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Original Research Article

Evaluation of Fingerprint Patterns in Different Blood Groups of North Indian Population - A Cross Sectional Study

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ABSTRACT

Background: Fingerprint is one of the oldest, reliable and mature biometric technology and it is considered the simplest, least expensive and bonafide proof of identification. It is conjointly helpful in diagnosis of genetically inherited diseases and in detection of crimes. Blood itself is a particularly vital entity within the medico legal observes that alone or in conjunction with different trace evidence can play a clinching role to unfold different criminal cases.
Objectives: The main objective of this study was to find the association between fingerprint patterns and ABO blood groups in males and females of North Indian Population.
Methodology: This study was carried out in the department of Anatomy, Teerthanker Mahaveer University among 330 students. The ink method was used for recording fingerprints and the collected fingerprints were further analyzed according to the *Ridge lines* and also the presence or absence of *Delta* and *Core*.
Result: In the present study, the maximum number of loops was seen among all the individuals of different blood group. The frequency of arches was seen higher in A blood group and least in AB blood group. The number of Loops was higher in AB blood group and least in B blood group while Whorls were predominant in B blood group and least in O blood group individuals.
Conclusion: This study suggests that there is an association between fingerprint patterns and gender as well as between blood group and gender but the linkage between the fingerprint patterns and blood group was statistically not significant.

Keywords: Dermatoglyphics, Fingerprint, Blood group, Significant, North Indian population

INTRODUCTION

The entire human body is covered with the skin which happens to be the most important and largest organ of the body. The skin performs several important functions within the lifetime of an individual, viz. protects and safe guards the body from vagaries of the weather, maintains temperature and saves the internal organs of the body from external injuries. [1]

The skin covering the palmar surface of hand and planter surface of the foot is different in the texture and appearance than the one which covers the rest of the human

body. This skin on the planter and palmar surface is continuously wrinkled with narrow minute ridges known as *friction ridges* which are functionally useful as they help in the grasping without which the objects would easily slip away from the hands. A finger print is an impression of the friction ridges on all parts. [2]

The scientific study of the epidermal ridges and the patterns formed by them on the volar aspect of the palmar and plantar regions is known as *Dermatoglyphics.* **Cummins and Midlo (1926)** were the first person who coined the term Dermatoglyphics. [3] Etymologically this term is harmonious blend of two Greek words 'Derma' means Skin & 'Glyph' means Carve, which has long been recognized as a scientific and valuable method for medico legal, anthropological and genetic studies. [4] Digital dermatoglyphics have become more important in forensic medicine and in the identification purpose. It is helpful in the diagnosis of genetically inherited diseases and in detection of crimes because fingerprints are constant and individualistic and form the most reliable criteria for identification.[5] The association of dermatoglyphics and blood groups has been used as a scientific tool for early prediction. **William Herschel (1858)** was the first to experiment with fingerprints for personnel identification in India. [6]

The crucial events for human fingerprint formation begins at the 10^{th} week of gestation when the embryo includes a size of simply 80 mm. [7] After 19^{th} week the primary ridge formation ceases and secondary ridges appear as folds in between the primary ridges. Although the fingerprint pattern just begins to become visible on the skin surface at this time, the geometry of the ridge system is now established for life and will not change anymore. At the 14^{th} week, sweat gland ducts start to project from the bottom of the primary ridges into the dermis. [8] Secondary ridges can be found between all primary ridges by 24^{th} week of pregnancy. Now dermal papillae invade the epidermis in the space between primary and secondary ridges, thus forming double rows. [9]

The first classification of fingerprint dates back to the famous anatomist **Purkinje (1823).** [10] The pioneer work on morphology, classification, heredity and racial variation was done by **Galton** in **1892.** He divided the ridge patterns on the distal phalanges of the fingertips into three basic groups (Figure 1) namely Arch, Loop and Whorl. [11]

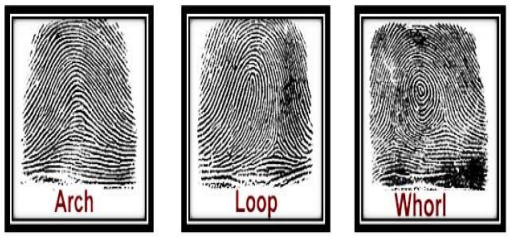

Figure 1: Three basic types of fingerprint

Blood group is classified based on the presence or absence of inherited antigenic substances on the surface of red blood cells. [12] The most significant ABO blood group system was discovered by **Karl Landsteiner** in 1901 at the University of Vienna during early experiments with blood transfusion. [13]

The spate of crimes in our society is increasing but the available tools for crime detection seems not improving proportionately to combat the rising challenges. With regards to forensic human identification, the fingerprints and blood samples may be the evidence at a crime scene. Many research works has been carried out on the digital dermatoglyphics and blood group and their relationship with gender. The purpose of this study was to determine various fingerprint patterns in relation with gender and blood group in

North Indian Population. This will provide as an important aid in gender and blood group determination and vice versa, thus, enhancing the legitimacy of fingerprint in investigation of crimes and criminals.

MATERIALS AND METHODS

This study was carried out among randomly selected 350 students of North Indian population belonging to age group 18-25 years. A total 20 students were excluded from the study due to suffering from any chronic disease of the skin e.g. Eczema, Leprosy and Chronic dermatitis having scars, Congenital or Acquired anomalies of fingers having worn fingerprints, extra or webbed fingers. So the total study population was 330 among which 166 were males & 164 were females. Fingerprints of all the ten digits were taken on the respective block on the same sheet of plain white paper by ink method as suggested by **Cummins** and for this purpose black colour rubber stamp ink pad was used. [14] Care was taken to avoid sliding of fingers so as to prevent smudging of prints. The details of their blood group along with their age and gender were noted and each subject was assigned a serial number. Further fingerprint patterns were studied with the help of a magnifying lens and were identified as: Arches, Loops and Whorls, based on the appearance of ***Ridge lines***, ***Delta*** and ***Core.***

Statistical analysis:

The data were recorded, tabulated and statistically analyzed using Microsoft Office Excel 2007 and Statistical Package for Social Sciences (SPSS) version 16. The association between fingerprint pattern and blood group was analyzed by applying the χ^2 (Chi-square) test. The level of significance was set as P value < 0.05 and the calculated value of χ^2 (Chi-square) test was further matched with the critical value of Chi-square distribution table and the level of significance was checked for individual table.

RESULTS

Blood group and Gender (Table 1):

In this study the number of male and female individuals were nearly same i.e. 50.30% and 49.69% respectively. Most of the study population belongs to blood group B (37.57%), which was followed by blood group O (26.66%), A (24.24%) and AB (11.51%) respectively. The Blood group A (57.5%) and AB (57.89%) were more common in females, whereas the blood group O (61.36%) were more common in males. The association between blood group and gender of the individual was found highly significant (i.e. $p < 0.05$).

Table 1: Gender wise distribution of subject with ABO blood group

Gender	**Blood Group**				
	A (n=80) (%)	B (n=124) (%)	AB (n=38) (%)	O (n=88) (%)	**Total (n=330) (%)**
Male	34 (42.5%)	62 (50 %)	16 (42.10%)	54 (61.36%)	**166 (50.30%)**
Female	46 (57.5%)	62 (50 %)	22 (57.89%)	34 (38.63%)	**164 (49.69%)**
Total	**80 (24.24%)**	**124 (37.57%)**	**38 (11.51%)**	**88 (26.66%)**	**330 (100 %)**
Test of significance	χ^2 = 11.793 df = 3	**p < 0.05**			

Fingerprint Patterns and Gender (Table 2):

The most commonly observed fingerprint was Loop (1724), while the arches (342) were least in number. Whorls

were found to be moderate in this study which was 1234. The arches and loops were more common in males (66.08% and 58.81% respectively) whereas whorls were more common in females (65.96%). The association between fingerprint pattern and gender of the individual was found highly significant (i.e. $p < 0.05$).

Table 2: Distribution of different fingerprint in males and females

Patterns of fingerprint	Gender		
	Male (n=166) (%)	Female (n=164) (%)	**Total (n=330)**
Arch	226 (66.08%)	116 (33.91%)	**342**
Loop	1014 (58.81%)	710 (41.18%)	**1724**
Whorl	420 (34.03%)	814 (65.96%)	**1234**
Test of significance	$\chi^2 = 214.639$ df = 2	**p < 0.05**	

Fingerprint Patterns and ABO blood group (Table 3):

The fingerprint pattern analysis showed that loops were the most common pattern among all the individuals of different ABO blood group. The frequency of arches were higher in blood group A (14%), followed by blood group B (11.12%) and blood group O (9.09%), while the least number of arches were observed in AB blood group (3.15%) individuals. The loops were seen higher in blood group AB (57.36%), followed by blood group O (55.90%) and blood group A (50.5%), while the least number of loops were seen in blood group B (49.19%). The frequency of whorls were higher in blood group B (39.67%), followed by blood group AB (39.47%) and blood group A (35.5%) while the least number of whorls were seen in blood group O (35%) individuals. The association between different types of fingerprint patterns and ABO blood group of the individual was not significant (i.e. $p > 0.05$).

Table 3: Distribution of fingerprint patterns among subject of ABO blood group (n=3300)

Types of fingerprint	Blood group			
	A (n=80) (%)	B (n=124) (%)	AB (n=38) (%)	O (n=88) (%)
Arch	112 (14 %)	138 (11.12%)	12 (3.15%)	80 (9.09%)
Loop	404 (50.5%)	610 (49.19%)	218 (57.36%)	492 (55.90%)
Whorl	284 (35.5 %)	492 (39.67%)	150 (39.47%)	308 (35 %)
Total	**800**	**1240**	**380**	**880**
Test of significance	$\chi^2 = 3.198$ df = 6	**p > 0.05**		

DISCUSSION

Many crimes happen by hand and on every hand are a fingerprint. We all know that fingerprints are never alike and they never change from birth till death. This study was an attempt made by us to associate fingerprint pattern with gender and blood group of an individual which may enhance the authenticity of fingerprint in identification and detection of criminals.

In the present study the association was found significant between different blood group and gender and also in between fingerprint patterns and gender (i.e. $p < 0.05$). Males were recorded higher percentage of arches (66.08%) and loop

(58.81%) while females were higher percentage of whorls (65.96%). Similar finding were also observed by Deepa Deopa, Chandra Prakash and Ishwer Tayal in 2014 among 200 medical students of Govt. Medical College Haldwani. [15] The above distribution of fingerprint and blood group differs from the finding of Prateek Rastogi and K. R. Pillai which reveals that arches and loops are more common in females whereas whorls are common in males. [16]

The general distribution of primary fingerprint pattern was of the same order in different ABO blood group i.e. high frequency of loops, moderate of whorls and least of arches. This agrees with the finding of Deepa Deopa (2014), Amit A. Mehta (2011), Rastogi and Pillai (2010) and Bharadwaja *et al*. (2004). [15-18]

In this study there was no any significant association found in between fingerprint patterns and ABO blood group ($P > 0.05$). In a related study, Deepa Deopa (2014) reported a significant association between fingerprint patterns and blood groups. Amit A. Mehta (2011) and Bhardwaja *et al*. (2004) also reported there is an association between distribution of fingerprint pattern and blood groups. [15,17,18]

The percentage of Arches was seen highest in individuals of blood group A and lowest in blood group AB in this study, which is similar to the findings of Deepa Deopa (2014) and Bhardwaja *et al.* (2004). However, Amit A. Mehta (2011) observed highest percentage of arches in AB blood group and lowest in B blood group individuals. [15,18,17]

In this study the percentage of loop were seen highest in individuals of AB blood group and lowest in B blood group, which correlates with the findings of S.V. Kshirsagar (2013). [19] However, a higher frequency of loops were observed in the individuals of O blood group by Deepa Deopa (2014) and Amit A. Mehta (2011). [15,17]

The present study also shows highest percentage of whorls in the individuals of B blood group and lowest in O blood group which is similar to the findings of Amit A. Mehta (2011) and contrary to the findings of Deepa Deopa (2014) and S.V. Kshirsagar (2013), who observed highest percentage of whorls in O blood group and lowest in AB blood group individuals. [17,15,19]

These disparities in distribution of fingerprint patterns may be due to genetic as well as environmental factors and it has been reported that digital dermatoglyphic patterns are genetically determined and influenced by physical, environmental and topological factors. [20]

CONCLUSION

Statistically no any significant association between fingerprint pattern and blood group were found in this study but the blood group and fingerprints are significantly associated with gender and this conclusion may be used in forensic science to describe a person's characteristics. But these information would not provide an exact description, still more studies are necessary for establishing any final conclusion.

Based on the result of this study it is hereby concluded that the prediction of gender of a person is possible on the basis of person's fingerprint pattern and blood group. The prediction ABO blood group of a person is not possible on the basis of fingerprint pattern. As a result the fingerprint, gender and ABO blood groups can only be used independently to identify an individual. Loops are the most common type of fingerprint and arches are the least. Loops are predominant in AB blood group and arches in A blood group. Whorls are more common in B blood group individuals. Males have highest percentage of arch

whereas females have higher percentage of whorls.

The similar studies were also carried out in other part of the world which shows no such type of linkage between Fingerprint pattern and Blood group. The reason for such type of result may be due to the fluctuation in sampling i.e. the variation in sample size and the sampling technique. To overcome such errors, similar type of studies should be conducted on a large number of sample, which may be at the national level so as to increase the accuracy of the prediction.

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