2024, Retos, 59, 709-714

Dermatoglyphic characteristics of elite level female skaters according to competition mode
Características dermatoglíficas de patinadoras nivel élite según modalidad de competencia

Jesús León Lozada-Medina, Manuel Enrique Moreno-Villamizar
Corporación Universitaria del Caribe (Colombia)

Abstract. Dermatoglyphics is presented as a method that allows understanding the relationship between the patterns established in the fingerprints of human beings and the physical abilities in the various sports modalities. The present work analyzed the dermatoglyphic characteristics of skaters of world elite level according to the competition modality. Skaters specialized in speed events (n=10) and endurance events (n=10) were evaluated (n=20). The protocol proposed by Cummins and Midlo was used for dermatoglyphic analysis. The results showed that there are significant differences (p>0.05) between competition modalities for the variables Delta (D10), whorls (W) and total line count (SQTL), as for the competition specialty; the speed modality presented an increase in the levels of arches (A) and loops (L) and decrease in the total line count (SQTL), as for the endurance presented an increase in the levels of (L), (W), (SQTL) and decrease (A). High-achieving sports develop elite athletes through constant selection and long-term directed training, which in the results of the present study orient the athlete's profile, concluding that the dermatoglyphic characteristics D10, SQTL and W differ between competition modalities, being higher in endurance skaters than in sprinters. Therefore, in the present work it was found that dermatoglyphics vary for the competitive specialty in the high-level skaters evaluated.
Keywords: Fingerprint Dermatoglyphics, Skating, Elite Athletes

Resumen. La dermatoglífia se presenta como un método que permite comprender la relación existente entre los dibujos establecidos en las huellas digitales de los seres humanos, y las capacidades físicas en las diversas modalidades deportivas. El presente trabajo analizó las características dermatoglíficas de las patinadoras de nivel élite mundial según la modalidad de competencia. Se evaluaron (n= 20) patinadoras especializadas en pruebas de velocidad (n=10) y pruebas de resistencia (n=10). Para el análisis dermatoglífico se usó el protocolo propuesto por Cummins y Midlo. Los resultados mostraron que existen diferencias significativas (p>0,05) entre modalidad de competencia para las variables Delta (D10), verticilos (W) y conteo total de líneas (SQTL), en cuanto a la especialidad de competencia; la modalidad de velocidad presentó un aumento en los niveles de arcos (A) y presillas (L) y disminución del SQTL, en cuanto a la resistencia presenta aumento en los niveles de L, W, SQTL y disminución de A. Los deportes con altos logros desarrollan deportistas de élite a través de la selección constante y el entrenamiento dirigido a largo plazo, lo cual en los resultados del presente estudio orientan el perfil del deportista, concluyendo que las características dermatoglíficas D10, SQTL y W difieren entre modalidad de competencia, siendo mayores en fondistas que en velocistas. Por lo tanto, en el presente trabajo se encontró que la dermatoglifia varía para la especialidad competitiva en las patinadoras de alto nivel evaluadas.
Palabras Clave: Dermatoglifia Dactilar, Patinaje, Deportistas élite

Fecha recepción: 08-11-23. Fecha de aceptación: 21-07-24
Jesús León Lozada-Medina
jesusleon.lm@gmail.com

Introduction

The characteristics of fingerprints have been the basis of several studies for decades, initially as identification (Galton, 1892; Vucetich, 1904). Where dermatoglyphia as a concept proposed by Cummins and Midlo (Cummins & Midlo, 1943), refers to the dermopapillary lines and drawings formed on the fingers of both hands. It comes from the Greek: Derma which translates skin and glyph drawing.

Fingerprints begin to appear from the sixth week (Abramova & Fernández, 1997; Abramova et al., 1996). Initially, the hands of the fetus have flat shapes where the finger is perceived in a rudimentary and featureless way. At the beginning of the eleventh week of formation in the womb, the lower zone of the fetal epidermis begins to thicken, the tiny lines begin to transform into raised lines or epidermal ridges separated by a depression or furrow containing a sweat pore with its respective sweat gland. Between the fifteenth and sixteenth week, the progress of the primary ridges ends and the process of formation of the secondary ridges or lines increasingly closer to the surface of the skin begins. These ridges do not present pores and will continue to form until the sixth month. At this moment, the process of formation of the digital lines and drawings is completed, and they are already recognizable in the distal phalanges of all the fingers of the fetus (Scheinsonhn & Saroka, 2013).

According to several authors, fingerprints present three fundamental principles: Perenniality, which establishes that the drawings formed in the distal phalanges are established from the intrauterine state and last throughout life. Immutability which states that no fingerprint changes its structure and diversity, there are only three types of drawings in human beings (Abramova & Fernández, 1997).

The three types of footprints existing in human (Figure 1), the first footprint formed is the arches, it is identified with the letter (A) and its numerical value is zero (0), its structure does not present deltas. This footprint is related to force levels (Abramova & Fernández, 1997; Abramova et al., 1996). The second trace to leivbe formed is known by the name of loop, it is identified by the letter (L) and its numerical value is (1)

this trace has a delta and is related to speed and power and the third trace to be formed is known by the name of whorl, it is identified by the letter (W) and its numerical value is 2, it is composed of two deltas and is related to coordination and resistance (Medellín, 2014; Negri de Almeida, 2005).

In this sense, dermatoglyphics is presented as an instrument that allows analyzing the phenotypology of people's fingerprints (de Abreu et al., 2007). Relating in a simple and reliable way genetic criteria, establishing characteristic groups according to their analysis profile (Leiva Deantonio et al., 2011). In such a way that studies on dermatoglyphics help us to understand the relationship between the patterns established in the fingerprints of human beings, and physical abilities in various sports specialties (Abramova, 2003; Herrera Romero & Castro Jiménez, 2022).

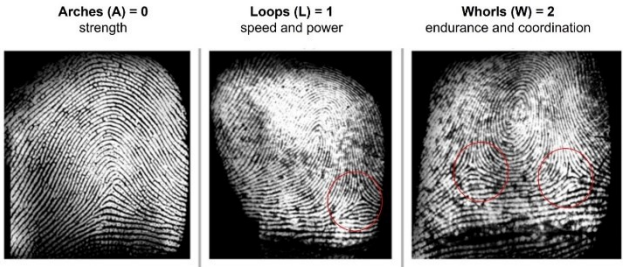

Figure 1. Types of fingerprints and their association with basic motor skills

Dermatoglyphics in sport is presented as an instrument that allows analyzing the phenotypology of the fingerprints of individuals (de Abreu et al., 2007; Hernández-Mosqueira et al., 2023). Relating in a simple and reliable way genetic criteria, establishing characteristic groups according to their analysis profile (Leiva Deantonio et al., 2011) In this sense, studies on Dermatoglyphics help to understand the relationship between the patterns established in the fingerprints of human beings, and physical abilities in various sports (Abramova, 2003).

For its part, roller speed skating is a growing sport that is shaping up to be part of the summer Olympic program, considering that in 2018 it was part of the Youth Olympic Games (Speed Technical Commission General Regulations, 2019). Its competitive structure is divided into two modalities, speed and endurance tests (Lozada, 2013) distribution that has had modifications in its competitive events in recent years and that, little by little those who take part in its competitions vary spontaneously their way of training seeking to maximize their physical capabilities.

As for the selection of the modality in racing skating, it is presumed that it is conditioned to the type of events and the way they are trained, and not to their dominant physical characteristics. In this sense having studies in dermatoglyphics for racing skating probably supports the sports processes within this sport, where a study related to the dermatoglyphic characteristics of children skaters according to the degree of somatic maturation is located (Moreno & Lozada-Medina, 2019), however no research studies are evidenced that address the dermatoglyphic characteristics of skaters according to the competition modality.

Therefore, the present study aims to analyze the dermatoglyphic characteristics of world elite level female skaters according to competition modality.

Material and methods

Participants

The sample was selected by means of a non-probabilistic purposive sampling and was specified in female subjects, world champions and with medals in Olympic cycle events and World Games, in the practice of roller speed skating, all in the world top thirty, according to their results over the last two years. It is convenient to emphasize that the research is of a descriptive nature, of transversal cut, and included the single taking of fingerprint samples of each athlete, as well as the basic variables of height, year of birth, weight and time performing sport.

The population universe consisted of professional skaters from twelve different countries. All competitors during the Arena International Speed Skating Championship. Being 20 female subjects (n=20), with an average age: 21.7 years old ±3.3, height 164.6 centimeters ± 6.9, weight 61.7± kilograms 5.8, being 10 sprinters and 10 endurance skaters.

For the selection of the sample, the researcher contacted the directors of the Arena Geisingen International event, and told them the intention of conducting research, and what it was trying to investigate, then they agreed to collaborate in the process. Subsequently, the athletes accepted and signed the informed consent, and in the case of minors, the signature of their parents or legal guardians was required during the event. In addition to this, the collection of fingerprints was conducted, in the presence of the parents, legal guardians and coaches present at the sporting event and with respect for the Declaration of Helsinki and Human Rights.

Procedure

Firstly, each subject who was evaluated was explained about the research, the objectives, and the purpose for which he/she was going to be part of it, after which it was suggested that he/she sign the informed consent form. Subsequently, basic questions such as name, date of birth, age, e-mail were asked. Also, height and weight data were taken.

The procedure for fingerprinting followed the protocol proposed by Cummins and Midlo Cummins y Midlo (Cummins & Midlo, 1943), and a high-precision Futronicc Fs55 biometric scanner was used for fingerprint collection, which scans and digitizes fingerprints and meets international biometric standards (INTERPOL INT-I. ANSI/INCITS 381),

The processing and identification of the types of footprints and line counts was performed using Dermasoft 2.0 © software (*DermaSoft | Cacsoftware*, 2015; Hernández-Mosqueira et al., 2023), which processes the digitized and enlarged image to verify the line count and identify the type of footprint.

Once the fingerprints are collected, the investigator selects each fingerprint, identifies the type or pattern (A), (L), (W), and categorizes them. Likewise, once the shape and structure have been identified, the digital signature is assigned, which is the composition of the type of drawing existing in both hands.

Once the data is obtained, the following equation is performed ($D10 = \sum L + 2 * \sum W$), this gives us what we know as Delta (D10). The total line count (SQTL) is performed by drawing a straight line that goes from the delta of each trace to the nucleus, this line serves as a guide to count the number of lines between these two points. It should be noted that to count the existing lines in the whorl type of footprint, two lines should be drawn from each delta to the nucleus, then count the existing lines and finally the result obtained should be divided by two, because this footprint has two deltas in its structure and only one nucleus.

Data analysis

In the processing of the data, an exploratory analysis was performed considering the nonparametric statistical technique shapiro wilk, then the descriptive analysis was performed, using the techniques to establish the measures of central tendency and dispersion, specifically mean and standard deviation, in addition to the maximum and minimum values of the dermatoglyphic variables. After verifying the violation of the normality assumption (p>.05) in the variables, the comparison of means between competence specialties was conducted using the nonparametric Mann Whitney U test, where the significance (p<.05) of the differences was evaluated and the hypothesis of equality was verified.

Results

Table 1 presents the characteristics that describe the sample, in these results are presented values such as age, weight and height for both female sexual phenotypes, as well as the averages standard deviation and minimum and maximum values, showing the diversity in terms of age and basic anthropometric characteristics of the skaters, where there are women from 18 to 29 years of age and between 49 to 70 kg of weight, as well as heights between 150 to 178 cm, however the averages of 21.7 years, 61.7 kg of weight and 164.6 show standard deviations of ±3.3 years, ±5.8 kg and ±6.9 cm, therefore the extreme minimum and maximum data, could be considered atypical in addition for being outside a standard deviation.

Table 1.
Descriptive statistics of the basic variables of the elite skaters

Variables	N		Media	standard deviation	minimum	maximum
	Valid	lost				
age (years)	20	0	21.7	3.3	18.0	29.0
weight (kg)	20	0	61.7	5.8	49.0	70.0
height (cm)	20	0	164.6	6.9	150.0	178.0

In table 2 the group presents significant differences (p <,05), among specialties, the long-distance runners present higher values in (D10) (p=,039 <,05), SQTL (p=,00,49 <,05) W (p=,037 <,05). Indeed, there are no significant differences for A (p=,261 >,05) nor for L (p=,092 >,05). In this way, the dermatoglyphic profile between specialties is presented which shows that the profiles vary according to the specialty, presenting lower SQTL in sprinters with respect to long-distance runners.

Table 2.
Dermatoglyphic characteristics and comparison by modality of elite-level skaters

Variables	Modality	Media	standard deviation	U de Mann-Whitney (p<,05)
Delta 10 (D10)	Sprinters	10.20	1.99	.039*
	Endurance	13.50	3.21	
Total line count (SQTL)	Sprinters	87.10	29.68	.049*
	Endurance	134.00	42.05	
Arches (A)	Sprinters	0.80	1.32	.261
	Endurance	0.20	0.42	
Loops (L)	Sprinters	8.20	1.14	.092
	Endurance	6.10	2.81	
Whorls (W)	Sprinters	1.00	0.94	.037*
	Endurance	3.70	2.98	

Figure 2 shows the comparison of means for the variables A, L, W, in the specialties of sprinters and endurance, which present statistically significant differences in relation to the W 0.037 (p<.05).

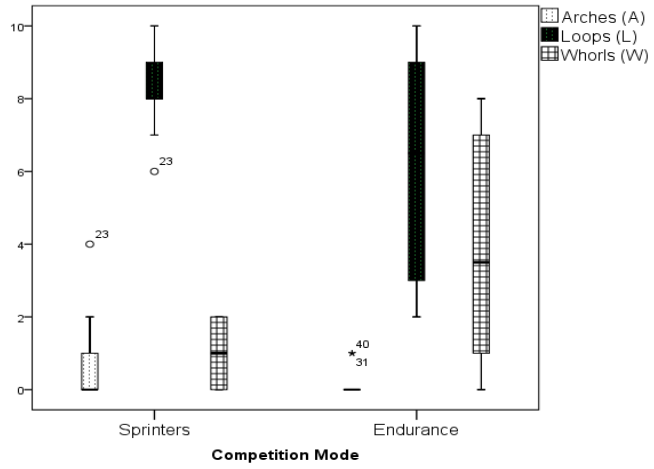

Figure 2. Mean and 95% confidence zone for A, L and W according to specialty

Discussion

The purpose of this study was to know the dermatoglyphic characteristics of world elite level skaters specialized in speed and endurance events, considering that there are no studies related to dermatoglyphics applied to this sport, in this study a comparison is made between the specialty.

The results indicate when comparing the modality, that the group presented significant differences ($p<.05$) for D10, SQTL and W, with higher values in the long-distance runners. Sports that present strength and coordination with aerobic participation exhibit elevated levels of lines with greater presence of L, W, and scarcity of A (del Vecchio & Gonçalves, 2010). Of the same the complexity of finger drawings and a high number of ridges or lines is typical of endurance sports (Abramova, 2003; Leiva Deantonio et al., 2011). In addition to this, the increase in D10 and SQTL is closely related to endurance sports which present marked decreases in explosive strength (Abramova & Fernández, 1997; Herrera Romero & Castro Jiménez, 2022; Juarez Toledo et al., 2017)

On the other hand, the study in elite distance and semi-distance swimmers presented: 136.13 ±49.01 for the Sum of Total Number of Lines (SQTL); 0.57 ±1.08 for the type of drawing Arc (A); 6.30 ±2.95 for the type of drawing Loop (L); 3.13 ±3.33 for the type of drawing whorl (W); 12.57 ±3.99 for the number of deltas in the ten fingers (D10). Likewise, analyzing the profile found in roller speed skating sprinters, they show similar characteristics, which shows a decrease in the total count of lines and an increase in L. As for the D10 of the swimmers, it is observed that it is lower in roller speed skating sprinters and presents similar values to roller speed skating long-distance runners (de Cecilio Pável & Filho, 2004).

For its part, one study about the profile of ice skaters of the cross-country specialty exhibiting: patterns WL, LW D10>13, SQTL> 130. This profile is associated with the one found with roller speed skaters in the endurance specialty, although the competitive tests do not have the same characteristics, the dermatoglyphic patterns do have similarities (Radchenko et al., 2016).

The dermatoglyphic values correspond completely with the specialization or sport specialty, finding relationships between its variables and the qualities of the subjects' potential (Abramova et al., 1996). This means that dermatoglyphic studies can show that diverse types of footprint patterns differ in the level of reactivity and energetic characteristic and their nature is specific for distinct types of activities.

In relation to the predominance of fingerprint patterns states that the analysis of the patterns found on the fingers presents relationships between the type of pattern and physical abilities (Fernández-Aljoe et al., 2020; Gastelum & Guedea, 2017). The types where they are found (W L and L W), are disposed to develop resistance and coordination, if the LW pattern predominates, they exhibit resistance characteristics, while the WL pattern is more related to the presence of coordination skills (del Vecchio & Gonçalves, 2010; Fernández-Aljoe et al., 2020). A recent study determined that a group of basketball players under 14 years of age, present a predominance of physical characteristics of power and speed, according to their dermatoglyphic characteristics (Hernández-Mosqueira et al., 2023), however, other studies that have sought to establish the relationship between dermatoglyphic markers and physical variables have not found a relationship neither in children according to their maturity (Moreno & Lozada-Medina, 2019), or even in professional level soccer players (Jiménez et al., 2020).

Dermatoglyphia as a morphogenetic marker, is a direction towards the relationship of the constitution of different sports disciplines, since its ontophylogenetic nature determines the order of their relationships with constitutional complexes at the phenotypic level, which indirectly determines their belonging to a physical characteristic (Abramova, 2003), a review conducted for sports dermatoglyphics studies in America found that in high achievement sports the number of arches (A) is low while more loops (L) than whorls (W) are observed (Fernández-Aljoe et al., 2020), which coincides with the findings of the group under study as high performance athletes.

Likewise, high-achieving sports develop elite athletes through constant selection and long-term directed training (Dantas et al., 2004; Fernández-Aljoe et al., 2020; Jiménez et al., 2020; Medellín, 2014; Montenegro Arjona et al., 2022). By analyzing this type of subjects and relating them to the various predominant bioenergetic characteristics and their development of basic physical qualities it has been possible to determine the unidirectional connections formed by the system of dermatoglyphic signs with these hereditarily obtained characteristics. Therefore, the results of the present study guide the way by evidencing the differentiation of the dermatoglyphic characteristics according to the modality (endurance and speed), for the group of high-performance skaters evaluated.

Conclusions

In the light of the results for the evaluated group, the speed skaters presented internally higher levels of A and L and decreased SQTL, the endurance skaters presented increased levels of L and W and SQTL and decreased levels of A.

The dermatoglyphic characteristics Delta 10, total line count (SQTL) and whorls (W) differ between competition modalities, being higher in long-distance runners than in sprinters. Therefore, in the present work it was found that dermatoglyphics vary for the competitive specialty in the high-level skaters evaluated.

Recommendations

Although the results of the present work show important indicators for the characterization of the group under study and similar groups, in the future a larger and more probabilistic sample is required to obtain parameters related to the population of high-performance skaters.

References

Abramova. (2003). *Dermatoglifía del Dedo y Habilidades Físicas*. Universidad Estatal de Moscu.

Abramova, & Fernández, F. (1997). Empleo de los indicadores dermatoglificos en calidad de marcadores genéticos para la selección de deportistas de coordinación compleja y juegos deportivos en Brasil. *Compendio de Trabajos Científicos VNIIFK 1996*, 386–391.

Abramova, T., Nikitina, T., & Ozolin, H. (1996). Posibilidades del empleo de la dermatoglífia dactilar en la selección deportiva. *Teoría y Práctica de La Cultura Física*, *3*, 8–14.

Cummins, H., & Midlo, C. (1943). Finger prints, palms and soles: An introduction to dermatoglyphics. *American Juornal of Physical Anthropology*, *2*(2), 227–229. https://doi.org/https://doi.org/10.1002/ajpa.1330020212

Dantas, E. H. M., Barrón-Luján, J. C., Bispo, M. D. C., de Godoy, E. S., dos Santos, C. K. A., de Nazaré Dias Bello, M., & Gastélum-Cuadras, G. (2022). Criteria for identifying and assessing sports training periodization models. *Retos*, *45*(April), 174–183. https://doi.org/10.47197/retos.v45i0.90837

Dantas, P. M. S., Alonso, L., & Fernandes-filho, J. (2004). A dermatoglifi a no futsal brasileiro de alto rendimento. *Fitness & Performance Journal*, *3*(3), 136–142. https://doi.org/10.3900/fpj.3.3.136.p

de Abreu, G., Moreira, P., & Fernandes-Filho, J. (2007). Perfil dermatoglífico, somatotípico e das qualidades físicas básicas dos bailarinos bolsistas do Centro de Movimento Deborah Colker. *Fitness & Performance Journal*, *6*(5), 331–337. https://doi.org/10.3900/fpj.6.5.331.p

de Cecilio Pável, D. A., & Filho, J. F. (2004). Identificação dos perfis dermatoglífico, somatotípico e das qualidades físicas básicas de atletas de alto rendimento em modalidades de natação em provas de meio-fundo e fundo. *Fitness & Performance Journal*, *3*(1), 18–27. https://doi.org/10.3900/fpj.3.1.18.p

del Vecchio, F. B., & Gonçalves, A. (2010). Dermatoglifos como indicadores biológicos del rendimiento deportivo. *Rev Andal Med Deporte*, *3*(2), 68–79.

dermaSoft | cacsoftware. (2015). https://cacsoftwarefacil.wixsite.com/cacsoftware/dermasoft

Fernández-Aljoe, R., García-Fernández, D. A., & Gastélum-Cuadras, G. (2020). La dermatoglifia deportiva en América en la ultima década una revisión sistemática. *Retos*, *83*, 831–837.

Galton, F. (1892). *Finger prints* (Great Mind Series). Prometheus Books.

Gastelum, G., & Guedea, J. C. (2017). *Potencial de la dermatoglifia en las ciencias del deporte y la salud en México*. *XI*, 108–114.

Hernández-Mosqueira, C., Cresp Barría, M., Peña-Troncoso, S., & Pavez-Adasme, G. (2023). Perfil dermatoglífico de seleccionados chilenos de básquetbol categoría sub 14 (Dermatoglyphic profile of chilean basketball teams category sub 14). *Retos*, *48*(2017), 630–636. https://doi.org/10.47197/retos.v48.96101

Herrera Romero, R. L., & Castro Jiménez, L. E. (2022). Revisión sistemática entre dermatoglifia dactilar y fuerza en el deporte a nivel mundial. *Revista Ciencias de La Actividad Física*, *23*(1), 1–12. https://doi.org/10.29035/rcaf.23.1.7

Jiménez, L. E. C., Gutiérrez, Y. P. A., Rojas, I. A. S., Gálvez, A. J., & Buitrago, P. J. M. (2020). Relationship between dermatoglyphic markers and morphofunctional profile in professional soccer players from Bogotá, Colombia. *Retos*, *2041*(41), 182–190. https://doi.org/10.47197/RETOS.V0I41.83032

Juárez Toledo, L., Domínguez García, M. V., Laguna Camacho, A., Sotomayor Serrano, N., & Balbás Lara, F. (2017). Somatotipo Y Dermatoglífia Dactilar En Futbolistas Mexicanos. *Revista Internacional de Medicina y Ciencias de La Actividad Fisica y Del Deporte*, *18*, 383–393. https://doi.org/http://dx.doi.org/10.15366/rimcafd2018.70.011

Leiva Deantonio, J. H., Melo Buitrago, P. J., & Gil Villalobos, M. J. (2011). Dermatoglifia dactilar, orientación y selección deportiva. *Revista Científica General José María Córdova*, *9*(9), 287. https://doi.org/10.21830/19006586.256

Lozada, J. (2013). *Patinaje. Manual Didáctico* (Edufisadred, Ed.; 1st ed.).

Medellín, J. P. (2014). Caracterización Dermatoglífica De Las Ciclistas Colombianas De Pista De Altos Logros En Pruebas De Semifondo. *Revista U.D.C.A Actualidad & Divulgación Científica*, *17*, 45–52. http://www.scielo.org.co/pdf/rudca/v17n1/v17n1a06.pdf

Montenegro Arjona, O. A., Urriago, O. L. C., Sterling, A. C. C., Parra, C. J. M., & Osso, G. C. T. (2022). Dermatoglifia y Somatotipo en Jugadores de Voleibol del Departamento del Huila en los XX Juegos Deportivos Nacionales Colombia (Dermatoglyphia and Somatotype in Volleyball Players from the Department of Huila in the XX National Sports Games Colombia). *Retos*, *44*(2008),

796–805. https://doi.org/10.47197/retos.v44i0.90474

Moreno, M., & Lozada-Medina, J. (2019). Características dermatoglíficas en patinadores según el grado de maduración somática. *Revista Actividad Física y Desarrollo Humano*, *10*. http://revistas.unipamplona.edu.co/ojs_viceinves/index.php/AFDH/article/view/3951

Negri de Almeida, M. (2005). Relação dos índices dermatoglíficos com avaliação isocinética e ergoespirometria. *Fitness & Performance Journal*, *4*(2), 101–106. https://doi.org/10.3900/fpj.4.2.101.p

Radchenko, E. N., Kalaev, V., Popova, I., & Sysoev, A. (2016). Algoritmo basado en marcadores dermatoglíficos para seleccionar niños para deportes. *Teoría y Práctica de La Cultura Física Teoriya.Ru*, *10*, 5.

Scheinsonhn, D., & Saroka, R. H. (2013). La Huella Digital Al Servicio De La Confederación Suiza. In Language Services fedpol (Ed.), *Federal Office of Police fedpol* (Language S). Federal Office of Police fedpol.

Speed Technical Commission General Regulations, Chairman Speed Technical Commission 95 (2019). http://www.worldskate.org/speed/about/regulations.html

Vucetich, J. (1904). Dactiloscopia Comparada. *2do Congreso Médico Latino Americano,* 84.

Datos de los/as autores/as y traductor/a:

Jesús León Lozada-Medina	jesusleon.lm@gmail.com	Autor/a
Manuel Enrique Moreno Villamizar	manuel.morenov@cecar.edu.co	Autor/a
Juan Ignacio Aduen Ángel	juan.aduen@cecar.edu.co	Traductor/a