

A Study of asymmetry in fingerprints in Lucknow, India**Devendra Pal Singh****Demonstrator/Tutor, Department of Anatomy, Anugrah Narayan Magadh Medical College, Gaya, India****Received: 07-06-2023 / Revised: 15-07-2023 / Accepted: 10-08-2023****Corresponding author: Devendra Pal Singh****Conflict of interest: Nil****Abstract:**

Background: Fingerprints are widely acknowledged as the most dependable and robust parameter for individual identification in various medical and academic contexts. The current study was conducted to investigate the distribution of fingerprint patterns among individuals of male and female genders, as well as to examine the asymmetry in the Bihar region.

Methods: The present descriptive cross-sectional study was carried out at the Department of Anatomy, integral institute of medical science and research Lucknow, India, spanning from July 2020 to September 2020. A total of 196 participants between the ages of 18 and 60 were included in the study. The fingerprints of all ten digits were collected and examined to assess the distribution pattern and scrutinised for potential gender disparities. A simple random sampling technique was employed, and the sample size was determined based on a prevalence rate of 50%. The acquired data were processed and evaluated utilising Microsoft Excel software in order to derive the outcomes.

Results: The research findings revealed that loops exhibited the most prevalent occurrence, with a frequency of 1033 instances, accounting for 52.71% of the observed patterns. Whorls followed closely behind, with a count of 537 occurrences (27.38%), while arches also exhibited a frequency of 537 (27.38%). Additionally, a composite pattern was identified in 300 instances, representing 15.28% of the total patterns observed. The study findings revealed a higher prevalence of radial loops among the male participants, accounting for 397 individuals (5.54%) out of the total male population. Conversely, the female participants exhibited a greater occurrence of ulnar loops, with 636 individuals (96.38%) out of the total female population. In the study, it was observed that males exhibited a higher prevalence of concentric whorls, accounting for 245 individuals (52.03%). Conversely, females displayed a greater occurrence of spiral whorls, with 292 individuals (53.27%).

Conclusion: For standard authenticity of the sexual dimorphism, fingerprint patterns, can also be considered for gender identification purposes.

Keywords: Fingerprint Pattern, Sex Difference, Sexual Dimorphism.

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Introduction

Dermatoglyphics, also known as dermatoglyphology, is an academic discipline that focuses on the systematic examination and analysis of the intricate ridge patterns present on the fingers, palms, and soles of individuals. The term 'dermatoglyphics' was initially introduced by Cummins in the field of medical and academic research. The classification of fingerprints is inherently distinctive, predicated upon the hereditary attributes specific to each person. Fingerprints play a pivotal role as a vital form of evidence discovered at the site of an incident, providing a definitive method of identification [1]. Fingerprints are discernible imprints resulting from the distinctive configurations created by the papillary or epidermal ridges located on the tips of the fingers. These ridges are commonly denoted as papillary or friction ridges in medical and academic literature. The dermal ridges exhibit a distinct

morphology and manifest in diverse arrangements or formations, each exhibiting unique characteristics that enable accurate identification [3]. The dermal ridge pattern of the fingers becomes discernible during the period of 12 to 16 weeks of gestation, occurring within the intrauterine environment. The intricate development of these ridges reaches its culmination by the 24th week of gestation. Fingerprint patterns exhibit a unique and enduring characteristic, maintaining their integrity throughout an individual's lifespan, and persisting beyond death until the process of skin decomposition occurs. However, in certain cases, alterations to fingerprints can occur due to unnatural changes in the ridges. These changes may manifest as deep cuts or injuries that penetrate all layers of the epidermis. Additionally, certain medical conditions such as leprosy can also contribute to modifications in fingerprint patterns.

Fingerprints are widely regarded as the most dependable and distinctive means of identification within the medical and academic communities [2]. This is due to their inherent stability and unique characteristics exhibited by each individual. The determination of both the vital and deceased status of individuals is a matter in which medical evidence can assume a significant role, and in certain cases, it represents the sole evidence that aids in establishing the identity of an individual. Owing to the distinctiveness of fingerprints, discerning between even monozygotic twins can be accomplished effortlessly, while DNA profiling proves ineffectual [1]. Sex is a crucial factor in distinguishing individuals, and scholars have proposed the utilisation of fingerprint analysis for gender identification, which can greatly assist in narrowing down potential suspects [3]. However, there is a paucity of research conducted regarding its application in the domain of gender identification.

The current investigation was undertaken to examine the dermatoglyphic patterns and their variations in terms of intensity, as well as the potential impact of gender and handedness in the Bihar region. This research was conducted due to the absence of existing scholarly literature on this specific topic.

Methods

The present descriptive cross-sectional study was conducted at the Department of Anatomy, integral institute of medical science and research Lucknow, India, spanning from July 2020 to September 2020. The research study recruited a total of 196 participants within the age range of 18 to 60 years. The participants' informed consent was obtained prior to the commencement of the procedure. The demographic information, including age and sex, as well as the fingerprint data from all ten fingers of the participants were documented.

Exclusion criteria

Individuals presenting with a significant anatomical anomaly (either congenital or acquired) affecting the upper limb, such as syndactyly or polydactyly, or those diagnosed with leprosy, as well as individuals with gender identity disorder, were excluded from participation in the research investigation. Fingerprints, being regarded as a matter of sensitivity, individuals who did not provide consent were likewise excluded from the study.

In order to obtain the fingerprints, the participant was instructed to position themselves in close proximity to the paper surface, approximately at a distance equivalent to the length of their forearm. The ink was administered onto the fingers from the stamp pad in a proximal to distal orientation. The fingerprint was subsequently obtained by positioning the finger perpendicular to the paper's surface. The digit was subsequently applied with gentle pressure onto the surface of the paper and rolled consistently in a radio-ulnar orientation. The obtained prints were subsequently subjected to scanning and magnification for the purpose of the investigation.

A simple random sampling technique was employed, and the sample size was determined based on a prevalence rate of 50%. The acquired data were processed and evaluated utilising Microsoft Excel software in order to organise and present the findings.

Results

In this research, a cohort of one hundred and ninety-six participants was recruited, resulting in the collection of a total of 1960 fingerprints. Among the fingerprints documented, the predominant category was loops, accounting for 1033 instances (52.71%). This was followed by whorls, with a count of 537 (27.38%), and arches, with a total of 300 (15.28%). The most

recent observation was observed in the composite pattern 90, accounting for 4.61% of the total occurrences (Figure 1).

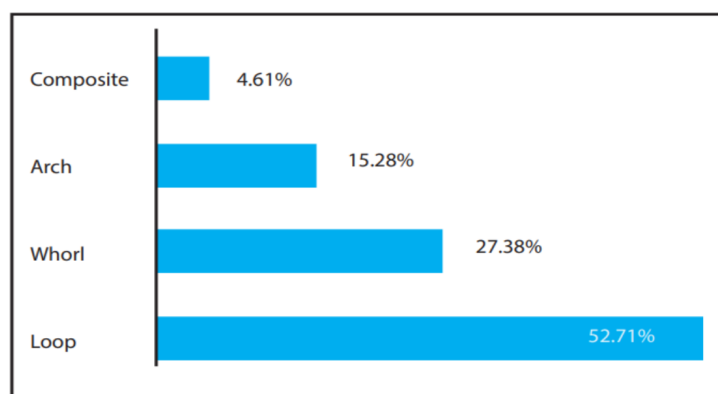


Figure 1. Fingerprint pattern distribution

The frequency of the observed patterns was investigated in both male and female subjects. The

presence of loop patterns was observed in a cohort of 397 males and 636 females, while whorl patterns

were found in 245 males and 292 females. In a similar vein, a total of 127 male individuals and 173 female individuals were observed to exhibit arches, while 41 male individuals and 49 female individuals were found to have composites. In the comprehensive distribution analysis, it was observed that all four patterns exhibited a higher prevalence among the female population.

The observed dermatoglyphic patterns of the loop, comprising a total of 397 males and 636 females, were subjected to a comprehensive medical and academic analysis. Similarly, the whorl patterns,

consisting of 245 males and 292 females, were further examined and categorised into radial and ulnar loops, as well as concentric and spiral whorls, as depicted in Figure 2. The findings of this study indicate that there were notable differences in the prevalence of ulnar loops (1) and radial loops (2) between male and female participants. Specifically, a higher proportion of females (613 out of 636) exhibited ulnar loops, whereas a higher percentage of males (5.54%, 22 out of 397 males) displayed radial loops compared to females (3.61%, 23 out of 636 females).

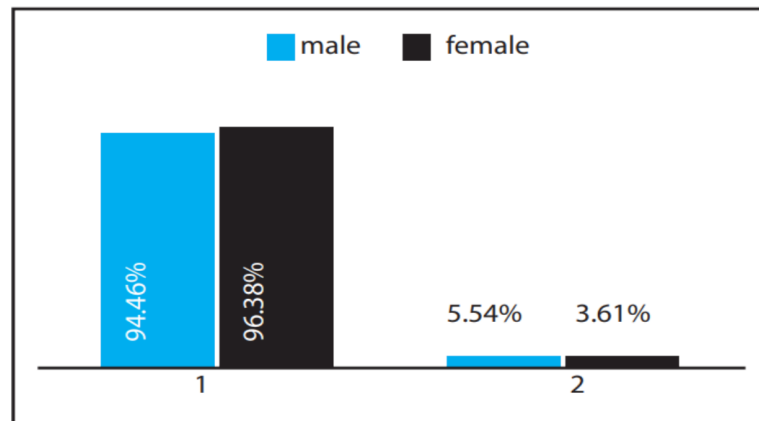


Figure 2. Loop pattern distribution

Among the whorls observed, the concentric whorls were seen more in males (128 out of 245 males) whereas the spiral whorls were seen to occur more in the females (156 out of 292 females).

Discussion

The comparative analysis of dermatoglyphic patterns, commonly known as fingerprints, is widely recognised as a universally accepted technique for establishing the unique identity of an individual within the medical and academic communities. Fingerprint patterns, owing to their inherent distinctiveness, hold significant significance in the identification and authentication of an individual within the realm of medical and academic research. The distribution of fingerprint patterns exhibits variability across diverse populations, while consistently preserving their unique characteristics. In this research investigation, a comprehensive collection of 1960 fingerprints was obtained, yielding insightful findings regarding the prevalence of different patterns. The analysis demonstrated that loops exhibited the highest frequency, followed by whorls and arches, respectively. This observation was in line with the research conducted by Karki and Singh as well as Shukla et al., in which they documented elevated occurrences of loops, followed by whorls and arches [3, 4]. Our investigation similarly corroborated the research conducted by Shrestha et al in Nepalese individuals, wherein loops were observed to manifest in approximately 52.90%

of the overall sample, while whorls accounted for 30.00% [5]. Although there were slight variations observed in the configurations of arches and composites, with reported percentages of 10.8% and 6.1% respectively [5]. A research conducted within the Sinhalese population in Sri Lanka has also documented a prevalence of 59.72% loops and 35.53% whorls, findings that align with the results of our own study [6]. Nevertheless, the prevalence of the arches documented in their investigation demonstrated a mere 4.75%, whereas our own scholarly inquiry revealed a slightly elevated rate of 15.28%.

The study conducted revealed that the composite patterns exhibited the lowest frequency, accounting for only 4.61% of the observed occurrences. Additional research conducted has also demonstrated that the composites exhibit the lowest frequency [5, 7]. Similarly, Nithin et al. documented the arches as the least prevalent fingerprint pattern within the South Indian population, accounting for 6.2% [8]. Likewise, Qayyum et al. have also documented the lowest prevalence of arches within the Rawalpindi population, with a frequency of 8.4% [9].

In accordance with our examination of the fingerprint pattern distribution within our research, it was determined that all four patterns exhibited elevated frequencies among the female

population. Several research studies have documented a higher prevalence of loops in males and whorls in females [5, 7]. Contrary to previous research findings, several studies have indicated a higher prevalence of loops in females and whorls in males [3, 6, 8, 10].

Upon investigating the various subtypes of loops and whorls, it was observed that the ulnar loop exhibited a slightly higher prevalence among females (96.38%) compared to males (94.46%). Conversely, the radial loop demonstrated a greater occurrence among males (5.54%). Contrarily, Reddy et al. have reported a heightened prevalence of radial loop patterns in the female population [11]. Within the dermatoglyphic patterns, the prevalence of concentric whorl patterns was observed to be higher in males (52.03%), whereas the occurrence of spiral whorl patterns was found to be more prominent in females (53.27%). Nithin et al [8] have previously reported a comparable observation regarding the elevated prevalence of the spiral whorl pattern among individuals assigned female at birth.

The prevalence of fingerprint patterns, as demonstrated by our study and other relevant literature, exhibited a high degree of similarity with minor variations [5, 8]. However, disparities in the prevalence of these patterns between genders were noted. Therefore, the observed sexual dimorphism in fingerprint patterns can be attributed to variations in heritability and developmental differences between genders.

The study's limitations may include a relatively smaller sample size of male participants due to data collection occurring during daytime hours, when a significant portion of males were engaged in occupational activities outside of their residences.

Conclusion

Fingerprints, undoubtedly play a pivotal role as a fundamental tool for the identification of individuals across diverse contexts. Due to the existence of variations in patterns between the sexes, it can also be deemed relevant for the purpose of gender identification. Nevertheless,

further comprehensive investigations must be undertaken to ascertain the veracity of sexual dimorphism in a standardised manner.

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