

Dermatoglyphic analysis and interpretation of motor skills expressed in strength test performance

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Abstract

Background and Study Aim The assessment of digital dermatoglyphic characteristics is still discussed as a method in the spectrum of high sport performance, especially in volleyball players. The study sought to identify the levels of strength produced in the lower and upper limbs of young school athletes, volleyball players, maturation, motor performance, relating them to dermatoglyphics.

Material and Methods The research presents itself as a cross-sectional study, carried out in a physical evaluation room (State School Antônio da Encarnação Filho; Adalberto Valle Educational Centre and La Salle Educational Centre) - central west zone of the city of Manaus - Brazil. The study included youth ($n= 43$), male ($n= 22$) and female ($n= 21$) from three schools of Manaus city, Amazon State, between 15 and 19 years old ($= 16,37 \pm 1,23$). The data were analyzed using the NCCS 2021 software, where descriptive statistics were performed for the variables. A correlation was applied between dynamometry tests, vertical jumps (SJ and CMJ), to make association with the categorical dermatoglyphic variables (A - RL - UL - W).

Results In the study, it was noticed that the physical quality, strength, expressed in the tests (CMJ, Dynamometry and SJ), showed a strong correlation with the dermatoglyphic drawings A (arch) and UL (ulnar loop).

Conclusions: This finding guides the practice of sports using force and high power. At the same time, the tests used in the experiment can serve as instruments for assessing physical strength.

Keywords: fingerprints, motor performance, talent detection, maturation.

Introduction

Detecting sports talents is a difficult and complex task today, because in addition to young people being interested in the “things” of their time, there is also the emergence of new technologies and their overuse; these are factors that contribute neither to the effective sporting practice nor to the improvement of the quality of life. Biological maturation is a factor that must be addressed individually in young people [1, 2], as they present variables that interfere and influence human growth and performance [3]. Segmental dimensions and body size are elements that contribute to sporting success and results [4, 5]. These observations point to the recognition of complexity in the identification of sports talent in Brazil [6, 7, 8]. In this context, physical evaluation is an important ally, and necessary to obtain knowledge of body structures, physical and functional capacity expressed by the body. Among the various methodologies for this purpose, by researchers and trainers, dermatoglyphia presents itself as a valid and reliable method in addition to those already known. Dermatoglyphics is the scientific study of fingerprints, and can be a method for guidance in programs for the discovery of sports talents, and in the preparation of the prescription of physical activity [9, 10]. In the identification of the sports trail, the evaluation of the genetic pattern is used which can be obtained by analyzing the pattern of fingerprints on the fingers [11, 12]. This assessment relates the digital designs to the proteins that make up DNA and the basic physical qualities. Through

the interpretation of dermatoglyphic drawings it is possible to define physical capacities expressed by genetics and separated by three types of fundamental traits, which are: Arch (A); loops (RL; UL); whorl (W) [13, 14]. The study aimed to obtain dermatoglyphic genetic characteristics with determination for the strength functionality in young school athletes practicing volleyball in Manaus city, and its relationship with the Peak Height Velocity (PHV) and motor performance.

Material and Methods

Participants

The study included male ($n= 43$) brazilian male ($n= 22$) and female ($n= 21$) youths from three schools, two private and one public, regularly registered and frequent, located in the central-west zone of Manaus city, in the State of Amazon - Brazil. The chronological age of the participants was determined with variation in the interval between 15 and 19 years of age, with a mean and standard deviation of $16,37 \pm 1,23$ respectively.

Research design

The work is adjusted to a cross-sectional study where the variables were observed and measured: levels of strength, growth and their relationship with dermatoglyphic characteristics in volleyball players. The data were obtained between the years 2019 and 2020. The study design was structured to assess the functional capacity of the physical strength of the upper and lower limbs, and its relationship with the dermatoglyphic drawings. The Free and Informed Consent Term was signed by the students and handed over to the Physical

Education coordination of the schools. To consolidate the study, the project was submitted to Brazil Platform, and from this to the Ethics Committee of the University of Amazonas State (UEA), in which it obtained evaluation and approval under CAAE 1450.1019.0000.5016. The development of the research followed the Declaration of Helsinki (WMA-2008) and Resolution 466/2012 of the National Health Council (NHC) of Brazil.

Anthropometry protocol

In the study, the anthropometric procedures were in accordance with the International Society for the Advancement of Kinanthropometry [15]. Body mass measurements (kg) were obtained using a digital scale with an approximation of 0,1 (kg), Omron brand (model HBF514®) 150kg, Tokyo, Japan. The height (cm) and trunk head height (cm) were measured using a digital stadiometer with an error range ± 0.5 cm, reference (portable model Inlab®) Seoul, Korea, applying Mollison's technique (to trunk head height) adjusted by the study (ultrasonic measurement). At the trunk-cephalic height, the participant was seated on the floor with the back joined to the wall, legs extended, separated by ($\pm 45^\circ$), and head oriented by the Frankfurt Plane, the hands fixed on the thighs, at which moment the ultrasonic wave sensor took the reading, with the device resting on the level above the head. To measure the length of the legs, an anthropometric tape (Prime Med brand in fiber, Saint Paul, Brazil) was used, with the participant in an anatomical position, from the maximum distance between the superior projection of the iliac crest to the ground, where the reading procedure was used (cm).

Dynamometry protocol

The upper limbs of the participants were evaluated using a mechanical dynamometer with scapular-manual movement, Crown® 100 kgf (Filizola brand, Saint Paul, Brazil). For measurement, participants should be in an upright position from the reference position (orthostatic), supported by the feet, with their upper limbs extended on the front axis of the body, where they should print the maximum possible lateral retraction force (on the grip surface) for two seconds. Three trials with 90 second recovery intervals were required, where the highest values were recorded. Every 50 collections, the device was calibrated [16].

Strength mat

To assess the level of strength of the athletes' lower limbs the strength mat [17, 18] Duo Jump model (CEFISE® brand, Saint Paul, Brazil) was used, which, using an attached software, expressed the power of the lower limbs in Watts (W).

Force measurement protocol on the force mat

For the test, the Counter Movement Jump (CMJ) protocols were used, which assesses muscle strength in a maximum repetition (1RM) [19], with the participant on the platform (mat) in a static position, barefoot, performing a counter movement. The Squat Jump (SJ) was applied, which evaluates the express form of muscle strength in a maximum repetition (1RM), where the participant being on the mat in static position, barefoot,

being considered the best performance in single jumps, with the participant with the legs parallel at 90° , and the hands fixed to the waist.

Peak Height Velocity (PHV) Determination

After obtaining data on age, height, leg length and trunk-head height measurements, it was possible to extract the Peak Height Velocity (PHV) [20, 21]. To achieve this objective, a predictive equation by Mirwald et al. [22] was applied, adjusted and suggested by Moore et al. [23]. Predictive Equation: Girls: $-9,709133+0,0042232 \cdot (A \cdot H)$; Boys: $-7,999994+0,0036124 \cdot (A \cdot H)$.

Dermatoglyphia

To obtain the dermatoglyphic expression of the fingers (FP), specific ink was applied on a pad for collecting fingerprints, model Gramline n°. 3, for reproduction on a collecting sheet. The analysis method was applied considering the three predominant types of designs in the literature arc (A); loops (RL and UL); whorl (W and WS). The D10 (delta index - total number of deltas for both hands) was determined for each participant. The TRC (Total Ridge Count; number of lines), was determined, with the focus of the research having a preference on the expressed presence of the arches (A) and loops (RL and UL) because they are the ones that present the approach to the conditions for determining the strength of physical ability.

Statistical analysis

Probabilistic sampling was used in the statistical analysis because it allowed phenomena to be described in a random way. The statistical software NCSS 2021 was used to perform the treatments and analysis. Categorical variables with nominal scale of the type: hand, finger, male, female and type of fingerprint (FP) were observed. The samples showed a 95% confidence level with a 5% margin of error. Inferential analysis was applied to the variables, such as: fingers of the right hand (RH-F1; RH-F2; RH-F3-RH-F4; RH-F5), types of drawings (FP) and total lines; fingers of the left hand (LH-F1; LH-F2; LH-F3; LH-F4; LH-F5) types of drawings (FP) and total lines.

Results

Quantitative analysis of D10 (Delta index) and TRC (total ridge count; number of lines) of both hands (RH and LH) were obtained (Table 1 and 2). Qualitative analysis was applied to fingerprints (FP) of the fingers. These values correspond to the distribution by sex, when the description of the dermatoglyphic variables was observed in the quantitative in the group. This information reveals the quantity of these variables per hand, facilitating decision making by sports coach [24].

Dermatoglyphic characteristics A (mean of 2,81) and RL/UL (with a mean of 0,40 and 11,30 respectively) were determined in the sample n of these categorical variables. They were also separated and analyzed to estimate how much they differed in the results of the vertical SJ tests (squat jump) with mean of 2.747,10W and CMJ (counter movement jump) presenting a mean of 2.919,82W; in the manual-scapular dynamometry test 178,11N (Table 3). In the composition of the ($n= 21$) female samples,

10 presented drawing A (arch), 1 RL (radial loop), and 9 presented UL (ulnar loop). Sample 3 (female) expressed the highest number of Arch, 7 in total, with 3 Arches in the right hand and 4 Archs in the left hand (Table 4). The mean for this FP (finger prints) in this gender was 2,90 and 1,87 (SD). (Table 4). As for the results of Peak Height Velocity (PHV) the mean for A (arch) was extracted from the universe of the sample considering the classification of Moore et al. [23], where 2,21 was obtained. In the anthropometric data, the means were obtained from the variables: age equal to 17 years; height value equal to 1,66m; body weight in 54,8 kg. In the total of the samples (n= 43), the BMI mean was calculated at 19,88, considered normal for the group according to the classification of the World Health Organization (WHO) [25].

The samples that showed a high UL (ulnar loop) and

low A (arch) index, also showed a strong correlation between SJ (= 2.747,10W) and CMJ (= 2.919,82) jumps, and dynamometry (= 212,71N). It is important to point out that in the strength tests, the CMJ test showed results superior to those of SJ considering the FP's A and UL. Ablicova and Serhyencko [26] found ALW patterns (0% - 62,7% - 37, 3% respectively) in players of volleyball, while the TRC (Total Ridge Count; number of lines) presented was = 145,0 ± 41,3 (SD). This observation corroborates the proposal of digital formulas (DF) to indicate the representation in participants with various types of FP's (fingerprints): AL- presence of arch and clips in any combination; ALW - presence of arch, loop and whorl in any combination; 10L- ten loops; 10W- ten whorls; L = W- same proportion of loops and whorls; L> W- loops and whorls, the number of loops being greater than five

Table 1. Descriptive analysis of the variables observed by hand in males (n= 22).

Variables	Right Hand					Left Hand				
	RH-F1	RH-F2	RH-F3	RH-F4	RH-F5	LH-F1	LH-F2	LH-F3	LH-F4	LH-F5
A ^a	3	4	1	1	0	1	2	3	0	0
RL ^b	0	1	0	1	0	0	1	0	0	0
UL ^c	7	13	19	14	14	10	15	17	12	15
W ^d	9	4	2	6	7	7	4	2	10	7
WS ^e	3	1	0	0	0	3	0	0	0	0
D10 ^f	31	23	23	27	29	30	24	21	22	31
TRC ^g	221	171	162	239	206	247	163	176	320	196

^aArch; ^bRadial Loop; ^cUlnar Loop; ^dWhorl; ^eWhorl with two cores; ^fDelta index; ^gTotal ridge count; number of lines; RH: Right Hand; LH: Left Hand.

Table 2. Descriptive analysis of the variables observed by hand in females (n= 21).

Variables	Right Hand					Left Hand				
	RH-F1	RH-F2	RH-F3	RH-F4	RH-F5	LH-F1	LH-F2	LH-F3	LH-F4	LH-F5
A	4	3	4	1	3	1	3	4	3	3
RL	1	2	0	0	0	0	1	0	0	0
UL	6	11	5	13	16	12	12	15	11	12
W	7	5	2	6	2	6	5	2	8	6
WS	3	0	0	1	0	2	0	0	0	0
D10	27	23	19	27	20	28	23	19	27	24
TRC	116	122	134	196	148	204	150	142	172	164

^aArch; ^bRadial Loop; ^cUlnar Loop; ^dWhorl; ^eWhorl with two cores; ^fDelta index; ^gTotal ridge count; number of lines; RH: Right Hand; LH: Left Hand

Table 3. Dermatoglyphic variables related to the performance of strength and power patterns, dynamometry tests and vertical jumps on the Duo Jump CEFISE strength mat. (Male/Female).

Variables(N)	(n=43) ^d	SD ^e	SJ test (Watts) ^f	CMJ test (Watts) ^g	Dynamometry test
A ^a	2.81 (n=17)	± 1.55		2.919.82704.46	178.11 ± 69.73
RL ^b	0.40 (n=07)	± 0.69		1.143.04	= 228.42 ± 104.5
UL ^c	11.30 (n=42)	± 3.46	943.52		= 212.71 ± 86.05

^aArch; ^bRadial Loop; ^cUlnar Loop; ^dmean of the variables analyzed; ^eStandart deviation; ^fSquat Jump test; ^gCounter Movement Jump test.

(5); $W > L$ - whorls and loops, provided that the number of whorls is greater than five. Correlations (r) were found for the arc drawings (A) in the strength tests: CMJ - A ($r = 0,89$), SJ - Dynamometry ($r = 0,97$), Dynamometry - A ($r = 0,91$), and specific association between upper and lower limb tests (CMJ - Dynamometry) $r = 0,98$. Both tests presented ($P < 0,001$) which shows very strong evidence. This analysis showed a strong correlation to direct the use of these instruments, to assess the strength and power produced by the body segments.

Regarding the Peak Height Velocity (PHV) and height, the group (female and male) studied presented age = 16,4 years of age, and PHV in the Moore et al. [23] = 1,99 equation, related to $n = 43$. These data assume a chronological age at the time of PHV = 14, 41. The results of the PHV found are classified as late maturation on the scale of Malina et al. [1] and level 2 ($1,50 \leq Y_i < 2,50$) in the classification of Moore et al. [23]. Eckert observed that an earlier maturation can point to superior motor performance [27]. This corresponds to the largest body area (size), strength and physiological aspects at puberty. In this study, mean height in boys was = $1,75m/age = 16$ years and 7 months, while in girls the values were = $1,63m$ in height/16 years of age. The PHV calculated in

mathematical equation and by sex had the following result: boys = 2,60 and girls = 1,97. In the group of boys, PHV was also considered level 3 on the scale of Moore et al., for girls the level found was 2 on this classification scale. For this PHV the means numbers of A, RL, UL and TRC (Table 4 and 5), were respectively 1; 0,19; 6; 85,07. The features A (archs) are rare in most populations (between 0 and 7%); the result obtained in Campos' study was 1A (one arch). L (loops) are more common in Caucasians and Africans (61-70%) and of (41-50% in Mongols). In the universe that presented these FP's ($n = 43$) in our study, the results were A= 10,14%; RL= 1,88%; UL= 60,84; W= 24,05; WS= 3,06 in a miscegenation of races in the ethnic groups: black, indigenous, caboclos, brown and whites.

Discussion

Descriptive values for strength and power were previously classified and determined in dermatoglyphia, where the participants observed an increase in A (archs drawings), speed and explosive strength with an increase in Loops ($L > 7$), a decrease in whorls ($W < 3$), and reduction of TRC (Total Ridge Count; number of lines). The small number of D10 (Delta index), an increase in the number of arc-type drawings (A) and loops (RL - UL), the

Table 4. Anthropometric data and FP^f dermatoglyphia (archs and loops) related to Peak Peak Height Velocity (PHV) female.

Samples (n)										
Variable	1	2	3	4	5	6	7	8	9	10
A ^a	1	1	7	2	4	2	5	3	3	2
RL ^b	0	1	0	0	0	0	0	0	0	0
UL ^c	8	1	0	8	7	8	3	7	3	8
Age	17	17	15	15	17	16	15	15	16	15
Height	1.66	1.57	1.62	1.65	1.70	1.60	1.64	1.71	1.64	1.72
Body mass	54.8	50.5	60.7	52	49	91	72	77.8	53.4	51.7
IMC ^d	19.88	20.48	23.12	19.10	16.96	29.37	26.91	26.65	19.85	17.48
PHV ^e	2.21	1.57	0.56	0.75	2.50	1.10	0.68	1.12	1.13	1.19

^aA arch; ^bRadial Loop; ^cUlnar Loop; ^dBody Mass Index; ^ePeak Height Velocity; ^fFinger Print.

Table 5. Anthropometric data and FP^f dermatoglyphia (archs and loops) related to Peak Peak Height Velocity (PHV) male.

Variable	Samples (n)					
	1	2	3	4	5	6
A ^a	1	3	2	3	3	3
RL ^b	0	0	1	0	1	0
UL ^c	7	7	5	3	6	6
Age	17	19	16	15	17	18
Height	1.75	1.77	1.76	1.73	1.77	1.83
Body mass	68	55.6	60.6	77.3	68.3	61
BMI ^f	22.2	17.25	19.6	25.83	21.8	18.21
PHV ^e	2.99	4.15	2.18	1.38	2.87	4.74

^aA arch; ^bRadial Loop; ^cUlnar Loop; ^dBody Mass Index; ^ePeak Height Velocity; ^fFinger Print.

reduction of the presence of whorl drawings (W and WS), and TRC (Total Ridge Count; number of lines) mean, are drawings patterns appropriate for high-powered sports, that is, sports or activities that they use in their motor action: strength, speed and power.

In the experiment, a concentration of 90% A (arch) was noted (Tables 1 and 2) in the fingers (RH-F1; RH-F2; RH-F3); being in the right hand finger (RH-F2 = 4 arches) in boys. In girls, this characteristic A (arch) was expressed in 10 samples, in boys only in 6 samples (Tables 1 and 2). The result presented in the study considering (A = 2,81), approximates those of Abramova et al. [13] = 3,2 and distances itself from the reports by Silva et al. [10] = 5,8 and = 8,0; Hernández-Mosqueira [28] = 19,0; Rodrigues et al. [29] = 5,0, with the mean estimated at = 8,2 for soccer players. The results of the study by Nodari Júnior et al [30], showed A= 1,1 and L= 5,2 for golf players, indicating that the movements of these sports require high power when the L index (speed, power) was higher in relation to A (strength). In a study about volleyball, they identified a low number of concentration in drawing A, and a high TRC index equal 8 (Total Ridge Count; number of lines) on the 3rd finger of the right hand (RH-F3). In this study, an TRC= 7,31 and A= 2,81 were obtained; indicating that the practitioners may or may not remain in the practice of volleyball.

Conclusions

The reflections on the theme dermatoglyphics point to its inclusion as a method of selection, orientation and evaluation of athletes for high performance or for the practice of physical activity. In this study, it was noticed that the physical quality, strength, expressed in the experiments, showed a strong correlation with the dermatoglyphic drawings A (arch). Significant correlations

were determined for the arch drawing (A) in the strength tests: CMJ - A ($r= 0,89$), SJ - Dynamometry ($r= 0,97$), Dynamometry - A ($r= 0,91$), and specific association between upper and lower limbs, through the tests (CMJ - Dynamometry; $r= 0,98$). Both tests had a significant $P < 0,001$, which shows very strong evidence. However, there is a high concentration of UL type loops that were detected and combined with the Squat Jump (SJ) and Counter-Movement Jump (CMJ) tests and the dynamometry test. The fact that they are not high-performance athletes, but of school level and with little training time, chronological age with an average of 16,4 years and Peak Height Velocity of 14,39 on average, may not have revealed their physical performance with the desired quality. the test time; that is, they are young people who practice volleyball without having been selected or trained, with regard to carrying out a technical-scientific selection test. The result of the study pointed out that in the school environment in the city of Manaus, especially in the public school, there may be precious sports talents, which are not being used by organs local bodies of practice, due to the absence of sincere sports policies.

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