

Prevalence of Fingerprint Pattern in North India Population



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Abstract

The aim of the study is to show a relationship among fingertip patterns of girls in comparison to boys in Haryana. In this study, 100 samples have been taken from GD Goenka university students between the age group of 19-25 years. The friction ridge is dotted with pore openings meant for discharging perspiration. This is largely made of water (98.5%). Unique fingertip pattern is formed seven months after conception. Fingerprints can be generally categorized into patterns and more specifically categorized into patterns and more specifically, individualized using minute details called minutiae. There are some basic classifications of fingertip patterns are: arches, loop, and whorls. Fingerprinting is one form of biometrics, a science which uses

people's physical or biological characteristics to identify them. The thickness of epidermal ridges has different type of sex like females have finer ridges than ridges than male. Significance: A unique identifier of male and female that easy signify weather it is male and female fingerprint.

Fingerprint evidence can play a crucial role in criminal investigations as it can confirm or disprove a person's identity that weather the suspect is male or female if the fingertip pattern was loop or whorl, we can suppose that at the crime scene. Result: Overall result is that there is more loop pattern and normal percent of whorls and less arches in girl population and there is more whorl pattern and less percent of arches in boy in Haryana population.

Keywords: Forensic Science; Fingerprint Pattern; Friction Ridges; Identification

Introduction

Fingerprint identification has long been recognized as one of the most reliable and widely used biometric techniques for personal identification [1]. The uniqueness and permanence of fingerprints have made them invaluable in various fields, including law enforcement, forensic science, and border control [2]. With advancements in technology and the increasing need for accurate identification methods, the study of fingerprint patterns has garnered significant attention from researchers worldwide [3].

In the Indian context, where the population is diverse in terms of ethnicity, culture, and geography, understanding the prevalence and characteristics of fingerprint patterns is particularly important [4]. North India, with its rich cultural heritage and large population, presents a unique opportunity for studying fingerprint patterns and their variations across different demographic groups [5].

The state of Haryana, located in North India, serves as the focal point of our study. Haryana, with its rapidly growing population and diverse socio-economic landscape, provides an ideal setting for investigating the prevalence of fingerprint patterns among young adults. The aim of this research is to examine the relationship between fingertip patterns and gender among students in Haryana, thereby contributing to our understanding of fingerprint variation within the Indian population. Fingerprints, the unique friction ridge patterns found on the fingertips, palms, and soles of humans, begin to develop around the seventh month of gestation [6]. These patterns are formed by ridges and valleys, which are further categorized into three primary types: arches, loops, and whorls [7]. Each fingerprint pattern is characterized by its distinct ridge flow and minutiae details, making it unique to an individual [8]. The study of these patterns, known as dermatoglyphics, has been instrumental in various fields, from anthropology and genetics to forensic science and biometrics.

Biometric identification, which utilizes unique physical or biological characteristics of individuals, has gained prominence in recent years due to its reliability and efficiency [9]. Fingerprinting, as a form of biometric identification, relies on the analysis of friction ridge patterns to establish the identity of an individual [10]. The use of fingerprints in forensic investigations, in particular, has been instrumental in solving countless cases by linking suspects to crime scenes or identifying victims [11]. Furthermore, research has shown that certain demographic factors, such as gender, can influence the characteristics of fingerprint patterns [12]. Studies have reported differences in ridge density, ridge thickness, and overall pattern types between males and females [13]. Understanding these gender-based variations in fingerprint patterns can have significant implications for forensic investigations, as it provides additional insights into the potential identification of individuals

based on their fingerprint characteristics [14].

Against this backdrop, our research aims to investigate the prevalence of fingertip patterns among young adults in Haryana and examine any gender-based differences in these patterns. By analyzing a sample of 100 students from GD Goenka University, aged between 19 to 25 years, we seek to shed light on the distribution of arches, loops, and whorls within the population and explore any correlations between gender and fingerprint pattern types.

This research aims to contribute to the existing body of knowledge on fingerprint patterns and their variation across demographic groups, with a specific focus on gender differences among young adults in Haryana, North India. By providing insights into the prevalence and characteristics of fingerprint patterns

in this population, we hope to enhance our understanding of biometric identification and its applications in forensic science and beyond.

Methodology

Materials required for the study include ink, inkpad, roller, fingerprint forms, and a magnifying glass. The study involves collecting 100 samples each of the right thumb, right index, left thumb, and left index fingers from male and female students aged 19 to 25 at GD Goenka University. The chosen method for fingerprint collection is the ink method, a commonly used technique in fingerprint surveys. Prior to fingerprinting, students with any permanent marks on their fingertips were excluded from the study. Each participant was instructed to wash their hands with soap and water and then dry them thoroughly.

The standard method of recording fingerprints was followed, which involves inking the fingers by rolling them on an inked surface and then placing them on a fingerprint form or a polished metal plate/glass slab. The materials used for this process include a rubber roller for spreading the ink, a tube of printer's ink, a suitable solvent (such as petrol or kerosene) for cleaning the slab, prescribed fingerprint recording forms, and cotton or a rag to clean the slab and roller after each use. This method ensures clear and accurate fingerprint impressions for analysis.

Additionally, a magnifying glass was used to examine the collected fingerprints in detail, allowing for the identification and classification of various fingerprint patterns, such as arches, loops, and whorls. By meticulously documenting and analyzing the fingerprint patterns of male and female students, this study aims to explore any gender-based differences in fingertip patterns among the young adult population in Haryana (Figure 1).

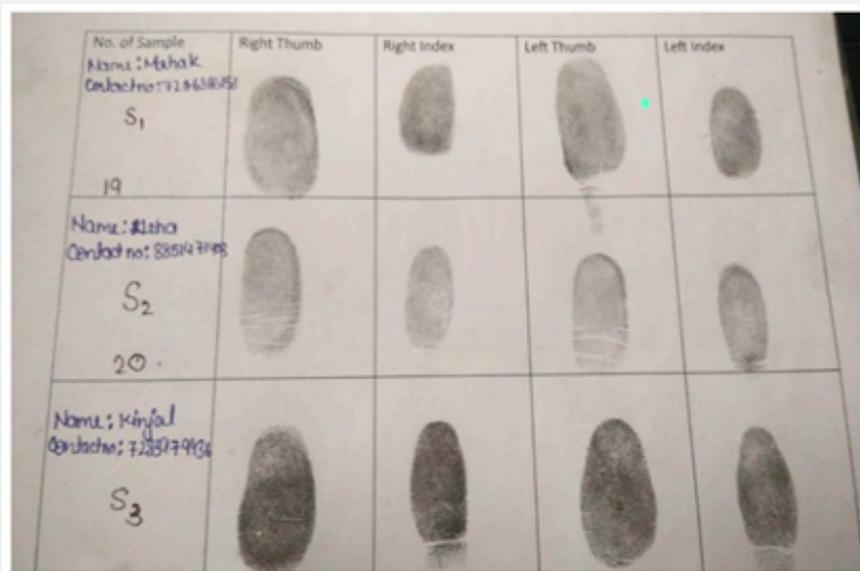


Figure 1: Collection of Fingerprint Pattern Sample.

Results and Discussion

The results of the fingerprint analysis reveal notable variations in fingertip patterns between male and female students at GD Goenka University, aged 19 to 25, in Haryana. The findings shed light on the prevalence of different fingerprint patterns across various fingers and provide insights into gender-based differences in fingerprint characteristics.

Arch Patterns

Analysis of arch patterns indicates that girls exhibit a higher prevalence of plain arches on their right index fingers compared to their left thumb and left index fingers. However, the right thumb displays a lower number of arches compared to the other fingers. This asymmetry in arch distribution among female participants suggests potential variations in fingerprint development across different fingers.

Tented Arches

Tented arches are less common among female participants, with fewer occurrences observed in the right thumb, right index, and left index fingers. Interestingly, the left thumb shows zero occurrences of tented arches, indicating a distinct pattern distribution on this finger compared to the others.

Loop Patterns

Among loop patterns, ulnar loops are more prevalent in the left index finger compared to the right thumb, while the right index finger exhibits a similar number of ulnar loops as the left thumb. However, the left thumb displays fewer ulnar loops compared to other fingers, suggesting variability in loop distribution among female participants.

Radial Loops

Radial loops are more frequent in the right thumb, right index, and left index fingers, with similar occurrences observed across these fingers. However, the left index finger exhibits a notably lower number of radial loops compared to the other fingers, indicating potential asymmetry in fingerprint pattern distribution.

Pocket Loops

Central pocket loops are more prevalent in the left index finger compared to the right thumb and right index finger. However, the left thumb displays a lower number of central pocket loops compared to other fingers. Similarly, lateral pocket loops are more common in the left index finger, while the right thumb and right index finger exhibit fewer occurrences. Interestingly, the left thumb shows zero occurrences of lateral pocket loops, indicating a distinct pattern distribution on this finger.

Whorl Patterns:

In contrast to female participants, male students exhibit a higher prevalence of whorl patterns and fewer arch patterns. This gender-based difference in fingerprint patterns suggests potential

biological or developmental factors influencing the formation of fingerprint ridges and patterns.

Overall, the results of this study highlight the complexity and variability of fingerprint patterns among young adults in Haryana, North India. The observed differences in pattern distribution between male and female participants underscore the importance of considering gender as a factor in fingerprint analysis and identification. Further research is needed to explore the underlying mechanisms driving these gender-based

variations in fingerprint patterns and their implications for forensic science and biometric identification. These findings contribute to our understanding of fingerprint variation within the Indian population and have implications for forensic investigations, law enforcement, and biometric systems. By elucidating the prevalence and characteristics of fingerprint patterns among young adults in Haryana, this study enhances our knowledge of biometric identification and its applications in diverse fields (Figure 2).

Conclusion

In this study, the analysis of fingerprint patterns among male and female students aged 19 to 25 at GD Goenka University in Haryana, North India, revealed several notable findings. Among girls, there was a higher prevalence of plain arches on their right index fingers compared to their left thumbs and left index fingers. However, the number of arches was consistent between the left thumb and left index finger, while the right thumb exhibited a lower number of arches.

Additionally, tented arches were less common across all fingers, with the right thumb, right index, and left index fingers showing fewer occurrences, whereas the left thumb had zero occurrences of tented arches. Furthermore, the analysis revealed variations in ulnar and radial loop patterns across different fingers. Ulnar loops were more prevalent in the left index finger compared to the right thumb, while the right index finger exhibited fewer ulnar loops. Conversely, radial loops were more common in the right thumb, right index, and left index fingers, with the left thumb showing a significantly lower number of radial loops. Additionally, the presence of central and lateral pocket loops was examined. Central pocket loops were more prevalent in the left index finger compared to the right index finger and right thumb, albeit less common in the left thumb.

Similarly, lateral pocket loops were more prevalent in the left index finger, with fewer occurrences in the right thumb and right index finger, and no occurrences in the left thumb. One noteworthy finding was the identification of twin loops, which were observed in 5% of the girls' left thumbs but were less common in the right thumb. These twin loops serve as unique identifiers and contribute to the overall variability observed in fingerprint patterns among individuals. In contrast to girls, boys exhibited a different pattern of fingerprint distribution, with a higher prevalence of whorls and fewer arches. This gender disparity in fingerprint patterns

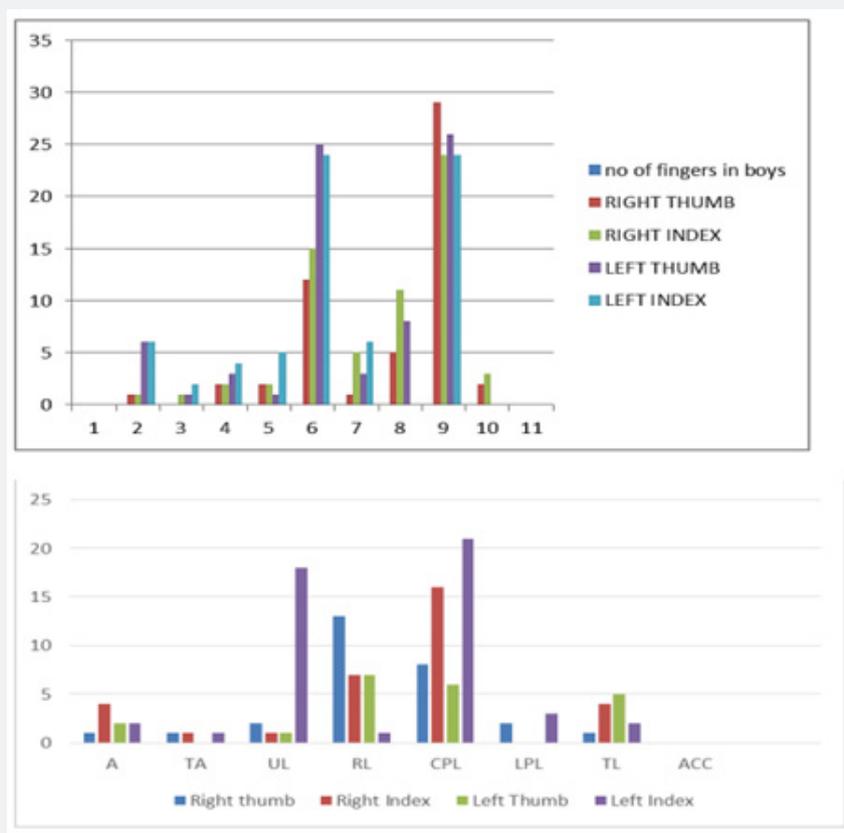


Figure 2: Chart (a) and (b) showing the indexes.

underscores the importance of considering gender-specific variations in forensic investigations and biometric identification processes.

Overall, this study provides valuable insights into the prevalence and distribution of fingerprint patterns among young adults in Haryana, North India. By understanding the variations in fingerprint patterns between genders, forensic experts and law enforcement agencies can enhance their ability to accurately identify individuals and solve criminal cases effectively. Additionally, these findings contribute to the broader understanding of dermatoglyphics and its applications in various fields, including anthropology, genetics, and biometrics. Further research in this area could explore additional demographic factors that may influence fingerprint patterns, thereby expanding our knowledge and improving the accuracy of fingerprint identification methods.

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42. The unanimity rule applies to all federal trials. It can be ruled out at the local level. The number of jurors may be less than 12 but may not be less than 6.
43. After DNA analysis, it was determined that the victim was not the rapist. He is the 200th person in the United States to be exonerated as a result of DNA analysis after a trial, according to the Innocence Project.
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