DETERMINATION OF STATURE FROM TYPE OF FINGERPRINTS AMONG EGYPTIAN

Wael Saad Kholeif [a]

[a] **Forensic Medicine and Clinical Toxicology Department, Faculty of Medicine, Alexandria**

University, Alexandria, Egypt

Corresponding author: Wael Saad Kholeif

E mail: waelkholeif@gmail.com

Phone number: 01221371021, 01099535291

ABSTRACT

Introduction: Stature determination is an important parameter in person identification. Fingerprints form a valuable physical evidence in crime investigation. The use of fingerprints in identification currently focuses on the patterns of fingerprints. The current study aimed to assess the ability of stature identification from the type of fingerprints among Egyptian.

Material and Methods: The study was conducted on 150 adult Egyptians in the age group above 18 year. Stature was measured by standard methods using a portable body meter measuring device. The fingerprint was taken by rolling the thumb of the right hand on paper from outward to inward. The relation between fingerprint patterns of right hand thumb of individuals with their heights was evaluated and analyzed.

Results: Among the studied cases, loop was the most common fingerprint main type representing followed by arch then whorl. While ulnar loop was the commonest fingerprint sub type. Whorl showed the higher mean stature (172.32 ± 8.25) followed by arch then loop. As regard the sub types, plain whorl showed the higher mean stature (176.0 ± 7.62) followed by double loop whorl. Whorl showed the highest mean stature among males while loop showed the highest mean stature females and there was a significant difference ($p<0.001$).

Conclusion: fingerprint pattern can provide useful information for stature determination among male and female adult Egyptians.

Key Words: stature, finger prints, right hand thumb, identification.

INTRODUCTION

Fingerprints are unique traits of human beings. Particularly, they are highly distinctive between individuals (**Kholeif, 2021**).

Human fingerprints make good permanent markers of identification because they are distinctive, challenging to alter, and enduring over the course of a person's lifetime. For example, following a natural disaster, they may be utilized by the police or other authorities to identify people who want to hide their identity or people who can't be identified, like after a natural disaster (**Ag & Suresh, 2020**).

The friction ridges on a person's finger leave behind prints on various surfaces (**Sagayam et al., 2018**).

There are three main fingerprint patterns according to Henry classification system: loop, whorl, and arch. There are also more complex classification schemes which divide arch pattern even further into plain arches or tented arches and loops into radial or ulnar, depending on the side of the hand toward which the tail points. Whorls also have sub-type classifications including plain whorls, accidental whorls, double loop whorls, and central pocket loop whorls (**Mukhaiyar, 2017**).

One of the essential technique used in forensic science is the recovery of partial fingerprints from crime scenes. Additionally, it is employed nowadays as a sign of identity, to distinguish between potential criminals and crime victims (**Byishimo, 2021**).

The main purpose of forensic investigation is to use the victim's remains to establish their identity which composed of human body parts that have been damaged, burned or mutilated. Such as, partially damaged bodies and human remains are frequently found in areas, where deliberate mutilation, demolition, explosions, or other large-scale disasters have occurred (**Kanchan & Krishan, 2011**).

Investigating mutilated remains is done primarily to build a biological profile that can be used to identify persons by assessing the age, sex, and stature. This profile contributes to increase the probability of knowing data about victim's event or disaster (**Kim, 2019**).

Statures estimation from human remains depending on the precept that there is a direct correlation between stature and different body parts (**Krishan et al., 2012**).

Human stature measurement is an essential component of identity verification. The pressure of fingers induce print on the objects and so making fingerprint impression which could be used to identify individuals. Utilizing fingerprints can help to reduce the possibility of identities matching. (**Moorthy, 2016**).

Therefore, the aim of the current work was to assess the ability of stature identification from the type of fingerprints among Egyptian.

SUBJECTS AND METHODS

The committee of ethics of Faculty of Medicine, Alexandria University approval was obtained after reviewing the proposal. Informed consent was obtained from each individual with explanation the aim of the study.

It was a cross sectional study done on 150 adult Egyptians (males and females). All participants were over 18 years old.

The study did not include anyone who had any visible hand-related diseases, scars, orthopedic deformities, or hand injuries.

Stature in centimeter was measured by standard methods using a portable body meter measuring device. Stature of the persons was obtained at a fixed time. The height of the individual was measured in a standing posture with the head and feet exposed. Individuals stood barefoot in an upright position, with heels, buttocks, back and back of head against the wall with hands presented side down and both feet kept beside. From the vertex to the floor, a centimeter-long measurement was obtained (**ISO 13225, 2012**).

The cleaned right hand thumb was placed on an inked plate and then positioned gently on an A4-sized piece of white paper. The thumb print was captured by rolling it from outside to inside on paper (**Moorthy, 2016**).

Using a magnifying glass, the fingerprint patterns were examined and classified as loops, whorls, and arches based on the presence of ridge lines using Henry's system. Individuals' right hand thumb fingerprints were studied and analyzed in relation to their heights.

Statistical analysis of the data

Using the IBM SPSS software program, version 20.0, data were imported into the computer and evaluated (Armonk, NY: IBM Corp). Numbers and percentages were used to display the data. The Kolmogorov-Smirnov test was used to determine whether the data were normally distributed. Range, mean, and standard deviation were used to express quantitative data.

RESULTS

The study included 150 adult Egyptians (112 males representing 74.7% and 38 females representing 25.3%) of known and confirmed age (18-40 years) with mean age of 26.90 ± 5.01 year.

Stature in this work ranged from $160 - 187$ cm with mean of 171.43 ± 6.16 cm. (Table 1)

Table (1): Distribution of the studied cases according to different parameters (n = 150)

	No. (%)
Stature	
Mean ± SD.	171.43 ± 6.16
Median (Min. – Max.)	171.0 (160.0 – 187.0)
Sex	
Male	112 (74.7)
Female	38 (25.3)
Age	
18- <30	96 (64.0)
30 – 40	54 (36.0)
Mean ± SD.	26.90 ± 5.01
Median (Min. – Max.)	25.0 (18.0 – 40.0)

n: **number**

Pattern of fingerprints of the right thumb:

Table 2 revealed that loop was the most common fingerprint main type representing 38.7% followed by arch (37.3%) then whorl (24.0%) while ulnar loop was the commonest fingerprint sub type representing 26.7 %.

Table (2): Pattern of fingerprints of the right thumb of the studied cases (n = 150)

Fingerprints types	No. (%)
Loop	**58 (38.7%)**
Ulnar	40 (26.7%)
Radial	18 (12.0%)
Arch	**56 (37.3%)**
Plain	29 (19.3%)
Tented	27 (18.0%)
Whorl	**36 (24.0)**
Plain	22 (14.7%)
Double loop	4 (2.7%)
Central pocket	10 (6.7%)

n: **number**

Relation between stature with main fingerprint types and sub types:

Regarding the main fingerprint types, it was observed that whorl showed the higher mean stature (172.32 ± 8.25) followed by arch then loop but there was no significant difference.

Regarding the sub types, plain whorl showed the higher mean stature (176.0 ± 7.62) followed by double loop whorl (175.50 ± 6.35) while radial loop showed the lower mean stature (167.33 ± 0.97). (Table 3)

Table (3): Relation between stature with fingerprint main type and sub type (n = 150)

Fingerprint types		Stature	
	N	Mean ± SD.	Min. – Max.
Whorl	**36**	**172.32 ± 8.25**	**164.0 – 187.0**
Plain	22	176.0 ± 7.62	164.0 – 187.0
Double loop	10	175.50 ± 6.35	170.0 – 181.0
Central pocket	4	171.20 ± 4.87	167.0 – 180.0
Arch	**56**	**171.50 ± 5.85**	**160.0 – 185.0**
Plain	29	170.91 ± 6.13	160.0 – 185.0
Tented	27	168.37 ± 7.08	160.0 – 178.0
Loop	**58**	**170.52 ± 3.30**	**167.0 – 181.0**
Ulnar	40	171.95 ± 2.96	167.0 – 181.0
Radial	18	167.33 ± 0.97	167.0 – 170.0
F (p)		**1.229(0.295)**	

SD: **Standard deviation**
F: **F for One way ANOVA test**
N: **Number**

Relation between stature with fingerprint main type and sub type as regard the sex. (Table 4)

A. Relation between stature with fingerprint main types and sub types among males:

Whorl showed the highest mean stature representing 176.54 ± 4.95 followed by arch (174.09 ± 5.83) then loop (170.17 ± 2.85) and as regard the sub types, plain arch showed the highest mean stature representing 179.65 ± 2.27 while radial loop showed the least main stature representing 167.0 ± 0.0. There was a significant difference (p <0.001).

B. Relation between stature with fingerprint main types and sub types among females:

Loop showed the highest main stature representing 172.20 ± 4.78 followed by whorl (166.9 ± 1.38) then arch (160.80 ± 1.74). As regard the sub types, ulnar loop showed the highest mean stature representing 172.75 ± 5.26 while tented arch showed the least main stature representing 160.0 ± 0.0 and there was a significant difference (p <0.001). (Table 4)

Table (4): Relation between stature with fingerprint main type and sub type as regard the sex (n = 150)

		Sex		
		Male stature		Female stature
		Mean ± SD.	Min. – Max.	Mean ± SD.	Min. – Max.
Whorl		**176.54 ± 4.95**	**169.0 – 187.0**	**166.92 ± 1.38**	**164.0 – 168.0**
	Plain	173.85 ± 6.43	169.0 – 187.0	166.67 ± 1.58	164.0 – 168.0
	Double loop	175.50 ± 6.35	170.0 – 181.0	-	-
	Central pocket	173.67 ± 4.93	170.0 – 180.0	167.50 ± 0.58	167.0 – 168.0
Arch		**174.09 ± 5.83**	**162.0 – 185.0**	**160.80 ± 1.74**	**160.0 – 165.0**
	Plain	179.65 ± 2.27	175.0 – 185.0	162.0 ± 2.37	160.0 – 165.0
	Tented	172.56 ± 4.58	162.0 – 178.0	160.0 ± 0.0	160.0 – 160.0
Loop		**170.17 ± 2.85**	**167.0 – 176.0**	**172.20 ± 4.78**	**169.0 – 181.0**
	Ulnar	171.75 ± 2.14	167.0 – 176.0	172.75 ± 5.26	169.0 – 181.0
	Radial	167.0 ± 0.0	167.0 – 167.0	170.0 ± 0.00	170.0 – 170.0
F (p)		**23.648*(<0.001*)**		**51.718* (<0.001*)**	

SD: **Standard deviation**
F: **F for One way ANOVA test**
*: Statistically significant at p ≤ 0.05
n: number

DISCUSSION

The primary objective of forensic investigations is the identification of the persons, whether they are alive or dead. Various types of identification are known as personal, civil, lawful and criminal identification **(Kholeif, 2021)**.

Stature is one of the main characteristics for identifying an unknown person and can be determined by the presence of evidence at a crime scene. Fingerprints are one of these evident that may be present at a crime scene.

Fingerprints are used on a wide range for both criminal investigations and personal identification, and there are much researches currently being done for improving the level of fingerprints investigation **(McMurchie et al., 2016)**.

Thus, the present research aimed to predict stature of the person from type of fingerprint.

This cross-sectional study was conducted on a sample of adult Egyptians in order to determine stature based on the pattern of fingerprints.

This research interested only with the print of the right thumb rather than entire fingerprints as usually the right thumb is the digit that frequently handles various objects and the print found in crime scenes mainly belong to the right thumb.

150 adult males and females were included in the current study. Participants age was ranged from 18 to 40 years which is suitable as stature at 18 years is determined as an adult stature **(Kholeif, 2021)**.

In the current study loop was the most common fingerprint main type among the studied cases which in consistency with the study done by **Lalan et al. (2013)** which showed that loop was the commonest fingerprint types.

Also the study done by Qayyum et al. (2013) on the pattern of finger prints in the population of Rawalpindi and the study done by Moorthy (2019) on the Malaysian Tamils revealed that the majority of the respondents were found to have loop type of fingerprint followed by whorl then arch.

The present research illustrates that whorl (especially plain whorl) showed the higher mean stature followed by arch then loop.

Similarly the study done by **Li et al. (2022)** revealed that persons with whorl type fingerprints have taller fingers than those who do not and this association has a direct relationship with genes involved in limb development.

In the current study whorl pattern showed the highest mean stature among males followed by arch then loop and there was a significant difference.

While in females, loop showed the highest main stature followed by whorl then arch and there was a significant difference.

This study pointed for the first time to the relation between patterns of fingerprints and stature. However, previous studies associated different measurements of the fingerprints with stature.

In Egypt, **Kholeif. (2021)** studied the estimation of stature from length of distal phalanges prints.

In Korea, **Kim. (2019)** studied the estimation of stature in Korean adults using hand measurements.

In Malaysian Malays, **Moorthy. (2016)** studied the determination of stature from fingerprints by regression analysis.

The present research showed that there is a relation between stature and fingerprint pattern and revealed a statistically significant relation of stature with fingerprint pattern in both sexes, suggesting a linear relationship between stature and types of fingerprint and illustrates that stature of males and females can be determined through the pattern of the fingerprint.

CONCLUSION

It was concluded from this work that, knowing of the fingerprint pattern can provide useful information for stature determination among male and female adult Egyptians.

ACKNOWLEDGEMENT

ETHICAL APPROVAL

All subjects provided written informed consent and the study complied with Alexandria University's ethical committee's standards.

REFERENCES

Ag, V. K., and Suresh, J. (2020): Study of fingerprint pattern: A cross sectional study. *Medico-legal Update,* 20(4): 1421-1423.

Byishimo, B. (2021): Origin of ordinary things: Fingerprint. Retrieved Sep, 2022, Retrieved from https://www.newtimes.co.rw/article/190418/Lifestyle/origin-of-ordinary-things-fingerprint

ISO 13225. (2012): Geometrical product specifications (GPS) — Dimensional measuring equipment; Height gauges — Design and metrological characteristics. Retrieved from https://www.iso.org/obp/ui/#iso:std:iso:13225:ed-1:v1:en

Kanchan, T., and Krishan, K. (2011): Anthropometry of hand in sex determination of dismembered remains - A review of literature. *Journal of Forensic and Legal Medicine,* 18(1): 14-17.

Kholeif, W. S. (2021): Stature estimation from the length of the distal phalanges prints among Egyptian using regression analysis. *Annals of Clinical and Analytical Medicine,* 2: 1-5.

Kim, W. (2019): A comparative study on the statistical modelling for the estimation of stature in Korean adults using hand measurements. *Anthropologischer Anzeiger; Bericht Uber Die Biologisch-anthropologische Literatur,* 76(1): 57-67.

Krishan, K.; Kanchan, T., and Sharma, A. (2012): Multiplication factor versus regression analysis in stature estimation from hand and foot dimensions. *Journal of Forensic and Legal Medicine,* 19(4): 211-214.

Li, J.; Glover, J. D.; Zhang, H.; Peng, M.; Tan, J.; Mallick, C. B., et al. (2022): Limb development genes underlie variation in human fingerprint patterns. *Cell,* 185(1): 95-112.

McMurchie, B.; Torrens, G., and Kelly, P. (2016): Forensic anthropometry from fingerprints - A collaboration between chemistry and design, Birmingham, UK: International Conference on Anatomy and Physiology.

Moorthy, T. N. (2016): Determination of stature from fingerprints in Malaysian Malays by regression analysis. *Malaysian Applied Biology,* 45(2): 57-62.

Mukhaiyar, R. (2017): Analysis of Galton-Henry classification method for fingerprint database FVC 2002 and 2004. *GEOMATE Journal,* 13(40): 118-123.

Sagayam, K. M.; Edwin, J. F.; Christopher, J. S.; Reddy, G. V.; Bestak, R., and Hun, L. C. (2018): Survey on the Classification of Intelligence-Based Biometric Techniques. In J. Hemanth and V. E. Balas (Eds.), Biologically Rationalized Computing Techniques For Image Processing Applications. London: Springer. 111-132

الملخص العربي

تحديد طول القامة من نوع بصمات الأصابع بين المصريين

وائل سعد خليف

قسم الطب الشرعي والسموم الإكلينيكية ـ كلية الطب ـ جامعة الإسكندرية، مصر

تحديد طول القامة هو عامل مهم في التعرف على الاشخاص. تشكل بصمات الأصابع دليلاً ماديًا قيمًا في التحقيق الجنائي. يركز استخدام بصمات الأصابع في تحديد الهوية حاليًا على أنماط بصمات الأصابع. هدفت الدراسة الحالية إلى تقييم قدرة التعرف على القامة من نوع بصمات الأصابع بين المصريين.

المادة والطريقة: أجريت الدراسة على ١٥٠ شخص بالغ في الفئة العمرية فوق ١٨ سنة. تم قياس القامة بالطرق القياسية باستخدام جهاز قياسات الجسم (محمول). تم أخذ البصمة عن طريق لف ابهام اليد اليمنى على الورق من الخارج إلى الداخل. تم تقييم وتحليل العلاقة بين أنماط بصمات إبهام اليد اليمنى للأفراد مع أطوالهم.

النتائج: تضمنت الدراسة ١٥٠ شخص بالغ (١١٢ من الذكور و ٣٨ من الاناث) وكان متوسط العمر ٢٦,٩٠ سنة وكان متوسط طول القامة بين الحالات ١٧١,٤٣ سم. بدراسة الحالات اظهرت النتائج ان بصمة الاصبع من نوع الدوامة مثلت اعلى متوسط للقامة تبع ذلك متوسط القوس ثم اخيرا نوع العروة. أظهر نوع الدوامة أعلى متوسط قامة بين الذكور بينما أظهر نوع العروة أعلى متوسط قامة بين الإناث.

الخلاصة: معرفة نمط بصمات الأصابع يمكن أن يوفر معلومات مفيدة لتحديد القامة بين الذكور والإناث المصريين البالغين.