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Relationship of Primary Fingerprint Patterns with Blood Groups and Gender: A Dermatoglyphic Study

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ABSTRACT

Background: *Dermatoglyphics is one of the tools for recognition and forensic exploration as it is anecdotal amongst different population groups across the world. It plays a dynamic role in the medical analysis of hereditary diseases and also in disclosing offenses.* ***Objective:*** *To find the correlation between the fingerprint patterns of the student community concerning their blood groups and gender.* ***Methods:*** *138 students from the Department of Zoology, Yogi Vemana University during the years 2015-2019 comprising of 39 (28.2%) males and 99 (71.7%) females within the age group of 22-25 were selected for the present study. The fingerprints of the subjects were taken using the stamp pad ink method and the obtained blueprints were classified into three primary fingerprint patterns (loop, whorl, and arch) and recorded. Statistical analysis was executed with the aid of Microsoft Excel 2007 and IBM SPSS 21.0 version. Chi-square analysis was used to verify the association between fingerprints and sex.* ***Results:*** *The common distribution patterns of fingerprints demonstrated high frequency (72.3%) of loops, whorls with moderate (24.9%) and arches with least (2.68%) frequency. Almost the same array was detected in both Rh+ve and Rh-ve individuals and A, B, AB, and O blood groups. The chi-square test revealed that there was no association between fingerprint pattern and A, B, AB, and O blood groups when results combined between both genders. The chi-square test results show that there is no association between fingerprint patterns and A, B, and O blood groups however, the chi-square value is zero as the little fingers of AB blood group students have no arches. The chi-square results also exhibited that there is no association between fingerprint patterns and Rh blood group as only B and O have Rh-ve individuals whereas A and AB blood groups are purely Rh+ve.* ***Conclusion:*** *This study concludes that the distribution of fingerprint patterns is neither related to gender nor blood groups. The uniqueness of each fingerprint facilitates them to be efficiently used in many forensic applications and identification of an individual in mob catastrophes. Hence, the reliability of the correlation of dactylographic pattern with sex and blood group requires many more studies which include a larger sample sizes.*

Keywords: Fingerprint patterns, Whorls, Loops, Arches, Blood groups, Gender

INTRODUCTION

Human identity is a primary requisite for personal, social, and legal grounds. There are many methods of human identification such as anthropometry, dermatoglyphics, DNA finger-typing, segregation by blood groups, sex determination, iris imaging, lip prints, and post-mortem information. Among all dermatoglyphics is considered to be the most well-known, rapid, and safe biometric method used in individual identification [1-6]. Dermatoglyphics was proved to be a useful tool in emphasizing the basic questions in biology, evolution, medicine, and genetics over the past 150 years. The dermatoglyphic patterns have become gradually more momentous in medicine, particularly in screening the chromosomal abnormalities and diseases which have a strong hereditary basis and are used as the main and flawless means of identification in forensic inquiries and assessment [7-11]. In recent years many studies have been accomplished on dermatoglyphics to appraise intragroup diversity and delineation of populations. Also, researchers are utilizing the dermatoglyphic profiles for population and genetic related studies [12-17]. Also, the latest studies are establishing a relationship between fingerprint pattern and learning, health and fitness, attitude, and blood group [8,18-22]. Some studies support an association between distributions of fingerprint patterns, personality, blood

groups, and sexes [23-25]. Appropriate null alternative hypothesis for the present study was designed as follows: H_0- There is no significant discrepancy between fingerprints and A, B, O blood groups and Rh blood types in female and male students and H_1- There is a significant discrepancy between fingerprints and A, B, O blood groups and Rh blood types in female and male students.

MATERIALS AND METHODS

The present study was carried out in the Department of Zoology, Yogi Vemana University, Kadapa, YSR District, Andhra Pradesh, India. As a part of the curriculum in the 'Genetics and Evolution' course, the fingerprint pattern studies were conducted among students pursuing the Zoology course during the years 2015-2019. Every year 25-30 students were registered for the class and the details of individual students such as name, sex, and blood group was noted. The total sample consisted of 138 students of which 39 (28.2%) were males and 99 (71.7%) were females. The oral consent of all the participants was obtained after explaining to them the aims and objectives of the study. Slide agglutination was conducted using antiserum A, B, and D to substantiate the ABO blood groups and Rh blood type. Each student was asked to wash his/her hands carefully with soap and water to remove oil, dirt, and other impurities. With dry hands, he/she was requested to press his/her fingertips on the stamp pad and then on respective blocks of a sheet for the fingerprint impression. Both rolled, and plane prints of each finger of right and left hand were taken. The same process was followed by all the participants. Due care was taken to avoid sliding of fingers to prevent blotching of the print. Qualitative analysis of the fingerprints was done by classifying fingerprint patterns as follows: loops (radial loop and ulnar loop), whorls, and arches (plain arch and tented arch) according to Galton's classification [26] (Figure 1-3). In loop patterns, the ridgeline starts from one side, move towards the center, curve, backward and terminate on the same side while the whorls are a circular or spiral arrangement of ridges in the center, and in arches, the ridgelines start from one side and end at the opposite end. The different pattern types are categorized by the number of triradius (the center of a delta-shaped junction of three regions). The simplest pattern i.e., arch, does not have a triradius whereas the loop (ulnar or radial) has one triradius and the whorl has two triradius. The distribution of fingerprint patterns in both the hands of the individuals and its relationship with sex and different blood groups and Rh blood types were subjected to statistical analysis using frequency distribution and Chi-square test with the help of Microsoft Excel 2007 and IBM SPSS 21.0 version. A p-value <0.05 was considered statistically significant for the association of variables.

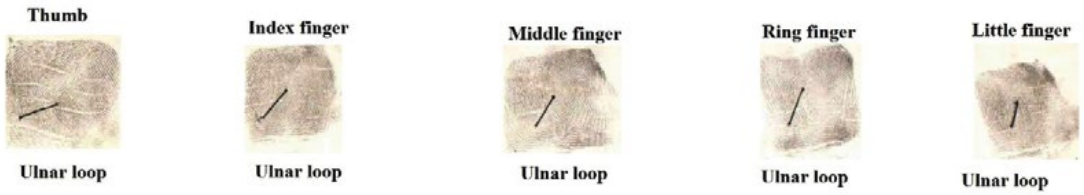

Figure 1 Right hand-rolled impressions (original)

Figure 2 Left hand-rolled impressions (Original)

Figure 3 General fingerprint patterns; A: Loops; B: Whorls; C: Arch (Arrow: Triradius; Line: a ridge count is made by counting ridge from triradius to the center of the pattern or core)

RESULTS AND DISCUSSION

The incidence of blood group O was highest followed by B, A, and AB blood groups respectively (Table 1). In males and females, similar results were reported by Bharadwaja, et al. Rastogi and Pillai and Sudhikshya, et al. [2,8,27]. There are also reports where the incidence of B blood group was at peak followed by O, A, and AB blood groups [13,28,29]. Similarly, the incidence of A blood group and O blood groups was maximum in few studies [30]. The current study exhibited a significantly high incidence of Rh+ve (95.6%) subjects in all blood groups as compared to Rh-ve (4.34%) which is following the other studies conducted by various researchers [2,8,10,13,27,29,31-33]. Loops are prevailing fingerprint patterns followed by whorls and arches in both the sexes which is in harmony with the earlier studies [2,8,10,27,29,31,32,34,35]. Chi-square test also demonstrated that the relation between fingerprint patterns and sex are not statistically significant at $p>0.05$ and thus, the null hypothesis is accepted (Table 2 and Figure 4a). Hence, it can be accomplished that there is no association between gender and the general distribution of primary fingerprint patterns. In comparison between the sexes, the loops are higher in incidence in males (76.6%) than in females (70.7%) but the whorls and arches in females (26.2% and 3.0%) are more than in males (21.5% and 1.9%) which is in agreement with the studies of Mehdipour and Farhaud [36]. Table 3 depicted that in all the blood groups, there was a predominance of loops ranging from 72.1% in blood groups A and B to 72.8% in blood group O with a difference of 0.7% which is following the studies of Mehta and Mehta, Sudhikshya, et al. and Vinay and Gowri [8,29,37]. However, studies of Shashikala and Aswini and Deopa, et al. proved the highest rate of incidence in AB and B blood groups respectively which are dissimilar to the present study [38,39]. It was also observed that percentages of whorls were highest and equal in blood groups A, B, and AB and lowest in O blood group with a difference of 0.8%. The incidence of arches in our study was highest in the A blood group (2.8%) and lowest in B and O blood groups (2.6%) with a difference of 0.2% which correlates with the studies of Deopa, et al. [39]. Similarly, blood group O showed a higher incidence of loops (77.1%) in males compared to females. However, the incidence of whorls was higher in females of A and B blood groups (26.3%) and least in the AB blood group (26.1%) compared to males. The incidence of arches was highest in females of the A blood group (3.15%) and least in the B blood group (2.8%) compared to males (Figure 4b). The general distribution of primary fingerprint patterns follows the same order in individuals with ABO blood groups i.e., higher frequency of loops followed by whorls and arches, and a statistically null hypothesis was also accepted. Hence, it can be accomplished that the primary fingerprint pattern is not related to ABO blood groups in both males and females. Table 4 represents the high percentage of loops in the Rh-ve blood group (73.3%) than the Rh+ve blood group (72.3%) which is contrary to the findings of Bharadwaja, et al. and Mehta and Mehta [27,29]. The percentage of whorls was more in the Rh+ve blood group (25%) than the Rh-ve blood group (23.3%). The percentage of arches was more in the Rh-ve blood group (3.3%) than the Rh+ve blood group (2.6%) which is per the findings of Bharadwaja, et al. and Mehta and Mehta [27,29]. The insignificant values of the chi-square test (χ^2=0.1712; p=0.917; $p>0.05$) showed the rejection of the alternative null hypothesis and thus reveals that there is no relation between primary fingerprint patterns and Rh blood group (Figure 4c). Table 5 demonstrated that the blood groups A and AB has only Rh+ve individuals with all the three primary fingerprint patterns i.e., high incidence of loops, followed by whorls and arches while blood group O and B has both Rh+ve and Rh-ve individuals and the frequency of loops is higher in both Rh+ve and Rh-ve individuals of ABO blood group, followed by whorls and arches. However, the B-ve blood group has no incidence of arches. Table 6 displayed that the high frequency of loops in middle and little fingers of all blood groups, i.e., blood group A (m: 76.5%, and l: 77.6%), blood group B (m: 74.0%, and l: 79.0%), blood group AB (m: 74.2%, and l: 77.5%) and blood group O (m: 74.1%, and l: 76.6%). But there is no significant correlation between fingerprint patterns of individual digits with the ABO blood group and Rh blood group which is contrary to the results of Sudhikshya, et al. [8]. Table 7 showed the comparative account of dermatoglyphic patterns about ABO blood groups and Rh blood groups.

Table 1 Year wise distribution of students with regard to gender, ABO and Rh blood group

Year	Males								Females								Total
	A^{+ve}	A^{-ve}	B^{+ve}	B^{-ve}	AB^{+ve}	AB^{-ve}	O^{+ve}	O^{-ve}	A^{+ve}	A^{-ve}	B^{+ve}	B^{-ve}	AB^{+ve}	AB^{-ve}	O^{+ve}	O^{-ve}	
2015	1	-	2	-	0	-	2	2	3	-	5	1	3	-	6	-	25
2016	1	-	4	-	1	-	3	1	6	-	4	-	2	-	4	-	26
2017	1	-	1	-	2	-	6	-	6	-	3	-	0	-	8	-	27
2018	1	-	1	-	1	-	2	-	1	-	13	-	3	-	5	1	28
2019	2	-	3	-	1	-	1	-	3	-	9	-	5	-	7	1	32
Total	**6**	**-**	**11**	**-**	**5**	**-**	**14**	**3**	**19**	**-**	**34**	**1**	**13**	**-**	**30**	**2**	**138**

Table 2 Arrangement of primary patterns of fingerprints in all digits of both hands of males and female students (n=138)

Types of the fingerprint pattern	Males (n=39)	Females (n=99)	Total (%)
Loops (% within sex)	299 (76.66%)	700 (70.7%)	999 (72.3%)
Whorls (% within sex)	84 (21.5%)	260 (26.2%)	344 (24.9%)
Arches (% within sex)	7 (1.79%)	30 (3.0%)	37 (2.68%)
Total	390 (100%)	990 (100%)	1380 (100%)
Statistics	χ^2=5.4703; p=0.064; p<0.05; N.S		

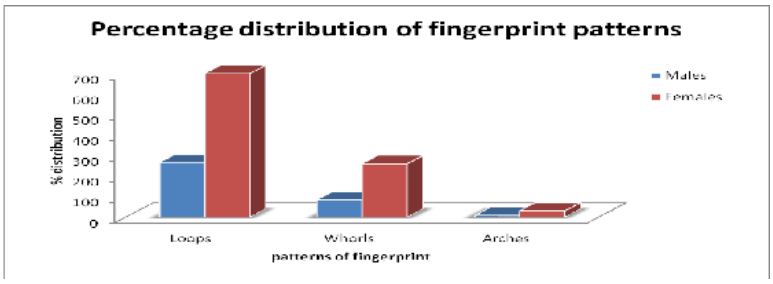

Figure 4a Graphs representing the percentage distribution of fingerprint patterns among males and females

Table-3: Arrangement of primary patterns of fingerprints in all digits of both hands among males, female students, ABO blood groups (n=138 × 10=1380); N.S.: Not significant

Types of fingerprint patterns	Blood group A (n=25)		Blood group B (n=46)		Blood group AB (n=18)		Blood group O (n=49)	
	Males (6)	Females (19)	Males (11)	Females (35)	Males (5)	Females (13)	Males (17)	Females (32)
Loops (% within males and females in each blood group)	(46) 76.60%	(134) 74.40%	(84) 76.30%	(248) 70.80%	(38) 76.00%	(92) 70.70%	(131) 77.10%	(226) 70.60%
Whorls (% within males and females in each blood group)	(13) 21.60%	(50) 27.70%	(24) 21.80%	(92) 26.30%	(11) 22.00%	(34) 26.10%	(36) 21.20%	(84) 26.25%
Arches (% within males and females in each blood group)	(1) 1.66%	(6) 3.30%	(2) 1.81%	(10) 2.80%	(1) 2.00%	(4) 3.07%	(3) 1.76%	(10) 3.13%
Total	60 (100%)	190 (100%)	110 (100%)	350 (100%)	50 (100%)	130 (100%)	170 (100%)	320 (100%)
Statistics	χ^2=0.9921; p=0.608; p<0.05; N. S		χ^2=1.3604; p=0.506; p<0.05; N. S		χ^2=0.5368; p=0.7646; p<0.05; N. S		χ^2=2.572; p=0.276; p<0.05; N. S	

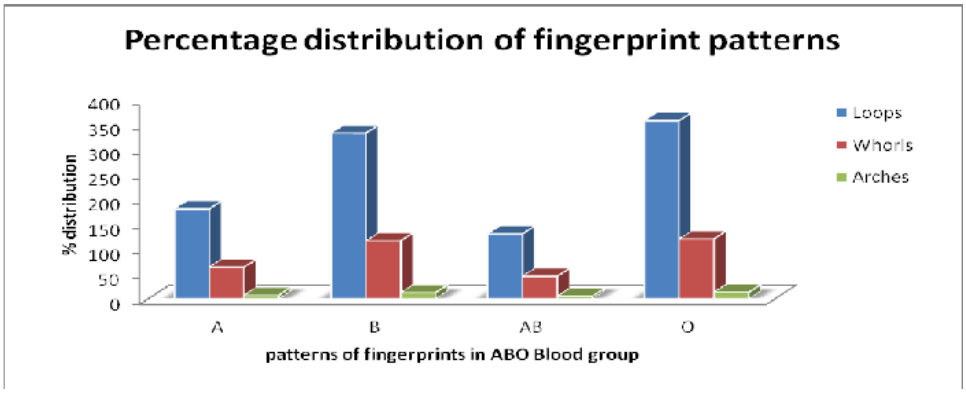

Figure 4b Graphs representing the percentage distribution of fingerprint patterns among different blood groups

Table 4 Arrangement of primary patterns of fingerprints in all digits of both hands among Individuals) of Rh+ve and Rh-ve blood type (n= 138 × 10)

Types of Fingerprint patterns	Rh+ve (n=132)	Rh-ve (n=6)
Loops (% within Rh)	(955) 72.3 %	(44) 73.3 %
Whorls (% within Rh)	(330) 25 %	(14) 23.3 %
Arches (% within Rh)	(35) 2.6 %	(2) 3.3 %
Total (%)	1320 (100 %)	60 (100 %)
Statistics	χ^2=0.1712; p=0.917; p>0.05	

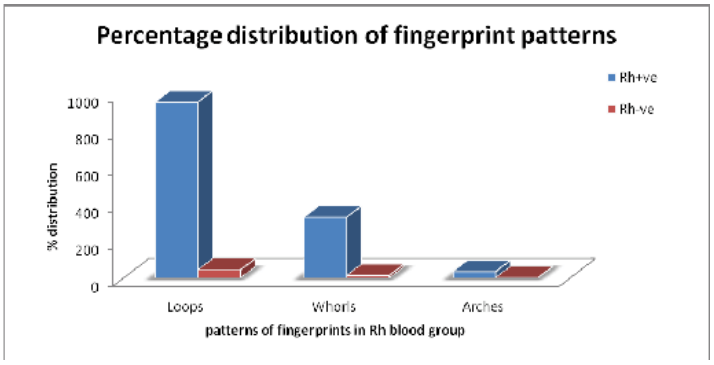

Figure 4c Graphs representing the percentage distribution of fingerprint patterns among Rh blood group students

Table 5 Arrangement of primary patterns of fingerprints in all digits of both hands among ABO blood group and Rh+ve and Rh-ve blood type (n= 138 × 10)

Types of fingerprint patterns	Blood group A (n=25)		Blood group B (n=46)		Blood group AB (n=18)		Blood group O (n=49)	
	Rh+ve	Rh-ve	Rh+ve	Rh-ve	Rh+ve	Rh-ve	Rh+ve	Rh-ve
Loops (% within Rh of blood group)	180 (72%)	-	325 (70.6%)	7 (1.5%)	130 (72.2%)	-	343 (70%)	14 (2.8%)
Whorls (% within Rh of blood group)	63 (25.2%)	-	113 (24.5%)	3 (0.65%)	45 (25%)	-	115 (23.4%)	5 (1.02%)
Arches (% within Rh of blood group)	7 (2.8%)	-	12 (2.6%)	-	5 (2.7%)	-	12 (2.4%)	1 (0.20%)
Statistics	χ^2=0		χ^2=0		χ^2=0		χ^2=0.4585; p=0.795; p<0.05	

Table 6 Arrangement of primary patterns of fingerprints in individual digits of both hands in subjects of different blood group (n=138 × 10) (L: loops; W: whorls; A: arches)

Types of fingerprint patterns	Blood group A (n=25)			Blood group B (n=46)			Blood group AB (n= 18)			Blood group O (n= 49)		
	L	W	A	L	W	A	L	W	A	L	W	A
Thumb (% types of fingerprints within each blood group)	35 (70%)	12 (24%)	3 (6%)	60 (73.1%)	20 (24.3%)	2 (2.45%)	24 (70.5%)	9 (26.4%)	1 (2.9%)	68 (73.9%)	22 (23.9%)	2 (2.1%)
Index (% types of fingerprints within each blood group)	23 (65.7%)	11 (31.4%)	1 (2.8%)	58 (71.8%)	20 (24.6%)	3 (3.7%)	26 (72.2%)	9 (25%)	1 (2.7%)	63 (73.2%)	21 (24.4%)	2 (2.3%)
Middle (% types of fingerprints within each blood group)	49 (76.5%)	12 (18.75%)	3 (4.6%)	80 (74.0%)	24 (22.2%)	4 (3.7%)	26 (74.2%)	8 (22.8%)	1 (2.8%)	83 (74.1%)	26 (23.2%)	3 (2.6%)
Ring (% types of fingerprints within each blood group)	25 (73.5%)	8 (23.6%)	1 (2.9%)	60 (67.4%)	27 (30.3%)	2 (2.2%)	25 (71.4%)	9 (25.7%)	1 (2.8%)	67 (72.0%)	23 (24.7%)	3 (2.6%)
Little (% types of fingerprints within each blood group)	52 (77.6%)	14 (20.89%)	1 (1.5%)	79 (79%)	19 (19%)	2 (2%)	31 (77.5%)	9 (22.5%)	0	82 (76.6%)	23 (21.4%)	2 (1.86%)
Statistics	χ^2=4.28, p=0.83; p<0.05, NS			χ^2=4.51, p=0.80; p<0.05, NS			χ^2=0			χ^2=0.87,p=0.99; p<0.05, NS		

Table 7 Comparative table showing dermatoglyphic patterns in relation to ABO blood groups

Reference	Loops		Whorls		Arches	
	Highest	Lowest	Highest	Lowest	Highest	Lowest
[27]	A	O	AB	A	B	AB
[2]	A	-	O	-	O	-
[29]	O	AB	B	O	AB	B
[39]	O	A	AB	B	A	AB
[3]	B	AB	O	AB	AB	O
[4]	B	AB	A	B	AB	B
[24]	B	AB	B	O	B	AB
Present Study	O	AB	B, AB	O	AB	B

CONCLUSION

The main aim of the present study is to substantiate the correlation between various fingerprint patterns and ABO blood groups and Rh blood types in postgraduate students. It is a known fact that the fingerprints are never identical nor they change from birth till death. Hence, an effort was made to relate fingerprints with gender, different blood groups, and Rh blood types to authenticate these patterns in the identification and forensic medicine including prediction of certain diseases. It was observed that loops are the most common and arches are the least common types of fingerprint patterns among males and females and also in ABO blood groups. Higher frequency of loops followed by whorls and arches were observed in Rh+ve blood types. The present study concluded that the general distribution of the primary pattern of fingerprints is not related to gender, ABO blood group, Rh blood type, and individual digits of both hands. Such type of studies gives more accurate results when conducted on a large scale on different ethnic groups of people.

DECLARATIONS

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Author's Contribution

The first author deals with the 'Genetics and Evolution' practicals for Zoology students in Yogi Vemana University with the assistance of the other two authors. The compilation of the data and the statistical analysis were done by all the authors.

Availability of Data and Materials

The data was obtained from Students of the Department of Zoology, Yogi Vemana University, YSR district from 2015-2019.

Consent for Publication

Given by all authors.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Approval and Consent to Participate

Since, the above participation is a part of the Zoology Curriculum; Institutional ethical committee clearance was obtained for the study.

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