



## Variation of Finger Print Patterns among Medical Students

Dhiraj Kumar Shah<sup>1</sup>,<sup>\*</sup> Kashev Shreshta<sup>1</sup>, Anish Karki<sup>2</sup>, Aarju Khadka<sup>3</sup>

<sup>1</sup>Department of Forensic Medicine, College of Medical Sciences-Teaching Hospital, Bharatpur, Chitwan, Nepal.

<sup>2</sup>Department of Forensic Medicine, Birat Medical College, Biratnagar, Morang, Nepal.

<sup>3</sup>MBBS, College of Medical Sciences-Teaching Hospital, Bharatpur, Chitwan, Nepal.

### ABSTRACT

#### Background

A vital component of every medico-legal investigation is the identification of individuality. Finger prints, as a biometric technology is accepted globally, for identification in legal proceedings. Research on its application in this area of gender identification would improve the efficacy of legal process on identification issues. To examined variation of finger print patterns among medical students of College of Medical Sciences-Teaching Hospital, Bharatpur.

#### Methods

A cross-sectional observational study was conducted in the forensic medicine department at College of Medical Sciences-Teaching Hospital from April to July 2025. This, study includes, MBBS students from 1<sup>st</sup> semester to 9<sup>th</sup> semester. All the ten fingerprints of the participants were obtained on a clear A4 sized paper. The dermatoglyphic patterns were recorded on paper as an arch, whorl, loop, or composite of the right and left fingers. The data were initially entered in MS Excel and later analysed using Statistical Package for Social Sciences (SPSS) version 20. The distribution of dermatoglyphic fingertip patterns on each person's two hands were analysed using descriptive statistics and their association with gender were measured using inferential statistics. P-value of <0.05 was considered statistically significant.

#### Results

The most common type of fingerprint pattern was found to be a loop, which was seen in more than half of the samples 1506 (63%). This was followed by whorl 646 (27%), arch 145 (6%), and the composite which was the least common, accounting for 93 (4%) samples. Statistically significant association was found between sex and fingerprint pattern of right thumb (p-value 0.021) and ring finger (p-value 0.035).

#### Conclusions

Loop pattern was the most common in study population and statistically significant association was found between sex and fingerprint pattern of right thumb and ring finger.

**Keywords:** Dermatoglyphics; Forensic Anthropology; Hand; Individuality.

**\*Correspondence:** Dr. Dhiraj Kumar Shah, Department of Forensic Medicine, College of Medical Sciences-Teaching Hospital, Bharatpur, Chitwan, Nepal. E-mail: dhirajshah2025@gmail.com, Phone: +977-9816849049 **Article received:** 2025-07-11 **Article accepted:** 2026-04-06. **Article published:** 2026-06-30

## INTRODUCTION

Identification refers to determining an individual's uniqueness.<sup>1</sup> One of the greatest methods for identification is the fingerprint system. Fingerprints are characteristics that allow for easy recognition and classification.<sup>2</sup> Research suggests that the likelihood of two individuals having the same fingerprint patterns is approximately 1 in 64 billion, whereas the current global population is around seven billion.<sup>3</sup> Fingerprints are among the most developed biometric technologies and are accepted as valid forms of proof for human identification in legal proceedings worldwide.<sup>4</sup> There is limited information regarding the distribution of fingerprint patterns among medical students, particularly in Nepal. Existing research focuses on general population, creating a need for institution-specific data. Therefore, this study seeks to assess baseline data on fingerprint variation among medical students and contribute to forensic and biometric research.

The study, includes MBBS students from the first to the ninth semester, aimed to investigate variations in fingerprint patterns and any association between the fingerprint pattern and demographic variables among the medical students at the College of Medical Sciences-Teaching Hospital, Bharatpur.

## METHODS

### Study Area

This study was conducted in the department of forensic medicine, at College of Medical Sciences-Teaching Hospital, Bharatpur, Chitwan, Nepal.

### Study Design

A cross-sectional observational study was conducted with the voluntary participation of MBBS students from 1<sup>st</sup> to 9<sup>th</sup> semester in 2025 with a study period of 8 months.

### Sample size and sampling

The finite population formula was used to calculate the sample size, where total number of students was 600 which yield 239 samples. We collected 10 fingerprints from each of the 10 fingers of a single student. A total of 2390 fingerprints was gathered, and sampling was conducted using a probability

method.

### Data Collection

The study was conducted from April to July 2025 with the study period of 8 months, after receiving permission from the principal of college and ethical approval from the institutional review committee, College of Medical Science-Teaching Hospital (Ref. No.: COMTH-IRC/2025-028). The participant's names and addresses were not collected in order to maintain the anonymity of the records. The process for collecting fingerprints were started after taking informed consent from all participants. Students who had additional, webbed, or bandaged fingers, permanent scars on their fingers or thumbs, or hand deformities from disease, injury, or birth defect were excluded from the study, and those with normal digits and absence of such deformities were included in this study. Participants were instructed to dry their hands with a towel and wash them if needed. Participants were instructed to apply ink to their fingertips using a stamp pad, starting with the right hand and then moving to the left. Participants firmly pressed their fingertip onto a sheet of clear A4 paper and created a print of their fingerprints on the paper. Following the acquisition of the fingerprint, the patterns were recorded on a self-designed pro forma as an arch, whorl, loop, or composite of the right and left fingers.

### Data Analysis

The data was entered using MS Excel and later analysed in the Statistical Package for Social Sciences (SPSS) software, version 20. Descriptive statistics were used to show the distribution pattern of fingerprints and were expressed in terms of frequency and percentage, and for inferential statistics, Chi square test was used to assess the correlation between distribution of fingerprint patterns and demographic variables.

## RESULTS

A total of 2390 fingerprint samples were collected from 124 male and 115 female participants. Analysis was done on number of fingerprints collected. The

most common type of fingerprint pattern was found to be a loop, which was seen in more than half of the samples 1506 (63%). This was followed by whorl 646 (27%), arch 145 (6%), and the composite 93 (4%) which was the least common (Table 1).

**Table 1: Overall distribution of fingerprint pattern (n=2390).**

Characteristics	Frequency n (%)
Composite	93 (3.89)
Arch	145 (6.07)
Whorl	646 (27.03)
Loop	1506 (63.01)

Across all right-hand fingers (1195 samples), loops were the most frequent pattern that accounted for 770 (64.5%) and was also the most frequent type in male and female (380 vs 390) which was followed by whorl (197 vs 335) while arch (31 vs 34) and composite (12 vs 13) were infrequent. A statistically significant association with gender was observed for the fingerprint pattern of right thumb (with p-value of 0.021) and right ring finger (with p-value of 0.035). No significant association was found for the right index, middle and little fingers (Table 2).

**Table 2: Sex wise distribution of right-hand fingerprint pattern and their association (n=239).**

Finger print patterns	Male (n=124) (%)	Female (n=115) (%)	p-value
<b>Right thumb</b>			
Composite	6 (4.84)	9 (7.83)	<b>0.021*</b>
Arch	0	7 (6.08)	
Whorl	44 (35.48)	31 (26.95)	
Loop	74 (59.67)	68 (59.13)	
<b>Right index</b>			
Composite	4 (3.22)	3 (2.60)	0.201
Arch	21 (16.93)	17 (14.78)	
Whorl	40 (32.25)	25 (21.73)	
Loop	59 (47.58)	70 (60.86)	
<b>Right middle</b>			
Composite	1 (0.80)	0	0.254
Arch	7 (5.64)	9 (7.82)	
Whorl	29 (23.38)	17 (14.78)	
Loop	87 (70.16)	89 (77.39)	
<b>Right ring</b>			
Composite	0	1 (0.86)	<b>0.035*</b>
Arch	2 (1.61)	0	
Whorl	66 (53.22)	54 (46.95)	
Loop	56 (45.16)	70 (60.86)	
<b>Right little</b>			
Composite	1 (0.80)	0	0.526
Arch	1 (0.80)	1 (0.86)	
Whorl	18 (14.51)	21 (18.26)	
Loop	104 (83.87)	93 (80.86)	

Among the left-hand fingers (1195 samples), loop pattern again predominated in both gender (male vs female: 380 vs 356) in the left hand which accounted for 736 (61.5% of 1195 samples). It was followed by whorl pattern (167 vs 144), arch

(34 vs 46) and composite (39 vs 29) which were least common. However, there was no statistically significant association between fingerprint pattern and gender for any of the left-hand fingers (p-value >0.05) (Table 3).

**Table 3: Sex wise distribution of left-hand fingerprint pattern and their association (n=239).**

Finger print patterns	Male (%) (n=124)	Female (%) (n=115)	p-value
<b>Left thumb</b>			
Composite	19 (15.32)	21 (18.26)	0.073
Arch	1 (0.80)	8 (6.95)	
Whorl	29 (23.38)	25 (21.73)	
Loop	75 (60.48)	61 (53.04)	
<b>Left index</b>			
Composite	9 (7.25)	3 (2.60)	0.11
Arch	21 (16.93)	15 (13.04)	
Whorl	39 (31.45)	30 (26.08)	
Loop	55 (44.35)	67 (58.26)	
<b>Left middle</b>			
Composite	6 (4.83)	2 (1.73)	0.08
Arch	8 (6.45)	18 (15.65)	
Whorl	28 (22.58)	22 (19.13)	
Loop	82 (66.12)	73 (63.47)	
<b>Left ring</b>			
Composite	3 (2.41)	0	0.197
Arch	1 (0.80)	3 (2.60)	
Whorl	56 (45.16)	46 (40)	
Loop	64 (51.61)	66 (57.39)	
<b>Left little</b>			
Composite	2 (1.61)	3 (2.60)	0.526
Arch	3 (2.41)	2 (1.73)	
Whorl	15 (12.09)	21 (18.26)	
Loop	104 (83.87)	89 (77.39)	

## DISCUSSION

The distribution pattern of fingerprint is consistent with the findings from previous study where Nandy reported the most frequent distribution of loops (65%) followed by whorls (25%), arches (7%), and composites (2-3%).<sup>5</sup> However, a study in Ajmer population showed a contrasting result where arches were more common than loops and whorls.<sup>6</sup>

Gender related differences in distribution of fingerprint have been noted in various studies. A study among medical students by Rastogi found that the distribution of fingerprint patterns was correlated with gender, with males having a higher frequency of whorls and females having a higher frequency of loops, whereas the present study showed a higher frequency of loops in both genders.<sup>7</sup> Similarly, Karki found that loops were more common in

females while whorls were more common in males.<sup>8</sup> Gangadhar M.R. and Rajashekara Reddy, K. also discovered that there was a significant gender difference in the fingerprint patterns of the general population, with loops (57.11%) being the most common pattern, followed by whorls (27.89%) and arches (15.00%).<sup>9</sup>

Various studies support the dominance of loop pattern across populations. Sinha R. noted that loops were the most common pattern and arches were the least common, whereas composite pattern was the least common in our study.<sup>10</sup> The least occurrence of composite pattern is comparable to a study done in Nellimarla community.<sup>11</sup> Similar were the dermatoglyphic finding from indigenous Black Zimbabweans where the most common digital pattern type in both sexes was loops, followed by arches in females and whorls

in males.<sup>12</sup> In the year 2003, a comparative study by Purkait further highlighted the fingerprint variation in tribal population, in which the greater prevalence of whorl and loop patterns was observed among Mundas and loops among the Lodhas.<sup>13</sup> The findings of a related study conducted by Deepa found that the most common fingerprint pattern was loops (58.29%), while whorls were moderate (37.00%) and arches were the least common (4.71%) which is comparable to the present study; however, a marginal difference is observed with our study, where the composite is the least common pattern.<sup>14</sup> Basu also has a high incidence of loops, moderate whorls, and low arches.<sup>15</sup> Nithin, in the year 2009 documented loop as the most common fingerprint pattern in both sexes and the whole population of South India, which is in harmony with the current study.<sup>16</sup> In a recent study by Yadav S. in the year 2024, documented loops as the most frequent fingerprint pattern, followed by whorls, arches, and composites, which is similar to our observations. The males exhibited a greater occurrence of loops, while females showed a higher incidence of whorls; however, loop patterns were the most prevalent in both sexes in our research.<sup>17</sup>

Ranjan SK<sup>18</sup> and Chukwumeka O<sup>19</sup> in their study determined no statistically significant association between gender and fingerprint pattern; however, the present study documents the statistical association between gender and fingerprint pattern, which is parallel with the finding by Deepa D.<sup>14</sup>

### Limitations

The study is single centered focusing only on MBBS students of almost same age which forms a homogenous group and the findings cannot be generalized. Variables such as ethnicity, dermal lesions, and blood group are not considered in this study. Further detailed categorization of fingerprint patterns is needed to avoid subjective bias.

### Conclusions

Loop patterns were most common in both sexes in the general population, followed by whorl, arch, and composite patterns. In both genders, composite results were less prevalent than arch, which is marginally different from some studies. Statistically significant association was found between sex and fingerprint pattern of right thumb and right ring fingers.

**Ethical Approval:** The ethical approval was taken from the institutional review committee, College of Medical Science-Teaching Hospital (Ref. No.: COMTH-IRC/2025-028). The participant's names and addresses were not collected in order to maintain the anonymity of the records. The process for collecting fingerprints was started after taking informed consent from all participants.

**Conflict of Interest:** The author declares no conflict of interest.

**Funding:** No funding was received for this study.

**Availability of data and materials:** All data analysed during this study will be made available upon reasonable request from the corresponding author.

### Author's contributions

**Conceptualization:** Dhiraj Kumar Shah

**Data Curation:** Dhiraj Kumar Shah, Anish Karki, Ms. Aarju Khadka

**Formal Analysis:** Kashev Shrestha, Dhiraj Kumar Shah, Anish Karki

**Investigation:** Dhiraj Kumar Shah, Aarju Khadka

**Methodology:** Dhiraj Kumar Shah, Aarju Khadka

**Supervision:** Kashev Shrestha

**Writing-original draft:** Dhiraj Kumar Shah

**Writing-review & editing:** Kashev Shrestha, Dhiraj Kumar Shah, Anish Karki

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