Original Article

Study Of Fingerprint Patterns And Their Relationship With Blood Groups And Gender In Erode, Tamilnadu

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Abstract

Background and Objectives: Fingerprint is one of the most mature biometric technologies and is considered as legitimate proofs of evidence in court of law. Blood grouping can also be utilized in genetic research, forensic pathology and anthropology. In this study an effort is made to study the relationship between fingerprint patterns with ABO, Rh blood groups and gender. **Methods:** 100 male and 100 female subjects from students and teaching staffs of Government Erode Medical college Perundurai were included after excluding any congenital or acquired deformities of fingers. Fingerprints of subjects are obtained with help of pre-inked strips and blood grouping done by slide method. **Results:** In study A, B and O blood groups were equally distributed with 31.5% each and AB was least common blood group (5.5%). Majority of subjects were Rh +ve (92.5%). A group (37.2%) was most common among males and O group (37.4%) in females. Loops was most frequently observed (53%) followed by whorls (26.4%), composites (14.35%) and arches (6.25%) in whole study group and in both genders. Loop and arch pattern of fingerprints was most common in B group, whorls in O, composites in A blood group. Loops were most consistent in little fingers, whorls in ring fingers, arches in index fingers and composites in thumb of both hands. In sub-patterns ulnar loop pattern (95.2%) out-numbered radial loop. Concentric whorls (77.5%) were most common type of whorls. Among arches, tented arches (56.8%) and among composites, central pocket loops (53.1%) were most predominantly seen. **conclusion:** The regression equations derived were found to be statistically significant and correlate the relationships between the fingerprint patterns and blood groups and also fingerprint patterns and gender.

Key words: Fingerprint patterns; Blood groups; Gender; Identification.

INTRODUCTION:

Identification means determination of individuality of a person. It may be complete (absolute) or incomplete (partial). Complete identification means the absolute fixation of an individuality of person. Partial identification implies ascertainment of only some facts about the identity while others still remain unknown. The most successful

approach utilises the combination of more than one method[1]. When human began taking an interest in the strange patterns on their hands and fingers will never be known, but the presence of fingerprints on cave walls and on ancient artefacts has led some historians to believe that the individuality of fingerprints has been recognized for many centuries[2]. Some of the following points are usually noted for the purpose of identification like race, sex, age, complexion and features, hair, fingerprints, footprints, deformities, tattoo marks, scars, occupational marks, handwriting, clothes, personal articles, speech, voice, gait, mental power, memory education and DNA profile etc[3]. Out of which, fingerprint system is the best and it has been estimated that chances of two persons having identical finger impressions is one in sixty-four thousand million population. Even the fingerprints of the identical twins are not similar[3].

Personal identification through fingerprints has been recognized since long time and is regarded as the greatest contribution to the law enforcement. Through its unique characteristics, the science of fingerprint provides a special service in the administration of justice and also in other areas where positive identification is of paramount importance[4]. Study of fingerprint as method of identification is also known as Dactylography or Dactyloscopy and at present it is also known as Henry – Galton system of identification[5]. The common uses of fingerprints for the identification are criminals whose fingerprints are found at the scene of crime and of fugitives through fingerprint comparison, in identifying the unknown deceased person, missing persons, those who are suffering from amnesia, in cases of kidnapping and in detection of bank forgeries. It also helps in prevention of either accidental or purposeful exchange of new-born infants in hospitals.[4] Like fingerprints blood is also an extremely important entity in the medico-legal practice, which alone and/or along with other trace evidences can play a clinching role to unfold different criminal problems.[5] The ABO group system is the primary and most important because it is most common, conspicuous and easily detectable.[5] Blood grouping is utilized in civil cases for solving forensic problems like disputed maternity and paternity, divorce and nullity of marriage, compensation cases related to workman's welfare considerations or civil negligence issues arising in hospital or medical practice.[5] Similarly it is equally important in criminal cases like identification of victim or offender of a crime of assault, homicide, sexual offences and death occurring due to rash or negligent act of the offender etc.,

In case of homicide, if the blood stain present on a lethal weapon matches with the blood stained present on the wearing apparel of a suspect on the one hand and blood of the victim on the other, then relationship between the offence of homicide, the victim, the offender and the offending agent get authenticated[5].

Blood grouping in disputed paternity cases can achieve non-identity or exclusion. The two important principles in this context are a blood group antigen cannot appear in a child unless it is present in one of the parents. If one of the parents is homozygous for a particular blood group antigen, that antigen must appear in the child's blood[6]. The Rh system is the second most significant blood-group system in human-blood transfusion. Currently 50 antigens have been identified[7]. The presence of the D antigen occurs in majority of individuals. These individuals are Rh positive. The absence of the D antigen individuals are Rh negative[6].

There is paucity of literature in this region regarding the study of relationship between the fingerprint patterns and the sex and about their relationship with different blood groups. Hence an attempt is made in the present study to know relation between various fingerprint patterns and different blood groups and gender among students and teaching staff in Government Erode Medical College, Perundurai, Erode, Tamilnadu.

AIMS AND OBJECTIVES OF THE STUDY:

1. To find-out the profile of fingerprint pattern and blood groups among the study group subjects of both sexes.
2. To correlate any relation between the fingerprint patterns with sex and blood groups.

MATERIALS AND METHODS:

This Cross sectional study, by using Simple random sample technique 100 male and 100 female subjects were randomly selected from students and teaching staffs of Government Erode medical college, Perundurai, Erode. Apparently healthy adults are included in this study. Participants those who are a) Permanent scar on any of the fingers, b) Hand deformity due to injury, c) Birth defect or disease of the hands, d) Students and teaching

staffs who could not be traced even after three consecutive visits and e)Those who have not consented are excluded from this study.

Wooden table of proper height, pre-inked strips of 10x3 inches, unglazed white bond paper one per subject, wooden pad for supporting the paper, magnifying lens, soap, water, antiserum A, antiserum B, antiserum D, sterile lancets, applicator sticks and sterile alcohol swab.

The method to be used for obtaining fingerprints in the present study will be by pre inked strip method. These pre inked strips are being currently used by Fingerprint Bureau of Tamilnadu state Police. The aim and objectives of study will be properly explained to the subjects and informed written consent will be taken on the proforma sheet. The persons whose fingerprints are to be recorded are made to clean both hands to remove sweat, oil and dirt by washing them with soap and water. Then the hands are air dried.

Recording of fingerprints:

A pre inked strip of size 10x3 inches was placed on a wooden table. The transparent wrapper over the strip was peeled and the palmar aspects of the distal phalanges of a person's right and left hand are inked one after the other by applying firm pressure on the strip starting from the little finger.

The unglazed white bond paper is applied firmly over a wooden pad. Then the bond paper was divided into two halves (right and left), and each half further into five columns marked as thumb, index, middle, ring and little. The fingers were rolled from side to side to obtain complete print of ridged area of the distal phalanges in the respective columns on the bond paper.

Recording of blood groups:

ABO blood group was determined by slide method. Blood was collected by a finger prick with a sterile lancet after cleaning the puncture site with alcohol swab. A drop of anti-A, anti-B, anti-D was placed on a clean glass slide. A drop of blood from each subject was mixed with each antisera individually with help of applicator sticks. Blood groups were determined on the basis of presence or absence of agglutination[7].

RESULTS:

Table 1: Relation with gender and ABO blood groups

			Blood group				Total
			O	A	B	AB	
Sex	Male	Count	25	36	32	7	100
		% within sex	25.0%	36.0%	32.0%	7.0%	100.0%
	Female	Count	38	27	31	4	100
		% within sex	38.0%	27.0%	31.0%	4.0%	100.0%
Total		Count	63	63	63	11	200
		% within sex	31.5%	31.5%	31.5%	5.5%	100.0%

Table no. 1 shows O, A, B blood groups were equally distributed with 63 (31.5%) subjects each and AB group with 11 (5.5%) subjects. In males the maximum number of subjects were with A Blood group with 36 (36%) and

minimum number of subjects were noticed in AB Blood group with 7 (7%).In females, maximum number of subjects were noticed in O Blood group with 38 (38%) and minimum number of subjects in AB blood group with 4 (4%).Chi-square value - 4.802, p value - < 0.187 which shows that there was no statistically significant relationship between gender and blood group distribution.

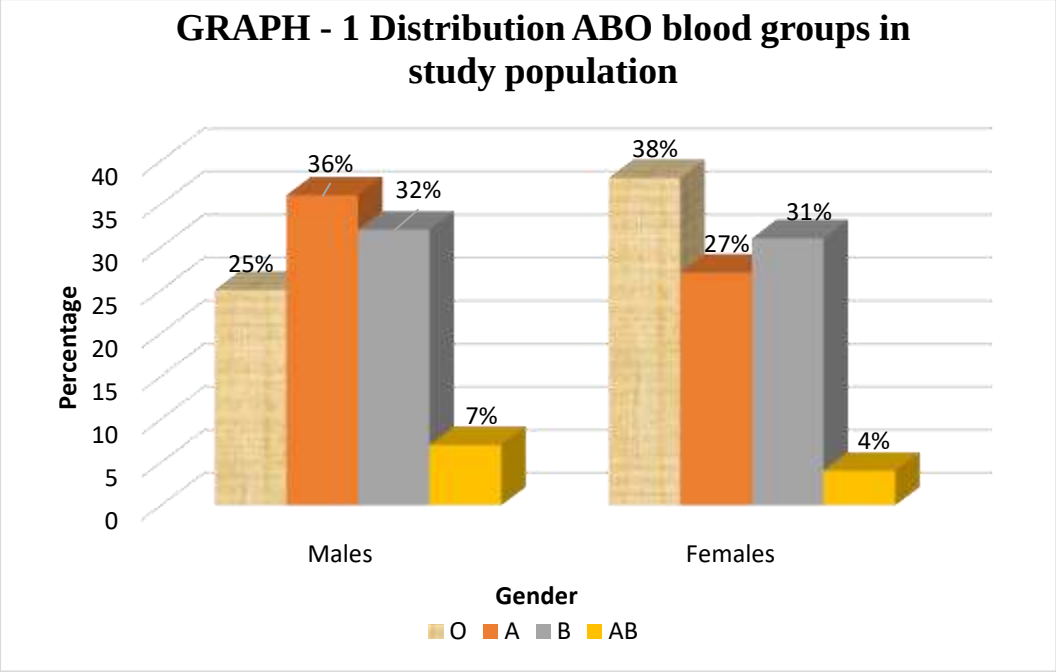
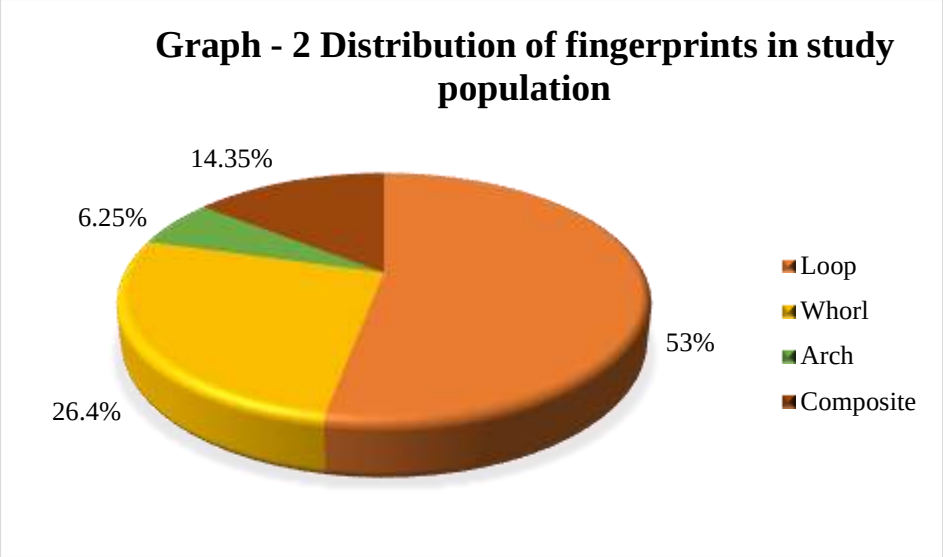


Table 2: Distribution of fingerprint patterns among different gender groups

Fingerprint patterns	Males	Females	Total
Loops	529 (52.9%)	531 (53.1%)	1060 (53%)
Whorls	279 (27.9%)	250 (25%)	529 (26.4%)
Arches	61 (6.1%)	64 (6.4%)	125 (6.25%)
Composites	131 (13.1%)	155 (15.5%)	286 (14.35%)
Total	1000	1000	2000 (100%)

Table 2 shows that among the study population it was found that Loops was the most common type of fingerprint pattern in 1060 (53%) fingers and Arches the least common in 125 (6.2%) fingers. The above table also shows in both genders most common fingerprint pattern was loops followed by whorls, composites and arches. Chi-square value- 3.68, p value- < 0.29 which shows that there was no statistically significance in distribution of fingerprints patterns with gender.



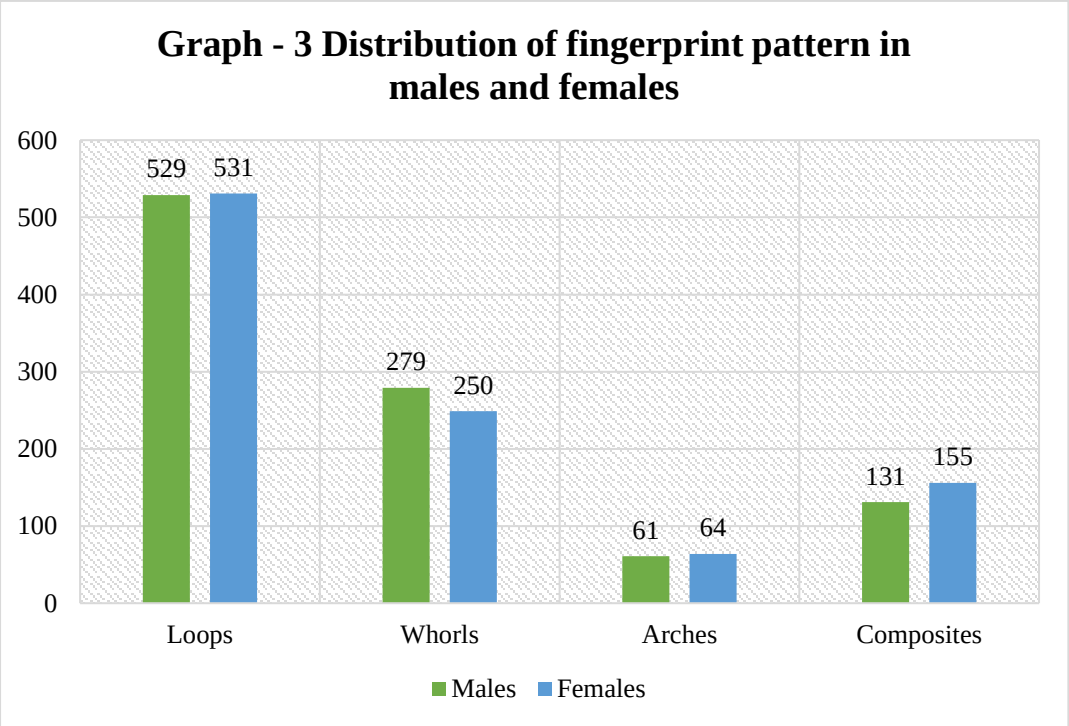


Table 3: Distribution of fingerprint patterns in ABO and Rh blood groups

Fingerprint patterns	O			A			B			AB		
	+ ve	- ve	Total	+ ve	- ve	Total	+ ve	- ve	Total	+ve	- ve	Total
Loops	279	40	319	308	26	334	323	13	336	63	8	71
Whorls	186	8	194	142	12	154	154	10	164	17	0	17
Arches	27	4	31	40	2	42	45	3	48	4	0	4
Composites	78	8	86	90	10	100	78	4	82	16	2	18

Total	570	60	630	580	50	630	600	30	630	100	10	110

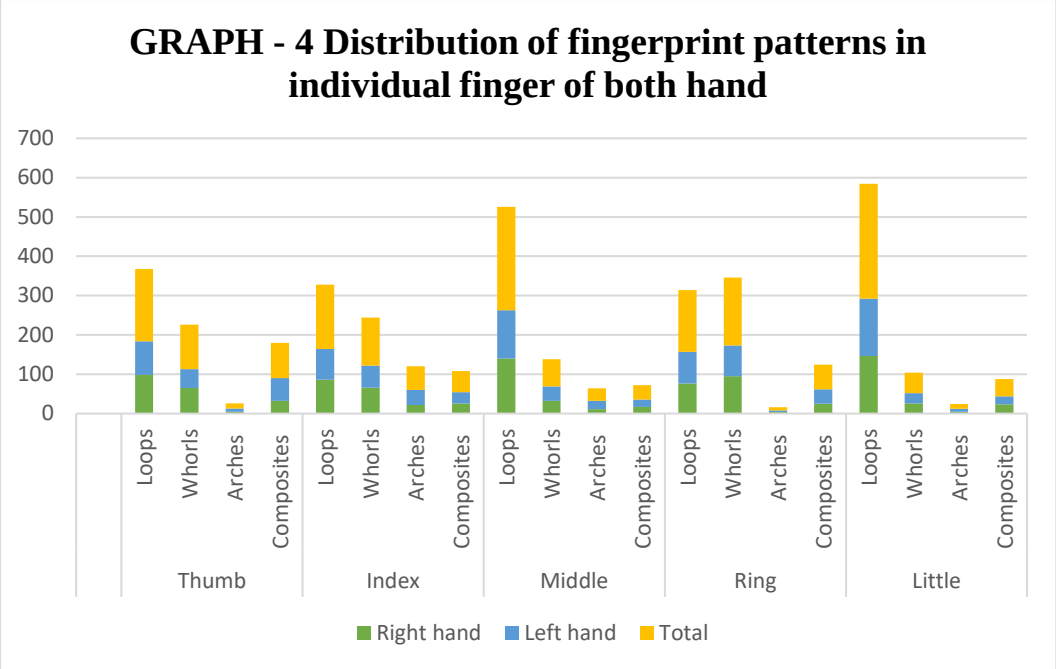
The table 3 shows that loops were the most common and arches the least common type of fingerprint pattern irrespective of any of the blood groups. The similar distribution of fingerprints was found even in Rh type of blood grouping also i.e. in both Rh +ve and Rh –ve blood groups. Totally 125 arch type of fingerprint pattern was found in study population. Among these 48 (38.4%) were seen in blood group B. Whorls pattern was most common in blood group O i.e. 194 patterns. Composites was seen more in A blood groups with 100 patterns. In general all fingerprint patterns were least common in AB blood group. Chi-square value- 21.34 p value- < 0.01 which shows that there was statistically significance between fingerprints patterns and ABO blood groups.

Fingerprint patterns	Right hand		Left hand		Total
	Frequency	%	Frequency	%	
Loops	514	51.40%	546	54.60%	1060
Whorls	245	24.50%	284	28.40%	529
Arches	78	7.80%	47	4.70%	125
Composites	163	16.30%	123	12.30%	286
Total	1000	100%	1000	100%	2000

TABLE 4: Distribution of fingerprint patterns in both hands

The table 4 shows loops pattern was predominantly seen in both hands followed by whorls, composites and arches. The above table also shows that loops and whorls count was more in left hand than in right hand. Whereas arches and composites pattern count were more in right hand than in left hand. Chi-square value- 17.12, p value - < 0.0006 which shows that there was statistically significance in fingerprints patterns of both hands.

The graph 4 shows, loops were predominantly seen in little fingers with equal distribution in right and left side than in any other fingers. In ring fingers of both sides' whorls pattern was predominantly seen. In index fingers of both sides arch patterns was most commonly observed than in other fingers and near equal distribution in thumb, ring and little fingers. It can be deduced that composite pattern was the most commonly seen in left thumb with 58 subjects than in any other fingers.



In Thumb - Chi-square value - 11.54 p value - < 0.009

In Index - Chi-square value - 5.55 p value - < 0.13

In middle - Chi-square value - 4.69 p value - < 0.19

In Ring - Chi-square value - 4.15 p value - < 0.24

In Little - Chi-square value - 0.42 p value - < 0.93

which shows that there was statistically significance in thumb fingerprints patterns only other fingers are not statistically significant.

The table 5 shows, among loops, ulnar loop patterns (95.3%) outnumbered radial loop patterns (4.8%). In this radial loop were more common in males than females. In whorls, concentric whorl type was most common (77.5%) followed by single spiral whorl (17.8%) and double spiral whorl type (4.7%). It also shows maximum number of double spiral whorls were noticed in males. Among arches, tented arches (56.8%) were common than plain arch (43.2%). In composites, central pocket loop was most common (53.1%) followed by twinned loops (38.1%), lateral pocket loop (5.9%) and accidentals (2.8%). Twinned loops were more in females than males. In this table also shows, there was statistically significant in distribution of ulnar loops, radial loops, concentric whorls, tented arches in gender. Other types of fingerprints were not significant.

TABLE 5: Distribution of subtype fingerprint patterns of both hands in gender

Fingerprint Patterns		Male (%)	Female (%)	Total (%)	X^2 value	p value
Loops	UL	493 (48.8)	517 (51.2)	1010 (95.3)	6.22	0.006
	RL	36 (72)	14 (28)	50 (4.8)	2.9	0.04
	Total	529	531	1060		
	CW	209 (51)	201 (49)	410 (77.5)	3.8	0.02

Whorls	SSW	52 (55.3)	42 (44.7)	94 (17.8)	1.5	0.1
	DSW	18 (72)	7 (28)	25 (4.7)	0.05	0.4
	Total	279	250	529		
Arches	PA	26 (48.1)	28 (51.9)	54 (43.2)	0.27	0.2
	TA	35 (49.3)	36 (50.7)	71 (56.8)	4.5	0.01
	Total	61 (48.8)	64 (51.2)	125		
Composites	CPL	73	79	152 (53.1)	1.26	0.13
	LPL	7 (41.2)	10 (58.8)	17 (5.9)	1.25	0.13
	TL	47 (43.1)	62 (56.9)	109 (38.1)	0.5	0.23
	X	4 (50)	4 (50)	8 (2.8)	-	0.5
	Total	131	155	286		

DISCUSSION:

The modern system of fingerprinting owes its indebtedness to the fact that the skin over the finger tips, are covered with ridges and furrows. These ridges, by their arrangement, distribution and characteristic features, form particular pattern both in epidermis and dermis which are absolutely individualistic. The patterns of these ridges and accompanying furrows on the finger tips are absolutely constant and unchangeable[8].

The importance of blood group discovery lies in the transfusion of blood amongst different population irrespective of their ethnic origin, in organ transplantation and development of legal medicine, genetic research and anthropology[28].

The first blood group antigen system was recognized in 1900, was ABO, the most important in transfusion medicine[10].

Rh blood group system was the fourth system to be discovered and yet it was second most important blood group from the point of view of transfusion. The ABO and Rh antigens are recognised as the major clinically significant blood group antigens[28].

In present study total 200 (100 males and 100 females) subjects were included to take fingerprint by pre-inked stripped method and blood group was examined by slide method. Study was conducted at the department of Forensic medicine and Toxicology, Government Erode Medical College, Perundurai, Erode, Tamilnadu during the period of 1st July to 31st December 2022.

Relation with gender and ABO blood groups

In present study as per table 1, the ABO blood groups were equally distributed in O, A and B blood group 63 (31.5%) subjects each but AB group was very less distributed in 11 (5.5%) subjects of study population. In our study, distribution of A, B, O blood groups does not correlate with any other study but the distribution pattern of AB group was similar to the studies of Bharadwaja A, Saraswat PK, Aggarwal SK, Benerji P, Bharadwaja S[13], Pasha AK, Hashir MM, Khawar S[10], Rastogi P, Pillai KR[11]. Among males, majority of the subjects belonged to the blood group A i.e. 36 (36%) subjects followed by B - 32 (32%), O - 25 (25%) and AB - 7 (7%) subjects. In females, majority of the subjects belonged to the blood group O i.e. 38 (38%) subjects followed by B - 31 (31%),

A - 27 (27%) and AB - 4 (4%) subjects (Table 1). The distribution of ABO blood groups among females was similar to the studies of Rastogi P, Pillai KR[11] and Kshirsagar SV, Fulari SP[12].

Relation between gender with ABO and Rh blood groups

As per our study, majority of subjects were Rh positive with 185 (92.5%) and 15 (7.5%) subjects had Rh negative type of blood group. Among males Rh positive blood group were noticed in 94 (94%) subjects and negative in 6 (6%) subjects. In females, 91 (91%) subjects were Rh positive and 9 (9%) subjects were negative. Similar results were found in other studies of Bharadwaja A, Saraswat PK, Aggarwal SK, Benerji P, Bharadwaja S[13], Pasha AK, Hashir MM, Khawar S[10], Rastogi P, Pillai KR[11],Bhavana D, Ruchi J, Prakash T, Kalyan JL[14] and Sultana R et al[28].

Distribution of fingerprint patterns among different gender groups

In present study Loops was the most common type of fingerprint pattern in 1060 (53%) fingers and Arches the least common in 125 (6.2%) fingers. It also shows in both genders most common fingerprint pattern was loops followed by whorls, composites and arches. This pattern was similar to the studies of Sivakova D, Scheil HG, Schmidt HD, and Vulpe C[15], Rastogi P, Pillai KR[11], Bhavana D, Ruchi J, Prakash T, Kalyan KL[14], Raloti SK et al.[16] and Qayyum R, Mateen A, Hameed S[17].

Distribution of fingerprint patterns in ABO and Rh blood groups

As depicted in table 3, loops were most common and arches the least common type of fingerprint pattern irrespective of any of the ABO blood groups. This observation was similar to these of Londhe SR, Jadhav A[18], Mehta AA, Mehta AA, Sonar V[19], Bhavana D, Ruchi J, Prakash T, Kalyan KL[14], Raloti SK et al[16]. Loops were most common and arches were the least common pattern even in Rh type of blood grouping. The similar observation was found in studies of Mehta AA, Mehta AA, Sonar V, Raloti SK et al[16]. Distribution of loops was most common and arches were the least common was found even in individual ABO blood groups with Rh type also.

This was not seen in other studies. In study of Fayrouz NE, Farida N, Irshad AH[20] showed loops was most common and arches least only in O positive, A positive and AB positive blood groups. In our study findings were almost similar to Bhavana D, Ruchi J, Prakash T, Kalyan KL[14] study, where O negative pattern did not follow this distribution. Here whorls were most common pattern. In our study population arches were most commonly found in B blood group in 48 subjects (38.4%). Similar observation was seen in studies of Thomas R, Shenoy SJ[21], Bhavana D, Ruchi J, Prakash T, Kalyan KL[14]. Whereas in studies Bharadwaja A, Saraswat PK, Aggarwal SK, Benerji P, Bharadwaja S[13] and Rastogi P, Pillai KR[11] arch pattern was most common in O group. The whorl pattern was most commonly seen in O group in 194 (36.7%) prints. This was similar to the studies of Bharadwaja A, Saraswat PK, Aggarwal SK, Benerji P, Bharadwaja S[13], Rastogi P, Pillai KR[11], Fayrouz NE, Farida N, Irshad AH[20], Thomas R, Shenoy SJ[21],Bhavana D, Ruchi J, Prakash T, Kalyan KL[14]. Composites were seen more in A blood group with 100 (35%) prints. This was contrast to the study of Raloti SK et al[16] where composite was most common in O group. In general all fingerprints were least common in AB blood groups. This was also observed in other studies of Bharadwaja A, Saraswat PK, Aggarwal SK, Benerji P, Bharadwaja S[13], Pasha AK, Hashir MM, Khawar S[10], Fayrouz NE, Farida N, Irshad AH[20], Thomas R, Shenoy SJ[21], Bhavana D, Ruchi J, Prakash T, Kalyan KL[14].

CONCLUSION:

Present study revealed that A, B and O blood groups were equally distributed with 31.5% each. Majority of subjects were Rh +ve 92.5%. Among male subject A group was most common and was found in 37.2% of subjects. Among females O +ve was common and was found in 37.4% of subjects. Distribution of fingerprint patterns in study group shows that loops (53%) were the common pattern followed by whorls (26.4%), composites (14.35%) and arches (6.25%). Similar pattern of distribution fingerprints was seen in both male and females.

Relationship between fingerprint and blood groups shows that the loops pattern of fingerprints were most common and arches were least common in ABO and Rh type of blood groups. In B blood group loop and arch pattern was most common. Similarly in O group whorls pattern, A group composite pattern were predominantly seen. In Rh +ve, loops and arches patterns were most common in B +ve, whorls in O +ve and

composites in A +ve. In Rh –ve, loops and arches were more predominant in O –ve, whorls and composites in A –ve.

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IEC Approval:

Institutional Ethical Committee was approved for the study by the Government Erode Medical College and Hospital, Perundurai, Tamil Nadu. Personal identifiers such as names were not collected during the study.

Author Contributions

Dr. Nandakumar.S (NS) and Dr. Sivakumar.R (SR) had the idea for this study. Dr Nithya.M (NM) and Dr. Muthukumar.D (MD) are the principal investigators of the research work. Vajiravelu Suganthi(VS), Panneerselvam Periasamy(PP) & NS designed the study protocol. Sasikala Gunasekaran (SG), SR & NM performed data collection, MD & VS conducted the analyses, and SR & GS drafted the manuscript. NS, MD, PP and NM further edited the manuscript, and all gave the final approval.

Declaration of interests:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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