

Inheritance of Finger Print Patterns among Medical Students: A Study

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Abstract

Dermatoglyphics deals with study of ridge pattern which includes finger prints, foot prints lip prints etc. Finger prints proved their uniqueness in identification. Studies indicate that similar trends in finger prints run in families. Major patterns of finger prints show inheritance. This paper deals with relationship between major finger print patterns among parents and off spring.

Keywords: Finger Prints; Arches; Loops; Whorls.

Introduction

Human beings are highly developed mammals and are unique in animal kingdom. Like any other living being, each human differs from others (Quetelet's law) [1]. No two finger prints match even in homozygous twins.

Identification of an individual by finger prints was first done in India in 1858 by Sir William Herschel to prevent impersonation. Later, Sir Francis Galton systematized it for identification of criminals, which was officially adopted in England in 1894 and was further modified by Sir Edward Henry [2]; hence called Galton system or Henry-Galton system.

Identification of individuals by finger print pattern started at the beginning of 20th century and reached its peak by the beginning of 21st century. It is said that if all the finger print cards in F.B.I. were to be piled one over the other, they would probably equal to one hundred thirty three times the height of empire state Building [3].

Since then various studies were conducted to

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Received | 04.09.2017, Accepted | 25.09.2017

study the inheritance of finger prints among family members.

Anatomy

The pattern of finger print ridges and pores is different in each person. No two people have same pattern of ridges. While it seems that the general pattern of friction ridges may be genetic, the specific pattern or fine detail is unique.

Most human skin is smooth and contains hair follicles and oil glands. The digit, palm and sole areas, however devoid of either, but instead have sweat pores and friction ridges that take various forms and shapes. The function of the friction ridges is to increase grip and the sense of touch. The study of friction ridge patterns is known as *dermatoglyphics*.

Development of primary ridges is a random process. It is dictated by the overall geometry and topography of the volar pad. If the primary ridges appear while the volar pad is still quite pronounced, the individual will develop a whorl pattern. If the primary ridges appear while the volar pad is less pronounced, the individual will develop a loop pattern. Finally, if the primary ridges appear while the volar pad is nearly absorbed, the individual will develop an arch pattern. The timing of these events is genetically linked [4].

Even for identical twins this is true: they may have similar general patterns but the fine details or

'*minutiae*' are different. The development of minutiae is a result of the environment and external stresses and pressures while they are in the womb [5].

This inspired, to take up this study on relationship between finger print pattern of individuals and their parents.

Materials and Methods

The materials used for this were.

1. Ink pad (Black/Blue color)
2. Printed pro forma
3. Consent form
4. Magnifying glass with light source.

Subjects were chosen from medical students studying in Narayana Medical College, Nellore and their parents residing in state of Andhra Pradesh. The procedure and the purpose of examination were explained to them and consent was obtained. Troublesome procedure of using glass plate smudged with printer black ink was avoided as prints from the parents have to be obtained from the houses of students all over the state.

Collection of the Prints

The subjects were asked to wash their hands to remove dust and grease. Ink pad is used to smudge their fingers with ink. Then the smudged fingers were applied carefully in the respective spaces in the pro forma. Only plain prints are obtained. No roll prints are used.

Prints of all the ten digits were taken, and those of only four fingers, namely left index finger, left thumb, right index finger and right thumb are used for the study purpose. These four fingers are chosen because thumb print is the commonly used one for identification and the index finger commonly used in biometrics.

The finger prints thus obtained were categorized into various patterns like loops, whorls, arches and composites.

This study has the approval of institutional ethical committee.

Observations and Results

Plain finger prints of 60 medical students (30 girls + 30 boys) and their parents (60+60) were obtained

with informed consent. The finger prints of right thumb, right index finger left thumb and left index finger were acquired in the printed pro forma.

A total 720 finger prints thus obtained, [four finger prints acquired from 180 individuals (60 students + 120 parents)] were categorized into four primary ridge patterns namely loops, whorls, arches and composites. This categorization was done by three different individuals to avoid observer errors.

The results thus obtained were fed into computer and the statistical data is analyzed.

Initially the data of various Primary ridge patterns like loops, whorls, arches and composites are analyzed to see whether the distribution of finger print ridge patterns in the study subjects is correlating with that of other studies or there is any geographical variations.

- Finger print patterns of 30 male and 30 female medical students of Narayana Medical College, Nellore, Andhra Pradesh and their parents. (Total 180 subjects) was studied.
- All the students (voluntarily) participated are within the age group of 18-25.

Discussion

When each finger print pattern is analyzed, Table 1 indicates the major ridge pattern of left index finger of the medical students is correlating statistically significantly with the pattern of finger print of his/her father (P value 0.000), where as they are not correlating with that of his/her mother (P value 0.124) statistically.

Table 2 also indicates that the finger print pattern of left thumb of medical students significantly correlative with that of their father (P value 0.000), where as there is no correlation with that of their mothers (P value 0.209) statistically.

Table 3 also indicates that the finger print patterns of right index finger of medical students are significantly correlating with that of their father (P value 0.038) where as there is no correlation with that of their mothers (P value 0.621) statistically.

Table 4 indicates that the finger print pattern of right thumb shows correlation with that of both parents [(P value 0.000: P value 0.029) Father: Mother) But there is statistically more correlation with that of father than the mother (significantly low P value).

Table 1: Showing relationship between left index finger of student with his/her parents

SLI	FLI				Total	P value
	A	C	L	W		
A	1	0	3	2	6	0.000
C	0	1	0	0	1	
L	5	1	17	9	32	
W	0	0	11	10	21	
Total	6	2	31	21	60	
	MLI					
SRI	A	C	L	W	Total	P value
SLI	A	C	L	W		
A	1	1	3	1	6	0.124
C	0	0	1	0	1	
L	4	0	22	6	32	
W	2	0	10	9	21	
Total	7	1	36	16	60	

Table 2: Showing relationship between left thumb of student with his/her parents

SLT	FLT				Total	P value
	C	L	W	*A		
A	0	3	0	-	3	0.000
C	3	2	1	-	6	
L	2	28	8	-	38	
W	0	5	8	-	13	
Total	5	38	17	-	60	
	MLT					
SLT	A	C	L	W	Total	P value
SLT	A	C	L	W		
A	1	0	1	1	3	0.209
C	0	1	3	2	6	
L	3	1	29	5	38	
W	0	1	7	5	13	
Total	4	3	40	13	60	

* No Arches for comparison in SLT Vs FLT

Table 3: Showing relationship between right index finger of student with his/her parents

SRI	FRI				Total	P value
	A	L	W	*C		
A	2	1	1	-	4	0.038
L	4	25	10	-	39	
W	1	7	9	-	17	
Total	7	33	20	-	60	
	MRI					
SRI	A	C	L	W	Total	P value
SRI	A	C	L	W		
A	0	0	2	2	4	0.621
L	2	2	27	8	39	
W	1	0	9	7	17	
Total	3	2	38	17	60	

Table 4: Showing relationship between right thumb of student with his/her parents

SRT	FRT				Total	P value
	A	C	L	W		
A	0	0	2	2	4	0.000
C	0	2	1	0	3	
L	1	0	26	10	37	
W	0	0	2	14	16	
Total	1	2	31	26	60	
	MRT					
SRT	A	C	L	W	Total	P value
SRT	A	C	L	W		
A	2	0	2	0	4	0.029
C	0	1	2	0	3	
L	3	1	26	7	37	
W	1	0	10	5	16	
Total	6	2	40	12	60	

Abbreviations

A	-	Arches
C	-	Composites
L	-	Loops
W	-	Whorls
SLI	-	Student Left Index
SRI	-	Student Right Index
FLI	-	Father Left Index
FRI	-	Father Right Index
MLI	-	Mother Left Index
MRI	-	Mother Right Index
SLT	-	Student Left Thumb
SRT	-	Student Right Thumb
FLT	-	Father Left Thumb
FRT	-	Father Right Thumb
MLT	-	Mother Left Thumb
MRT	-	Mother Right Thumb

Thus the tables 1 to 4 reveal the correlation between finger print patterns of medical students and their parents (father) in this study, indicative of inheritance property of finger print pattern.

Wilder's early studies on twins broaden the evidence of inheritance and he added to the literature two family trees demonstrating the transmission of patterns, one family represented by six children, their parents, and three sisters of the father illustrates the transmission of patterns of the thenar eminence of the palm in this family Both hands of the father carry prominent thenar pattern which are there in the three sisters bilaterally. Out of six children four of them have similar thenar pattern bilaterally and rest of the two have unilaterally, while their mother has no similar thenar pattern in both hands.

In the other family studied by Wilder, several members of the family present a rare calcar pattern. This particular pattern occurs in no more than 1% of individuals of the general population. Interestingly in this family the calcar patterns or their rudiments appeared in seven out of twelve examined [6].

In the family group considered by Cevdalli composing of six individuals of three generations showed inheritance of the palmar hypothenar pattern in its unusual form as a whorl. This hypothenar pattern was present in two siblings, their father and paternal grandmother.

Carriere recorded a Lapp family in which the members showed varying degrees of reduction of palmar main line C, occurring in such frequency in this family to indicate that the condition is hereditary.

Essen- Moller investigated the presence or absence of whorls in twins. Counting on those instances in which both members of twins have no whorls or both have whorls, he reports that the frequency of occurrence of whorls in diazygotic twins is 65.8% in comparison with monozygotic twins where it is as high as 85.7% [7].

Bohmer and Harren studying 100 families with 436 children, emphasize the extreme variability of pattern type among siblings. This variability, they observe, indicates that pattern type is not inherited, but their comments and their tabulated data actually shows hereditary transmission. Their observation on whorl demonstrate, in keeping with the conclusion of most other authors, that in spite of obscurity of the genetic process there is a definite hereditary tendency in the expression of whorl patterns [8].

Elderson, continuing attention to patterns of the index finger and considering rights and lefts separately tabulates the parental combinations and patterns in offspring (about 650 children) and observes that Neither, Arch x Arch nor Arch x composite, yields whorls.

Neither, whorl x whorl nor whorl x composite, yields arches.

- Arch x loop, Arch x whorl, whorl x loop, composite x loops and loop x loop produces all types of patterns.
- Possibly, composite x composite – No arches [9].

H M Slati et al conducted study on the finger print patters of 571 isolated individuals in an Israel community (formerly lived in and around Habban) and proposed a gene theory of finger print inheritance [10].

According to Glenn Langenburg evidence from the finger prints of identical twins who share the same DNA having similar size, shape and pattern type in finger prints shows their inheritable quality [9].

The present study reveals the inheritance property of finger prints as all the four fingers included in the study show correlation with his/her father (one of the parents). P value less than 0.05, clearly indicating the inheritance properties of finger print patterns.

Summary and Conclusions

The aim of this study is to determine whether there is any correlation between the finger print patterns of an individual and those of his/her parents.

The above aim was accomplished by studying finger print patterns of 30 male and 30 female medical students of Narayana Medical College, Nellore, Andhra Pradesh and their parents. (Total 180 subjects). All the students (voluntarily) participated are within the age group of 18-25 years. This study has the approval of institutional ethical committee Narayana Medical College, Nellore.

The finger prints thus obtained were categorized into various types like loops, whorls, arches and composites. The data thus obtained was fed into computer by using Microsoft Excel and was statistically analyzed.

The analysis of the data revealed the finger print patterns of medical students both males and females showing statistically significant correlation with that of his/her father in respect to all the four fingers studied i.e. left index, left thumb, right index and right thumb. (P value less than 0.05).

The finger print pattern of right thumbs of medical students both males and females also showed statistically significant correlation with that of his/her mother. (P value less than 0.05).

Thus this study shows inheritance property of major ridge pattern of finger prints, as there is statistically significant correlation between the finger print patterns of medical students with parents (either father or mother).

Limitations and Recommendations

This study has its own limitations and can suggest the following recommendations.

The limitations of this particular study include;

1. Small sample size - only sixty medical students and their parents were included. The sample is limited due to difficulty in obtaining finger prints from parents, single/both (non availability / refusal of either or both parent etc.).
2. Study group restricted to a small geographical area, the state of Andhra Pradesh.

With this known limitations the following recommendations are made.

1. Study group should include a large sample.
2. This study indicates strong inheritance traits in the *dermatoglyphics* [all the four finger print patterns under consideration shows similarities with either parent (father)]. Further studies are recommended involving larger number families for conclusive outcomes.

Acknowledgement

Are due to Dr. B.V. Subrahmanyam former HOD Forensic Medicine, Dr. G.V. Nagi Reddy Principal and Dr. L. Hema, HOD Anatomy for their advices and Mrs A. Karuna for computation assistance.

Funding agency NIL

Conflicts of interest-NIL

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