

Dermatoglyphic, somatotype, and explosive strength profiles of women's volleyball of the Brazilian team

Original Article

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ABSTRACT: Introduction: The position of prominence of the Brazilian volleyball in the international scenery requests investments, work and research. The determination of the profile of athletes of high qualification is important for the process of the athletes of youth selections during the training of long period of the modality. The objective of the study was to identify the dermatoglyphical, somatotypical and of the explosive force profiles of athletes' inferior members of the Brazilian feminine volleyball selection. It is a descriptive study, with post facto former typology. **Materials and Methods:** The sample was composed of 28 athletes. The used protocols were: Dermatoglyphics (ID) of Cummins & Midllo (1961); the somatotype of Heath & Carter (1967); the adapted Sargent Jump Test (1921) (IVP); and the Test of Vertical Impulse with 3 meters Displacement (IVD). **Results:** of the (ID) were: $D10=11.8\pm 3.6$; $SQTL=117.1\pm 46.0$; $A=11\%$; $L=60\%$; $W=29\%$; the somatotypical profile was characterized as "central"; and in the evaluation of the explosive strength was observed (IVP) = 47.0 ± 7.6 cm; (IVD) = 54.1 ± 8.9 cm. **Discussion:** The athletes' high genetic predisposition was verified for explosive strength, speed resistance and agility, besides morphologic indexes and of the jump capacity suitable for athletes of high international qualification.

Keywords: volleyball, dermatoglyphia, somatotype, explosive strength.

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RESUMO

Perfil dermatoglífico, somatotípico e da força explosiva de atletas da seleção brasileira de voleibol feminino

Introdução: A posição de destaque do voleibol brasileiro no cenário internacional requer investimentos, trabalho e pesquisa. A determinação do perfil de atletas de alta qualificação é importante para o processo de seleção dos jovens atletas durante o treinamento de longo prazo da modalidade. O objetivo do estudo foi identificar o perfil dermatoglífico, somatotípico e da força explosiva de membros inferiores de atletas de voleibol feminino da seleção brasileira. Trata-se de um estudo descritivo, com tipologia ex post facto. **Materiais e Métodos:** A amostra foi composta de 28 atletas. Os protocolos utilizados foram: a Dermatoglyphia (ID) de Cummins & Midllo (1961); o somatótipo de Heath & Carter (1967); o Sargent Jump Test adaptado (1921) (IVP); e o Teste de Impulsão Vertical com Deslocamento de 3 metros (IVD). **Resultados:** da (ID) foram: D10=11,8±3,6; SQT=117,1±46,0; A=11%; L=60%; W=29%; o perfil somatotípico foi caracterizado como “central”; e na avaliação da força explosiva observou-se (IVP)=47,0±7,6cm; (IVD)=54,1±8,9cm. **Discussão:** Foi verificada elevada predisposição genética das atletas para força explosiva, resistência de velocidade e agilidade, além de índices morfológicos e da capacidade de salto condizentes com atletas de alta qualificação internacional.

Palavras-chave: voleibol, dermatoglyphia, somatótipo, força explosiva.

INTRODUCTION

The formulation of applied scientific methodology to the process of selection in sports is intimately linked to the study of the “model characteristics” of the most outstanding athletes in the modality. The high performance athlete may serve as a standard to be followed by sports users^{1,2}. In this way, Fernandes Filho *et al.*³ suggest that the identification of the high performance athlete’s profile may be carried out by means of evaluation of the basic physical qualities of the modality, the somatotype, genetic characteristics, among others.

In Brazil, several studies^{4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20} have been carried out to identify the pattern referring to the Brazilian high performance athletes in several modalities. However, few studies have been carried out aiming to identify the profile of volleyball players in Brazil^{13,20}. The identification of the women’s volleyball profile in Brazil is an important measure to keep up the lead worldwide, which is unarguably considered to be the best of the world.

Outlining a profile based on physical qualities or somatotype characteristics is a common practice and extensively used, the inclusion of the Dermatoglyphy in the methodological practice¹³ represents an advantage for this study.

The dermatoglyphic method consists of an evaluation of the fingerprints found in all the fingers. It is a procedure able to identify some genetic characteristics such as the predisposition as regards the prevailing physical qualities inherent to the athletes^{9,19,21,22}.

Heath & Carter’s somatotype (1967) is defined as a valid method ($r=0.98$) for the description of the athlete’s anthropometric characteristics²³. In the women’s volleyball, some studies were carried out for the checking of the athlete’s somatotype profile^{23,24,25,26,27,28,29}, as well as for the identification of diseases as regards the level of qualifications of them^{26,27,28}.

RESUMEN

Perfil dermatoglífico, somatotípico y de la fuerza explosiva de atletas de la selección brasileña de voleibol femenino

Introducción: La posición de destaque del voleibol brasileño en el escenario internacional requiere inversiones, trabajo e investigación. La determinación del perfil de atletas de alta cualificación es importante para el proceso de selección de los jóvenes atletas durante el entrenamiento de largo plazo de la modalidad. El objetivo del estudio fue a identificar el perfil dermatoglífico, somatotípico y de la fuerza explosiva de miembros inferiores de atletas de voleibol femenino de la selección brasileña. Se trata de un estudio descriptivo, con tipologia ex post facto. **Materiales y Métodos:** La muestra fue compuesta de 28 atletas. Los protocolos utilizados fueron: la Dermatoglyphia (ID) de Cummins & Midllo (1961); el somatótipo de Heath & Carter (1967); el Sargent Jump Test adaptado (1921) (IVP); y el Test de Impulso Vertical con Desplazamiento de 3 metros (IVD). **Resultados:** de la (ID) fueron: D10=11,8±3,6; SQT=117,1±46,0; L=11%; L=60%; W=29%; el perfil somatotípico fue caracterizado como “central”; y en la evaluación de la fuerza explosiva se observó (IVP)=47,0±7,6cm; (IVD)=54,1±8,9cm. **Discusión:** Fue verificada elevada predisposición genética de las atletas para fuerza explosiva, resistencia de velocidad y agilidad, además de índices morfológicos y de la capacidad de salto convenientes con atletas de alta cualificación internacional.

Palabras clave: voleibol, dermatoglyphia, somatótipo, fuerza explosiva.

In the volleyball, the athletes need a high level of power from the lower limbs in order to carry out spikes, blocks and other moves that engages the capacity of jump, which are frequent during the matches^{30,31}. For it, it is suggested the Sargent Jump Test (1921), which is considered a valid, efficient and widely used test ($r=0.78$) by most coaches and physical coaches by its specificity in relation to the modality³². It is noteworthy that the literature suggests the existence of significant differences about the level of qualification on the static vertical impulsion and with displacement among male and female volleyball player^{33,34,35,36}.

The study herein aims to identify a set of characteristics, somatotype, dermatoglyphic aspects, and explosive strength of the lower limbs of female volleyball athletes of high performance in Brazil.

MATERIALS AND METHODS

The study herein is of descriptive nature, with ex post facto typology, according to Thomas & Nelson³⁷, “when the experimenter does not have control over the treatment, being frequently used for the comparison of characteristics of groups”.

The sample analyzed in this study was composed of 28 athletes, seeing that 17 young athletes, average age 17.6±0.5 years, stature of 183.7±6.3cm, body mass of 75.5±5.2kg, and time of practice of 6.7±1.3 years, and 11 athletes of the adult Brazilian team average age of 25.2±4.6 years, stature of 182.6±6.7cm, body mass of 70.9±6.5kg and time of practice of 12.0±4.2 years, selected intentionally and duly authorized by Brazilian Volleyball Confederation (CBV, in Portuguese), called in 2004.

The exclusion criteria were: not be participant of any group of athletes called for the Brazil team; be forbidden by the technical commission and/or medical department; not agree with the term

of commitment assumed with the researcher and not agree to take part of it freely and voluntarily.

The protocol for the determination of genetic characteristics of athletes was the dermatoglyphy of Cummins & Midllo (1961). This method includes the processing and later obtaining of fingerprints for the preliminary processing of reading, checking:

- a) The type of patterns on the distal phalanges of the fingers: Arch "A", pattern without deltas; Loop "L", pattern of one delta; Whorl "W", pattern of two deltas;
- b) The quantity of lines in every finger of the right hand (MDSQL) and of the left hand (MESQL), and total ridge count (SQTL) which is equivalent to the sum of quantity of lines on the ten fingers;
- c) The quantity of patterns, of different types, for all fingers of the right hand (MDT) and of the left hand (MET);
- d) The delta index, $(D10) = \text{sum of } L + 2 \times W$; and
- e) The types of digital formulas that indicate the representation in individuals of different combinations of types of patterns in the 10 fingers.

The measures of somatotype were obtained by Heath & Carter's method which provides with a more accurate study on the ideal physical type of each sport modality^{23,38}. For making of the indexes of endomorphy (relative adiposity), mesomorphy (musculoskeletal magnitude) and ectomorphy (relative linearity), it was used the protocols of measures of body mass, stature, perimeter of the right arm being contracted and corrected, perimeter of the left leg being corrected, subscapular, tricipital, supraspinatus and medial calf skinfolds) and osseous of diameters femoral and umeral biepicondilian³⁹.

The Sargent Jump Test (1921) was conducted as reported by Johnson & Nelson (1979) for the evaluation of explosive strength of the lower limbs³⁹. For greater specificity of the moves during a match, it was also used the test of vertical jump with displacement of 3m.

For the making of fingerprints, it was used a suitable form and Impress® collector (2005); the anthropometric measures were

taken using a Filizola scale (2005), stadiometer, skinfold compass, anthropometric tape-measure and Sanny caliper rule (2005); and, for the checking of explosive strength, a Cardiomed (2005) tape with precision of 0.1 cm and a box of chalk were used.

It was made use of the descriptive statistic, structured in mean values and its derivatives, for the variables of continuous nature, and of the frequency distributions, for the variable of discrete nature. It was used the Fernandes Filho Radar⁹, which defines the truth interval of the mean (95%), the calculated mean for normalized values for all variables which were evaluated, illustrating the complete profile of the evaluated group.

RESULTS

The results of the dermatoglyphic profile of women's volleyball are shown in the Table 1, 2, 3 and 4.

DISCUSSION

In the Table 1, the values showed great presence of (L), followed by (W), smaller occurrence of (A), and intermediate values D10 and SQTL. In dermatoglyphic scores of high performance, there is a tendency to the disappearance of (A), an increase of the pieces of (W), D10 and SQTL, indicative of the increase of the predisposition to the motor coordination^{9,18,19,21,22}.

The characteristics of the types of prevailing fingerprints in this group of athletes showed the combination which presents the predisposition to explosive strength and to velocity resistance^{1,19,26}. It may be considered that high levels of these physical qualities are necessary so that the volleyball athletes achieve high level of performance in the modality.

The results showed some dermatoglyphic parameters D10 and SQTL lower than those found in the national team of high qualified men's³ volleyball, basketball and futsal, whose worldwide fame is remarkable. However, these were higher than those found in

Table 1 - Descriptive data of the type of pattern, SQTL, D10 of Brazilian women's volleyball

	D10				SQTL			% frequency		
	N	X	SD	MED	X	SD	MED	A	L	W
Brazil	28	11.8	3.6	11	117.1	46	116	11%	60%	29%

D10: Delta index; SQTL: Total Ridge Count of the fingers; n: population; x: mean; sd: standard deviation; med: median; A: Arch; L: loop; W: Whorl.

Table 2 - Descriptive data of the type of pattern of MET and MDT of Brazilian women's volleyball

	MET1	MET2	MET3	MET4	MET5	MDT1	MDT2	MDT3	MDT4	MDT5
n	28	28	28	28	28	28	28	28	28	28
mean	1.2	1.0	1.1	1.2	1.1	1.3	1.2	1.1	1.3	1.2
median	1	1	1	1	1	1	1	1	1	1
sd	0.7	0.6	0.6	0.5	0.3	0.8	0.7	0.4	0.6	0.4
minimum	0	0	0	0	1	0	0	0	0	1
maximum	2	2	2	2	2	2	2	2	2	2
pattern	L	L	L	L	L	L	L	L	L	L
CV(%)	58.3	60	54.5	41.6	27.2	61.5	58.3	36.3	46.1	33.3

n: population; sd: standard deviation; CV: coefficient of variation;
 MET: Type of pattern of each finger of the left hand (1st finger to 5th finger);
 MDT: Type of pattern of each finger of right hand (1st finger to 5th finger).

Table 3 - Descriptive data of the type of SQTL of LH and RH of Brazilian women's volleyball

	LH TRC1	LH TRC2	LH TRC3	LH TRC4	LH TRC5	SQTL	RH TRC1	RH TRC2	RH TRC3	RH TRC4	RH TRC5	SQTLD
n	28	28	28	28	28	28	28	28	28	28	28	28
mean	11.1	9.4	9.7	13.6	12.5	57.0	13.5	10.5	10.0	13.4	12.8	60,2
median	12	10	9	13.5	12.5	52.5	14.5	11.5	9.5	15	13.5	64,5
sd	7.4	6.9	6.9	5.2	4.3	24.9	8.6	6.6	5.4	5.6	5.0	23,1
minimum	0	0	0	0	3	21	0	0	0	0	3	17
maximum	26	26	29	26	22	128	29	25	23	24	20	115
CV(%)	66.8	74.2	71.4	38.4	34.9	43.7	15.5	15.8	18.2	23.8	25.5	25,9

n: population; sd: standard deviation; CV: coefficient of variation;
MESQL: number of lines of each finger of the left hand (1st finger to 5th finger);
MDSQL: number of lines of each finger of the right hand (1st finger to 5th finger);
SQTL: Total Ridge Count of the left hand;
SQTLD: Total Ridge Count of the right hand.

Table 4 - Distribution of digital formulas of Brazilian women's volleyball

digital formula	10A	AL	ALW	10L	L=W	10W	L>W	W>L
% occurrence	0.0%	14.3%	28.6%	3.6%	0.0%	3.6%	28.6%	21.4%

FD: Fórmula Digital.

women's handball which, admittedly, are not acclaimed worldwide as a team of high qualification^{7,15}. This fact suggests differences of level of qualification as regards the dermatoglyphic parameters, for, although the group of athletes takes part of the Brazil team, this does not assure high sportive qualification when the greatest international competitions are considered.

According to the table of dermatoglyphic and somato-functional scores of Abramova *et al.*²¹, the indexes D10 and SQTL of the evaluated group lies in the class III, characterized by the relative and absolute strength, and high stature. The studies with athletes of the male adult Brazilian team remained in the class IV, represented by the predisposition to coordination, resistance, absolute strength and high stature^{13,20}. However, the study engaging juvenile male volleyball athletes of high performance in Brazil qualified these individual in the class III²⁰. It can be considered that these two "classes" present important characteristics for the success of the volleyball.

In the Table 2, as regards the type of prevailing patterns in each finger, it was observed greater presence of the loop (L) dermatoglyphic pattern. It was characterized as a symmetrical behavior of the type of pattern of all fingers, similar to the studies of Fernandes Filho⁹ and Medina¹³ for men's volleyball. For further explanation, Table 2 classified the dermatoglyphic pattern, observing the mean value of MET/MDT, where: (A) has the mean value lower than 0.50; (L) ranges from 0.51 to 1.50; and²⁷ the mean value greater than 1.50¹⁹.

In Table 3, the number of lines of the fingers is a qualitative value, indicated by means of MESQL and MDSQL, seeing that these directly influence the SQTL, which corresponds to the total ridge count of fingers. As regards the behavior of the number of ridge count of both hands, this does not indicate any symmetry.

According to Silva Dantas¹⁹, similar patterns of behavior of MET/MDT and MESQL/MDSQL characterize the groups of high qualification. This way, it was not noticed any pattern of symmetrical behavior only for MESQL/MDSQL, contrary to some extent to the results presented by Futsal^{18,19} and male Volleyball players^{13,20}.

In the Table 4, the digital formulas (DF) showed some association between the dermatoglyphic scores, and it is noticed some ratings

of physical qualities and variations. The athletes showed the predominance of digital formulas ALW (28.6%), L>W (28.6%), W>L (21.4%), showing the combinations of patterns which indicate the genetic predisposition for explosive strength (ALW), velocity resistance (L>W) and agility (W>L), which are physical qualities inherent to volleyball.

The literature suggest that the major characteristics of high performance athletes' somatotype are: higher levels of ectomorphy and mesomorphy and smaller values of endomorphy^{23,26,27,28} (Table 5).

However, the "central rating" (3,5-3,0-3,5) of the female Brazilian athletes reinforces the data of the American Volleyball team(3,1-3,4-3,2)²³ and those of the Italian athletes of the first division (2,9-3,1-3,0)²⁶, and different results presented by the Greek Volleyball team athletes (4,2-2,2-2,2)²⁸, those of the Argentinian team of the first division (4,5-2,8-2,9)²⁵, of the Italian team of the second division (3,1-3,5-2,7)²⁶ and amateur Italian athletes (4,7-3,9-2,3)²⁹. These data convey differences in relation to the level of qualification in the somatotype of women's volleyball^{26,27,28}, and the Brazilian athletes present morphological characteristics compatible with high performance.

For a better view of the group distribution in relation to the somatotype component, it can be observed that somatochart of the Figure 2.

In the Table 6, it is shown that the result obtained in the test of static vertical impulsion (SVI) was 47.0±7.6cm. These scores are regarded as high as they reflect performance above 90% in the vertical jump, according to the Table of Montaye (1988)³⁹, and rated as "very good" when compared with young Brazilian females aged 15-16 years, presented by Lancetta (1988)³⁸. Considering the values of German sports-people and non sports-people in general, these scores are quite above the mean found for women aged 15-30 years, as referred by Grosser & Starischka (1988)³⁸ in the test.

When one observes the studies on women's volleyball, these values are lower than those of the 1989 Brazilian adult team (53.4±4.7cm)⁴⁰ and the American adult team (52.4±4.5cm)³³.

Table 5 – Descriptive data of the somatotype of Brazilian women’s volleyball

	Endomorphy	Mesomorphy	Ectomorphy
n	28	28	28
mean	3.5	3.0	3.5
sd	1.0	1.3	1.1
median	3.4	3.0	3.5
minimum	2.0	0.6	0.2
maximum	6.5	5.9	5.4
CV(%)	28.5	43.3	31.4

n: population; sd: standard deviation; CV: coefficient of variation.

However, this can be due to the high number of juvenile athletes of the sample, which may be contributed for the reduction of the mean of the group. The results are upper than those the college American women’s volleyball ($45.5 \pm 6.4\text{cm}$)³³, young Australian athletes of the national team ($45.7 \pm 1.6\text{cm}$)³⁴, young American athletes ($37.4 \pm 5.7\text{cm}$)³⁵, including the setters’ scores ($42.8 \pm 8.1\text{cm}$) and opposite ($42.0 \pm 5.1\text{cm}$) the young English men’s volleyball team⁴¹.

In the test of vertical impulsion with displacement (VID), also referred as impulsion of attack by the coaches, the value $54.1 \pm 8.9\text{cm}$ was found. This result was upper in relation to the values obtained by the national team ($51.2 \pm 1.8\text{cm}$), state level ($45.3 \pm 1.0\text{cm}$) and new players ($38.7 \pm 1.5\text{cm}$), all from the young Australian division³⁴. It was also observed the shortage of data in the specialized literature in relation to this variable, maybe by the specificity of this type of jump in relation to volleyball.

The scores showed that the explosive strength of lower limbs is made potential when performed after the performance of displacement, this type of jump is more used during volleyball games both in situations of attack and block^{30,31}.

To investigate the dermatoglyphic, somatotype and explosive strength measures altogether with the results obtained were turned into a single non-dimensional score and presented in Fernandes Filho’s Graph (Graph 2). This illustrates the profile which reflects

Figure 1 - Types of dermatoglyphic patterns



1.1 - Arch (THE); 1.2 - Loop (L); 1.3 - Whorl (W)

Figure 2 - Somatochart of Brazilian women’s volleyball

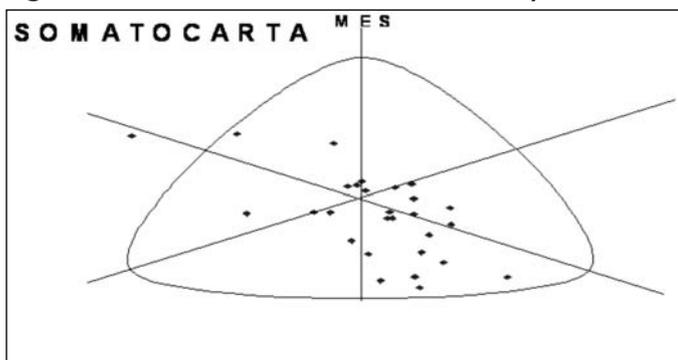


Table 6 - Descriptive data of the explosive strength of lower limbs of Brazilian women’s volleyball

	IVP	IVD
n	28	28
mean	47.0	54.1
sd	7.6	8.9
median	46.0	52.0
minimum	33.0	34.0
maximum	63.50	71.50
cv(%)	16.1	16.4

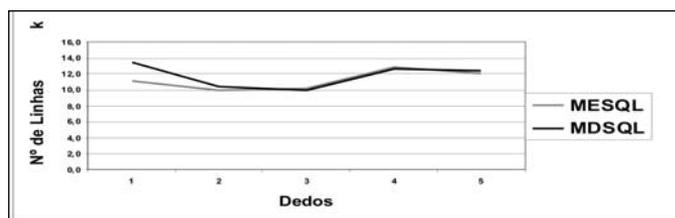
n: population; sd: standard deviation; CV: coefficient of variation; IVP: Sargent Jump Test (static vertical impulsion); IVD: Jump with displacement (vertical impulsion after a three-meter displacement).

This study can conclude that the evaluated group had the following characteristics in relation to dermatoglyphy: greater presence of (L), followed by (W), smaller occurrence (A), and intermediate values of D10 and SQTL; rating in the “class” III according to the Abramova Table; presence of symmetry of MET/MDT; predominance of digital formulas (ALW), (L>W) and (W>L). These data reveal high genetic predisposition for explosive strength, velocity resistance and agility, regarded as important physical qualities for volleyball.

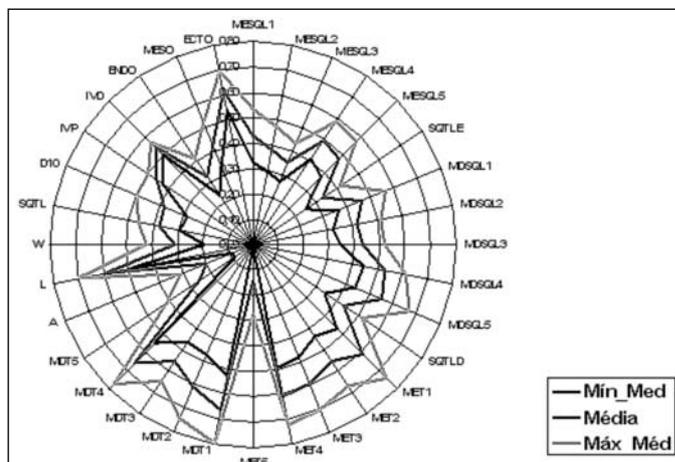
The “central” somatotype showed some compatible characteristics with high qualified athletes in this modality^{23,26}. In volleyball, there is a major worry about the morphological aspects during the selection of athletes^{23,26,27,28}.

As regards the scores of explosive strength, it was observed a high potential for the performance of moves of jump, because the scores found were considered “very good,” besides meeting the international standard for the modality and sex.

Graph 1 - Description of the behavior of each finger of the right and left hand of Brazilian women’s volleyball



Graph 2 - Fernandes Filho Radar Descriptive data of Brazilian women’s volleyball



This way, the results of this study showed some dermatoglyphic, somatotype and lower limbs explosive strength parameter compatible with the characteristics of high qualified athletes for the modality.

It is recommended that further studies are carried out with the inclusion of other physical qualities, evaluation of technical and tactical capacity of athletes, psychological characteristics, setting of intermediate scores during the long-term training process in the base categories, or even by comparing the characteristics of each age group aiming to provide an overview of the evolution of the scores.

Setting a profile is not about the exclusion, but the need, because the high performance is a special condition: it is the summing of genetic factor (genotype) and training (phenotype), whose sportive success depends on the dialectical complex unity (be it congenital, acquired; biological and social), in which the users' real capacity will only be found out during the learning process and education. However, one must not overlook that paraphrasing the distinguished researcher Fernandes Filho⁹, [...] "It is not the athlete who chooses the sports, but the sport who selects the athlete".

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REFERENCES

1. Fernandes Filho J. Treinamento desportivo: descoberta de talentos [CD ROM]. Rio de Janeiro: Shape; 2003.
2. Filiin VP, Volkov VM. Seleção de talentos nos desportos. Londrina: Midiograf; 1998.
3. Fernandes Filho J, Silva Dantas PM, Albergaria MB, Fernandes PR. Somatotype and dermatoglyphics in high income of Brazilian volleyball, futsal, basketball and handball adult. Pre-Olympic Congress; 2004; Aristotle University. Thessaloniki: Aristotle University; 2004.
4. Anjos MAB. Características antropométricas, dermatoglíficas e fisiológicas dos atletas de triatlo. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2002.
5. Carvalho E. Identificação do perfil dermatoglífico, somatotípico e fisiológico que caracterizam atletas masculinos de alto rendimento participantes de corridas de resistência no Rio de Janeiro. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2003.
6. Castanheda A. O perfil dermatoglífico e somatotípico que caracterizam atletas masculinos de alto rendimento participantes do futebol de campo no Brasil. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2003.
7. Cunha Júnior AT, Cunha AC.PT, Schneider AT, Silva Dantas PM, Fernandes Filho J. Características dermatoglíficas, somatotípicas, psicológicas e fisiológicas da seleção brasileira feminina adulta de handebol. *Fit Perf J*. 2006;5(2):81-6.
8. Cunha RS, Fernandes Filho J. Identificação do perfil dermatoglífico de esgrimistas estrangeiros de alto rendimento das três armas, participantes do Campeonato Mundial de Esgrima – Havana – Cuba/2003. *Fit Perf J*. 2004;3(5):247-53.
9. Fernandes Filho J. Impressões dermatoglíficas - marcas genéticas na seleção dos tipos de esporte e lutas (a exemplo de desportistas do Brasil) [tese]. Moscou; Instituto de Investigação Científica de Cultura Física e Esportes da Rússia; 1997.
10. Ferraz Filho R. Identificação dos perfis genético, somatotípico e das qualidades físicas que caracterizam atletas de pentatlo militar masculino adulto de alto rendimento no Brasil. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2004.
11. Ferreira AAM, Fernandes Filho J. Corrida de orientação: Caracterização dermatoglífica e somatotípica de atletas de alto rendimento da região Sul do Brasil. *Fit Perf J*. 2003;2(3):145-50.
12. João A. Identificação do perfil genético, somatotípico e psicológico de atletas brasileiras de ginástica olímpica feminina de alta qualificação esportiva. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2002.
13. Medina MF. Identificação do perfil, genético e somatotípico que caracterizam atletas de voleibol masculino adulto de alto rendimento do Brasil. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2000.
14. Menezes LS, Nogueira TN, Silva Dantas PM, Fernandes Filho J. Perfil dermatoglífico de atletas de ginástica rítmica do estado do Rio de Janeiro. Simpósio Internacional em Treinamento Desportivo; 2002. João Pessoa; 2002.

15. Nogueira TN, Cunha Júnior AT, Silva Dantas PM, Fernandes Filho J. Handebol feminino: perfil somatotípico, dermatoglífico e das qualidades físicas da seleção brasileira de handebol feminino adulto por posição de jogo. *Fit Perf J*. 2005;4(4):236-41.
16. Pavel DAC, Fernandes Filho J. Identificação dos perfis dermatoglífico, somatotípico e das qualidades físicas básicas de atletas de alto rendimento na modalidade de natação em provas de meio – fundo e fundo. *Fit Perf J*. 2004;3(1):18-27.
17. Roquetti Fernandes P, Fernandes Filho J. Estudo comparativo da dermatoglíflia, somatopia e do consumo máximo de oxigênio dos atletas da seleção brasileira de futebol de campo, portadores de paralisia cerebral e de atletas profissionais de futebol de campo, não portadores de paralisia cerebral. *Fit Perf J*. 2004;3(3):157-65.
18. Silva Dantas PM. Identificação do perfil, genético, de aptidão física e somatotípico que caracterizam os atletas de futsal masculino adulto de alto rendimento no Brasil. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2001.
19. Silva Dantas PM. Relação entre estado e predisposição genética no futsal brasileiro. [tese]. Natal: Universidade Federal do Rio Grande do Norte; 2004.
20. Zary JC. Perfil dermatoglífico e somatotípico de atletas de voleibol masculino das categorias infante-juvenil, juvenil e adulta de alto rendimento do Brasil. [thesys]. Rio de Janeiro: Universidade Castelo Branco; 2005.
21. Abramovav F, Nikitina TM, Chafranova EI. Impressões Dermatoglíficas - Marcas genéticas na seleção nos tipos de esporte. Atualidades na preparação de atletas nos esportes cíclicos. Volvograd; 1995.
22. Abramovav F, Nikitina TM, Ozolin NN. Possibilidades de utilização das impressões dermatoglíficas na seleção desportiva. Teoria e prática da cultura física. 1995;3:10-5.
23. Heath BH, Carter JEL. Somatotyping development and applications. New York: Cambridge University Press; 1990.
24. Caldeira S, Vivolo MA, Matsudo VKR. Somatotipo em volibolistas brasileiras. In: Ciências do Voleibol – Coletânea de Trabalhos Científicos CELAFISCS. 1994.
25. Esper A. Mediciones antropométricas en jugadoras argentinas de voleibol de primera división. Buenos Aires: [updated 2004 sep; cited 2008 jan 03]. Available: <http://www.efdeportes.com/efd76/voleib.htm>.
26. Gualdi Russo E, Zaccagni L. Somatotype, role and performance in elite volleyball players. *J Sports Med Phys Fitness*. 2001 mar;41(2):256-62.
27. Malousaris GG, Bergeles NK, Barzouka, KG, Bayios IA, Nassis GP, Koskolou MD. Somatotype, size and body composition of competitive female volleyball players. *J Sci Med Sport*. 2007 ago 11 (Epub ahead of print).
28. Papadoulos SD, Galos GK, Paraskevas AT, Tspakidou A, Fachantidou A. The somatotype of Greek female volleyball players. *International Journal of Volleyball Research*. 2002;5(1):22-5.
29. Viviani F, Baldin F. The somatotype of "amateur" Italian female volleyball players. *J Sports Med Phys Fitness*. 1993 dec;33(4):400-4.
30. Fonseca CLT, Sousa MVG, Aredes SG, Roqueti P, Fernandes Filho F. Volume de saltos de ataque e bloqueio executado por atletas de voleibol da categoria infante-juvenil do sexo feminino nas diferentes posições técnico-táticas. *FIEP Bouletin*. 2002.
31. Rocha MA. Quantificação do número das ações de saltos do ataque, bloqueio e levantamento no voleibol feminino. [thesys]. São Paulo: Universidade de São Paulo; 1999.
32. Shalmanov AA. Voleibol: fundamentos biomecânicos. Guarulhos: Phorte; 1998.
33. Fleck SJ, Case S, Puhl J, Van Handle P. Physical characteristics of elite women volleyball players. *Canadian Journal of Applied Sports and Science*. 1985 sep;10(3):122-6.
34. Gabbett T, Georgieff, B. Physiological and anthropometric characteristics of Australian junior national, state, and novice volleyball players. *J Strength Cond Res*. 2007;21(3):902-8.
35. Melrose DR, Spaniol FJ, Bohling ME, Bonnette RA. Physiological and performance characteristics of adolescent club volleyball players. *J Strength Cond Res*. 2007;21(2):481-6.
36. Smith DJ, Roberts D, Watson B. Physical, physiological, and performance differences between Canadian national team and universiade volleyball players. *J Sports Sci*. 1992 apr;10(2):131-8.
37. Thomas JR, Nelson JK. Métodos de pesquisa em atividade física. 3ª ed. Porto Alegre: Artmed; 2002.
38. Marins JCB, Giannichi RS. Avaliação e prescrição de atividade física. Guia prático. Rio de Janeiro: Shape; 1996.
39. Fernandes Filho J. A prática da avaliação física. 2ª ed. Rio de Janeiro: Shape; 2002.
40. Azzi M, Duarte CR, Dianno MV, Figueira JR A. Perfil de aptidão física da seleção brasileira feminina adulta de voleibol [abstract]. Ciências do voleibol - Coletânea de Trabalhos Científicos CELAFISCS. 1994.
41. Duncan MJ, Woodfield L, Al-Nakeeb Y. Anthropometric and physiological characteristics of junior elite volleyball players. *Br J Sports Med*. 2006 jul;40(7):649-51.

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