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Original Research Article

Dermatoglyphics of Medical Students of a Tertiary Teaching Hospital in Srikakulam District, Andhra Pradesh.

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Key words
Dermatoglyphics,
Fingerprint patterns,
Gender,
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Abstract

Introduction: A study to explore the association between fingerprint patterns, gender, and blood group types was carried out among medical students of GMC, Srikakulam, Andhra Pradesh with an objective to explore various fingerprint patterns, analyse and classify fingerprint patterns on individual digits, study the association between fingerprint pattern and gender, and determine any predominance of a particular pattern among different blood group types. **Material & Methods:** A total of 1320 fingerprints from 132 subjects were collected using stamp pad, printers' ink, and other tools. The collected data, including gender, blood group type, and fingerprints of all ten fingers, were analysed using statistical software. **Results:** Loops were the most common fingerprint pattern, followed by whorls, arches, and composite patterns. Ulnar loops were more prevalent in both males and females. The frequency of whorls was higher in females, contrary to previous studies. The association between fingerprint patterns and blood group types revealed varying distributions among different blood groups. The study also found a significant association between the right-hand ring fingerprint and gender as well as blood group type. **Conclusion:** Gender and blood group type may complement fingerprint patterns for identification purposes. The significant associations found in this study were limited to the right ring finger, and further research on a larger sample size is required to confirm the findings for other fingers.

1. Introduction

Dr Edmond Locard famously known as the "Sherlock Holmes of France" is well-known for his Locard's Principle of Exchange.[1] He stated that "every contact leaves a trace." Fingerprinting techniques were developed based on this principle. Dermatoglyphics is the study of fingerprint pattern

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of fingers, palm, and soles. The term was first coined by Harold Cummins in 1926. Fingerprint is an impression of the epidermal ridges of the bulb of finger.[1]

Fingerprint remains ubiquitous throughout life and forms the most reliable criteria of identification. The pattern makes their appearance as early as 10 weeks of intrauterine life. Various patterns like loop, Arch, Whorl and Composite were recognized worldwide and are in practical use. Literature shows, Loop as the most common pattern among all four (60-70%) and Composite is the least common type (1-2%). Whorls form 25-30% and Arches constitute 6-7%. Though the average distribution of different fingerprint patterns is known worldwide, published literature on the distribution of fingerprint patterns on individual digits are very few[2,3] and no such study was ever conducted in Srikakulam district of Andhra Pradesh.

Fingerprints have long been used as a reliable means of identification, due to their uniqueness and stability throughout a person's lifetime. Recent studies have suggested that there may be potential correlations between certain fingerprint patterns and individual characteristics such as gender and blood type.

The potential correlations between fingerprint patterns and individual characteristics such as gender and blood type are important to explore in order to improve the accuracy and effectiveness of fingerprint identification in forensic investigations. Several studies have investigated the association between fingerprint patterns and gender and blood group type, with some suggesting that certain patterns are more prevalent in males or females and certain blood group types. However, other studies have reported conflicting results, and these findings have not been consistently replicated in other studies indicating a need for further research to better understand the relationship.

A better understanding of these relationships could have important practical applications, such as helping to identify potential suspects or narrowing down the pool of potential suspects in criminal investigations. An attempt was made in this study to explore and understand these associations.

2. Objectives:

i. To explore various fingerprint patterns among final year part I MBBS students of GMC, Srikakulam.
ii. To analyse and classify fingerprint pattern on individual digits
iii. To study the association between fingerprint pattern and gender of an individual.
iv. To determine any predominance of a particular pattern among different blood group types.

3. Methodology

Study design: Cross-sectional study

Population & Setting: Final year part I MBBS students of GMC, Srikakulam, Andhra Pradesh.

Study period: May 2023.

Inclusive criteria: final year part I MBBS students of GMC, Srikakulam

Exclusion criteria: Students suffering with any medical or surgical conditions affecting the fingerprint, students with any scars on finger bulbs which will hamper the collection and analysing the fingerprint and students not willing to consent for the study are excluded from the study.

Sample size: 1320 finger prints of 132 subjects.

Study Tools: Stamp pad, Printers ink (Black), Torch. Magnifying lens, Data collection sheets, Data analysing software (SPSS 16).

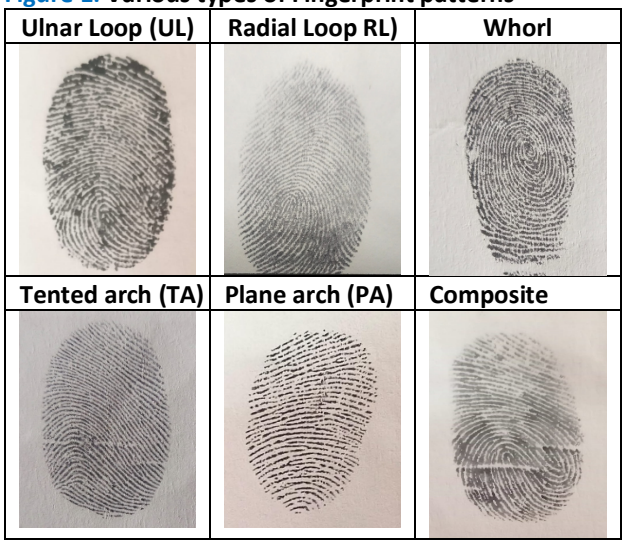
Method of data collection*:* Institutional ethics committee of GMC & GGH, Srikakulam, approval was obtained (Approval Certificate no: IEC23/GMC&GGH/SKLM/170523/40). Written informed consent is obtained before collecting the fingerprint from individual study participants. All the researchers involved in the study were trained in the dept of FMT, GMC, Srikakulam in collecting, analysing, and classifying the fingerprints. The researchers were trained by collecting and reviewing fingerprints of random samples in the department. Data collection sheets are designed to collect the gender, blood group type and finger print of all ten fingers. Everyone is assigned a unique code for future reference. The study participants were instructed to clean the bulb of finger with soap and water to remove any dirt particles. The bulb of finger is allowed to dry before application of ink. Ink is spread on the bulb evenly and the study participant were instructed to press the finger gently on data collection sheet. The researcher would ensure the appropriateness of the fingerprint. All prints which are smudged or inappropriate were repeated. Similar procedure was followed for all ten fingers of each individual. A total of 1320 fingerprints were collected within the study period. All fingerprint patterns were classified as per study definitions described below. To

minimize the inter-observer and intra-observer bias, certain patterns were randomly classified by all researchers with the help of unique code assigned.

Data Analysis: The collected data entered into Microsoft excel sheet and analysed with statistical software SPSS 16. Appropriate statistical tests were performed to achieve the study objectives.

Study Definitions: Sir Francis Galton classified different fingerprint patterns. Fingerprint patterns were classified into four types based on the presence of a core and delta. A core is a ridge that curves back on itself, while a delta (or triradius) is formed by the convergence of ridges from three directions. An arch pattern is characterized by the absence of both core and delta. A loop pattern is defined by the presence of one core and one delta. A whorl pattern has no core and two deltas. Composite patterns are a combination of two or more of these types. [4]

Figure 1: Various types of Fingerprint patterns



All prints will be analysed by all the researchers and classified as follows **(Figure 1)** -

a. Loops are the most common fingerprint pattern, accounting for approximately 67% of all fingerprints. They are characterized by ridges that enter from one side, curve around, and exit from the same side, with a single core and delta. Loops are further divided into two types: radial loops (RL) where ridges enter and exit from the radial side, and ulnar loops (UL) where ridges enter and exit from the ulnar side.
b. Whorls are the second most common fingerprint pattern, comprising approximately 25% of all fingerprints. Whorls are characterized by ridges that make a complete 360° circuit around the centre of the print, with two deltas.
c. Arches are the least common fingerprint pattern, accounting for only 7% of all fingerprints. They do not have a core or delta and are further divided into two types: plain arches (PA) where ridges enter from one side, rise to a slight bump, and exit out from the opposite side, and tented arches (TA) which are similar to plain arches but have ridges that stand at an angle of 45° or more.
d. Composite fingerprints make up only 1% of all fingerprints and are a mixture of two or more of the above fingerprint types in a single print.

Gender and blood group type of the study participants are also collected on a data sheet along with the fingerprints. The data were analysed for distributions of fingerprint patterns and correlations if any among various study variables.

4. Results

Sixty five percent of study participants are females and remaining 35% are males. Among 132 study participants 60 (45.5%) were O+ve blood group followed by 33(25%) of B+ve blood group. Thirty students (22.7%) were of A+ve blood group. AB+ve & O-ve blood group constituted 3%. A-ve blood group participants were 1(0.8%). No study participants belonged to B-ve and AB-ve blood groups **(Table 1 & 2)**.

Table 1: Distribution of gender

Gender	Frequency	Percentage
Female	85	64.4%
Male	47	35.6 %

Table 2: Distribution of Blood group types

Sex	A		B		AB		O		Total
	Rh+	Rh-	Rh+	Rh-	Rh+	Rh-	Rh+	Rh-	
M	10	0	15	0	1	0	19	2	47
F	20	1	18	0	3	0	41	2	85
T	30	1	33	0	4	0	60	4	132

M- Male, F- Female, T- Total.

Table 3: Distribution of patterns

Pattern	Frequency	Percentage
Loops	810	61.363 %
Whorls	397	30.075%
Arches	98	7.424%
Composite	15	1.136%
Total	1320	100 %

Table 3 shows maximum (61.36%) number of fingers print patterns are loops followed by whorls (30.07%), arches (7.42%) and composite (1.13%). Ulnar Loops are most seen in both males and females (17.87% and 39.92% respectively). Composite being the least with 0.76% in males and 0.37% in females **(Table 3 & 4)**.

Ulnar Loop has shown highest frequency in all the blood group types. Highest percentage of Ulnar Loops are present in O+ve (27%) followed by 13.5% in B+ve, 13.4% in A+ve.

Table 4: Patterns distribution among males and females

Sex	Loops		Arch		Whorl	Composite	Total
	UL	RL	PA	TA			
Male	236(17.87%)	19(1.43%)	9(0.68%)	12(0.90%)	184 (13.93%)	10 (0.75%)	470
Female	527(39.92%)	28(2.12%)	41(3.10%)	36(2.80%)	213 (16.13%)	5(0.37%)	850
Total	763	47	50	48	397	15	1320

Table 5: Patterns distribution among blood group types

Blood Group	Loops		Arch		Whorl	Composite	Total
	UL	RL	PA	TA			
A+	177 (13.40%)	18 (1.36%)	14 (1.06%)	14 (1.06%)	73 (5.53%)	3 (0.22%)	299
A-	7 (0.53%)	2 (0.15%)	0	0	01 (0.07%)	0	10
B+	178 (13.48%)	13 (0.98%)	17 (1.28%)	8 (0.60%)	108 (8.18%)	6 (0.45%)	330
B-	0	0	0	0	0	0	0
AB+	33 (2.5%)	1 (0.07%)	1 (0.07%)	0	5 (0.37%)	0	40
AB-	0	0	0	0	0	0	0
O+	355 (26.89%)	11 (0.83%)	15 (1.13%)	23 (1.74%)	191(14.46%)	6(0.45%)	601
O-	15 (1.13%)	1 (0.07%)	3 (0.22%)	4 (0.30%)	17 (1.28%)	0	40

Table 6: Association between fingerprint and gender and Blood groups

Association between fingerprint and gender				Association between fingerprint and blood groups		
	Value	df	p value	Value	df	p value
Pearson Chi Square	16.86	4	0.002	1.438E2	20	0.000
Likelihood ratio	18.56	4	0.001	22.92	20	0.293
Linear –by –linear Association	14.32	1	0.000	0.006	1	0.940
Phi	0.35		0.002	1.044		0.000
Crammer's v	0.35		0.002	0.52		0.000

The second most frequently seen pattern is whorls in all the blood groups. Among Arches Tented Arches are with higher frequencies in O+ve and A+ve blood groups; Plane Arches are with higher frequencies in, B+ve, O+ve & A+ve and least in O-ve & AB+ve blood groups. Arches were not observed in A-ve blood group. Composites are the least with 1.1% frequency. **(Table 5)**. **Tables 6** show a statistically significant association between right hand ring fingerprint and gender and blood group type. (p=0.002 & 0.000 respectively).

5. Discussion

The results of our study are in accordance with the studies done by Chandra Sekhar V *et al* 2020[5], Iju Shrestha *et al* 2019[6], and followed the general pattern with loop being the predominant type followed by whorl and arch patterns. Ulnar loop pattern is more common compared to radial loop pattern in our study similar to the studies done by Iju Shrestha *et al* 2019.[6] Frequency of loops were higher in both males and females similar to the study done by Chandra Sekhar V *et al* 2020.[5] The similarity of the results of our study with the study conducted in Visakhapatnam by Chandra Sekhar V *et al* 2020 assumes its importance due to their geographical location with, both centres being located within 100 km from each and similarities between study population. Many studies found higher frequency of whorls in males compared to females, however our study revealed higher frequency of whorls in females.[6]

Ulnar Loops were highest in O+ve and Radial loops were highest in A+ve group. Both the loop patterns were least distributed in A-ve blood group type. Highest frequency of PA found in A+ve group and TA were found in highest numbers in O+ve group. AB+ve and O-ve had lesser numbers of PA and TA respectively. Highest frequency of whorl pattern seen in O+ve group and least in A-ve group. Similar results were found by Manikandan S *et al* 2019.[7] When analysed for association between print pattern and gender and blood group type, the right-hand ring fingerprint showed a highly significant association with gender (p=0.002) and blood group type (p=0.000) in our study. Similar attempt by some researchers found that gender and blood group types

were associated with a particular pattern but these studies did not explore the statistical correlation.[7]

Fingerprint ridge density (FPRD) was used to study the gender specificity. Fingerprint ridge density refers to the number of ridges (raised lines) present in a specific area of a fingerprint. Some researchers found a strong association between gender and print pattern with the help of FPRD, and concluded that fingerprints could accurately predict the sex of an individual.[8] Significant association was observed between print pattern and gender in this study (p=0.002).

Our study revealed as strong association between fingerprint of right-hand ring finger and blood groups (p=0.000). This finding should be considered as a casual association, as currently there is no scientific evidence to support a direct association between fingerprints and blood groups. While fingerprints are unique to each individual and can be used for identification purposes, they are not directly related to an individual's blood type. There have been some studies that have looked at the relationship between fingerprints and blood types in terms of their potential use in forensic investigations and found that individuals with higher ridge densities tended to have a higher frequency of certain blood types, but the relationship was not statistically significant.[9-15]

It is important to note that while these studies suggest a potential relationship between fingerprints and blood types, more research is needed to confirm these findings and to determine the practical applications of such relationships in forensic investigations.

6. Conclusion

The findings of this study suggests that the gender and blood group type could complement fingerprint patterns of an individual for identification. The significant association between gender, blood group type and fingerprint pattern found in this study was limited to one finger (Right ring finger), however, further research on a larger sample would increase the odds of finding association in remaining fingers and confirm the findings of this study.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

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