



# Fingerprint Pattern Study With Respect To Gender And Blood Group

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**Abstract:** Dermatoglyphics is the study of the ridge pattern of the skin. Fingerprints are the impression made by the tip of the fingers or the upper layer of the finger when it comes in contact with other surfaces. Many studies have been made for the effective determination of ridge pattern and its relation with other factors. A group of people were included in the study. A population size was chosen and the fingerprints and blood samples were collected. ABO blood grouping along with rhesus blood grouping was taken into consideration. The result of a different study shows that O is the most common blood group among all the blood types. Whorl is the most common fingerprint pattern and arches are the least. Whorl and loop are most common in males whereas arches and loops are common in females.

**Index Terms** - Fingerprint pattern, blood groups, sex determination, gender identification.

## I. INTRODUCTION

Fingerprints represent the most frequently encountered evidence at crime scenes. They are also regarded as the most dependable and broadly employed tools in forensic investigations and in identifying individuals. The characteristics of fingerprints like their uniqueness, permanence, and straightforward collection technique make them fundamental to forensic investigation. There are many techniques for collecting fingerprints, including dusting, chemical methods, tape lifting, alternative light sources, and more.

Each individual has different fingerprint patterns. These fingerprint patterns are formed when the basal layer of skin grows faster than the layers above. Fingerprints begin to be created before you are born. When the fetus starts to grow, the outside layer is smooth. Still, as the development of the basal layer is completed followed by the dermis and epidermis the

pressure is exerted on the basal layer, resulting in the contraction of the basal layer. This leads to the formation of ridges which are seen on the upper layer of skin. This skin on the front side of the hand is wrinkled and forms frictional ridges. Fingerprints are unique and consistent throughout life. Even identical twins do not have the same fingerprint pattern. Fingerprints of an individual never change until there is any accidental injury to the outer layer of skin which causes damage to the epidermal layer or any dermatological disease. According to the Federal Bureau of Investigation (FBI), there are a total of 8 fingerprint patterns. The patterns listed in FBI are; loop (radial & ulnar), double loop, central pocket loop, arch (plain & tented), plain whorl, and accidental.

Fingerprints or latent prints are formed when natural secretion from the eccrine glands, oil, and sweat on the skin is deposited onto the other surface. The fingerprint is the most common evidence in the crime scene. Most of the cases are solved using fingerprint detection as fingerprints cannot be forged and they are unique to one another. The study of ridges of fingers, palm and sole is known as dermatoglyphics. Harold Cummins and Charles Midlo were the ones who coined the term dermatoglyphics.

Karl Landsteiner was the first person who gave ABO blood grouping. Later in 1937 Landsteiner along with Wiener defined the term "Rhesus". In ABO blood grouping he classified blood groups based on the presence of A and B antigens and in Rhesus blood grouping is based on the presence of D antigen. Total 30 blood

groups in humans are now recognized by the International Society of Blood Transfusion. The ABO blood group is divided into four categories: A, B, AB, and O, while Rhesus was divided into Rh+ and Rh-. Given the enormous potential of fingerprints as a reliable identification technique, the current study attempts to examine their relationship with a person's blood type and gender. The relationship between these parameters and fingerprint patterns may make it possible to use fingerprints as a crucial tool for determining blood type and sex and vice versa, increasing the validity of fingerprints in the identification of criminals and crimes.

## II. MATERIALS AND METHODS

This study was conducted among a particular group of people. Proper information along with consent from the participant were taken. This study was conducted after taking the permission from various Institutional Ethical committees.

### Inclusion criteria

The individuals who actively and willingly participated were taken into consideration. And those who fit into the criteria were selected.

### Exclusion criteria

- Individuals with any hand deformity like permanent scars on fingers which may be congenital or acquired due to trauma on fingers.
- Individuals suffering from any chronic skin disease, having worn fingerprints or extra or bandaged fingers. To continue the study each individual's consent was taken. They were requested to wash their hands using hand wash to remove dirt and oil. Then it is dried using the towel. Now the fingerprints were taken using the desired ink pad as per our requirement. Plain and rolled prints were taken for study. To obtain the fingerprints the individual was made comfortable on a seat. He/she must not be in any uncomfortable position, as it may affect our fingerprints. The individual was asked to press his/her fingertips onto the ink pad and then gently pressed it on the blank sheet or a block of Proforma sheet. All the ten fingerprints were obtained from every individual. The information regarding the individual like age and gender was written with pencil onto the upper corner of the sheet. These prints were further studied using different instruments like linen tester, microscope and VSC. The fingerprint patterns were identified using magnifying glass and were basically classified into four major groups; Loops, Arches, Whorls and Composites. Blood groups of all the individuals were obtained from the institutional records. If any of the individual blood group was not known the test was performed and using antiserum A B and D, it was identified.

## III. RESULT

By studying all the fingerprint patterns in relation with gender and blood group and by analyzing them we got the results. The most common group among Rh positive male donors' blood was group B (39.84%), followed by group O (29.10%), A (21.73%), and AB (9.33%). Among Rh positive female donors, blood group B was the most prevalent (35.08%), followed by group O (26.31%), A (22.83%), and AB (15.78%). Blood group B (41.80%) was the most prevalent among Rh-negative males, followed by O (33.39%), A (13.39%), and AB (11.42%), while in Rh-negative females, blood group B (57.14%) was followed by O (22.86%) and A (20.00%). None of the female donors tested AB negative. The most prevalent ABO blood group was B (39.92%), followed by O (29.27%), A (21.38%), and AB (9.43%).

Table-1 shows the distribution of blood group by gender and Rh factor by [1]. And table 2 shows the distribution fingerprint pattern among ABO blood groups with Rh factor.

Table-1 blood group distribution with respect to gender and Rh factor

Blood groups	Male	Female	Rh positive	Rh negative
A	11%	10%	19.5%	1.5%
B	17.5%	19.5%	35%	2%
AB	3.55	3.5%	6.5%	0.5%
O	18%	17%	34%	1%

Table-2 distribution fingerprint pattern among ABO blood group with Rh factor

Types of pattern	Blood group A		Blood Group B		Blood Group AB		Blood Group O	
	Rh+	Rh-	Rh+	Rh-	Rh+	Rh-	Rh+	Rh-
Loop	57.94%	60%	59.57%	67.5%	60.76%	50%	59.11%	20%
Whorls	31.28%	26.67%	27.71%	17.5%	37.6%	40%	28.52%	70%
Arches	10.76%	13.34%	12.71%	15%	1.53%	10%	12.53%	10%

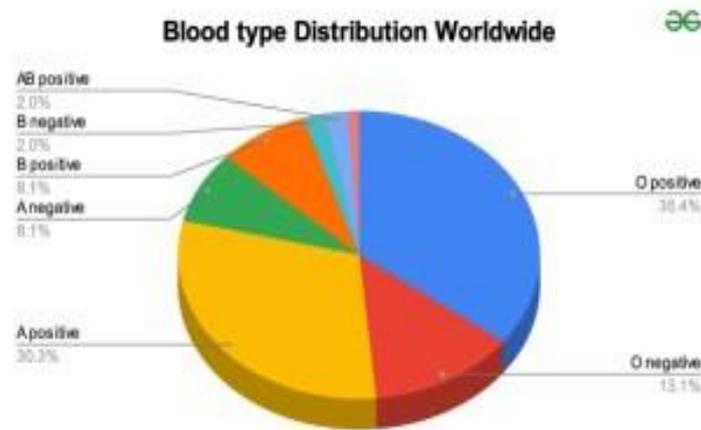


Fig 1.1 Pie chart giving distribution of blood group in world

<https://images.app.goo.gl/4pASDKTTaM9NCwzT9>

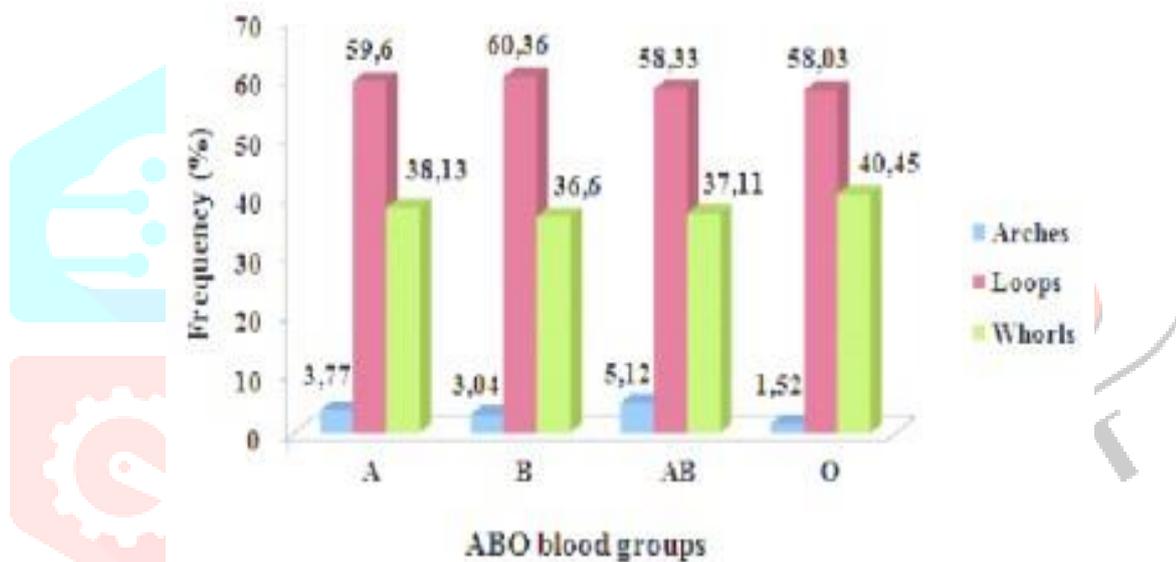


Fig1.2 Graph showing distribution of fingerprint pattern according to blood group

<https://images.app.goo.gl/qWhoZj89eVQcMsfz8>

#### IV. DISCUSSION

Fingerprints are impressions created by the fine ridges, present at the fingertips, and are highly individualistic. Fingerprints are critical in determining the identities of the perpetrators who were present at the site of the crime, as well as the victims of catastrophic tragedies [2]. The classification system which is still in use is a modified version of the system proposed by Sir Francis Galton and was modified by Sir Edward Henry. This classification is currently called Henry's classification. The basic fingerprint patterns used in this study were loop, whorls, arches and composite. Among this composite pattern is the rarest one. The ridges in the loop pattern form the loop at the core and flow back to the same direction of origin of the ridges. Loop pattern resembles the hook or reversed "U". There are two types of loop pattern: ulnar loop (towards the ulnar bone of the hand) and radial loop (towards the radial bone of the hand). Loop has a single delta and single core. Whorl is characterized by circular or spiral ridge formation, creating a spiral structure at the center. There are four types of whorl pattern; plain whorl, central pocket, double loop and accidental. Whorl pattern consists of a single core with two or more deltas. The deltas are located on the opposite side of each other. Arches are the least among the three main fingerprint patterns. They are found only in about 5% of the population. The ridge comes from the one end and forms a

mount-like structure at the center and flows to the other side. Arches do not have core or delta. Arches are typically classified into two types; plain arch and tented arch (similar to the plain arch but have slight tint at the center of the wave).

In 2000-2001, Bharadwaja et al. conducted a survey of 300 medical students in Rajasthan. The study showed that the individuals with blood group A have more of loops and the individuals with blood group AB have more of whorls, this is inconsistent with the current study [3]. The

The study includes 200 people, with 100 males and 100 females. The majority of participants in the study were from blood type O, followed by B, A, and AB. Maximum population belongs to Rh positive blood type, among which blood group O were 34.5%, blood group B were 30.5%, blood group A were 26.5% and AB were 4.5%. Among Rh negative individuals, 1.5% belongs to blood group A, 1.5% belongs to blood group B and 1.5% belongs to blood group O. Not even a single individual showed AB type blood in Rh -ve blood group. According to the study loops were the most common fingerprint pattern followed by whorls and then by arches. In Rh +ve and Rh -ve both the blood groups loops were significantly seen subjects, except in O negative where whorls were predominant [4].

Fingerprints are formed in the womb around 10<sup>th</sup> to 16<sup>th</sup> week of gestation. It remains unchanged throughout life. However due to skin elasticity it may change with age. Fingerprints also varied according to gender as the surface areas varied.

A study was performed on 300 Nepalese by Sudikshya KC et al., in which they considered the individuals of known blood groups of different ages and classified them on the basis of the primary pattern of fingerprints. In all the blood groups, loops were more in number except in "A -ve" and "A +ve" in which whorls were dominant. The statistical studies revealed that in both male and female, loops frequently occurred in ABO blood group and Rh+ blood type followed by whorls and arches. The largest occurrence of whorls was in the ABO blood group and Rh blood type followed by loops and arches. In middle finger loops were prominently seen while ring finger whorls were highest in all the blood types. In thumb and index whorls were most prominent, with the exception of blood group "O" where loops were predominant. They concluded that the distribution of fingerprint patterns is connected to individual digits rather than gender or blood group [5].

Joshi S et al. studied the fingerprint of 100 dental students aged between 18-25 chosen from Dental College & Hospital, Baddi (HP). All of the ten finger fingerprints were studied and the results showed that loops (53.4%) were most common next to the whorls (31.2%) and then the arches (15.1%). They concluded that men's have a larger prevalence of whorls whereas females have higher frequency of loops. Incidence of loop was highest in Rh +ve females and incidence of whorls was highest in Rh +ve males, except in O -ve cases where arches are predominant in females in comparison to males. The final finding was that there is a link between fingerprint pattern, blood group, and gender, therefore predictions can be made [6].

Dannis Eboh studied the fingerprint pattern among the students in Delta State University of Abraka in Nigeria. In this study a total 490 subjects of age 17-30 were taken. Study states that females have a higher percentage of loop along with whorl pattern whereas males have more percentage of arches. In the ABO blood group, the loop was present in a higher percentage compared to arches and whorls. There was no relation between fingerprint patterns and ABO blood group. Within Rhesus blood group, the loop has greater percentage compared to arches and whorls. There is a relation between Rhesus blood group and fingerprint pattern. Within the ABO-Rhesus blood group, the loop has greater percentage than arches and whorls, except in blood group O negative where whorls have greater percentage. There was no significant relation between gender and fingerprint pattern [7].

Dr. Ramrekh Shaker et al. has studied the fingerprint in 100 people (50 males and 50 females)

who have different blood groups and who belong to various age groups. All the 10 fingerprints were studied and results showed that blood group O was predominating.

Incidence the loop was highest as compared to whorls, arches and composite. Loops were highest in males and whorls and arches were highest in females. Blood group O +ve has higher incidence of loops followed by blood group B +ve [8].

## V. CONCLUSION

The current research seeks to examine the relationship between patterns of fingerprint and an individual's sex along with blood group. It is established that fingerprints are unique and remain unchanged from birth until death; however, this study aims to connect fingerprints with gender and blood type, potentially increasing the reliability of fingerprints for identifying and apprehending criminals. Understanding fingerprint variations due to age, gender, and blood group can help in forensic investigations and biometric authentication. Based on the study, the following findings were made: i) Loops were frequently observed

fingerprint patterns, while Arches were least prevalent. ii) Most frequent blood group is B +ve, whereas the least common are O –ve and AB –ve. iii) The highest occurrence of whorls was identified in individuals with O negative when compared with Rh – blood types (in line with the findings of Dr. Prateek Rastogi and Ms. Keerti R. Pillai). iv) Loops along with arches were predominantly found in individuals having blood group B and blood group O. v) Blood groups B positive and O positive demonstrated an equal prevalence of whorls being the highest. vi) The lowest occurrence of arches was noted in individuals with AB blood type. vii) Females were seen most commonly with loops along with arches and in male's whorls were predominant.

## VI. REFERENCES

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