ORIGINAL PAPER

A New Approach to Dactyloscopy

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ABSTRACT

Dactyloscopy, i.e. the study of fingerprints is a very important tool in establishing the identity of an individual, whether living or dead. The present study was undertaken in the Department of Anatomy, Gauhati Medical College, Guwahati, Assam, amongst a group of 145 1st MBBS students comprising of 89 males and 56 females between the age group of 18 to 23 years, having different ethnic backgrounds, after approval of the Institutional Ethical Committee, with an aim to find out if there was any variation between persons showing 'same fingerprint pattern in all five fingers', 'same fingerprint pattern in four fingers', 'same fingerprint pattern in three fingers', and 'same fingerprint pattern in two fingers' and also to see whether there is any difference between male and female pattern of fingerprint distribution. The fingerprint patterns were classified on the basis of Michael Kucken's classification system as Loop, Arch, Whorl and Composite pattern. The data recorded was analysed statistically using Student's T-test. P value d" 0.05 is considered as statistically significant. Such a study may be useful in establishing a database which may be useful in forensic science.

Keywords: Identification, Dactyloscopy, Fingerprint

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INTRODUCTION

Dactyloscopy is a very important tool that aid forensic experts in establishing the identity of an individual, whether living or dead.[1] It is the system of examination of fingerprints (from the Greek word *'dactylos'* which means finger and *'skopein'* which means to watch). Finger prints are the reproductions of the patterns formed by the papillary ridges present on the palmar aspects of the thumbs and fingers. They afford an infallible means of personal identification, because the ridge arrangement on every finger of every human being is unique and does not alter with growth or age. Fingerprint ridge density is a potential tool for identification, even from partial prints.[2,3] The study of finger prints is also known as Dermatoglyphics.[4,5,6] Englishmen Henry Faulds and William James Herschel first described the uniqueness and permanence of finger prints. Sir Francis Galton suggested the first elementary system for classifying fingerprints. Galton's system served as the basis for the fingerprint classification systems developed by Sir Edward R. Henry. The Galton-Henry system of fingerprint classification, published in June 1900, was officially introduced at Scotland Yard in 1901 and quickly became the basis for its criminal-identification records.[7]

OBJECTIVES

(i) To find out if there was any difference between persons showing 'same fingerprint pattern in all five fingers', 'same fingerprint pattern in four fingers', 'same fingerprint pattern in three fingers', and 'same fingerprint pattern in two fingers'.

(ii) To see whether there is any difference between male and female in the above mentioned categories.

MATERIALS AND METHODS

Materials: (i) Printer's blue ink, (ii) White bond paper (Royal Executive Bond, Premium White A4 sheets), (iii) Magnifying glass (10X), (iv) Pen for labelling individual details.

Method: The present study has been conducted in the Department of Anatomy, Gauhati Medical College, Guwahati, Assam, amongst a group of 145 1st MBBS students comprising of 89 males and 56 females between the age group of 18 to 23 years, having different ethnic backgrounds, after approval of the Institutional Ethical Committee. All the participants were briefed about the purpose of the study and written informed consent was also taken from them. Care was taken to select individuals having no lesions, whether active or passive on the fingers.

Collection of Prints: For obtaining the finger prints, the dominant hand of the subjects was taken. The impressions of all five fingers were taken using printer's blue ink on the A4 sheets.

Analysis of Prints: The prints that were recorded were studied with a magnifying lens. The fingerprint patterns were classified on the basis of Michael Kucken's classification system as Loop, Arch, Whorl and Composite pattern. The data recorded was analysed statistically using Student's T-test. *P* value d" 0.05 is considered as statistically significant.

OBSERVATION & RESULTS

The results and observations of the present study is tabulated and graphed as follows:

Table 1 Cases where five fingers show same fingerprint pattern

Pattern of fingerprint	Male	Female
Loop	18	10
Arch	1	1
Whorl	3	4
Composite	0	0
SUM	22	15
Mean	5.5	3.75
SD	±8.426	±4.500
SEM	±4.213	±2.250

In the present study it is seen that in the category of 'five fingers showing same fingerprint' the number of male cases according to different pattern of finger print ranges

from 18 to nil with a mean value of 5.5, Standard Deviation ±8.426 and Standard Error of Mean ±4.213 and the number of female cases according to different pattern of finger print ranges from 10 to nil with a mean value of 3.75, Standard Deviation ±4.500 and Standard Error of Mean ±2.250 as evident from **Table 1.**

Table 2 Frequency, relative frequency & percentage

Class interval of different type of finger print	Four fingers showing same print in male & female					
	Male			Female		
	f (frequency)	fr (relative frequency)	f% (percentage)	f (frequency)	fr (relative frequency)	f% (percentage)
Loop	18	0.818	81.800	10	0.666	66.600
Arch	1	0.045	4.500	1	0.066	6.600
Whorl	3	0.136	13.600	4	0.266	26.600
Composite	0	0.001	0.100	0	0.002	0.200
Sum	**22**	**1.000**	**100.000**	**15**	**1.000**	**100.000**

Table 2 shows that for the male group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.818, simple frequency of 18 and a percentage of 81.800. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.001, simple frequency of 0 and a percentage of 0.100 as evident in **Figure 1.**

For the female group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.666, simple frequency of 10 and a percentage of 66.600. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.002, simple frequency of 0 and a percentage of 0.200 as evident in **Figure 1.**
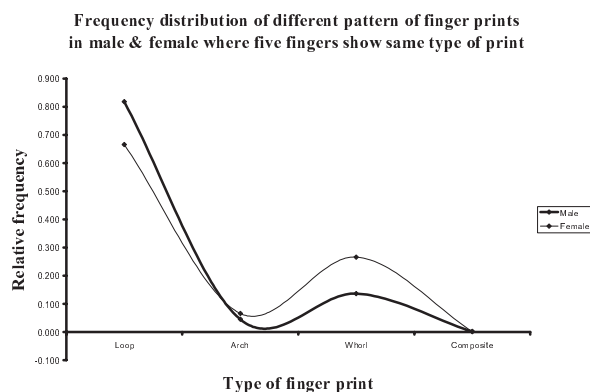

Figure 1 Relative frequency distribution

Table 3 Cases where four fingers show same fingerprint pattern

Pattern of fingerprint	Male	Female
Loop	16	21
Arch	2	3
Whorl	8	3
Composite	0	0
SUM	**26**	**27**
Mean	**6.5**	**6.75**
S D	**±7.188**	**±9.605**
SEM	**±3.594**	**±4.802**

In the category of 'four fingers showing same fingerprint' the number of male cases according to different pattern of finger print ranges from 16 to nil with a mean value of 6.5, Standard Deviation ±7.188 and Standard Error of Mean ±3.594 and the number of female cases according to different pattern of finger print ranges from 21 to nil with a mean value of 6.75, Standard Deviation ±9.605 and Standard Error of Mean ±4.802 as evident from **Table 3**.

Table 4 Frequency, relative frequency & percentage

Class interval of different type of finger print	Four fingers showing same print in male & female					
	Male			Female		
	f (frequ-ency)	fr (relative frequ-ency)	f% (percen-tage)	f (frequ-ency)	fr (relative frequ-ency)	f% (per-centage)
Loop	16	0.615	61.500	21	0.777	77.700
Arch	2	0.076	7.600	3	0.111	11.100
Whorl	8	0.307	30.700	3	0.111	11.100
Composite	0	0.002	0.200	0	0.001	0.100
Sum	**26**	**1.000**	**100.000**	**27**	**1.000**	**100.000**

Table 4 Shows that for the male group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.615, simple frequency of 16 and a percentage of 61.500. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.002, simple frequency of 0 and a percentage of 0.200 as evident in **Figure 2.**

For the female group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.777, simple frequency of 21 and a percentage of 77.700. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.001, simple frequency of 0 and a

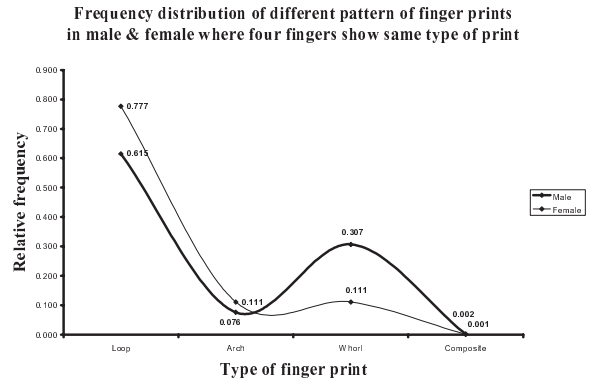percentage of 0.100 as evident in **Figure 2**.

Frequency distribution of different pattern of finger prints in male & female where four fingers show same type of print

Figure 2 Relative frequency distribution

Table 5 Cases where three fingers show same fingerprint pattern

Pattern of fingerprint	Male	Female
Loop	22	8
Arch	3	0
Whorl	10	4
Composite	0	0
SUM	**35**	**12**
Mean	**8.75**	**3**
S D	**±9.777**	**±3.830**
SEM	**±4.888**	**±1.915**

In the category of 'three fingers showing same fingerprint' number of male cases according to different pattern of finger print ranges from 22 to nil with a mean value of 8.75, Standard Deviation ±9.777 and Standard Error of Mean ±4.888 and the number of female cases according to different pattern of finger print ranges from 8 to nil with a mean value of 3, Standard Deviation ±3.830 and Standard Error of Mean ±1.915 as evident from **Table 5.**

Table 6 Frequency, relative frequency and percentage

Class interval of different type of finger print	Three fingers showing same print in male & female					
	Male			Female		
	f (frequ-ency)	fr (relative frequ-ency)	f% (percen-tage)	f (frequ-ency)	fr (relative frequ-ency)	f% (per-centage)
Loop	22	0.628	62.800	8	0.665	66.500
Arch	3	0.086	8.600	0	0.001	0.100
Whorl	10	0.285	28.500	4	0.333	33.300
Composite	0	0.001	0.100	0	0.001	0.100
Sum	**35**	**1.000**	**100.000**	**12**	**1.000**	**100.000**

Table 6. shows that for the male group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.628, simple frequency of 22 and a percentage of 62.800. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.001, simple frequency of 0 and a percentage of 0.100 as evident in **Figure 3.**
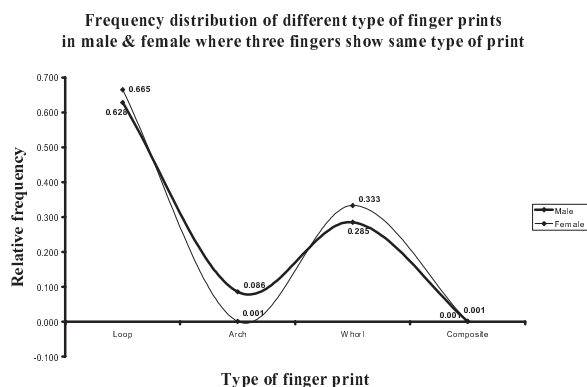
For the female group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.665, simple frequency of 8 and a percentage of 66.500. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.001, simple frequency of 0 and a percentage of 0.100 as evident in **Figure 3**.

Figure distribution of different type of finger prints in male & female where three fingers show same type of print

Figure 3 Relative frequency distribution

Table 7 Cases where two fingers show same fingerprint pattern

Pattern of fingerprint	Male	Female
Loop	13	5
Arch	5	0
Whorl	10	4
Composite	1	0
SUM	**29**	**9**
Mean	**7.25**	**2.25**
S D	**±5.315**	**±2.630**
SEM	**±2.657**	**±1.315**

In the category of 'two fingers showing same fingerprint' number of male cases according to different pattern of finger print ranges from 13 to 1 with a mean value of 7.25, Standard Deviation ±5.315 and Standard Error of Mean ±2.657 and the number of female cases according to

different pattern of finger print ranges from 5 to nil with a mean value of 2.25, Standard Deviation ±2.630 and Standard Error of Mean ±1.315 as evident from **Table 7**.

Table 8 Frequency, relative frequency and percentage

Class interval of different type of finger print	Two fingers showing same print in male & female					
	Male			Female		
	f (frequency)	fr (relative frequency)	f% (percentage)	f (frequency)	fr (relative frequency)	f% (percentage)
Loop	13	0.448	44.800	5	0.554	55.400
Arch	5	0.173	17.300	0	0.001	0.100
Whorl	10	0.344	34.400	4	0.444	44.400
Composite	1	0.035	3.500	0	0.001	0.100
Sum	**29**	**1.000**	**100.000**	**9**	**1.000**	**100.000**

Table 8 Shows that for the male group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.448, simple frequency of 13 and a percentage of 44.800. The lowest number of subjects are found in the class interval of 'Composite' type of fingerprint with a relative frequency of 0.035, simple frequency of 1 and a percentage of 3.500 as evident in **Figure 4**.

For the female group highest number of subjects are found in the class interval of 'Loop' type of fingerprint with a relative frequency of 0.554, simple frequency of 5 and a percentage of 55.400. The lowest number of subjects are found in the class interval of 'Arch' & 'Composite' type of fingerprint with a relative frequency of 0.001, simple frequency of 0 and a percentage of 0.100 as evident in **Figure 4**.
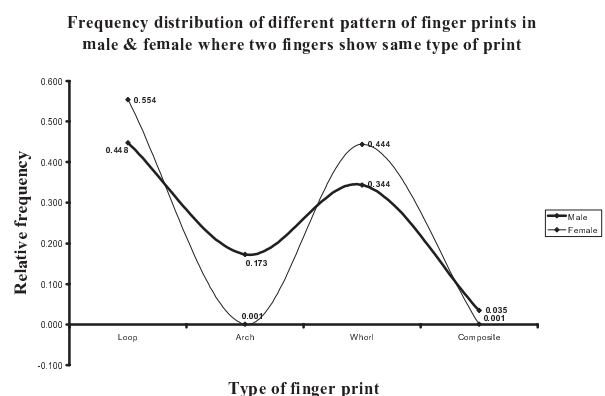

Frequency distribution of different pattern of finger prints in male & female where two fingers show same type of print

Figure 4 Relative frequency distribution

Table 9 Level of significance of differences between the various categories

Comparison of mean between	"t"	P
Male and female subjects where five fingers show same print	0.274	P <0.05
Male and female subjects where four fingers show same print	0.021	P >0.05
Male and female subjects where three fingers show same print	1.095	P >0.05
Male and female subjects where two fingers show same print	1.686	P >0.05
Male subjects of 'five fingers showing same print' & 'four fingers showing same print'	0.180	P >0.05
Male subjects of 'four fingers showing same print' & 'three fingers showing same print'	0.370	P >0.05
Male subjects of 'three fingers showing same print' & 'two fingers showing same print'	0.269	P >0.05

Figure 5 (A) & (B) Photograph of 'three fingers showing same print'

DISCUSSION

Establishing the identity of an individual is necessary for many reasons such as personal, social, and legal, including certification of death.[8] It becomes necessary to establish the identity of an individual in cases of discovering an unknown deceased person in situations concerning homicide, suicide, accident, mass disaster etc. It is also necessary for locating living missing individuals or culprits concealing their identity.[9] It is one of the most challenging subjects to be dealt with in forensic science. The concept of identity is a set of physical characteristics, functional or psychic, normal or pathological, that defines an individual.[10] The use of fingerprints in establishing the identity of an individual has been known since the finding of finger impressions on the clay surface of Babylonian legal contracts almost 4,000 years ago.[11] Fingerprints are constant and individualistic and form the most reliable criteria for identification.[12, 13] These patterns are genotypically determined and remain unchanged from birth till death.[14] Fingerprints collected at a crime scene can be used to identify suspects, victims and other persons who touched the surface. Fingerprint scans can be used to validate electronic registration, cashless catering and library access especially in schools and colleges.[15]

A lot of research has been conducted till date on fingerprinting. Most of the studies have concluded that loop pattern of finger print is the most common followed by whorl pattern, arch pattern and composite pattern.[15, 16] Our study is consistent with this universal observation. However, the distribution of fingerprint patterns in all the five fingers has not been considered for statistical analysis till date. Our study seems to be the first of its kind and hopes to provide a reliable help while considering distribution of fingerprints in forensic science.

CONCLUSION

The present study revealed that the number of male cases is significantly higher (p < 0.05) than the female cases where five fingers show same print pattern. On the other hand, though the number of male cases is higher than the number of female cases in all the three categories i.e. 'four fingers showing same print', 'three fingers showing same print' and 'two fingers showing same print', this is of no statistical significance (p> 0.05). The number of male cases is higher in the group of "Five fingers showing same print" than the group of "Four fingers showing same print" but without any statistical significance (p>0.05). The number of male cases in the group of "Four fingers showing same print" is less than the group of "Three fingers showing same print" but without any statistical significance (p>0.05). The number of male cases in the group of "Three fingers showing same print" is more than the group of "Two fingers showing same print" which is also without any statistical significance (p>0.05).

Hence, from the above study, we can conclude that the highest to lowest trend of finger print pattern are seen respectively as 'Five fingers showing same print', 'Three fingers showing same print', 'Two fingers showing same print' and 'Four fingers showing same print' which is without much significance. Further, in most of the varieties of finger print pattern there are no significant differences between male and female, but male cases are significantly higher than the female cases in the pattern of 'five fingers showing same print' (p<0.05).

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