Original Article

Dermatoglyphic Patterns of the Medical Students and their Parents in Jammu Region of North India

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Abstract

Background and Aims: Fingerprints have a general flow to the ridges that translates into three major pattern types; a whorl, loop, or arch. Pattern types are considered to be genetically inherited, but the individual details that make fingerprint unique are not. This descriptive study was conducted to differentiate the fingerprint patterns of MBBS students to their parents and to look for the uniqueness of fingerprint patterns in these medical graduates.

Methods: To do this study, all ten fingerprints were examined from hundred first-year MBBS students of Acharya Shri Chander College Of Medical Sciences in the Jammu region of north India over 6 months from September 2019 to February 2020 along with their two biological parents. Rolled fingerprints were obtained by carbon ink in all 300 subjects divided into three groups(fathers, mothers, and students). Fingerprint patterns were examined by magnifying glass under the supervision of a forensic expert of our institute and classified as loops, whorls, or arches.

Results: The most frequent fingerprint pattern in all 3000 fingers examined is the loop pattern, which represents 64.8%, followed by whorl pattern 30.8% and the least frequent pattern is arch(4.3%).these results were almost similar in medical graduates fingerprints patterns(loops 63.7%,whorls32.5% and arches 3.8%)indicating no difference from other groups. Students show similar fingerprint patterns with those of their father's fingers in 659 fingers, 468 as matching loop patterns, 187 as a whorl, and 4 arch pattern types and the percent of similarity was 65.9% with higher similarity in the RL 76% and LL72% fingers. Students show similar fingerprint patterns as that of their mother in 685 fingers, 500 as matching loop patterns, 183 as a whorl, and 2 arch pattern types and the percent of similarity was 68.5% with higher similarity in the RT78% and RL finger 78%. Fathers and mothers groups unrelated genetically when observed among themselves for similarity in fingerprint pattern showed similarity in 584 fingers, 455 as matching loop patterns, 125 as a whorl, and 4 arch pattern types and the percent of similarity was 58.4% with higher similarity in the LL77% and RL73% fingers.

The statistical analysis for similarity correlation between students' and fathers' fingerprints shows a non-significant p-value found in the right index, left index, left middle, and left little fingers while other fingers show a significant p-value. Similarity correlation between students and mother shows a non-significant p-value found in the right middle, left thumb, left index, left middle, and left little fingers while other fingers show a significant p-value. Similarity correlation between father and mother showed no significant correlation in all fingers except in the LL finger, and negative correlation in RT, RM, and LM fingers.

Conclusions: We concluded that the most common fingerprint pattern is the loop followed by whorl then arch in MBBS graduates of our institute along with their parents. Moreover, the present study showed that fingerprint patterns do not 100% match one of the parents; nevertheless, there is a similarity between offspring and their parents.

Keywords*: Fingerprints, patterns, Medical, Students, Parents*

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Introduction

Fingerprint-based biometric systems are being increasingly used to determine the identity of the person that cannot be faked or stolen easily. Fingerprints have

been used for about 100 years as the oldest biometric signs of identity. The foundations of modern fingerprint identification were established by the studies of Sir F. Galton (Galton 1892)[1] and E. R. Henry (Henry 1905) [2]. Since then, fingerprints have been used for identification in many social conditions such as access control, crime investigation, personal trust, etc., since they will remain almost constant during people's lifetime [3].Fingerprints are very popular due to their lower changeability and easier accessibility than other methods such as signature and hand geometry [4]. The use of fingerprints for identification is based on the immutability and the individuality of fingerprints. Immutability refers to the permanent and unchanging character of the pattern on each finger, from the perinatal period until decomposition after death. Individuality refers to the uniqueness of ridge details across individuals. No two persons, even identical twins, have been found to have identical fingerprints, despite elements of similarity.[5] Fingerprints have two levels of structure: the Henry(1900) fingerprint pattern (with ridge count) and the Galton (1892) characteristics. The Henry Classification is the standard qualitative scheme for characterizing the global structure of ridge patterns and has traditionally been used to partition fingerprint databases.[5] At approximately ten weeks of embryonic development, the epidermal ridges on the palms and fingertips begin to develop precise, minute patterns, which are fully formed approximately at 25 weeks.[6] The study of such epidermal ridge pattern on fingers, palm, and soles is known as "Dermatoglyphics". Harold Cummins was the first to coin this word in 1926. [7] Development of these ridges were found to be affected by environmental and genetic factors. These patterns do not change throughout one's life once they are formed. [8] Although the worldwide average distribution of different fingerprint patterns is known, there is a paucity of published literature on the distribution of fingerprint patterns on individual digits, especially in this part of the world.

Material and Methods

This descriptive study was conducted at Acharya Shri Chander Medical College, Jammu (Jammu and Kashmir), India on the 100 first year MBBS students and their biological parents over six months.

Inclusion Criteria

Healthy first-year medical students of the 2019-20 batch of our medical college with no deformities or disfigurement in their fingers were included in the study.

Biological parents of first-year medical students were also included in the study

Exclusion Criteria

Medical students with deformity or disfigurement of fingers were excluded.

Medical students with single parents or no parents were also excluded.

However Medical students with parents having disfigured or lost fingers due to accidents or burns or trauma were not discouraged to participate and data of available digits included in our results.

Rolled fingerprints of 100 medical students are taken on plain paper after they consented for study .There were 72 males and 28 females. Hands were washed thoroughly with soap and water before taking the prints. Carbon ink was applied to all the ten fingertips, and prints are taken on plain papers (proforma) by simply rolling the fingers from one side to another. A pair of proforma along with instructions was given to each student to obtain fingerprints of their respective parents. Written consent from parents for the study was also taken on the consent form. Fortunately, there was no dropout, but unfortunately, the right thumb of one mother and Right index and Right middle fingers of one father was not available for fingerprint due to an accidental burn in former and accidental amputation in later. Fingerprints thus taken were studied with the help of a magnifying glass and categorized accordingly as loops, whorls, and arches under the supervision of an expert from the forensic department. Data obtained from the study were tabulated and analyzed for frequency and percentage of fingerprint patterns in students and their parents separately. Fingerprint patterns obtained were also analyzed in terms of their differentiation among different sexes and also on different digits. On the similarity of the fingerprint pattern between offspring and their parents, the percentage of matching fingers pattern type with father or mother were calculated and aggregated. Finally, the p-value and correlation between

offspring fingerprint pattern types and their parents were calculated using SPSS software version 22(Descriptive analysis, cross sheets, t-test, and chi-square test were used for validation and analysis of data collected as excel). A "p" value <0.05 is regarded as significant.

Ethical clearance has been obtained from the institutional ethical committee and informed written consent after the briefing objective of the study was taken from the subject.

Results

This study of 3000 fingers of 100 families is distributed into three groups, fathers group (100), mothers group (100), and one student group (100). The variation in the percentage of various patterns of fingerprint among subgroups is studied. The number/ frequency and percentage of various patterns of overall and different subgroups were calculated and compared in Table 1 to 6.

Legend:

RT= right thumb, RI= right index, RM= right middle, RR= right ring, RL= right little, LT= left thumb, LI= left index, LM= left middle, LR= left ring,

LL= left little finger

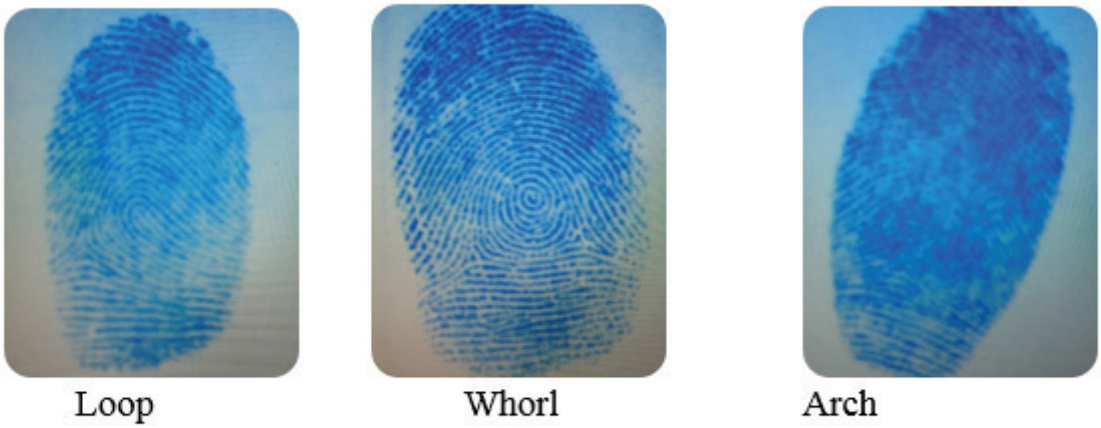

Figure 1: picture of various fingerprint patterns observed during the study

Table 1: Distribution of various fingerprint patterns in fingers of both hands in various subgroups .

GROUPS	LOOPS (%)	WHORLS (%)	ARCHES (%)	UNPRINTED	TOTAL
Father	626(62.6%)	325(32.5%)	47(4.7%)	2	1000
Mother	681(68.1%)	274(27.4%)	44(4.4%)	1	1000
Students	637(63.7%)	325(32.5%)	38(3.8%)	0	1000
Total (%)	1944 (64.8%)	924 (30.8%)	129 (4.3%)	3(0.1%)	3000

Out of total 2997 fingers studied , 1944 (64.8%) showed loops pattern,924 (30.8%) whorl pattern and129 (4.3%) as arch pattern. On comparing different groups we found that the father's group had 626 (62.6 %)fingerprints with a loop pattern whereas it was 681 (68%) in the mother's group and 637 (63.7%) in the student's group. Whorl pattern was observed in 325 (32.5 %) in the father's group, 274 (27.4%) in the mother's group, and 325 (32.5%) in the student's group. The arch pattern was seen in fewer numbers in all the three groups as 47 (4.7 %) in the father's group, 44 (4.4%) in the mother's group, and 38 (3.8%) in the student's group. It was also inferred from the data that medical students in our institute have the same fingerprint pattern as that of other groups with a predominance of loop pattern.

Table 2: Fingerprint patterns distribution among different sexes.

GROUPS	SUB GROUPS(NO.)	LOOPS (%)	WHORLS (%)	ARCHES (%)	TOTAL FPP
	Father (100)	626(62.6%)	325(32.5%)	47(4.7%)	1000
Male	Students (72)	451(63%)	236(33%)	33(4%)	720
Female	Mother (100)	681(68.1%)	274(27.4%)	44(4.4%)	1000
	Students (28)	186 (66%)	89(32%)	5 (2%)	280

On analyzing the distribution of fingerprint patterns in either sex, it was observed that there were 172 males and 128 females in the subgroups studied. The female group had a high percentage of loops pattern (mothers 681 (68%) and students186(66%) compared to the male group with 626 (62.6%) fathers and 451 (63%)students having loops.

Similarly, on analyzing whorls it was found that males(fathers 325 (32%) and male students236 (33%) showed a higher number of whorls compared to the female group(mothers with 274 (27.4%) and female medical students with 89 (32%)whorls.

Furthermore, the arch pattern was high in the male group (47fathers and 33 (4%)male) than the female group (44mothers and 5 (2%)females).

However contradictory findings concerning medical students of our institute were observed where the loop pattern was found to be slightly higher in males than females by 3%(66 versus 63), while the arch pattern was high in the female by 2%(4versus 2).

Table 3: Distribution of Fingerprint Patterns on Different Fingers.

FPP	RT	RI	RM	RR	RL	LT	LI	LM	LR	LL	TOTAL
LOOPS	181	176	217	168	233	184	176	203	166	240	1944
WHORLS	105	107	65	124	65	102	101	73	127	55	924
ARCHES	13	16	18	8	3	14	23	23	7	5	129

This study results showed a preponderance of loop pattern on little fingers(LL 240(80%) and RL 233 (77.66%), whorls on ring fingers (LR127 (42.3%) and RR 124(41.3%), and arches on LI and LM finger23 (7.6% each) in both hands and both sexes.

Table 4: Students' Fingerprint patterns similarity with father

FPP	RT	RI	RM	RR	RL	LT	LI	LM	LR	LL	TOTAL
LOOPS	44	37	58	34	64	43	39	49	36	64	468(46.8%)
WHORLS	21	26	12	25	12	20	21	17	26	7	187(18.7%)
ARCHES	0	0	1	0	0	1	1	0	0	1	4(0.4%)
TOTAL	65	63	71	59	76	64	61	66	62	72	659
%	65	63	71	59	76	64	61	66	62	72	65.9%

Students show similar fingerprint pattern with those of their father's fingers in 659 fingers, 468 as matching loop patterns, 187 as a whorl, and 4 arch pattern types and the percent of similarity was 65.9% with higher similarity in the RL 76% and LL72% fingers. . The non-significant p-value was found in the right index, left index, left middle and left little fingers while other fingers show significant p-value. All ten fingers had a positive correlation with the father's finger.

Table 5 : Students' fingerprint patterns similarity with mother

FPP	RT	RI	RM	RR	RL	LT	LI	LM	LR	LL	TOTAL
LOOPS	43	47	59	40	68	41	42	53	40	67	500(50%)
WHORLS	35	17	10	27	10	19	19	14	25	7	183(18.3%)
ARCHES	0	0	0	0	0	0	1	1	0	0	2(0.2%)
TOTAL	78	64	69	67	78	60	62	68	65	74	685
%	78	64	69	67	78	60	62	68	65	74	68.5%

Students show similar fingerprint patterns as that of their mother in 685 fingers, 500 as matching loop patterns, 183 as a whorl, and 2 arch pattern types and the percent of similarity was 68.5% with higher similarity in the RT78% and RL finger 78%. The non-significant p-value was found in the right middle, left thumb, left index, left middle, and left little fingers while other fingers show significant p-value. All the ten fingers had a positive correlation with the mother's fingers.

Table 6: Fathers and mothers fingerprint patterns similarity

FPP	RT	RI	RM	RR	RL	LT	LI	LM	LR	LL	TOTAL
LOOPS	34	36	49	36	64	46	38	47	35	70	455(45.5%)
WHORLS	11	14	7	18	8	15	14	9	24	5	125(12.5%)
ARCHES	0	0	1	0	1	0	0	0	0	2	2(0.2%)
TOTAL	45	50	57	54	73	61	52	56	59	77	584
%	45	50	57	54	73	61	52	56	59	77	58.4%

Fathers and mothers groups unrelated genetically when observed among themselves for similarity in fingerprint pattern showed similarity in 584 fingers, 455 as matching loop patterns, 125 as a whorl, and 4 arch pattern types and the percent of similarity was 58.4% with higher similarity in the LL77% and RL73% fingers. There was no significant correlation in all fingers except in the LL finger, and negative correlation in RT, RM, and LM fingers. Therefore, the present results showed that fingerprint patterns do not 100% match one of the parents in all populations; nevertheless, there is a similarity between offspring and their parents.

Discussion

Percentage of distribution of fingerprints

Keeping the aim of the study in mind it was found that the most commonly occurring fingerprint pattern type in overall fingers of all groups was the loop pattern in 64.8% of observations followed by whorl pattern in 30.8% and the arch pattern in 4.3%, which is quite similar to the prevalence reported by other authors as 60-70% loops,30-35%whorls and 5-15% arches.[9,10]

Percentage of distribution of fingerprints in medical students.

The overall preponderance of loops among medical students in our institute is (63.7%) followed by whorls (32.5%) and arches 38 (3.8%) which is as per that reported in other studies involving medical students. [11,12] Study conducted by Prateek R et al [13]shows (32.55%) whorls amongst medical students similar to our study. A study conducted by Desai B et al.[14], shows a similar distribution of loop pattern(64.6%) and whorl pattern (29.6%) just like worldwide distribution, whereas studies conducted by Sandeep V et al.[15]showed 24.34% of whorls and Sangita S Babu et al.[16] noticed 23.8% of whorls which is lesser number of whorls than worldwide distribution. Nagraj et al.[17], interestingly found equal numbers whorls and arches (both 14%) in their study, as compared to 64% of loops.

Sex distributions of various fingerprints

On analyzing the distribution of fingerprint patterns in either sex, the females were found to have a high percentage of loops (68%and 66%in mothers and female students respectively) in comparison to males (62.6% and 63%in fathers and male medical students respectively).

Contrary to the loops pattern whorls were found in high percentage in males (32% and 33% in fathers and male medical students respectively)than females (27.4%and 32%in mothers and female students respectively). Furthermore, the arch pattern was high in males (4.7% and 4%in fathers and male medical students respectively)compared to females (4.4%and 2%in mothers and female students respectively). This was found to be agreed with Bhavana, et al.[18]and also with Rastogi and Pillai et al[19] whose study of fingerprints about gender and blood group found that males have a higher incidence of whorls and females have a higher incidence of loops.

Therefore, loops were the predominant pattern in both genders, followed by whorls. The less common pattern in both genders was arch. This was found to be

agreed with Sam Rema et al.[20] who found the same result in the study of fingerprint patterns in the South Indian population.

Distributions of various fingerprints in different fingers

This study results matched the results of earlier studies conducted by Kanchan et al.,[11] and Mehta AA et al.[21] and demonstrated a preponderance of loop pattern on little fingers(80% in LL fingers and 77.66% in RL fingers)and whorl pattern on ring fingers (42.3% in LR and41.3% in RR fingers), However, arches pattern were observed with increased frequency in LI fingers (7.6%) and LM finger (7.6%) in both hands and both sexes.

The similarity in the distribution of fingerprints of students with their parents

On the similarity of fingerprint pattern between offspring and their parents, The percentage of matching fingers pattern type with father or mother were calculated and aggregated. Finally, the p-value and correlation between offspring fingerprint pattern types and their parents were calculated. We found that the similarity between offspring and their parents had a significant p-value in some fingers and non-significant in others:

Students show similar fingerprint patterns with fathers in 65.9% fingers and with mothers in 68.9% of fingers with matching loop pattern in maximum numbers(46.8%with father and 50% with mothers), indicating loop pattern in offspring fingers had the highest matching tendency to his/her parent. Furthermore, on analyzing the data it was found that whorl pattern was matching with fathers in 18.7% of fingers and with mothers in 18.3% of fingers which is consistent with the earlier study performed by Herman M. Slatis et al[22]. Arches were the least matching patterns with only 0.4% fingers matching with fathers and 0.2% with mothers indicating that it shows less similarity between siblings and parents, which affect the general p-value, we observed that when we exclude arch patterns the significance of the p-value increased. All ten fingers had a positive correlation with the fingers of both the parents.

When we compare the relation between fingers pattern type of genetically unrelated parents with each other it was found to be matching in only 58.4% of fingers with the maximum matching of loop pattern in 45.5% of fingers followed by whorls in 12.5% and least matching arches in only 0.4% of fingers. There was no significant correlation in all fingers except in the left little finger, and negative correlation in right thumb, right middle, and left middle fingers. Therefore, the present results showed that fingerprint patterns do not 100% match one of the parents in all populations; nevertheless, there is a similarity between offspring and their parents.

Fingerprint pattern types were similar to one of the parents more than non-related people according to this study and this agrees with Jacob B. Adler et al[23] who found that there is indeed a relationship between fingerprints of people in a family. All of the groups of related people had more features in common than non-related people.

The results of this study should be followed by other studies to find out more correlation within the family fingerprint-like inheritance of fingerprint pattern type, the relation between pattern types and other fingerprint details (delta, type line etc.), and twins fingerprint patterns similarity.

Conclusion

On the base of this study, we conclude that:

●The most common fingerprint pattern among MBBS graduates of our institute is the loop followed by whorl while arch was found to be the least fingerprint which was also the pattern observed in their parents as well.

●The loop pattern and the arch pattern were higher in female medical graduates, while the whorl Pattern was higher in male medical graduates just like in their mothers and fathers.

●Loops were found more in little fingers and whorls in ring fingers in medical graduates which is also a similar pattern in their parents.

● Loop patterns in medical graduates had the highest similarity percentage for their parents.

● The arch pattern of medical graduates does not match to their parents.

●Fingerprint patterns do not 100% match one of the

parents in all populations and MBBS graduates of our institute were no different justifying that fingerprints are unique to every individual.

●The similarity between fingerprints was more in genetically related groups (parents and students) than between father and mother group which were genetically unrelated.

Acknowledgment: MBBS students of Acharya Shri Chandra Medical College and their parents. The authors declare that we have no competing interests.

Department of forensic medicine and toxicology for providing fingerprint experts.

Conflict of Interest: None

Source of Funding : Nil

References

1. Galton F. Fingerprints, Macmillan and Company (1892).
2. Henry ER. Classification and uses of fingerprints, HM Stationery Office (1905).
3. Jain LC, et al. Intelligent biometric techniques in fingerprint and face recognition, CRC press. (1999)
4. Zhang Q and Yan H . Fingerprint classification based on extraction and analysis of singularities and pseudo ridges. Pattern recognition.2004; 37(11): 2233-2243.
5. Hrechak AK and McHugh JA . Automated fingerprint recognition using structural matching. Pattern Recognition.1990; 23(8): 893-904
6. Penrose L and Ohara P. The development of the epidermal ridges. J of Medical Genetics.1973; 10(3): 20.
7. Cummins H and Midlo C. Fingerprints, palms, and soles: an introduction to dermatoglyphics. Dover Publications New York. (1926)
8. Babler W . Prenatal development of dermatoglyphic digital patterns: Associations with epidermal ridge, volar pad and bone morphology. Collegium Antropologicum. 1987; 11(2): 297-303.
9. Oladipo G. and Akanigha B. Dermatoglyphic patterns in androgenetic alopecia in a southeastern Nigerian population. J of Exp and clinical Anatomy. 2005; 4(2): 44-47
10. Mark R. Hawthorne. Fingerprints: analysis and understanding, Taylor & Francis Group. 2009;13–54.
11. Kanchan T, Chattopadhyay S. Distribution of fingerprint patterns among medical students, J of Indian Acad of Forensic Med, 2006; 28(2):65-8.
12. Rao BN, Padmini MP. Malleshwari Survey on the frequency of dermatoglyphic related personal attributes involving medical students of MIMS. J of Anat Soc of India. 2006; 55(1):84.
13. Prateek R, Pillai KR. A study of fingerprints in relation to gender and blood group. J of Indian Acad Forensic Med, 2010; 32(1):11-4.
14. Desai B, Jaiswal R, Tiwari P, Kalyan JL. Study of Fingerprint Patterns in Relation with Blood Group and Gender – a Statistical Review. Res J of Forensic Sci. 2013; 1(1):15-7.
15. Sandeep V, Kulkarni AB. Study of the fingerprint pattern and gender distribution in and around Nanded district of Maharashtra state. Eur J of Forensic Sci. 2017; 4(1):7-11.
16. Babu Sangeeta S, Power BP, Khare ON. Palmar Dermatoglyphics in Pulmonary Tuberculosis. J Anat Soc India. 2005 54(2):1-9.
17. Nagraj G, Tangpu V, Lakshmi KS, Geetha R,Study on distribution of fingerprint patterns-A novel experiment for school students. Int J. for Life Sci and Edu Res. 2015; 3(2):25-30
18. Bhavana, D, et al. Study of fingerprint patterns in relationship with blood group and gender-a statistical review. Res J Forensic Sci. 2013; 1(1): 12-17.
19. Rastogi, P. and Pillai KR . A study of fingerprints in relation to gender and blood group .J of Ind Aca of Forensic Med.2010;32(1): 11-14.
20. Sam NM, et al. Sex Determination Using Fingerprint Ridge Density In South Indian Population. J of Indian Academy of Forensic Med.2014: 36(4): 381-386.
21. Mehta AA, et al. Study of fingerprint patterns among medical students in the Vidarbha region, India. Int. J of Anatomy and Research. 2015; 3(2):1043-5.
22. Herman M. Slatis et al .s The Inheritance of Fingerprint Patterns, Am J Hum Genet, 1976;Jan 28(1); 280-289.
23. Adler J B. Are There Genetic Relationships between Fingerprints in a Family.S California state science.2003.