Original Article JCMCTA 2025 ; 36 (1) : 141-146

Analysis of Fingerprint Patterns and Their Impact on Understanding Human Behavioral Traits in Forensic Contexts

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Abstract

Background: Dermatoglyphics, the study of fingerprint patterns, offers valuable insights into individual identity, with each person having a unique and permanent fingerprint design. These patterns are shaped by both genetic and environmental influences during fetal development. The aim of this research was to explore the relationship between fingerprint patterns and human behavioral traits.

Materials and methods: This descriptive cross-sectional study aimed to explore the relationship between sociodemographic factors (Age, gender, blood group and handedness) in medical students through fingerprint analysis. Conducted at Southern Medical College in Chattogram, Bangladesh, the study included 350 undergraduate students from the 1st to 5th year selected using census sampling. Data were collected using a structured questionnaire and fingerprint analysis. Descriptive statistics and the Chi-square test were used for analysis. Ethical approval was obtained from the Institutional Review Board (IRB) prior to the study.

Results: The study analyzed the socio-demographic profile and fingerprint patterns of 350 students, revealing a mean age of 21.49 years, with a higher proportion of females (57.7%). The most common fingerprint pattern across all fingers was whorls, particularly on the right thumb (59.4%). Significant associations were found between the right thumb's fingerprint patterns and various personality traits, including Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Notable correlations were observed for traits like indulging in fancies (p=0.000) helping others (p=0.000) and bursts of rage (p=0.000) suggesting that fingerprint patterns, particularly whorls, may be linked to personality characteristics.

Conclusion: This study reveals significant associations between right thumb fingerprint patterns, especially whorls and personality traits like Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism.

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Submitted on : 24.02.2025
Accepted on : 25.04.2025

Key words: Agreeableness; Conscientiousness; Extraversion; Fingerprint; Human behavioral traits; Openness to experience; Neuroticism.

Introduction

Dermatoglyphics is the study of fingerprint patterns on the fingers, palms, and soles, shaped by both genetic and environmental factors during fetal development. Fingerprint patterns begin forming between the 12th and 16th weeks of pregnancy and are fully developed by the 24th week. The chances of two individuals having identical fingerprints are extremely low, even among identical twins. Disruptions in fetal development can lead to abnormal patterns, influenced by hereditary or environmental factors.[1-5] Fingerprinting is widely used as an effective and affordable method of identification. The impressions left by fingerprints are known as fingerprint patterns, formed by raised areas (Ridges) and recessed areas (Grooves) on the skin. These patterns are shaped by various factors, including genetic, environmental and regional influences.[6-8] Individuals can be identified by various traits, including their face, height, body shape, gait, voice and sex, with sex being one of the key factors for differentiation. Researchers have investigated fingerprint analysis for gender identification, which can be especially useful in narrowing down suspects. Recently, there has been a growing trend in civilian and commercial sectors to adopt fingerprint-based identification, due to the affordability of compact solid-state scanners and the technology's higher accuracy in matching compared to other biometric methods.[9] People may exhibit similar variations in their interests, values, desires, and motivations due to systematic differences in how they perceive and interpret things. They may also differ in what they excel at and what they most enjoy doing. This concept is explored through an indicator that aims to identify individuals' core preferences for perception and judgment based on self-reported responses, seeking to understand how these preferences interact in their daily lives.[10] Even in

identical twins, dermatoglyphics (Fingerprints) remain unique and unchanged from birth to death. A person's fingerprint is a distinct and permanent form of identification, marked by intricate details that are hard to alter. Similarly, a person's blood type is a biological trait that remains consistent throughout their life.[11-13] Even in identical twins, fingerprints remain unique and unchanged throughout life. As a permanent and detailed trait, fingerprints provide distinct identification, similar to how a person's blood type stays the same.[14] The aim of this research was to explore the relationship between fingerprint patterns and human behavioral traits.

Materials and methods

This cross-sectional descriptive study, conducted at Southern Medical College in Chattogram, Bangladesh, from July 2024 to January 2025, aimed to explore the relationship between sociodemographic factors such as age and gender and fingerprint patterns among 350 medical students. Using census sampling, the study included all undergraduate students from the 1st to 5th year. The primary objective of the research was to analyze the connection between various fingerprint patterns (Loops, whorls and arches) and human behavioral traits in forensic contexts. By examining these patterns, the study sought to assess the potential correlation between fingerprint types and individual behaviors and to investigate the utility of fingerprint analysis in forensic investigations, particularly for profiling suspects and understanding behavioral patterns.

The ethical clearance for the study was taken from the Institutional Review Board (IRB) prior the commencement of this research. The aim of this research was to explore the relationship between fingerprint patterns and human behavioral traits.

Inclusion criteria

i) Medical students enrolled in the 1st to 5th years and interns at Southern Medical College.

ii) Students who voluntarily consent to participate in the study.

iii) Students who were willing to provide accurate sociodemographic information and undergo fingerprint analysis.

Exclusion criteria

i) Medical students not enrolled in the undergraduate program .

ii) Students who refused to participate or provide incomplete data.

iii) Students with any known skin conditions or physical conditions that may interfere with fingerprint analysis.

iv) Students who did not provide informed consent.

Data was collected using a structured questionnaire, which included questions related to sociodemographic factors (Such as age, gender). The questionnaire consisted of three parts: the first part collected socio-demographic information, the second part assessed the types of fingerprints on both hands, and the third part classified social behavior based on the five factors—Neuroticism (N) Extraversion (E) Openness (O) Agreeableness (A) and Conscientiousness (C)—which have been identified not only in peer rating scales but also in various psychological assessments.[15-16] The fingerprint analysis was performed using a standard method of collecting and analyzing fingerprints. Before data collection began, participants were briefed about the study's objectives and were provided with an informed consent form to sign. The principal investigator then administered the structured questionnaire to all eligible students. Fingerprint patterns were recorded using standardized equipment, and participants were asked to provide their blood group information. The study involved 350 participants, each providing their name, age, and gender. The participants were instructed to clean their hands using tap water and soap, then dry them to remove any dirt. Following this, they were asked to roll their fingertip pads on a forensic fingerprint ink pad, ensuring even ink application on the finger's tip by rolling the thumb towards the body while keeping the other fingers out. The fingerprints were then rolled onto paper from the outside to the inside, capturing the full fingerprint impression (Using the ink method by Cummins and Midlo). If any prints were deemed undesirable, the procedure was repeated. The resulting fingerprint patterns were categorized into loops, whorls, arches, or composite forms, using a

magnification lens for better clarity. Following data collection, the information underwent a process of scrutiny for accuracy, after which it was compiled and organized. The data were then presented for statistical analysis. A professional data manager conducted the statistical analysis using statistical software. Statistical analysis was performed using the χ^2 test, and p-value. Data analysis was conducted using SPSS software (Version 23). Descriptive statistics, including mean, standard deviations and frequencies, were used to summarize sociodemographic characteristics and behavioural traits. The Chi-square test was applied to examine associations.

Results

The socio-demographic profile of the students in the sample (n=350) reveals a mean age of 21.49 years. Regarding gender distribution, the majority of students were female, making up 57.7% (n=202) of the sample, while males accounted for 42.3% (n=148). These findings highlight a slightly higher representation of female students, which is consistent with general trends observed in the population shown in Table I.

Table I Socio-demographic pattern of the students

Variables	Frequency n= 350 (%)
• Mean age	21.4886
• Sex	
1. Male	148 (42.3)
2. Female	202 (57.7)

The fingerprint analysis of 350 participants revealed that whorls were the most common pattern across all fingers. For the right thumb, whorls were observed in 59.4%, with arches at 21.8% and radial loops at 8.9%. On the left thumb, whorls were seen in 49.7%, with radial loops at 17.7%. On the right index finger, whorls appeared in 47.1%, while on the left index finger, they were 46.6%, and radial loops were higher at 17.1%. For the right middle finger, whorls were 42.6%, and on the left middle finger, 42.9%. The right ring finger showed whorls at 64.9%, and the left ring finger had 59.7%. The right little finger had whorls at 49.1%, while the left little finger showed radial loops at 23.1% revealed in Table II.

Table II Pattern of fingerprints on both hands

FINGER	Right n=350 (%)	Left n=350 (%)
1. Thumb		
• Whorls	208 (59.4)	174 (49.7)
• Arches	75 (21.8)	67 (19.1)
• Ulnar loops	22 (6.3)	25 (7.1)
• Radial loops	31 (8.9)	62 (17.7)
• Composite	14 (4.0)	22 (6.3)
2. Index finger		
• Whorls	165 (47.1)	163 (46.6)
• Arches	74 (21.1)	75 (21.4)
• Ulnar loops	59 (16.9)	33 (9.4)
• Radial loops	30 (8.6)	60 (17.1)
• Composite	22 (6.3)	19 (5.4)
3. Middle finger		
• Whorls	149 (42.6)	150 (42.9)
• Arches	72 (20.6)	70 (20.0)
• Ulnar loops	87 (24.9)	38 (10.9)
• Radial loop	37 (10.6)	82 (23.4)
• Composite	5 (1.4)	10 (2.9)
4. Ring finger		
• Whorls	227 (64.9)	209 (59.7)
• Arches	49 (14.0)	57 (16.3)
• Ulnar loops	36 (10.3)	26 (7.4)
• Radial loops	24 (6.9)	45 (12.9)
• Composite	14 (4.0)	13 (3.7)
5. Little finger		
• Whorls	192 (49.1)	157 (44.9)
• Arches	62 (17.7)	52 (14.9)
• Ulnar loops	67 (19.1)	30 (8.6)
• Radial loops	26 (7.4)	81 (23.1)
• Composite	23 (6.6)	30 (8.6)

The association between the right thumb fingerprint patterns and personality traits such as Openness to Experience and Conscientiousness was examined. For Openness to Experience, significant associations were found with the right thumb's whorls and arches. Specifically, participants who sometimes indulge in fancies (p=0.000), change ideas after presenting them (p=0.000), and prefer thinking alone over talking to others (p=0.023) showed notable relationships. Additionally, a preference for a busy life (p=0.034) was associated with certain fingerprint patterns. For Conscientiousness, significant associations were observed with the right thumb in behaviors like not being particular about anything (p=0.007), knowing how to refresh (p=0.000), persevering despite problems (p=0.001) and not visiting someone without a present (p=0.001). However, there was no significant association with being careful about

doing something (p=0.181). These findings suggest that the right thumb fingerprint patterns may be linked to certain aspects of personality, particularly Openness to Experience and Conscientiousness shown in Table III.

Table III Association between fingerprint of right thumb with Openness to experience and Conscientiousness

Openness to Experience	Whorls yes	Arches yes	Ulnar loops yes	Radial loops yes	Composite yes	Chi square	p-value
Sometimes indulge in fancies	95	43	3	10	14	31.671	0.000***
Change ideas once you present it	92	47	16	24	13	28.704	0.000***
Thinks alone more than to talk to others	126	42	15	22	14	11.340	0.023
Fond of busy life	118	33	7	17	4	10.443	0.034
Conscientiousness							
Not particular about anything	88	28	6	3	7	14.167	0.007
Knows how to refresh	184	54	22	25	4	43.930	0.000***
Careful of doing something	168	66	19	28	14	6.258	0.181
Perseveres despite problems	128	41	9	18	3	25.776	0.001
Doesn't like to visit someone without presents	90	28	16	8	11	19.738	0.001

The association between the right thumb fingerprint patterns and Extraversion traits was explored. Significant relationships were found between whorls and behaviors such as trying to make efforts (p=0.042) helping unknown people (p=0.000) telling jokes (p=0.000) and making merry when delighted (p=0.001). Other traits, such as wanting parties at home (p=0.000) having a shy personality (p=0.005) and bursting into rage frequently (p=0.000) also showed significant associations with certain fingerprint patterns. In contrast, there were no significant associations for traits like being ready to keep company (p=0.061) or trying to be a leader (p=0.064) revealed in Table IV.

Table IV Association between fingerprint of right thumb with Extraversion

Extraversion	Whorls yes	Arches yes	Ulnar loops yes	Radial loops yes	Composite yes	Chi square	p-value
Ready to keep company	173	66	22	24	14	8.986	0.061
Tries to make efforts	189	64	22	31	14	9.921	0.042
Tries to be a leader	101	43	6	20	7	8.900	0.064
Helps unknown people	140	65	22	21	14	24.782	0.000***
Has a lot of friends	91	40	10	11	11	9.348	0.053
Tells jokes	148	29	16	31	4	51.854	0.000***
Interested in ceremonies	129	57	19	20	11	9.783	0.044
Wants to have parties at home	124	46	10	10	14	20.585	0.000***
Make merry whenever delighted	132	43	22	21	13	18.983	0.001
Shy personality	94	40	16	21	11	14.740	0.005
Bursts into rage frequently	54	43	6	9	8	28.186	0.000***

The association between the right thumb fingerprint patterns and Agreeablenessand Neuroticism was analyzed. For Agreeableness, significant associations were found between the right thumbwhorls and traits such as getting along with others (p=0.031) being characterized as a loser (p=0.02) helping unknown people (p=0.000) and not liking to visit someone without presents (p=0.001). However, humility (p=0.262) showed no significant association. For Neuroticism, significant relationships were observed between whorls and being worried by tasks (p=0.000) having a shy personality (p=0.005) and bursting into rage frequently (p=0.000). Other traits like moving to tears (p=0.051) showed no significant association displayed in Table V.

Table V Association between fingerprint of right thumb with Agreeableness and Neuroticism

Agreeableness	Whorls yes	Arches yes	Ulnar loops yes	Radial loops yes	Composite yes	Chi square	p-value
Good at getting along with others	140	51	16	16	14	10.623	0.031
Has humility	196	66	22	28	13	5.252	0.262
Characterized as a loser	32	23	0	9	1	17.122	0.02
Helps unknown people	140	65	22	21	14	24.782	0.000***
Doesn't like to visit someone without presents	90	28	16	8	11	19.738	0.001
Neuroticism							
Worried by what you are asked to do	128	31	22	21	11	28.653	0.000***
Often moves to tears with slight discomfort	61	32	7	14	8	9.417	0.051
Shy personality	94	40	16	21	11	14.740	0.005
Bursts into rage frequently	54	43	6	9	8	28.186	0.000

Discussion

The socio-demographic profile of the participants showed a mean age of 21.49 years. Females made up 57.7% of the sample, while males accounted for 42.3%, indicating a slight female predominance, which is consistent with trends in medical education. In a research in India, he total sample consisted of 194 medical students, including 107 (55.15%) males and 87 (44.84%) females, with an age range of 19 to 28 years.[17]

The fingerprint revealed that whorls were the most common pattern across all fingers, with the highest frequency observed on the right ring finger and thumb. Arch patterns were more frequent on the right thumb and left thumb, while

radial loops were less common but more prominent on the left thumb. The distribution of fingerprint patterns across different fingers was consistent, with whorls being dominant, particularly on the thumbs and ring fingers, supporting the general pattern of fingerprint variations seen in the population. In a Malaysian research, the statistical analysis revealed that the frequency of the whorl pattern was significantly different ($p < 0.05$) between the left and right hands. However, no significant differences ($p > 0.05$) were found for the loop, arch, or composite patterns between the two hands.[18]

For Openness to Experience, whorls and arches were linked to behaviors like indulging in fancies ($p=0.000$) changing ideas after presenting them ($p=0.000$) and preferring solitary thinking ($p=0.023$). In a Nepalese study, individuals with loop and whorl fingerprint patterns were more likely to engage in activities such as indulging in fancy thoughts, changing their ideas after presenting them, and preferring solitary thinking compared to those with other fingerprint patterns.[19]

Limitations

A limitation of this study is that it was conducted solely at Southern Medical College, Chattogram and did not include participants from other medical colleges or hospitals in different regions. This geographic limitation may affect the generalizability of the findings, as the sample may not fully represent the diverse population across the country or in other healthcare settings.

Conclusion

In conclusion, this study highlights significant associations between right thumb fingerprint patterns, particularly whorls, and various personality traits such as Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. The findings suggest that fingerprint patterns may serve as a potential indicator for understanding certain personality characteristics, with whorls being particularly linked to behaviors related to creativity, perseverance, social interactions and emotional responses. These results contribute to the growing body of research exploring the connection between biometric traits and personality, offering insights that could have implications for both psychological profiling and forensic applications.

Recommendation

Based on the findings of this study, it is recommended that future research further explore the relationship between fingerprint patterns and broader personality traits across diverse populations, including different cultural and age groups. Additionally, longitudinal studies could help examine how these associations evolve over time. Incorporating other biometric data, such as genetic or behavioral factors, could provide a more comprehensive understanding of the connections between fingerprint patterns and human behavior.

Acknowledgement

We would like to express our heartfelt gratitude to all the institutes and participants who contributed to this study, as well as the administrators and staff of Southern Medical College, Chattogram.

Contribution of authors

SK-Conception, data acquisition, study design, critical revision, manuscript writing and final approval.

HRB-Conception, study design, interpretation of data, manuscript writing and final approval.

Disclosure

The authors declared that there is no conflict of interest.

References

1. Khan F, Bachh U. Relationship of fingerprint with gender among medical students in Manglore. IJFMT. 2019;13(4):37–40.

2. Glover JD, Sudderick ZR, Shih BB-J,Charlton L , Krause AL, Anderson C et al. The developmental basis of fingerprint pattern formation and variation. Cell. 2023;186(5):940-956.e20.

3. Afza R, Khurshid N. A study of fingerprints in relation to gender: A study done on medical students of Skims Medical College Srinagar. Int J Adv Res. 2019;7(7):316–319.

4. Das NK, Tamuli RP, Saikia B, Sarmah S. Fingerprint patterns of MBBS students: A study from Assam. Int J Med Health Res. 2018;4(4):18–21.

5. Singh A, Gupta R, Zaidi S, Singh A. Dermatoglyphics: A brief review. Int J Adv Integr Med Sci. 2016;1(3):111-115.

6. Aamir Y, Masood R, Irshad N, Malik R, Farid N, Shahab MA. Relationship between Pattern of Fingerprints and Blood Groups. Pakistan Journal of Medical & Health Sciences. 2022; 16(09): 698-700.

7. Králík M, Polcerová L, • uta M. Sex differences in frequencies of dermatoglyphic patterns by individual fingers. Annals of human biology. 2019; 46(3): 231- 245.

8. Narayana BL, Rangaiah YKC, Khalid MA. Study of fingerprint patterns in relation to gender and blood group. J. Evolution Med. Dent. Sci. 2016;5(14):630-633.

9. Karki RK, Singh PK. Gender determination from fingerprints. J Univ Coll Med Sci. 2014;2(1):12-15.

10. Steinmayr R, Weidinger AF, Schwinger M, Spinath B. The importance of students' motivation for their academic achievement – replicating and extending previous findings. Front Psychol. 2019;10:1730.

11. Krishan Vij: Textbook of Forensic Medicine and Toxicology Principles & Practice 6e . Krishan Vij (ed): Elsevier India Pvt. Limited, India. 2014.

12. Verma P, Sachdeva SK, Verma KG, Saharan S, Sachdeva K: Correlation of lip prints with gender, ABO blood groups and intercommisural distance. N Am J Med Sci. 2013, 5:427-431.

13. Rastogi A, Bashar MD, Sheikh NA. Relation of primary fingerprint patterns with gender and blood group: a dermatoglyphic study from a tertiary care institute in Eastern India. Cureus. 2023;15(5):e38459.

14. Aamir Y, Masood R, Irshad N, Malik R. Relationship between pattern of fingerprints and blood groups. Pak J Med Health Sci. 2022;16(9):698-700.

15. Zhang Z, Yao X, Yuan S, Deng Y. Big five personality influences trajectories of information seeking behavior. Pers Individ Dif. 2021;173(5):110631.

16. Lin H, Wang C, Sun Y. How big five personality traits influence information sharing on social media: A meta-analysis. PLoS One. 2024;19(6):e0303770.

17. Yadav S. Study of fingerprint pattern among medical students in a tertiary hospital in Nepal: a descriptive crosssectional study J Gen Pract Emerg Med Nepal. 2024;11(17):42-45.

18. Heng GS, Ismail NA, Rahman ZA, Anan A. Distribution of fingerprint patterns among young adults and siblings in Malaysia. Int J Med Sci. 2018;3(1):11-17.

19. Shrestha DB, Gupta VP, Chaurasiya PS, Shrestha S, Chaudhary S, Aryal L. Study of correlation between different fingerprint patterns, blood groups, and social behavior among medical students (Nepalese citizens). Pac J Sci Technol. 2016;17(2):288-292.