ORIGINAL ARTICLE

Evaluation of Fingerprint Patterns among a Study Population in India

Anil P. Trimbake

Assistant Professor, Department of Skin & V.D., Institute of Medical Sciences and Research, Mayani, Maharashtra, India

ABSTRACT:
Background: Fingerprint patterns, formed by epidermal ridges, are unique, genetically determined, and remain unchanged throughout life, making them valuable in personal identification and forensic science. The study of fingerprint patterns—dactylography and dermatoglyphics—has revealed significant variation across populations and geographical regions. **Objective:** To assess the distribution and frequency of different fingerprint patterns among a sample population, and to determine the predominant pattern type with potential implications for identification and anthropological profiling. **Materials and Methods:** A cross-sectional study was conducted on 130 individuals (66 males and 64 females) across the age range of 20 to 50 years. Fingerprints of all ten digits were collected using ink and paper and analyzed using a magnifying glass. Patterns were categorized into arches, loops, whorls, and composites, based on Michael and Kucken's classification. Statistical significance was determined using a p-value threshold of <0.05. **Results:** The age-wise distribution of participants was balanced across three age groups. Among the fingerprint patterns observed, whorls were the most prevalent (56%), followed by loops (21%), arches (19%), and composite patterns (8%). The observed distribution showed statistically significant variation (p = 0.01). **Discussion:** The predominance of the whorl pattern aligns partially with findings from previous studies on Indian and other populations, although loop patterns are often reported as the most frequent globally. Differences in pattern distribution were not significantly associated with gender or bilateral hand differences, corroborating earlier research. The uniqueness and stability of fingerprints reaffirm their importance in biometric identification and population studies. **Conclusion:** Whorl patterns emerged as the dominant fingerprint type in the study population. Fingerprint analysis remains a robust, non-invasive method for personal identification and has relevance in forensic and anthropological investigations. Further studies across diverse populations are recommended to explore regional and ethnic variability in dermatoglyphic traits.
Keywords: Finger Prints, Population, Dactyloscopy.

Corresponding author: Anil P. Trimbake, Assistant Professor, Department of Skin & V.D., Institute of Medical Sciences and Research, Mayani, Maharashtra, India

INTRODUCTION

The ridges are the raised portions of skin between furrows on either side. They are also known as "Papillary" or epidermal ridges. The ridges flow in various directions giving rise to innumerable patterns.[1] Dactylography or Dactyloscopy is the study of finger prints identification. The word Dactylography is derived from two Greek words, daktylos meaning 'finger' and graphein meaning 'to write'.[2] It is the study of the impressions of patterns formed by the papillary ridges on the bulbs of fingers and thumbs. It is taken with the help of printer's ink on unglazed paper. Fingerprint patterns are genotypically determined and remain unchanged from birth till death.[3] The peculiar factor regarding fingerprints is that no two person can have same finger prints. Even to identical twins can have same finger print patterns. This makes identification of suspect useful especially in crime scenes. This pattern remains uninfected by any disease process. Different fingers of same individual can have any pattern and that is unique for that finger.[4] They are present at birth, both on epidermis and dermis. Finger prints appear for the first time from the 12th to 16th week of intrauterine life and their formation gets completed by 24th week of intrauterine life. The ridges appear on the fingers first, then on the palm or sole.

The study of science and technology in the fingerprint is known as Dactyloscopy or Dactylography.[5] The study of epidermal ridges and the patterns formed by them is known as Dermatoglyphics.[6] The term Dermatoglyphics was coined by the anatomist Harold Cummins of Tulane University, which means skin carving (Krishan, 2009). Population distribution based on the fingerprint pattern can be an important evidence in ruling out or including the individual in population specific manner. A study conducted by[7] confirms the variation in a fingerprint pattern of individuals from different geographical origin. In the similar study, the Indian population has been subject for the study of Fingerprint patterns and different segment of the population has been chosen to be the subject of study. One such study has been performed in the Marathi population and it concluded that Ulnar Loop was the most common pattern among them, which was recorded to be 51.3%.[8]

Fingerprint distribution has shown the varying nature with reference to the geographical origin. A study has been carried out by[9] showed the global variation of fingerprint pattern. In the same study it was observed

that the two persons can be same by Anthropology wise, but their fingerprint impression has been an eminent identity proof which helps in improving the latent fingerprint evidence. Another study recorded the racial pattern distribution of fingerprint among the three different population, namely, Chinese, Malaysian and Indian which showed the variation in their respective fingerprint pattern.[10] It was also confirmed that in the above population Loop pattern was maximum in Indian population which is followed by the Malaysian and Chinese. Likewise, the Whorl pattern was maximum for Chinese when compared to the Malaysian and Indian.[10]

MATERIALS & METHODS
The present study was conducted among 130 subjects of both genders. All subjects were informed about the study and written consent was taken. Demographic data such as name, age, sex etc was recorded in performa. Finger prints of all fingers were taken on paper with the help of stamp pad. All patterns were assessed by using magnifying glass following classification given by- Michael and Kucken into 4 types- Arches, Loops, Whorls and composite. Results thus obtained were studied. P value less tha 0.05 was considered significant.

RESULTS
Table 1 shows that age group 20-30 years had 23 males and 19 females and age group 31-40 years had 202males and 25 females and 41-50 years had 21 males and 20 females.

Table 1 Distribution of patients

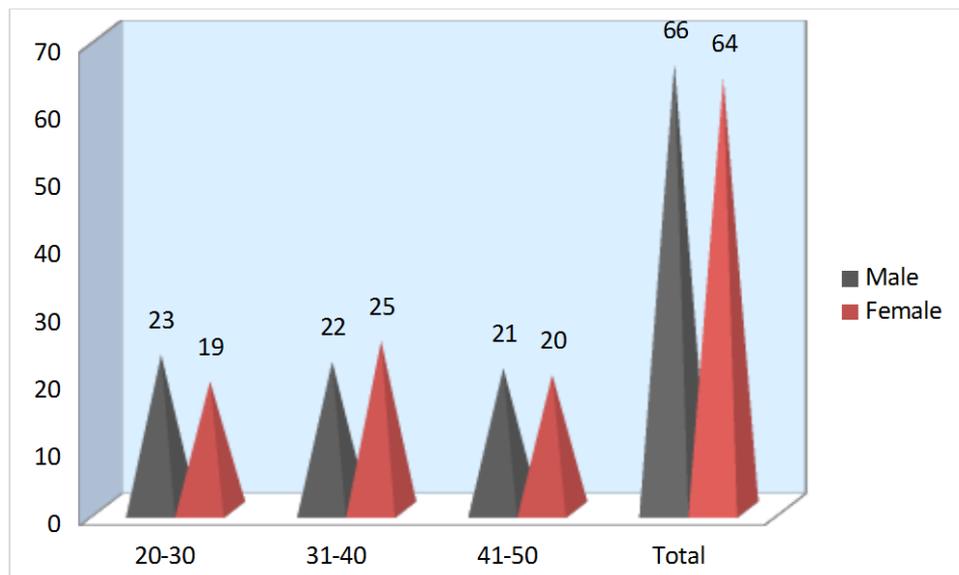| Age group (Years)	Male	Female
20-30	23	19
31-40	22	25
41-50	21	20
Total	66	64

Figure 1: Distribution of patients

Table 2 shows that different finger print patterns were whorl in 56%, loop in 21%, arch in 19% and composite in 8%.

Table 2 Assessment of finger print patterns

Finger print patterns	Percentage	P value
Whorl	56%	0.01
Loop	21%	
Arch	19%	
Composite	8%	

DISCUSSION
As far back as seventieth century AD, the finger print impressions in ink were used in Assyria and Far East as an evidence of good faith in the sealing of bonds or the issue of documents.[11] Dr. Henry Faulds came to Darjeeling, Bengal in 1872 as a medical missionary and observed the use of Tip Sahi in lieu of signature and other official purposes.[12] The finger prints of an individual do not change throughout his life. In fact, the ridges appear before birth. They start appearing

during third or fourth month of pregnancy. They remain even after the death of the individual, till the epidermal skin is destroyed by fire, putrefaction or is eaten by insects or other creatures.[13] The present study was conducted to assess the finger print pattern among population.

In present study, age group 20-30 years had 21 males and 19 females and age group 31-40 years had 22 males and 25 females and 41-50 years had 21 males and 20 females. Srilakha et al[14] conducted a study during 2000- 2001 on 300 medical students with different ABO blood groups in Rajasthan which revealed that individuals with blood group A have more of loops, while that of blood group AB had more of whorls. Arch can be of two types, plain Arch and tented arch. In plain arch, the ridges run from one side to the other making no backward turn. There is usually no delta. But when delta appears, no ridge must intervene between the inner terminus and outer terminus. In tented Arch, the ridges near the middle may have an upward thrust, arranging themselves as it were on both sides of an axis towards which adjoining ridges converge. The ridges thus converging give to the pattern the appearance of a tent in outline, hence the name tented arch.[15]

We found that different finger print patterns were whorl in 56%, loop in 21%, arch in 19% and composite in 8%. Sam et al[16] found that rolled fingerprints of ten fingers of all the 200 subjects were collected. Hence a total of 2000 fingerprints were obtained, which were analysed and their patterns and subtypes were determined. Among the 2000 fingerprints obtained, 1142 were loops, 607 were whorls, 127 were composites and 124 were arches. The distribution of different patterns of fingerprints was analysed separately for both males and females. Out of the 1142 loop patterns obtained in this study, 1089 were ulnar loops (95.36%) and 53 were radial loops (4.64%). Similar distribution was observed in both males and females. Out of the 607 whorl patterns obtained in this study, 374 were spiral whorl (61.6%), 154 were circular whorl (25.4%), 48 were double core whorl (7.9%) and 31 were elliptical whorls (5.11%). In both males and females, same distribution pattern was observed.

CONCLUSION

Detailed classification and frequency distribution of finger- print patterns were obtained in a Muslim population of Cen- tral India. Ulnar loop was found to be the most predominant in males as well as in females. Gender differences and bilateral differences were found to be statistically insignificant ($p > 0.05$). The results were compared to the available data for var- ious other populations and ethnic groups from India and around the world. Various indices were calculated and com- pared to study the population variability. Finger print assessment is considered best method of human identification. In most of the patients, whorl type pattern was found.

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