, 127-132.
8. Carvajal, W., Rios, A., Echavarria, I., Martinez, M., & Castillo, E. 2008. Tendencia secular en deportistas cubanos de alto rendimiento: periodo 1976-2008. *Rev Esp Antrop Fís., 28*, 71-79.
9. Chen, S. 1999. Some differences in non-technique factor between Asian and Euro-American female volleyball player *Journal of China Sport Science and Technology, 14*, 35-43.
10. Chen, X. 2005. *Volleyball.* Beijing: Higher Education Press.
11. Dopsaj, M., Nesic, G., & Copic, N. 2010. The multicentroid position of the anthropomorphological profile of female volleyball players at different competitive levels. *Series: Physical Education and Sport, 8*(1), 47-57.
12. Dostálová, I., Riegerová, J., & Přidalová, M. 2007. Body composition of young volleyball players. *Acta Universitatis Palackianae Olomucensis.Gymnica 37*(2), 42-54.
13. Ferris D, Signorille J & Caruso J.1995;The relationship between physical and physiological Variables and volleyball spiking velocity. *Journal of strengh and Conditioning Research, 9*(1),32-36.
14. Fleck, S. J., Case, S., Puhl, J., & Van Handle, P. 1985. Physical and physiological characteristics of elite women volleyball players. *Canadian Journal of Applied Sport Sciences,, 10*(3), 122-126.

15. Gabbett, T., & Georgieff, B. 2007. Physiological and anthropometric characteristics of Australian junior national, state, and novice volleyball players. *J Strength Cond Res, 21*, 481-486.
16. Gabbett, T., Georgieff, B., & Domrow, N. 2007. The use of physiological, anthropometric and skill data to predict selection in a talent-identified junior volleyball squad . *J Sports Sci, 25*(12), 1337-1344. doi.org/10.1590/S1555-79602012000200006.
17. Gao, S.-L. 2006. Comparative Analysis on the Physique and Height over Net of Women's Volleyball Players between the 27th and the 28th Olympic Games. *Journal of Beijing Sport University, 5*.
18. Gladden, L., & Colacino, D. 1978. Characteristics of volleyball players and success in a national tournament. . *Journal of Sports Medicine & Physical Fitness, 18*, 57-64.
19. Grgantov, Z., Katic, R., & Jankovic, V. 2006. Morphological Characteristics, Technical and Situation Efficacy of Young Female Volleyball Players. *Coll. Antropol., 30*(1), 87-96.
20. Gualdi – Russo, E., & Zaccani, L. 2001. Somatotipe, role and performance in elite volleiball players. *J Sports Med Phys Fitness., 41*, 256-262.
21. Gualdi – Russo, E., & Zaccani, L. 2001. Somatotype, role and performance in elite volleyball players. *Journal of Sports Medicíně and Physical Fitness,, 41*(2), 256-262.
22. Gualdi – Russo, E., & Zaccani, L. 2001. Somatotype, role and performance in elite volleyball players. *J Sports Med Phys Fitness., 41*(12), 256-262.
23. Hakkinen, K. 1993. Changes in physical fitness profile in female volleyball players during the competitive season. *Journal of Sports Medicine & Physical Fitness, 33*, 223-232.
24. Heymsfield, S. B., Lohman, T. G., Wang, Z., & B, G. S. 2007. *Human body conposition*. Chanpaing: McGraw-Hill.
25. Kautzner, N. 2010. Selecao de testes para o jogador de voleibol. *Movimento & percepcao, Espirito Santo do Pinhal, 11*(16).
26. Li, J. 2004. Comparative analysis on characteristics of smash high between our volleyball players and world elite players. *China Sport Science and Technology, 3*, 46-50.
27. Lidor, R., & Ziv, G. 2010. Physical and physiological attributes of female volleyball players-A Review. *Journal of Strength & Conditioning Research, 24*(7), 1963-1973. doi.org/10.1519/JSC.0b013e3181ddf835.
28. Mala, L., Maly, T., Zahalka, F., & Bunc, V. 2010. The profile and comparison of body composition of elite female volleyball players. *Kinesiology, 42*(1), 90-97.
29. Malosaouris, G. G., Bergeles, N. K., Barzouka, K. G., Bayios, I. A., Nassis, G. P., & Koskolou, M. D. 2008. Somatotype, size and body composition of competetive female volleyball players. *Journal of Science and Medicine in Sport, 11*(3), 337-344. doi.org/10.1016/j.jsams.2006.11.008.
30. Maly, T. 2010. Body composition profile of elite women volleyball players. *International Journal of Volleyball Research, 10*(1), 14-19.

31. Maly, T., Mala, L., Zahalka, F., Balas, J., & Cada, M. 2011. Comparison of body composition between two elite womens volleyball teams. *Acta Univ. Palacki. Olomuc., Gymn., 41*(1).
32. Marques, M. C., Tillaar, R. V. d., Vescovi, J. D., & Gonzalez-Badillo, J. J. 2008. Changes in strength and power performance in elite senior female professional volleyball players during the in-season: a case study. *Journal of Strength and Conditioning Research;, 22*(4), 1147-1155. doi.org/10.1519/JSC.0b013e31816a42d0.
33. Mika, C., Herpertz-Dahlmann, B., Heer, M., & Holt-kamp, K. 2004. Improvement of nutritional status as assessed by multifrequency BIA during 15 weeks of refeeding in adolescent girls with anorexia nervosa. *The Journal of Nutrition, 134*(11), 3026-3030.
34. Moon, J., Tobkin, S., Smith, A., Loockwood, C., Walter, A., Cramer, J., Stout, J. 2009. Anthropometric Estimations of percent body fat in NCAA division I female Athletes: A 4-compartment model validation. . *Journal of Strength and Conditioning Research;, 23*(4), 1068-1076. doi.org/10.1519/JSC.0b013e3181aa1cd0.
35. Morrow, J., Jackson, A., Hosler, W., & Kachurik, J. 1979. Importance of strength, speed, and body size for team success in women's intercollegiate volleyball. *Research Quarterly, 50*, 429.437.
36. Papdopoulou, S., Gallos, G., George, P., Tspakidou, A., & Fachantidou, A. 2002. The Somatotype of Greek Female Volleyball Athletes. *International Journal of Volleyball Research, 5*, 22-25.
37. Piuco, T., & Santos, S. 2009. Relacao entre porcentual de gordura corporal, desempenho no salto vertical e impacto nos membros inferiores em atletas de voleibol. *Fitnes & Performance Journal, 8*(1), 9-15. Doi 10.3900/fpj.8.1.9.p
38. Riegerová, J., & Ryšavý, J. 2001. Somatodiagnostic of female, secondary school age volleyball players. *Acta Universitatis Palackianae Olomucensis. Gymnica,, 31*(1), 37-42.
39. Rocha, M. A., & Barbanti, V. J. 2007. Análise das Ações de Saltos de Ataque, Bloqueio e Levantamento no Voleibol Feminino. *Rev. Bras Cineantropom Desempnh, 9*(Valdir José Barbanti), 284-290.
40. Sampaio, J., Janeira, M., Ibanez, S., & Lorenzo, A. 2006. Discriminant analysis of game-related statistics between basketball guards, forwards and centres in three professional leagues. *European J Sports Sci, 6*(3), 173-178. doi.org/10.1080/17461390600676200.
41. Sands, W., Smith, L., Kivi, D., Mcneal, J., Dorman, J., Stone, M., & Cormie, P. 2005. Anthropometric and physical abilities profiles: US National Skeleton Team. *Sports Biomech 4*(2), 197-214. doi.org/10.1080/14763140508522863.
42. Sheppard, J. M., Cronin, J. B., Gabbett, T. J., McGuigan, M. R., Etxebarria, N. & Newton, R. U. Relative importance of strength, power, and anthropometric measures to jump performance of elite volleyball players. J. Strength. Cond. Res., 22(3):758-65, 2008. doi.org/10.1519/JSC.0b013e31816a8440.

43. Stamm, R., Veldre, G., Stamm, M., Thomson, K., Kaarma, H., Loko, J., & Koskel, S. 2003. Dependence of young female volleyballers' performance on their body build, physical abilities, and psycho-physiological properties. *J Sports Med Phys Fitness., 43*(3), 291-299.
44. Stanganelli, L., Dourado, A., Oncken, P., Mançan, S., & Da Costa, S. 2008. Adaptations on Jump Capacity in Brazilian Volleyball Players Prior to the Under-19 World Championship. *Journal of Strength & Conditioning Research, 22*, 741-749. doi.org/10.1519/JSC.0b013e31816a5c4c.
45. Svantesson, U., Zander, M., Klingberg, S., & Slinde, F. 2008. Body composition in male elite athletes, comparison of bioelectrical impedance spectroscopy with dual energy X-ray absorptiometry. *Journal of Negative Results in BioMedicine, 7*(1), 1017-1022. doi.org/10.1186/1477-5751-7-1.
46. Toledo, C., Silva, P., Roquetti, P., & Fernández, J. 2008. Perfil dermatoglifico, somatotípico e da força explosiva de atletas da seleção brasileira de voleibol feminino. *Fitnnes & Performance Journ, 7*(1), 35-40.
47. Tsunawake, N., Tahara, Y., Moji, K., Muraki, S., Minowa, K., & Zukawa, K. 2003. Body composition and physical fi tness of female volleyball and basket-ball players of the Japan inter high school champion-ship teams. *Journal of Physiological Anthropology and Applied Human Science, 22*(4), 195-201. doi.org/10.2114/jpa.22.195.
48. Voigt HF, V. K. 2003. The Value of Strength-Diagnostic for the Structure of Jump Training in Volleyball. *European Journal of Sport Science,, 3*(3), 1-10. doi.org/10.1080/17461390300073310.
49. Wang, Y.-d., & Yang, Z. 2009. A Comparative Analysis on Non-technical Factors of China Women's Volleyball Team and Strong Teams from America and Europe in Olympic Games. *Journal of Beijing Sport University, 03*, 128-141.
50. Zhang, R. 1998. Features of the women volleyball player's body shape and bounce quality in the 26th Olympic game analyzing the present situation of Asian women volleyball teams. *Journal of Guangzhou Physical Education Institute, 18*, 99-103.
51. Zhang, Y. 2010. An investigation on the anthropometry profile and its relationship with physical performance of elite Chinese women volleyball players. *Southern Cross Univers.*

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