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ORIGINAL

DERMATOGLYPHIC PROFILE AND PREDOMINANT PHYSICAL QUALITIES IN MEXICAN UNIVERSITY ATHLETES: EXPLORATORY STUDY

PERFIL DERMATOGLÍFICO Y CUALIDADES FÍSICAS PREDOMINANTES EN ATLETAS MEXICANOS UNIVERSITARIOS: ESTUDIO EXPLORATORIO

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ABSTRACT

The objective of the study is to analyze the dermatoglyphic profile and its relationship with the predominant physical qualities in university athletes in track and field modalities. A non-experimental design of transverse and exploratory type is presented in a sample of 87 (81%) student-athletes who are part of the representative team of athletics of a public university in Mexico, with an average age of 20.05 ± 2.2 years, 44 (50.6%) men and 43 (49.4%) women. For the measurement and analysis of innate physical potentialities, the technique of fingerprint dermatoglyphics was used. The results show that the most relevant digital formulas are, L>W and W>L with a D10 index (13.3). 83% of the athletes are in the right discipline according to the type of fingerprint, number of designs and lines. The study, provides a reference for future studies or for the detection and selection of talent for athletics.

KEYWORDS: dermatoglyphs, biological marker, sports talent, athletics.

RESUMEN

El objetivo del estudio es analizar el perfil dermatoglífico y su relación con las cualidades físicas predominantes en atletas universitarios en modalidades de pista y campo. Se presenta un diseño no experimental, de tipo trasversal y exploratorio, en una muestra de 87 (81%) estudiantes-atletas que forman parte del equipo representativo de atletismo de una universidad pública de México, con una edad promedio de 20.05 ± 2.2 años, 44 (50.6%) hombres y 43 (49.4%) mujeres. Para la medición y análisis de las potencialidades físicas innatas se utilizó la técnica de dermatoglifia dactilar. Los resultados muestran que las fórmulas digitales más relevantes son, L>W y W>L con un índice D10 de 13.3. El 83% de los atletas están en la disciplina adecuada según el tipo de huella dactilar, cantidad de diseños y líneas. Este estudio proporciona un referente para futuros trabajos o para la detección y selección de talento para el atletismo.

PALABRAS CLAVE: dermatoglifos, marcador biológico, talento deportivo, atletismo

INTRODUCTION

The term dermatoglyph is attributed to Cummins (glyph: writing, carving; derma: skin) and refers to the dermal papillae lines on the fingertips, palms of the hands, and soles of the feet (Midlo and Cummins, 1942). And although dermatoglyphics, in general, studies the impressions or reproductions of the ridge patterns formed on the fingertips of the hands (palmar complex), fingers (third phalanx), and soles of the feet (de Abreu-Cruz et al., 2007), in dermatoglyphics that focuses on the study of the physical potentials of athletes, fingerprints are used exclusively for analysis; therefore, the most accurate term to speak of this methodology would be sports finger dermatoglyphics (Gastélum and Guedea, 2017). Fingerprints are formed between the third and sixth month of intrauterine life, at the same time as the development of the central nervous system (Chakraborty, 1991).

For some authors (Dantas, 2012; Ferrão et al., 2004) dermatoglyphs represent a genetic marker because of their association with the basic physical qualities and type of muscle fibers, but it is necessary to point out that DNA does not intervene in the analysis; thus, it is necessary to talk about them as an epigenetic marker; that is, a genetic-environmental combination (Bowman, 2018; Zammatteo, 2015). However, an even more correct term, at least in dermatoglyphics, according to Nodari-Junior (2019), would be a marker of biological individuality that can constitute an alternative for the detection of sports talent that, although it has been little studied, has scientific evidence of its importance, application, and use in different contexts, such as sports (Del Vecchio and Gonçalves, 2011; Fernández-Aljoe et al., 2020; Juárez-Toledo et al., 2018; Sánchez and Rodríguez, 2017).

The first to use dermatoglyphs in this setting were sports scientists in Russia who were able to detect sports talents with this methodology. Beginning in the 60s, the USSR began a series of studies to optimize sport development in young individuals as a source of information that allowed determining their physical sports performance potential (Gastélum and Guedea, 2017).

Currently, two techniques for the study of sports dermatoglyphics are referenced in the scientific literature; one of these is very basic, consisting of taking fingerprints on pre-established paper formats or direct observation with a magnifying glass. Another is based on the use of digital readers with automated reading software (Nodari-Junior and Heberle, 2014). In this sense, Fernández-Aljoe et al. (2020) carried out a systematic review of the state of the art of sports dermatoglyphics in America in the last decade, locating 13 articles that met the inclusion criteria; they found that only three studies used technology in their research. They concluded that although the use of the traditional technique is much more economical and accessible, the use of technology in this field is recommended because it optimizes the analysis and offers greater reliability in obtaining data, a situation with which the authors of this work agree.

These authors (Fernandez et al., 2020) found in a general way, that whether you use technology or not, dermatoglyphics is an effective methodology to characterize physical potentials in the studied sports. And although they report soccer in its different modalities as the most studied sport, they also found at least three articles about tests related to athletics. But if you consider that they are studies performed during 10 years, there is little that is being studied in this sporting discipline. Also, these studies have specific tests, such as speed, middle distance, and triathlon, which justify and demonstrate the relevance of this study, since it considers all athletic activities.

According to Del Vecchio and Gonçalves (2011), Rodriguez, Montenegro, and Petro (2019), the most common digital designs, as well as the qualities that they represent, are listed below: the arch (A), which exhibits the absence of deltas and is formed only by the papillary ridges, is related to the physical quality of strength. The ulnar and radial loop (UL and RL) are composed of three areas, base, core, and delta; only one delta represents the physical quality of speed, although the radial loop is also related to a high sports performance. Whorls are present in two modalities (W and S); the W design with two deltas on both sides corresponds to a closed coiled figure with only one core. The S whorl design has two deltas on both sides and in contrast to the aforementioned presents two cores that form an «s»; this is a less common digital design and both are related to motor coordination and agility (Figure 1).

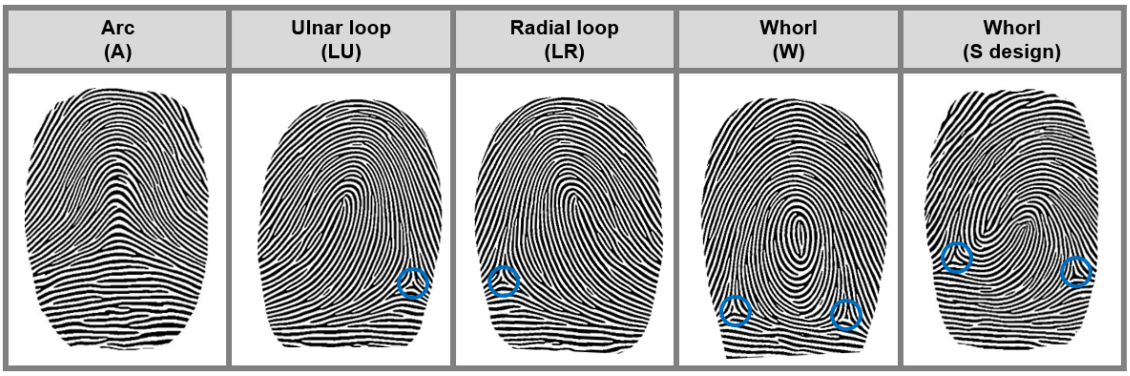

Figure 1. Classification of common human dermatoglyphic patterns (Gastélum-Cuadras, 2022)**.**

Other quantitative elements have to do with the total quantity of lines in all the fingers that are generated from the sum of the total of the left (SQTLL) and right (SQTLR) hands after tracing Galton's Line (Figure 2); the higher the line count, the greater the physical potential for endurance. The delta index (D10) is calculated from the sum of the deltas (Figures 1 and 2) and is related to motor coordination and agility.

In recent years, the UANL Tigres athletics team (men's and women's division) has been champion in the National Universiade, showing great progress in the different athletic events, even being able to appear in international events. Given the achievements of these university athletes, it becomes necessary to identify their dermatoglyphic characteristics as a reference that allows defining the predominant physical qualities in both genders to detect and guide their talents in athletics that are related to speed tests, endurance, jumps, throws, combined events, and race-walking.

OBJECTIVE

The objective of this work was to analyze the dermatoglyphic profile and its relationship with the predominant physical qualities in university athletics in the modalities of track and field.

MATERIAL AND METHOD

RESEARCH DESIGN

This study adopted a non-experimental cross-sectional design since data collection (fingerprints) was carried out at one time; it was also exploratory-descriptive due to its scope, based on the use of fingerprints and their relationship with physical potentials. Also exploratory, since, at least in Mexico, and in the researched literature, there is no work where the dermatoglyphic profile of a complete athletic team has been studied.

PARTICIPANTS

The study population consisted of athletes that form part of the representative team from a public university that in the last 10 years has won first place in university sports events (National Universiade) in the country in the area of track and field. This was a non-probabilistic sample since the 108 athletes that compose the university team were invited through their coaches to measure all of them; a sample of 87 (81%) come to the appointment (date, place, and time) with a mean age of 20.05 ± 2.20 years, of which 44 (50.6%) were men and 43 (49.4%) were women. A total of 19% of the athletes did not participate because they were concentrated in Mexico City or they were participating in an international sports event. Participants were informed of the aim of the research and their participation, signing written informed consent according to the Declaration of Helsinki (World Medical Association, 2013).

DERMATOGLYPHIC FINGERPRINT READER

To measure and analyze innate physical potentials, the dermatoglyphic fingerprint technique according to the protocol proposed by Cummins and Midlo (1961) was used. This methodology consists of fingerprinting the 10 fingers of the hands, which was previously based on ink and paper or with a magnifying glass; in the present work, it was done with the Computerized Dermatoglyphic Software by Salus (Nodari-Junior et al., 2008; Nodari-Junior and Heberle, 2014), which consists of an optical scanner that collects and interprets the image by building a binary code, providing real and binary images in black and white. After collecting the fingerprints, the software user has the option of selecting them one-by-one to join the points in the loops and whorls, as needed, using Galton´s line (Figure 2), an imaginary line that has as its starting point the core and its endpoint the center of the delta or deltas (Sanchez and Rodriguez, 2017).

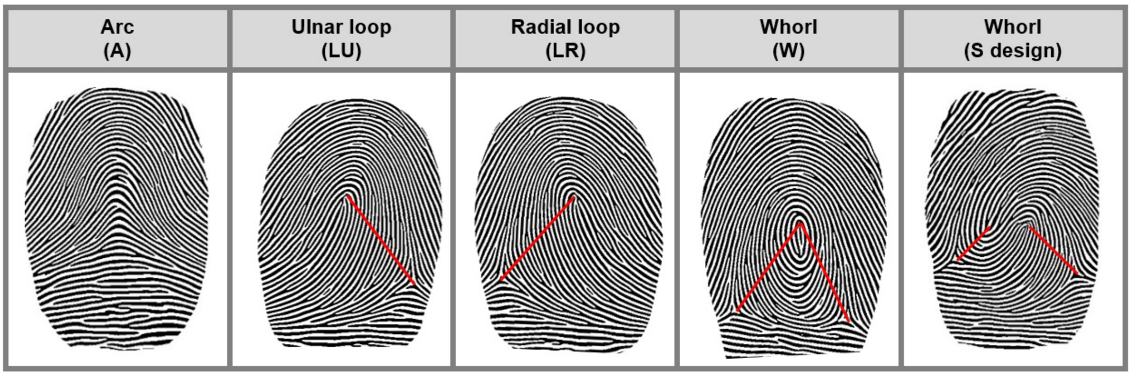

Figure 2. Galton´s line in dermatoglyphic patterns for line counts (Gastélum-Cuadras, 2022).

Finally, the software makes a qualitative identification of the image and a quantitative identification of the lines, core, and deltas, generating an Excel spreadsheet with the processed data (Nodari-Junior et al., 2008) that are expressed in descriptive statistical results ready tabulation and interpretation. For data analysis, descriptive statistics and analysis of variance were used with a significance level of $p<0.05$, using SPSS v24.

RESULTS

The descriptive data of the type of fingerprint of all the students measured, men and women, who practice the different athletic events are shown below, highlighting a high count in the ulnar loop (mean of 6), followed by the whorl (mean of 3.3), with a mean Delta 10 of 13.4. The arc, the whorl S design and the radial loop are relevant appearances in the study sample (Table 1).

Table 1. Arcs, radial loop, ulnar loop, W whorl, WS whorl, and Delta 10 in university athletes.

Print type	Mean	SD	Minimum	Maximum
Arcs	0.2	0.7	0	6
Radial loops	0.3	0.6	0	3
Ulnar loops	6	2.5	0	10
W whorl	3.3	2.6	0	10
WS whorl	0.3	0.6	0	3
Delta 10	13.4	4	4	20

Table 2 shows the athletes (men) grouped by related athletic events, in relation to the ridge count of the fingers of the left, right, and both hands. What is notable is that those who participate in combined events such as the decathlon have a greater number of finger lines, SQTLL = 170.7, and those with the lowest number are from race-walking SQTLL = 100 and throwing events SQTLL = 122.6.

Table 2. Frequencies and percentages of fingerprint ridge lines of men athletes by athletic event.

Event	f	%	Left-hand ridges	Right-hand ridges	Total ridge lines
Sprint: 100, 200, 400, 110 w/hurdles, 400 w/hurdles	15	34.1	66.00 ± 11.64	73.00 ± 11.89	139.00 ± 19.89
Middle distance race: 800, 1500, 3000 obstacles	3	6.8	67.00 ± 19.28	72.00 ± 72.00	139.00 ± 35.04
Long and very long-distance running: 5000, 10000, marathon 42 km195 m	3	6.8	62.00 ± 7.21	73.66 ± 9.71	135.66 ± 20.51
Jumps: long, triple, high, and pole	11	25.0	62.81 ± 14.45	65.63 ± 15.75	128.45 ± 28.51
Throws: shot put, discus, javelin, and hammer	6	13.6	59.66 ± 24.14	63.00 ± 29.09	122.66 ± 52.98
Combined events: decathlon	4	9.1	83.00 ± 11.46	87.75 ± 6.02	170.75 ± 17.15
Race-walking: 10 and 50 km	2	4.5	56.50 ±19.09	43.50 ± 16.26	100.00 ± 35.35
Total	44	100.0	65.25 ±15.42	69.77 ± 17.54	135.02 ± 31.08

In the same sense, women athletes in race-walking 10 and 20 km have the greatest number of print ridges, SQTL=184.5. Those with the lowest number were middle distance athletes SQTL=112.3, followed by throws, SQTL=114.9, and jumps, SQTL=120.3 (Table 3).

Table 3. Frequencies and percentages of fingerprint ridge lines of women athletes by athletic event.

Event	Frequency	%	Left-hand ridges	Right-hand ridges	Total ridge lines
Sprint: 100, 200, 400, 100 w/hurdles, 400 w/hurdles	16	37.20	60.12±17.32	60.00±22.35	120.12±38.87
Middle distance race: 800, 1500, 3000 obstacles	7	16.27	56.14±22.19	56.14±19.73	112.28±41.50
Long and very long-distance running: 5000, 10000, marathon 42 km195 m	1	2.32	69.00 SD	77.00 SD	146.00 SD
Jumps: long, triple, high, and pole	6	13.95	59.66±24.15	60.66±18.01	120.33±41.10
Throws: shot put, discus, javelin, and hammer	9	20.93	58.66±12.72	56.22±16.70	114.88±27.71
Combined events: heptathlon	2	4.65	65.50±36.06	58.50±36.06	124.00±72.12
Race-walking: 10 and 20 km	2	4.65	90.00±11.31	94.50±23.33	184.50±34.64
Total	43	100.0	60.95±18.97	60.60±20.94	121.55±38.90

Regarding digital formulas located in the different groups of male athletic events, the L>W formula was notable with a prevalence of 56.8%, which was present in sprint and jump events. Another formula that was present to a lesser degree was W>L with 18.2%, but it was spread out in different athletic event groups. These formulas were present in 75% of male athletes (Table 4).

Table 4. Frequencies and percentages of male athletes by event and predominant physical qualities.

Event	f	%	L>W	W>L	L=W	10L	LWA	L>A	LAW	Total
Sprint: 100, 200, 400, 110 w/hurdles, 400 w/hurdles	15	34.1	9 (60%)	2 (13.3%)	1 (6.7%)	2 (13.3%)	1 (6.7%)	0 (0%)	0 (0%)	**15 (100%)**
Middle distance race: 800, 1500, 3000 obstacles	3	6.8	1 (13.3%)	0 (0%)	1 (33.3%)	0 (0%)	1 (33.3%)	0 (0%)	0 (0%)	**3 (100%)**
Long and very long-distance running: 5000, 10000, marathon 42 km 195 m	3	6.8	3 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**3 (100%)**
Jumps: long, triple, high, and pole	11	25.0	7 (63.6%)	1 (9.1%)	0 (0%)	3 (27.3%)	0 (0%)	0 (0%)	0 (0%)	**11 (100%)**
Throws: shot put, discus, javelin, and hammer	6	13.6	3 (50%)	2 (33.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (16.7%)	**6 (100%)**
Combined events: heptathlon and decathlon	4	9.1	1 (25%)	3 (75%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**4 (100%)**
Race-walking: 10 km, 20 km, and 50 km	2	4.5	1 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	**2 (100%)**
Total	**44**	**100.0**	**25 (56.8%)**	**8 (18.2%)**	**2 (4.5%)**	**5 (11.4%)**	**2 (4.5%)**	**1 (2.3%)**	**1 (2.3%)**	**44 (100%)**

L> W Speed predominates with good coordination (agility) and endurance. **W> L** Coordination and agility predominate, with good endurance and satisfactory speed. **L = W** Agility predominates with very good motor coordination, good speed. **10L** Speed predominates with good endurance. **LWA** Speed, motor coordination, and strength predominate. **L> A** strength and speed predominate. **LWA** Speed, motor coordination, and strength predominate.

In women, the same digital formulas predominate but these are more balanced (L>W with 37.2% and W>L with 30.2%) and are spread out in different events. These formulas were present in 67.4% of women athletes (Table 5).

Table 5. Frequencies and percentages of women athletes by event and predominant physical qualities.

Event	f	%	L>W	W>L	L=W	10L	LWA	L>A	10W	A>L	Total
Sprint: 100, 200, 400, 110 w/hurdles, 400 w/hurdles	16	37.20	7 (43.8%)	5 (31.3%)	1 (6.3%)	3 (18.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**16 (100%)**
Middle distance race: 800, 1500, 3000 obstacles	7	16.27	1 (14.3%)	2 (28.6%)	2 (28.6%)	1 (14.3%)	0 (0%)	0 (0%)	0 (0%)	1 (14.3%)	**7 (100%)**
Long and very long-distance running: 5000, 10000, marathon 42 km 195 m	1	2.32	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**1 (100%)**
Jumps: long, triple, high, and pole	6	13.95	1 (16.7%)	2 (33.3%)	1 (16.7%)	0 (0%)	1 (16.7%)	1 (16.7%)	0 (0%)	0 (0%)	**6 (100%)**
Throws: shot put, discus, javelin, and hammer	9	20.93	6 (66.7%)	3 (33.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**9 (100%)**
Combined events: heptathlon and decathlon	2	4.65	0 (0%)	0 (0%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**2 (100%)**
Race-walking: 10 km, 20 km and 50 km	2	4.65	0 (0%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	**2 (100%)**
Total	**43**	**100.0**	**16 (37.2%)**	**13 (30.2%)**	**5 (11.6%)**	**5 (11.6%)**	**1 (2.3%)**	**1 (2.3%)**	**1 (2.3%)**	**1 (2.3%)**	**43 (100%)**

L> W Speed predominates with good endurance and motor coordination. **W> L** Motor coordination and agility predominate, with good endurance and satisfactory speed. **L = W** Agility predominates with very good motor coordination, good speed. **10L** Speed predominates with good endurance. **LWA** Speed, motor coordination, and strength predominate. **L> A** Strength and speed predominate. **10W** Motor coordination, agility, and endurance predominate. **A>L** Strength, power, and satisfactory speed predominate.

When determining the percentage of athletes according to their competition event, 72 out of 87 were located in their specialty according to their dermatoglyphics evaluation; this corresponds to a total of 83%. The following figure shows the percentages for each event, distinguished by gender (Figure 3).

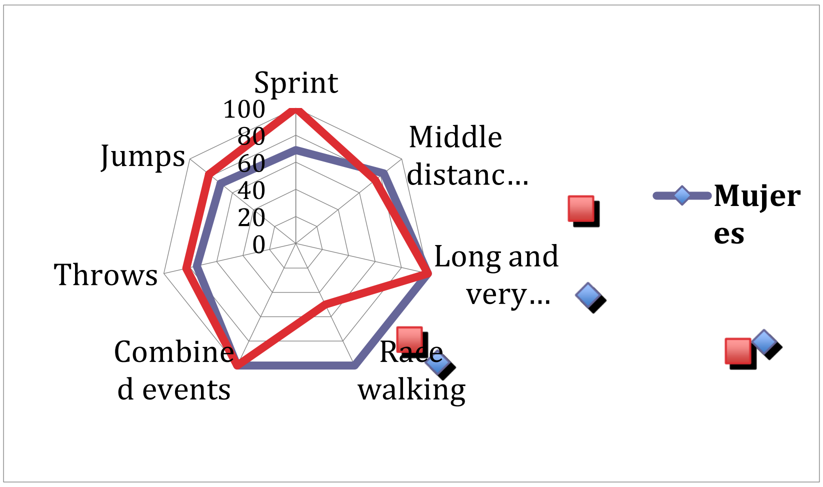

Figure 3. Percentage of athletes located in their specialty according to their dermatoglyphic profile.

DISCUSSION

In the practice of a sport, specifically track and field, it is essential to have an appropriate basic profile and also according to the specialty; however, it is unusual that, at an early age, through objective testing, there is a process of analysis of sports talent (Leiva et al., 2011). The objective of this work was to analyze the dermatoglyphic profile and its relationship with the predominant physical qualities in university athletes in the modalities of track and field for use as a basis for future studies and for the detection of talent in that modality.

We found, in these athletes, that an ulnar loop (6) showed that speed is the most relevant physical potential in the studied sample, followed by the whorl (3.3), which identifies motor coordination and agility as important physical potentials in the general dermatoglyphic profile of these university track and field practitioners. It is also significant to point out endurance as another element to consider in these athletes since the mean Delta 10 index was 13.4. This provides an important basis for the detection and orientation of talent for track and field at an early age since regardless of the modality involved, speed and motor coordination are essential for the majority of athletic events. This coincides with Carvalho et al. (2005) who recognize dermatoglyphics as a key element in the pedagogical process of sports selection, identifying the innate potential of individuals.

Concerning D10, we found a higher index (13.4); these values differ from other studies although not too much. For example, in a study of high-performance endurance athletes from Río de Janeiro, the D10 index was 11.5 (Carvalho et al., 2005). Another in middle-distance runners reported a mean D10 of 11.2 (Sánchez and Rodríguez, 2017). In Colombian Pan American Games participants, women and men had a mean D10 of 12.1 (Avella and Medellín, 2013).

The values of this study (arc 0.2 ± 0.7; loop 6.3 ± 3.1; whorl 3.6 ± 3.2; and 13.4 ± 4 deltas) coincide considerably; for example, Avella and Medellín (2013) report results close to those of this research in 8 sprint athletes from the representative team of Colombia in the Pan American Games Guadalajara 2011. They studied five women: arc 0; loop 7.8 ± 2.17; whorl 2.2 ± 2.17; delta 12.2 ± 2.17. The assessment in men was: arc 0.67 ± 1; loop 6.7 ± 1.5; whorl 3 ± 1.15; delta 12 ± 2. Other results (Sánchez and Rodríguez, 2017) in middle-distance runners of Bogota, Colombia, report values in 13 women (arcs 1.4 ± 0.8; loop 6.7 ± 1.4; and whorl 3.3 ± 4.1) and 14 men (arcs 0.3 ± 1; loop 5.5 ± 1.6; and whorl 2.1 ± 1.3). In this same sport of track and field, authors such as Carvalho et al. (2005), in endurance events, with 12 high-performance athletes from Rio de Janeiro showed the following results: arc 0.3 ± 0.6; loop 7.83 ± 1.59; and delta 1.83 ± 1.70. With the caveat that they are contrasting results from specific events; however, these results provide some light on future work. It is also important to point out the similarity of data reported by Toledo et al. (2008) with those of this work since they report a distribution of 1.1 arcs, 6 loops, and 2.9 whorls in a sample of 28 women Brazilian volleyball players with only the number of arcs being different with these being greater in these Brazilian athletes.

The arc, the whorl “S” design, and the radial loop are relevant appearances in the study sample. The arc-type design is particularly noteworthy since these data contrast in the predominance of the type of fingerprint presented by Díaz and Espinoza (2008), who conducted a study with 29 male sprinters from Brazil, highlighting a high correlation between loops and arcs in sprinting and throwing athletes. The "S" design whorl is expected since it appears in general and is reported in a very low proportion in dermatoglyphics studies. Also, this design correlates with motor coordination and agility, in a homologous way with the W whorl and although it has not yet been corroborated, it seems that this "S" whorl design is associated with fine motor coordination (Nodari-Junior, 2019).

According to dermatoglyphs, the higher the number of finger lines, the greater the endurance capacity of individuals (Rodríguez et al., 2017). In this work, men who practice combined events, such as the decathlon, have the highest number of finger lines (left hand 83 and right hand 88, SQTL = 171). On the other hand, women in race walking have a greater number of lines (left hand 90 and right hand 95, SQTL = 185); these results correspond to what dermatoglyphics show, according to the type of event, both in men and women. On the other hand, one result that deviates from the norm is that found in men who race walk 10 and 50 km; they have a mean SQTL of 100. In other words, this is a low count for this type of activity which is related to aerobic endurance. For example, if we compare these results with those found in the two women studied in the same sport discipline with mean values of 184.5, they correspond to the mentioned sports discipline.

In general, L>W and W>L are the two dermatoglyphic formulas that prevail in greater proportion in athletes of both sexes. In men it is present in 75% and is distributed as follows, L>W 56.8% in athletes of speed and jumping events, and W>L 18.2% dispersed in several groups of athletic events. In women, L>W was

37.2% and W>L, 30.2%, which were present in 67.4%. This confirms speed, motor coordination, and endurance as the physical abilities that prevail in the studied sample. This is in agreement with Díaz and Espinoza (2008) who report that the W design in combination with the L design is associated with long-distance athletes. The remaining works on dermatoglyphics in track and field do not report fingerprint formulas in their results, which makes them difficult to compare.

CONCLUSIONS

The results of this work show that the most predominant fingerprints types in the athletes studied are the ulnar loop, followed by the whorl; therefore, the most relevant digital formulas are L> W and W> L, with a D10 index of 13.3. The aforementioned data show a significant variation in physical qualities, maximizing the functional levels of coordination, endurance, strength, speed, and agility. Regarding the athlete´s discipline according to the type of fingerprint that shows the predominant physical qualities, the results show that 83% are in the appropriate discipline according to the type of fingerprint, number of designs, and lines

This study provides a reference for future research in the detection, selection, and orientation of talent for track and field, considering elements or variables of dermatoglyphics and other areas of sports sciences, for specific cases according to the diversity of tests that covers this sport discipline.

Finally, this study is far from being conclusive; on the contrary, the idea is that new questions should appear from the results reported here. Above all, lines of research should open, if not by individual events, but by grouped events, as in this first effort presented here, to find specific dermatoglyphic profiles and with the ability to generalize the results.

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