

# Fingerprint Patterns of Varanasi Region: An Observational Study

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## 1. Introduction

Identification refers to determining a person's uniqueness. It could either be absolute (complete) or not (partial). Complete identification entails the unwavering fixation of identity based on the presence of distinctive traits (Name, age, sex, address etc). The efforts of the police, doctors, family members, and friends help to achieve this. Identification of a person using only some of their facts is referred to as partial identification. When a person is severely disfigured, decomposing quickly, etc., and just a few details about them, such as their age, sex, race, or nationality, have been determined but others are still unknown. The strategy that is most effective combines several techniques [1]

For the purpose of identification, the following characteristics are frequently noted: race, sex, age, appearance, hair, fingerprints, footprints, deformities, tattoos, scars, occupational marks, handwriting, clothes, personal items, speech, voice, gait, mental capacity, memory, education, and DNA profile, among others.

The finest fingerprint technique has been identified, and the likelihood of two people having identical finger impressions is thought to be one in 64 million people worldwide. Even identical twins' fingerprints are different from one another [2]

The use of fingerprints for personal identification is well known and is regarded as having made the most impact on law enforcement. The study of fingerprints offers a special service in the administration of justice and other areas where accurate identification is crucial due to its distinctive properties [3]

Dactylography, dactyloscopy, and the Henry - Galton system of identification are all terms used to describe the study of fingerprints as an identification method. Dactylography is the practice of making papillary ridge impressions from the fingertips in order to identify a person. This method of identification is absolutely accurate and error-free [4].

The following are some frequent ways that fingerprints are used for identification:

The identification of fugitives and criminals whose fingerprints are discovered at crime scenes, as well as the determination of the proper identity and cases of kidnapping and bank fraud, are all made possible by fingerprint

comparison. Additionally, it aids in preventing the intentional or unintentional exchange of newborn infants in hospitals [3]

As the frequency of crimes like robberies, rapes, and assaults rises, fingerprints are quickly turning into a vital instrument in the hands of detectives looking to catch the offenders. Numerous studies on fingerprint analysis have already been conducted, and regionally focused studies on fingerprints are constantly ongoing. The gender of the perpetrator may now be determined using the fingerprint gender classification from the current study, which will make it even easier to identify the offender's sex in both criminal and civil cases. This study sought to analyse the predominant fingerprint pattern using "Henry method" in and around Varanasi Region.

## 2. Material and Methods

The present study was conducted at Department of Forensic Medicine, Institute of medical science, Banaras Hindu University, Varanasi from August 2021 and February 2022

### Inclusion criteria:

Total subjects included were 300 Males and 300 Females. Students and Staff members from Institute of Medical Sciences, population from in and around Varanasi district were included in the study. Subjects who were healthy and having normal hands were included in the study.

### Exclusion criteria:

Subjects where there was any evidence of injury of fingertips that leads to change in the fingerprint pattern (Leprosy, scars of the fingertips, lacerations); students and staff who were not from Varanasi district were excluded from the study. Informed written consent was obtained prior to taking the fingerprints with proper procedure explained to the subjects. Sir Edward Richard Henry modified Galton's - Arch, loop, whorl system and classified them into four main groups according to the percentage of their distribution in the whole population of the world, these are [20].

- Loop (65 - 67%)
- Whorl (25%)
- Arch (6 - 7%) and
- Composite or accidental or chance (3 - 4%)

This method is known as "Henry Galton method" or "Henry method" is name derived from its originators Sir Francis Galton and Sir Edward Richard Henry. This Henry system of classification is the most efficient and is in almost universal use [5].

**Materials:** Glass slab –Inking Roller method 5

The materials which were used for this study are as follows:

- 1) Printer Black Ink - Kores quick drying duplicating ink.
- 2) Glass Plate (12x12 inches).
- 3) Ink roller.
- 4) A foldable magnifying lens which could be placed over the print was used instead of the usual hand lens as it ensures a steady view of the fingerprints and also hands were free to note down the fingerprint type.
- 5) Pencil.
- 6) Measuring scale.
- 7) Proforma.

**Procedure:** The subject was asked to wash and dry their hands to remove dirt and grease. For collection of fingerprint, a plain glass plate of 12x12 inches was cleaned uniformly smeared with a thin layer of black printers ink by using the inking roller.

The subject was asked to keep his/her arm relaxed and not to try to help in rolling the fingers as this may cause smearing. Then the finger bulbs were rolled on the glass slab - “the thumbs were rolled towards the subject’s body and the fingers were rolled away from the body, i. e. thumb in fingers out method”.

And then the rolled impressions of each finger were obtained in the allotted space for that finger on the proforma. In this way for each and every individual the entire prints of ten fingers were prepared. Only rolled prints were taken i. e. no plain prints.

**Statistical Analysis**

The study was done using SPSS software package.

The frequency of each fingerprint pattern was tabulated and the percentage of each pattern was calculated using Descriptive statistics.

**3. Results**

**Table 1:** Sex distribution

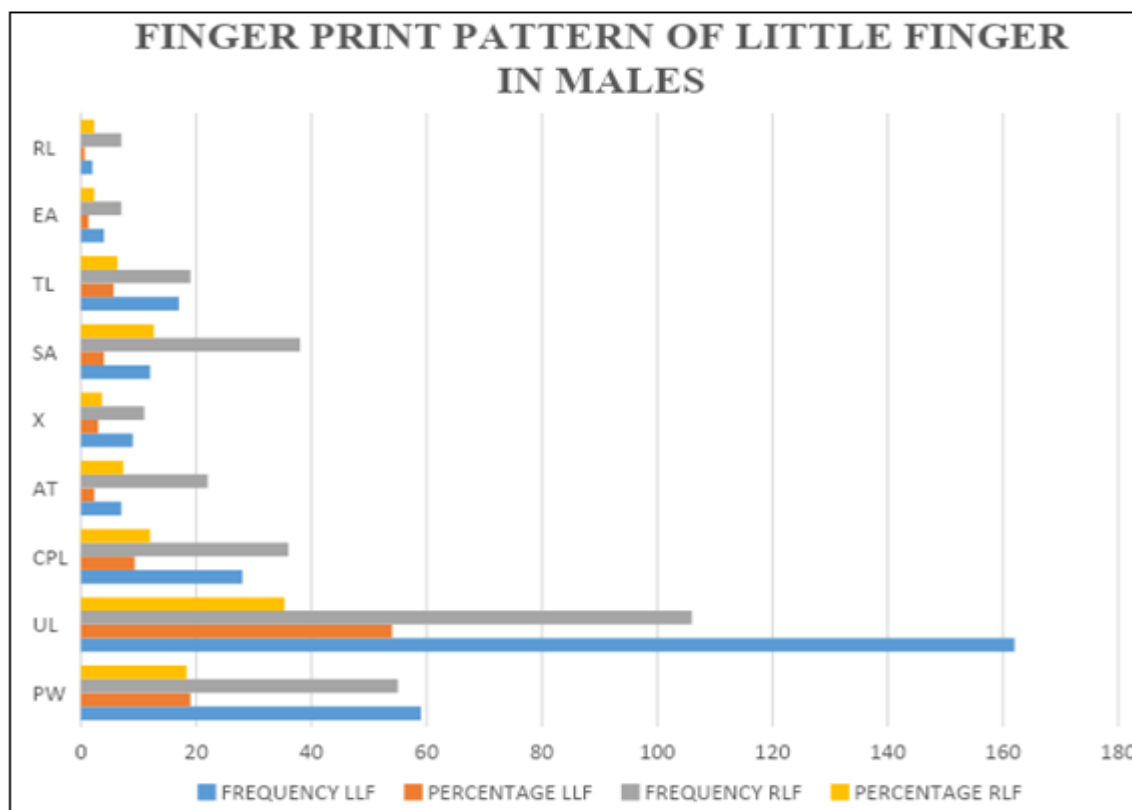
| Sex     | Cases |     |
|---------|-------|-----|
|         | NO    | %   |
| Males   | 300   | 50  |
| Females | 300   | 50  |
| Total   | 600   | 100 |

300 males and 300 females were included in the study.

**Fingerprint Patterns in Males**

**Table 2:** Pattern of Little finger in both hands

| Pattern             | Little Finger |      |       |       |
|---------------------|---------------|------|-------|-------|
|                     | Left          |      | Right |       |
|                     | NO            | %    | NO    | %     |
| Plain Whorl         | 59            | 19   | 55    | 18.33 |
| Ulnar Loop          | 162           | 54   | 106   | 35.33 |
| Central Pocket Loop | 28            | 9.33 | 36    | 12    |
| Tented arch         | 7             | 2.33 | 22    | 7.33  |
| Accidental          | 9             | 3    | 11    | 3.66  |
| Simple arch         | 12            | 4    | 38    | 12.66 |
| Twinned loop        | 17            | 5.66 | 19    | 6.33  |
| Exceptional arch    | 4             | 1.33 | 7     | 2.33  |
| Radial loop         | 2             | 0.66 | 7     | 2.33  |
| TOTAL               | 300           | 100  | 300   | 100   |



**Table 3:** Pattern of Ring finger in both hands

| Pattern             | Ring Finger |       |       |      |
|---------------------|-------------|-------|-------|------|
|                     | Left        |       | Right |      |
|                     | NO          | %     | NO    | %    |
| Plain Whorl         | 124         | 41.33 | 81    | 27   |
| Ulnar Loop          | 82          | 27.33 | 141   | 47   |
| Central Pocket Loop | 58          | 19.33 | 21    | 7    |
| Tented arch         | 7           | 2.33  | 18    | 6    |
| Accidental          | 4           | 1.33  | 8     | 2.66 |
| Simple arch         | 7           | 2.33  | 20    | 6.66 |
| Twinned loop        | 13          | 4.33  | 7     | 2.33 |
| Exceptional arch    | 4           | 1.33  | 3     | 1    |
| Radial loop         | 1           | 0.33  | 1     | 0.33 |
| TOTAL               | 300         | 100   | 300   | 100  |

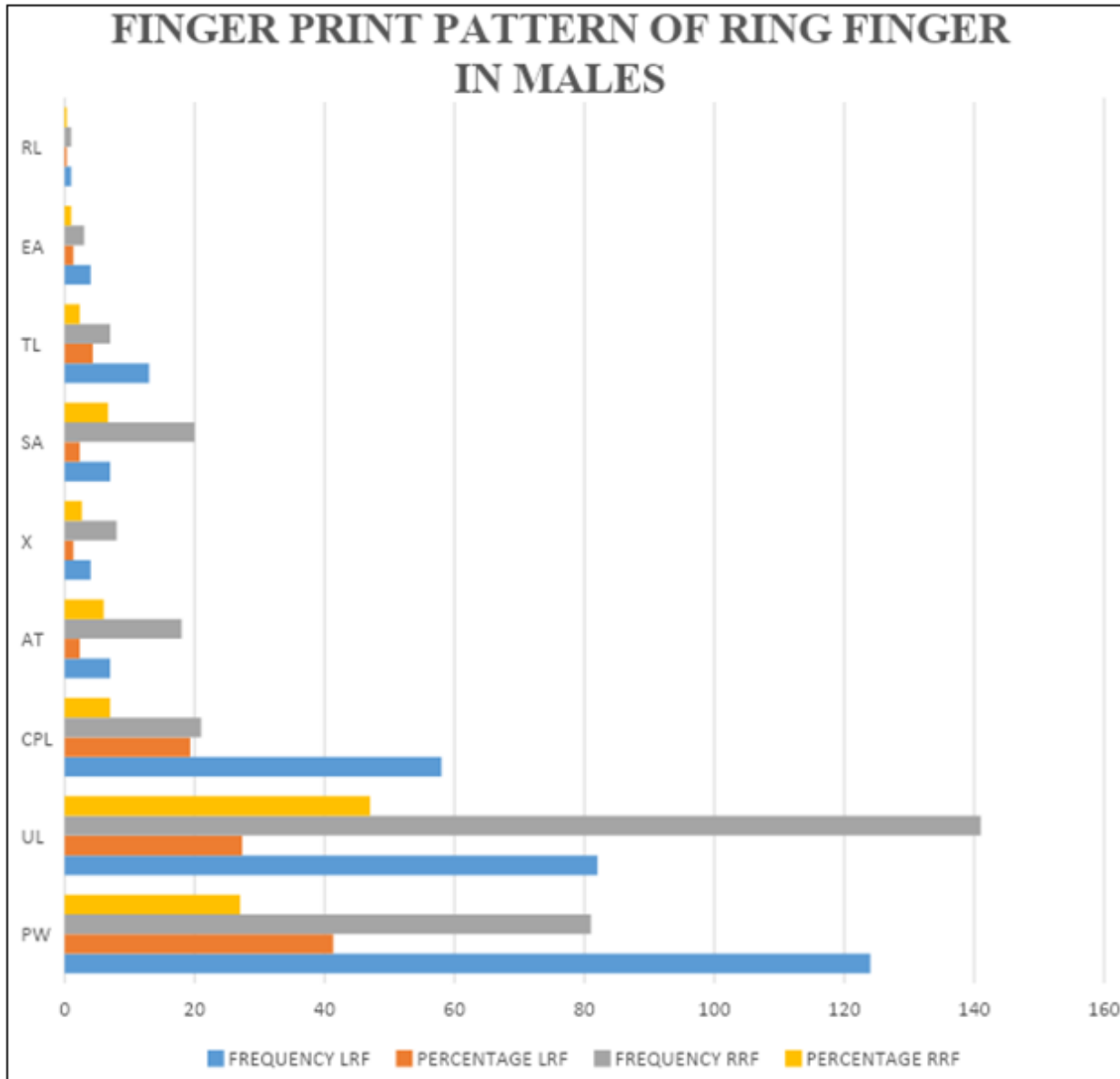


Table 4: Pattern of Middle finger in both hands

| Pattern             | Middle Finger |       |       |       |
|---------------------|---------------|-------|-------|-------|
|                     | Left          |       | Right |       |
|                     | NO            | %     | NO    | %     |
| Plain Whorl         | 52            | 17.33 | 87    | 29    |
| Ulnar Loop          | 151           | 50.33 | 118   | 39.33 |
| Central Pocket Loop | 23            | 7.66  | 56    | 18.66 |
| Tented arch         | 20            | 6.66  | 1     | 0.33  |
| Accidental          | 4             | 1.33  | 9     | 3     |
| Simple arch         | 20            | 6.66  | 13    | 4.33  |
| Twinned loop        | 25            | 8.33  | 9     | 3     |
| Exceptional arch    | 5             | 1.66  | 5     | 1.66  |
| Radial loop         | 0             | 0     | 2     | 0.66  |
| TOTAL               | 300           | 100   | 300   | 100   |

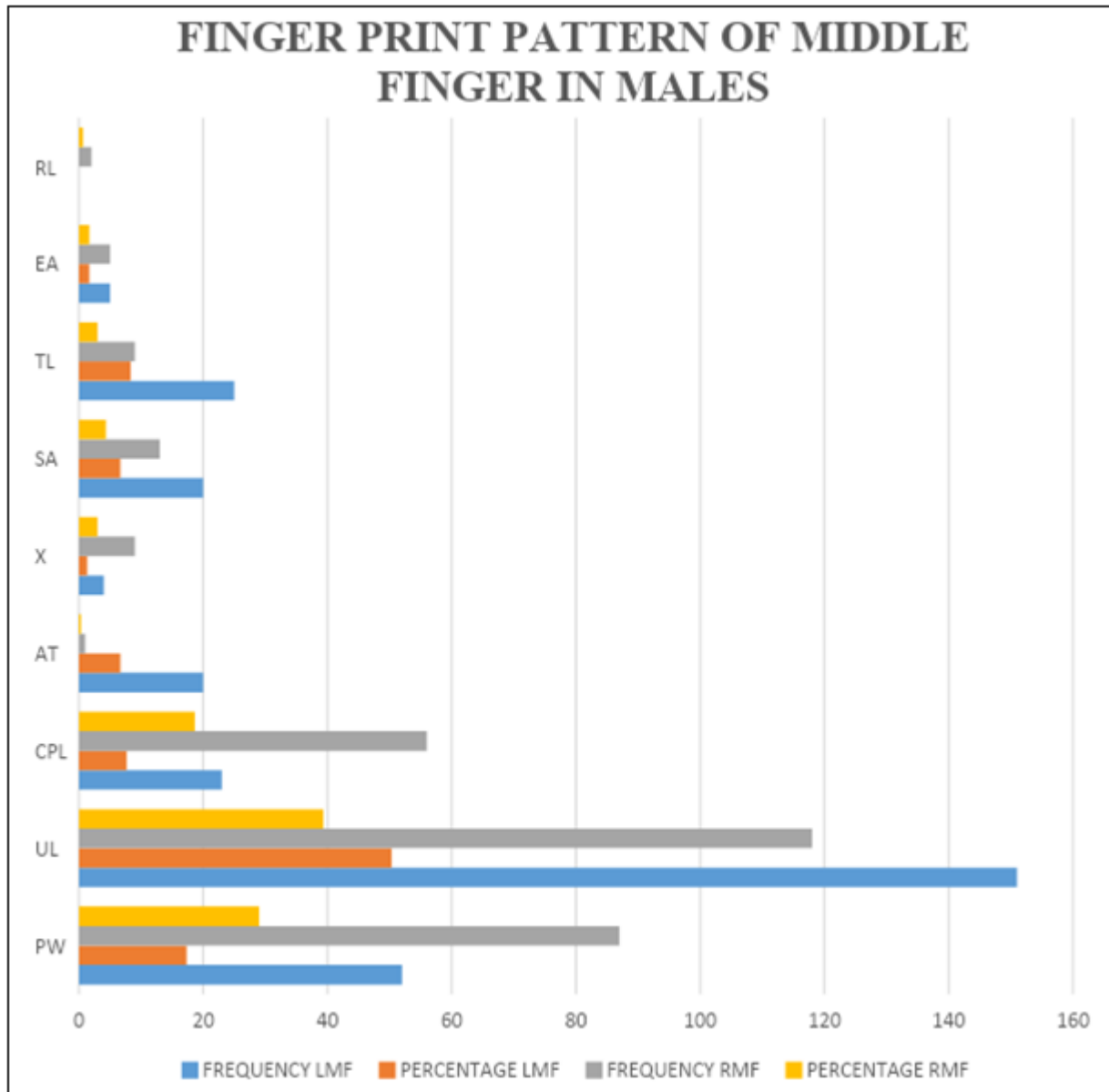


Table 5: Pattern of Index finger in both hands

| Pattern             | Index Finger |       |       |       |
|---------------------|--------------|-------|-------|-------|
|                     | Left         |       | Right |       |
|                     | NO           | %     | NO    | %     |
| Plain Whorl         | 71           | 23.66 | 60    | 20    |
| Ulnar Loop          | 81           | 27    | 157   | 52.33 |
| Central Pocket Loop | 21           | 7     | 23    | 7.66  |
| Tented arch         | 27           | 9     | 6     | 2     |
| Accidental          | 7            | 2.33  | 12    | 4     |
| Simple arch         | 49           | 16.33 | 15    | 5     |
| Twinned loop        | 18           | 6     | 12    | 4     |
| Exceptional arch    | 8            | 2.66  | 10    | 3.33  |
| Radial loop         | 18           | 6     | 5     | 1.66  |
| TOTAL               | 300          | 100   | 300   | 100   |

### FINGER PRINT PATTERN OF INDEX FINGER IN MALES

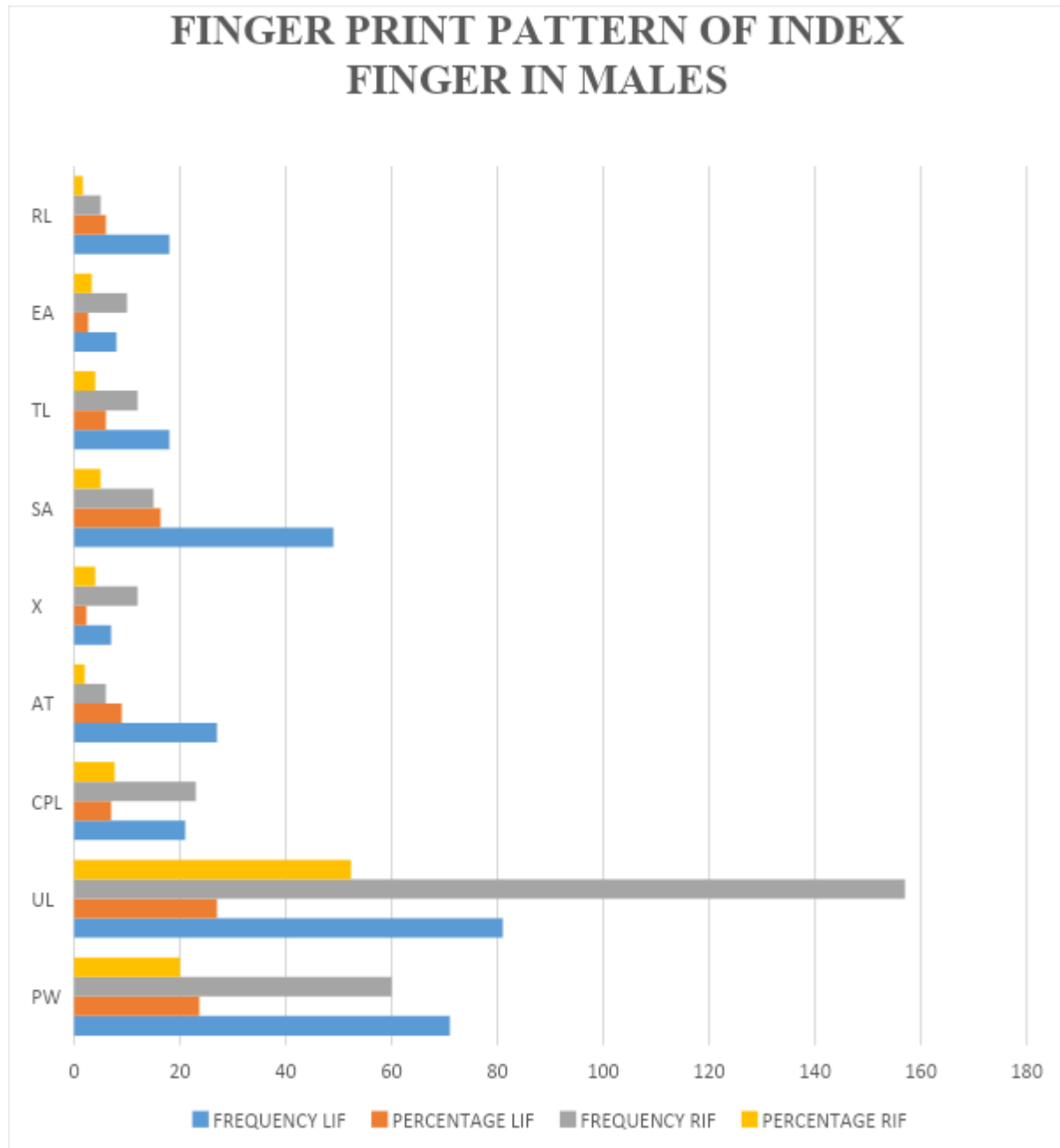
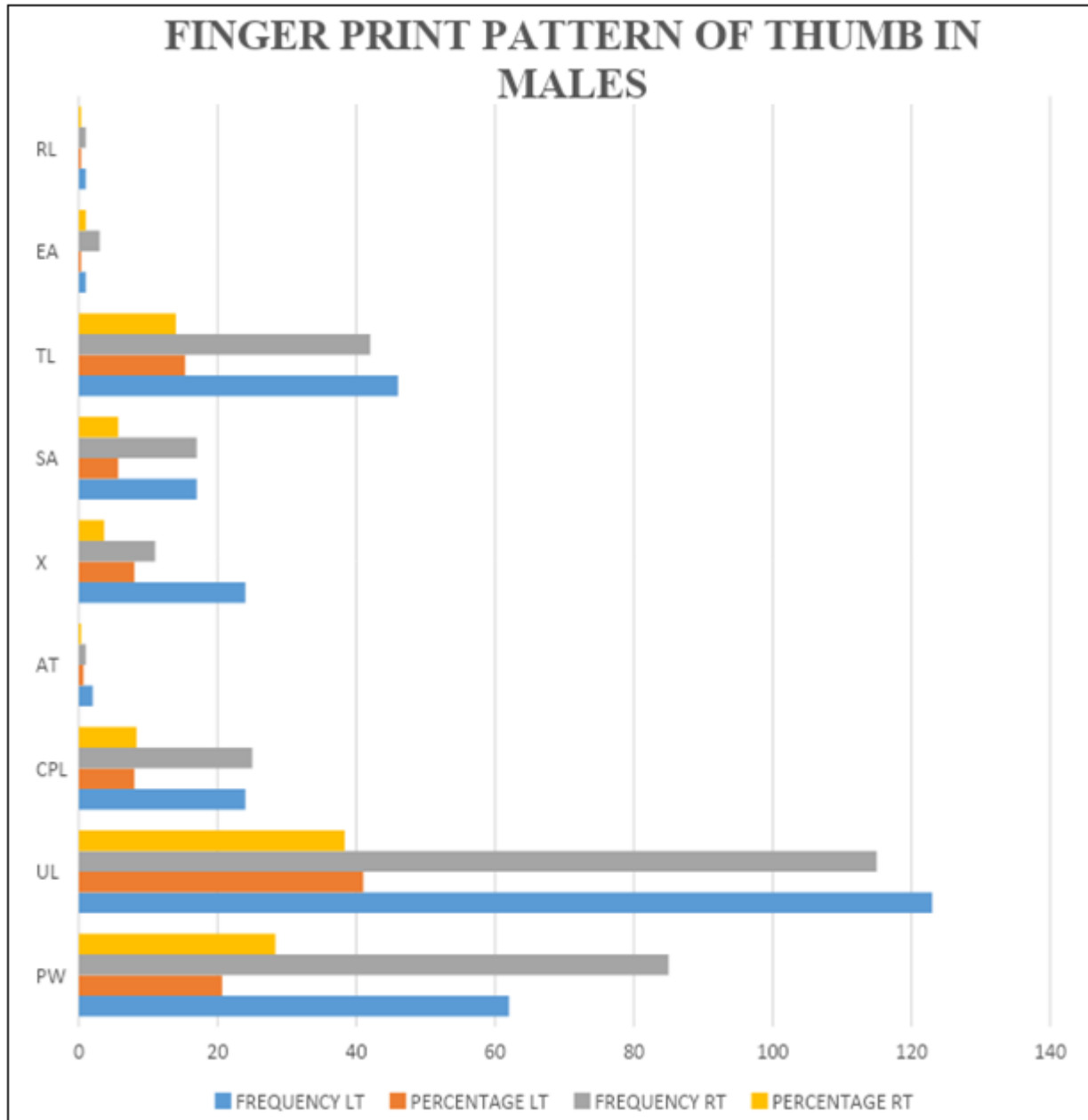


Table 6: Pattern of Thumb in both hands

| Pattern             | Thumb |       |       |       |
|---------------------|-------|-------|-------|-------|
|                     | Left  |       | Right |       |
|                     | No    | %     | No    | %     |
| Plain Whorl         | 62    | 20.66 | 85    | 28.33 |
| Ulnar Loop          | 123   | 41    | 115   | 38.33 |
| Central Pocket Loop | 24    | 8     | 25    | 8.33  |
| Tented arch         | 2     | 0.66  | 1     | 0.33  |
| Accidental          | 24    | 8     | 11    | 3.66  |
| Simple arch         | 17    | 5.66  | 17    | 5.66  |
| Twinned loop        | 46    | 15.33 | 42    | 14    |
| Exceptional arch    | 1     | 0.33  | 3     | 1     |
| Radial loop         | 1     | 0.33  | 1     | 0.33  |
| TOTAL               | 300   | 100   | 300   | 100   |



Fingerprint Patterns in Females

Table 7: Pattern of Little finger in both hands

| Pattern             | Little Finger |       |       |       |
|---------------------|---------------|-------|-------|-------|
|                     | Left          |       | Right |       |
|                     | No            | %     | No    | %     |
| Plain Whorl         | 60            | 20    | 51    | 17    |
| Ulnar Loop          | 185           | 61.66 | 133   | 44.33 |
| Central Pocket Loop | 17            | 5.66  | 29    | 9.66  |
| Tented arch         | 4             | 1.33  | 14    | 4.66  |
| Accidental          | 12            | 4     | 8     | 2.66  |
| Simple arch         | 8             | 2.66  | 34    | 11.33 |
| Twinned loop        | 13            | 4.33  | 21    | 7     |
| Exceptional arch    | 0             | 0     | 1     | 0.33  |
| Radial loop         | 1             | 0.33  | 9     | 3     |
| TOTAL               | 300           | 100   | 300   | 100   |

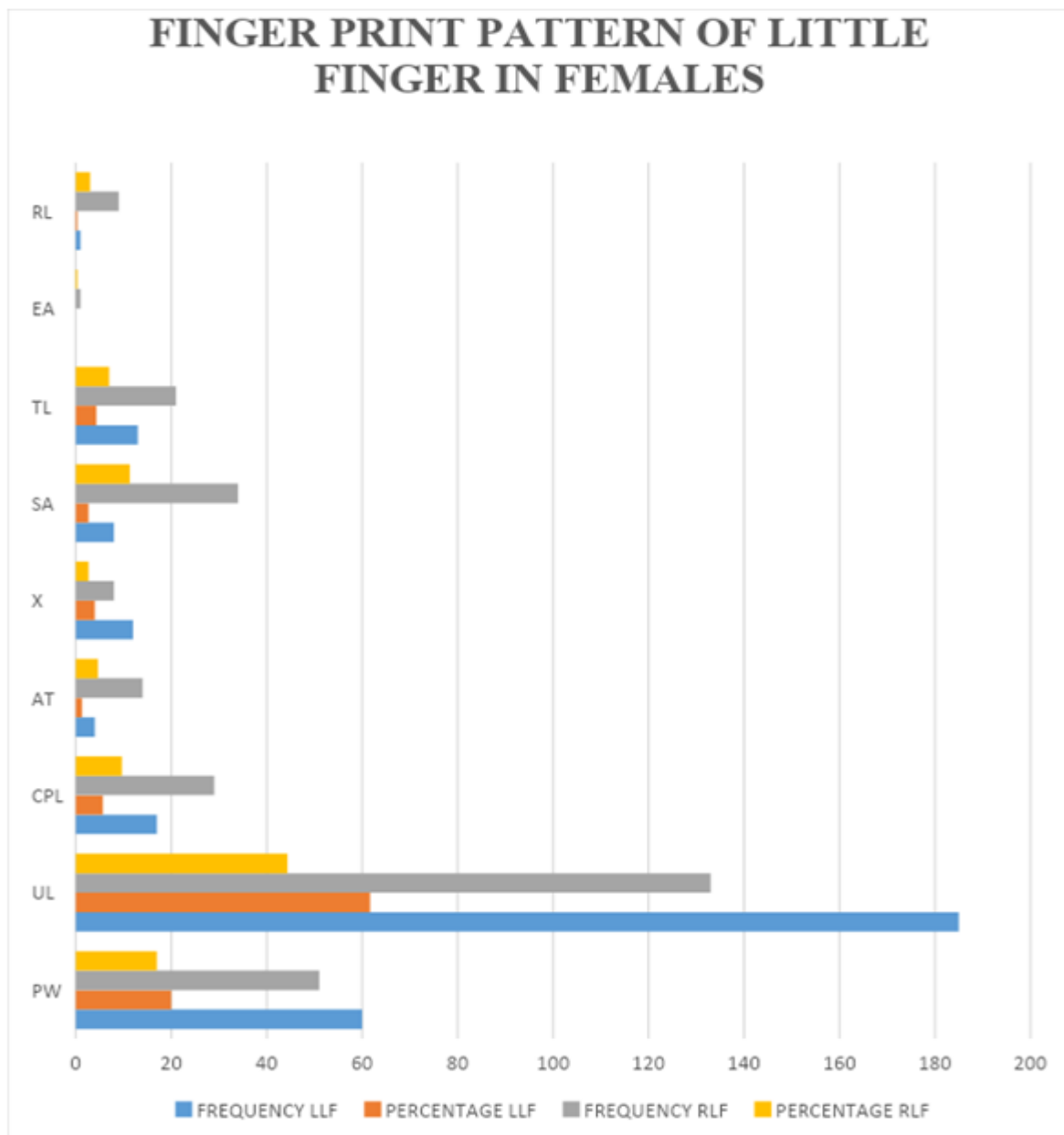


Table 8: Pattern of ring finger in both hands

| Pattern             | Ring Finger |       |       |       |
|---------------------|-------------|-------|-------|-------|
|                     | Left        |       | Right |       |
|                     | No          | %     | No    | %     |
| Plain Whorl         | 114         | 38    | 87    | 29    |
| Ulnar Loop          | 85          | 28.33 | 149   | 49.66 |
| Central Pocket Loop | 81          | 27    | 19    | 6.33  |
| Tented arch         | 2           | 0.66  | 11    | 3.66  |
| Accidental          | 1           | 0.33  | 9     | 3     |
| Simple arch         | 4           | 1.33  | 17    | 5.66  |
| Twinned loop        | 8           | 2.66  | 8     | 2.66  |
| Exceptional arch    | 4           | 1.33  | 0     | 0     |
| Radial loop         | 1           | 0.33  | 0     | 0     |
| TOTAL               | 300         | 100   | 300   | 100   |

### FINGER PRINT PATTERN OF RING FINGER IN FEMALES

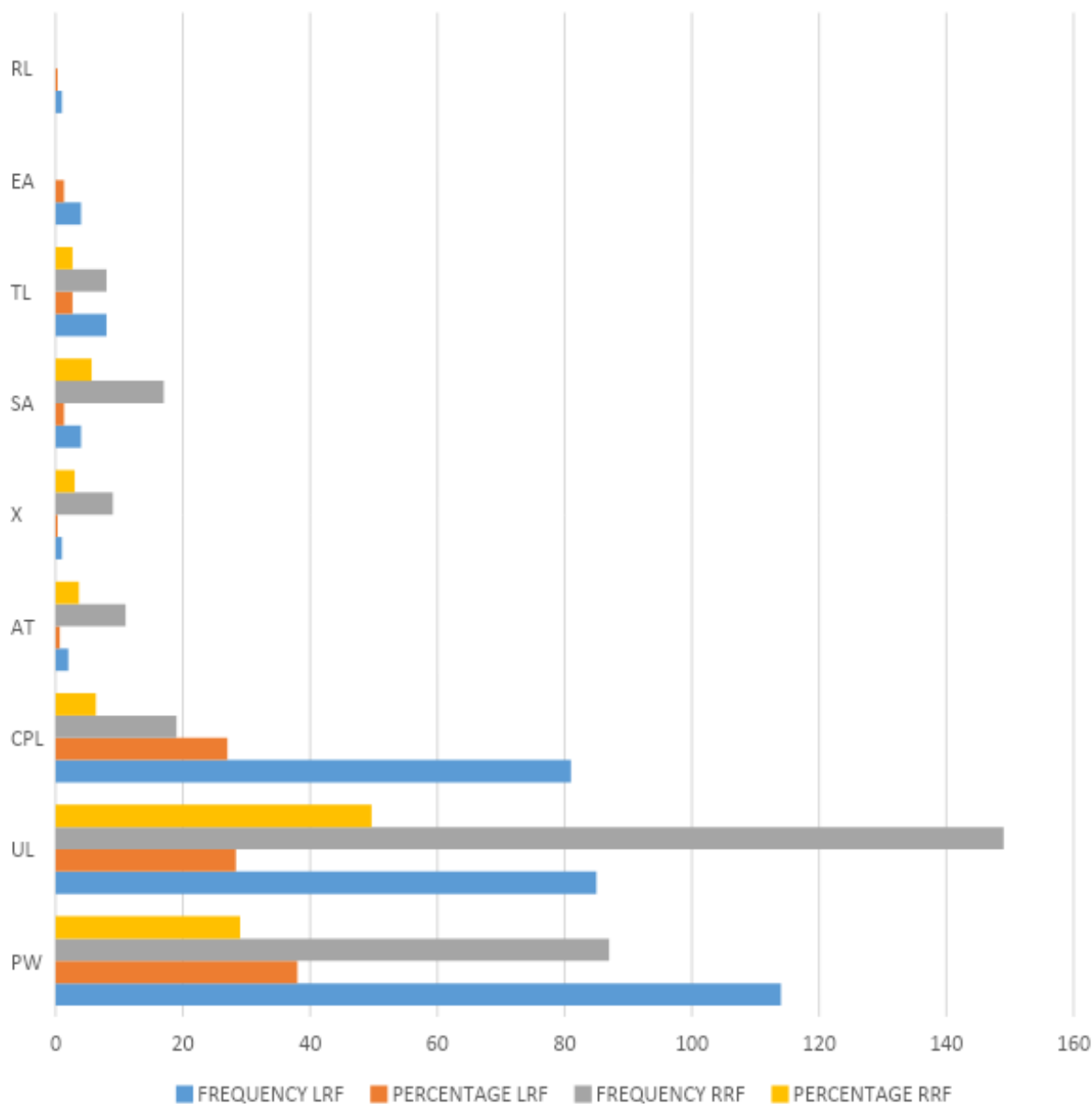




Table 9: Pattern of middle finger in both hands

| Pattern             | Middle Finger |       |       |       |
|---------------------|---------------|-------|-------|-------|
|                     | Left          |       | Right |       |
|                     | NO            | %     | NO    | %     |
| Plain Whorl         | 60            | 20    | 81    | 27    |
| Ulnar Loop          | 185           | 61.66 | 129   | 43    |
| Central Pocket Loop | 14            | 4.66  | 65    | 21.66 |
| Tented arch         | 8             | 2.66  | 2     | 0.66  |
| Accidental          | 6             | 2     | 4     | 1.33  |
| Simple arch         | 12            | 4     | 4     | 1.33  |
| Twinned loop        | 14            | 4.66  | 8     | 2.66  |
| Exceptional arch    | 1             | 0.33  | 3     | 1     |
| Radial loop         | 0             | 0     | 4     | 1.33  |
| TOTAL               | 300           | 100   | 300   | 100   |

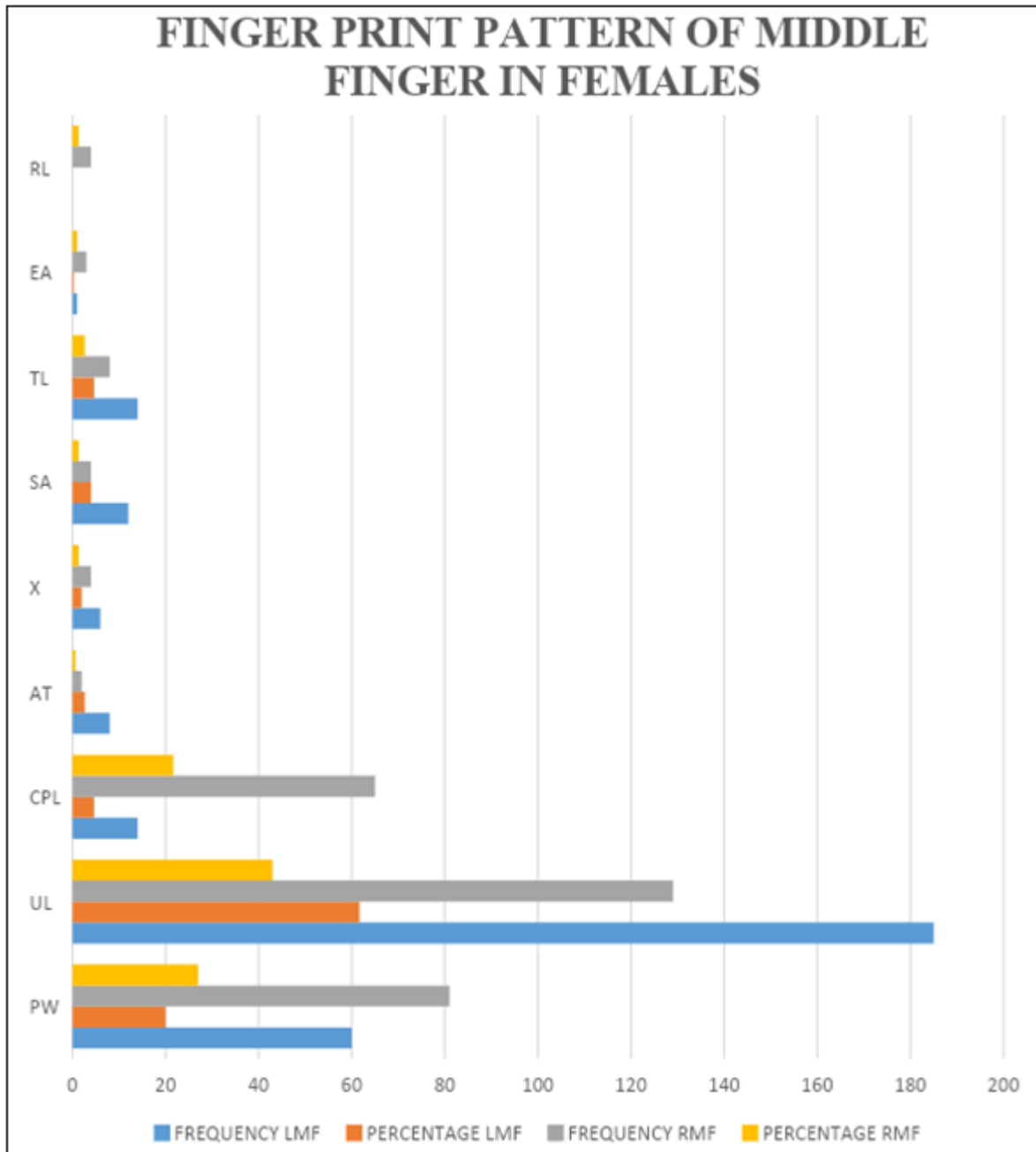


Table 10: Pattern of Index finger in both hands

| Pattern             | Index Finger |       |       |       |
|---------------------|--------------|-------|-------|-------|
|                     | LEFT         |       | RIGHT |       |
|                     | No           | %     | No    | %     |
| Plain Whorl         | 73           | 24.33 | 62    | 20.66 |
| Ulnar Loop          | 95           | 31.66 | 168   | 56    |
| Central Pocket Loop | 21           | 7     | 27    | 9     |
| Tented arch         | 26           | 8.66  | 2     | 0.66  |
| Accidental          | 5            | 1.66  | 10    | 3.33  |
| Simple arch         | 37           | 12.33 | 8     | 2.66  |
| Twinned loop        | 24           | 8     | 16    | 5.33  |
| Exceptional arch    | 2            | 0.66  | 3     | 1     |
| Radial loop         | 13           | 4.33  | 4     | 1.33  |
| TOTAL               | 300          | 100   | 300   | 100   |

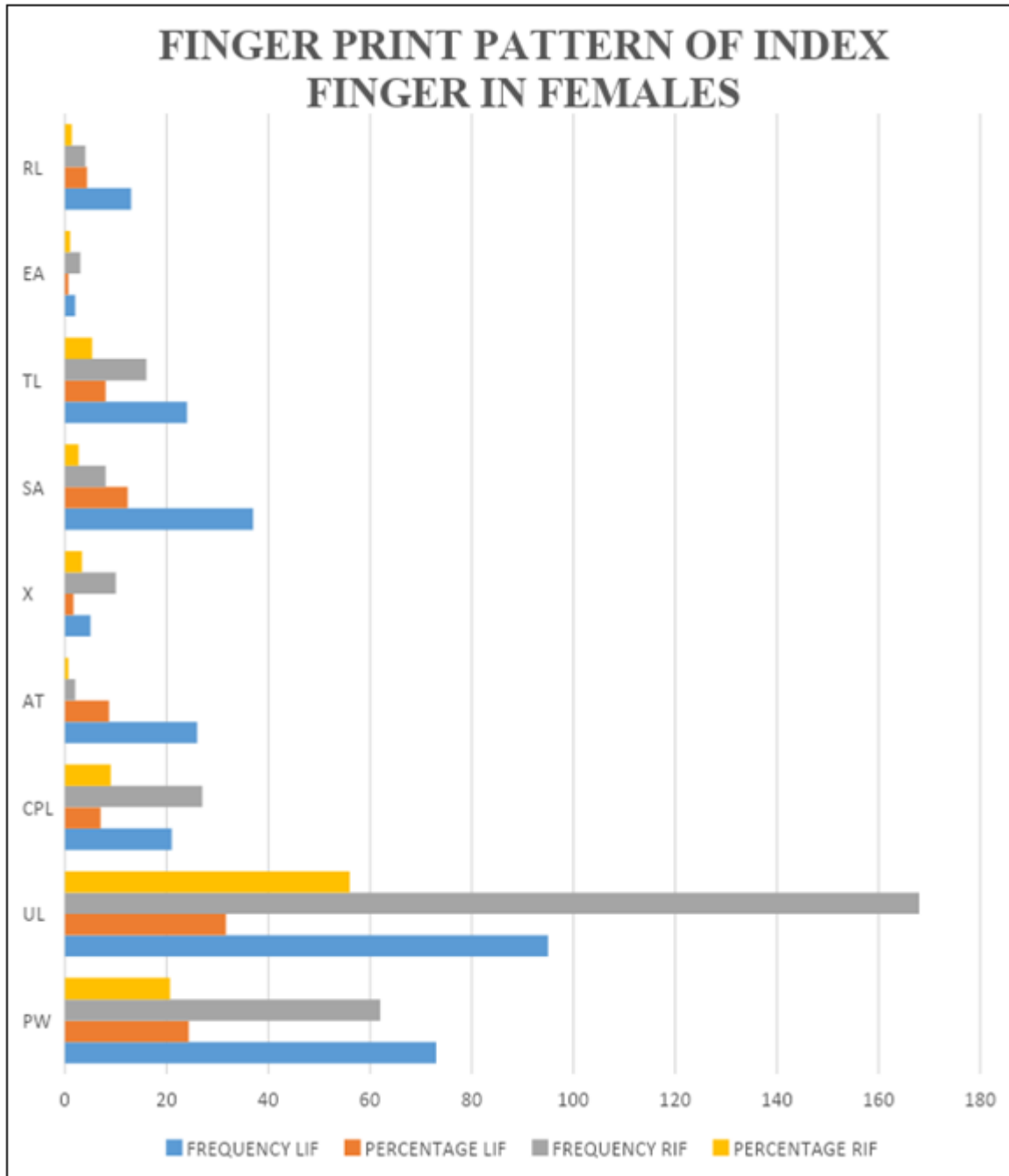
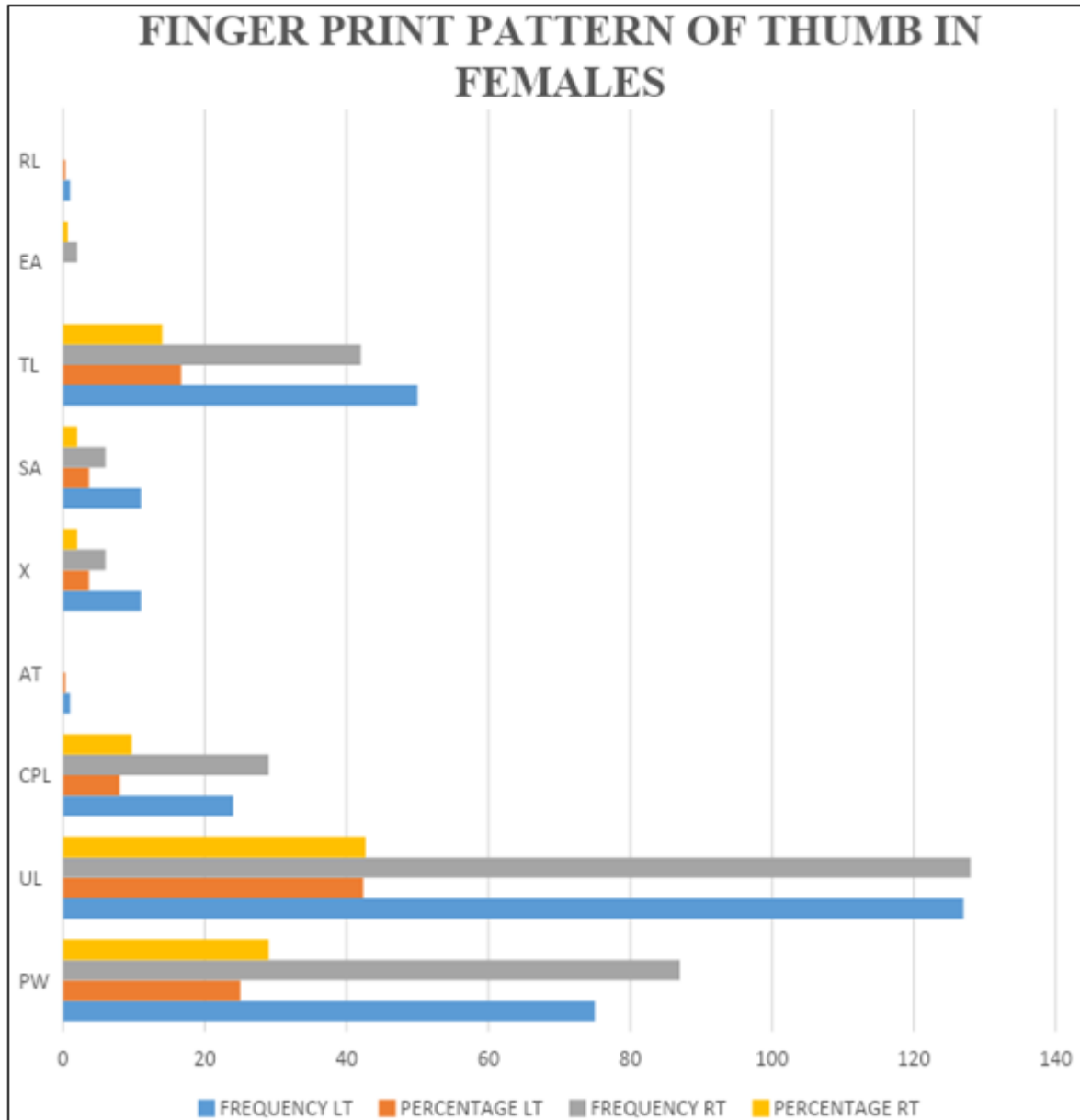
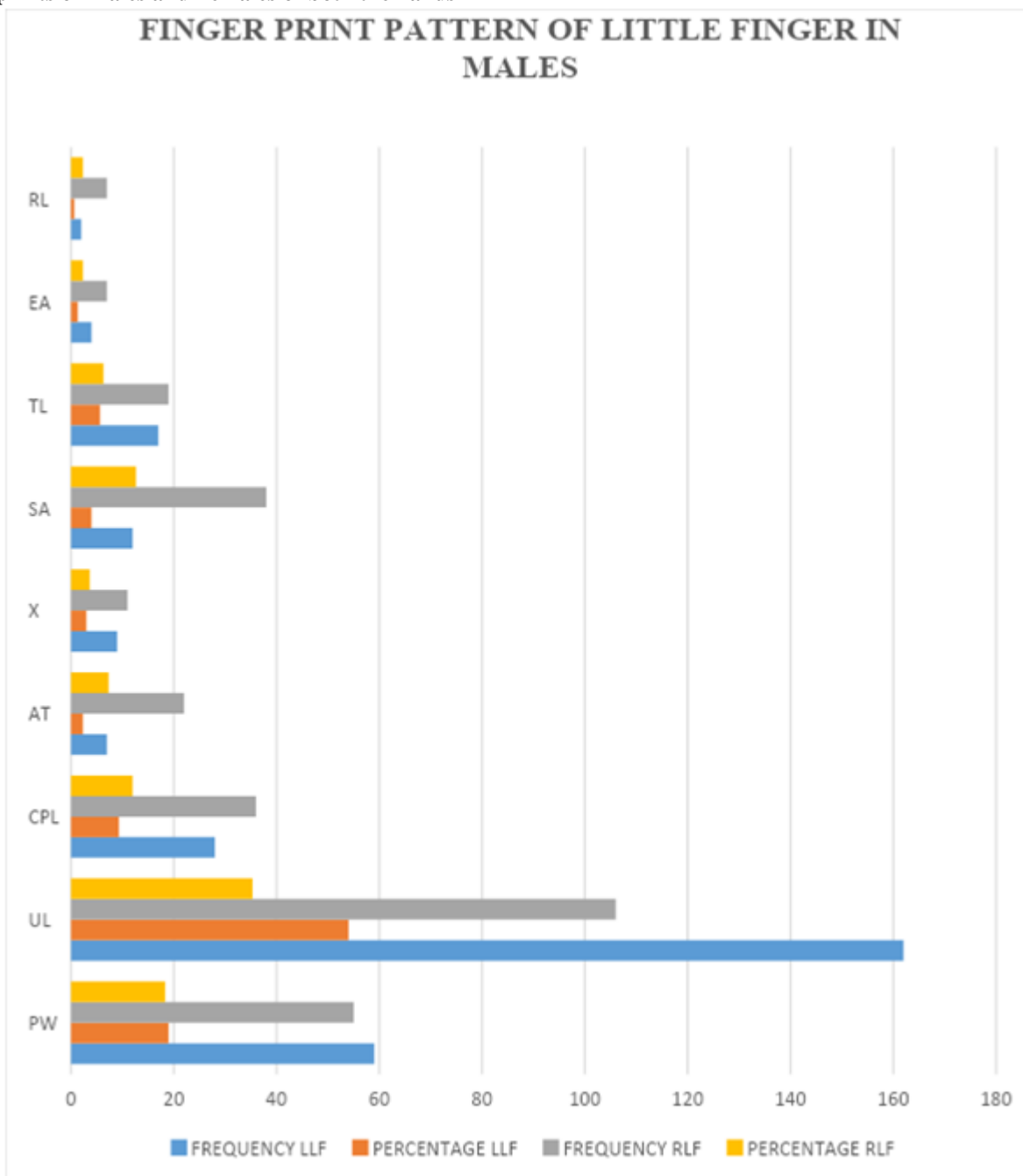


Table 11: Pattern of Thumb in both hands

| Pattern             | Thumb |       |       |       |
|---------------------|-------|-------|-------|-------|
|                     | Left  |       | Right |       |
|                     | No    | %     | No    | %     |
| Plain Whorl         | 75    | 25    | 87    | 29    |
| Ulnar Loop          | 127   | 42.33 | 128   | 42.66 |
| Central Pocket Loop | 24    | 8     | 29    | 9.66  |
| Tented arch         | 1     | 0.33  | 0     | 0     |
| Accidental          | 11    | 3.66  | 6     | 2     |
| Simple arch         | 11    | 3.66  | 6     | 2     |
| Twinned loop        | 50    | 16.66 | 42    | 14    |
| Exceptional arch    | 0     | 0     | 2     | 0.66  |
| Radial loop         | 1     | 0.33  | 0     | 0     |
| TOTAL               | 300   | 100   | 300   | 100   |



Fingerprints of Males and Females of both the hands



The predominant finger print pattern of males and females was Ulnar Loop (41.2 % among males and 46.13 % among females) followed by Plain Whorl (24.53% and 25%).

**4. Discussion**

The ability to identify a person through their fingerprints has long been acknowledged, and it is thought to have had the most impact on law enforcement. The science of fingerprints offers a special service in the administration of justice and other areas where accurate identification is crucial because to its significant properties [3].

The widespread usage of anthropometric means of identification immediately decreased as a result of the uniqueness of fingerprints being discovered, and fingerprints were soon adopted as a more effective form of identification

[6].

In the current study, the glass slab method of collecting fingerprints from 300 male and 300 female individuals was used. From August 2021 to February 2022, studies were conducted at Banaras Hindu University's Institute of Medical Sciences.

The predominant finger print pattern of males and females was Ulnar Loop (41.2 % among males and 46.13 % among females) followed by Plain Whorl (24.53% and 25%). Least noted pattern among both Male (1.66 %) and Female (0.63%) is Exceptional Arch.

**Frequency and Percentage of the Fingerprint Patterns**

In the current study, the ulnar loop and Plain Whorl were the two most often seen patterns across the entire subject

population in all 10 digits (Table 1 - 11). Simple arches, twinned loops, tented arches, radial loops, accidental kinds, and exceptional arches in both males and females were the least often detected patterns in the entire population.

Ulnar loops were found to be the most common type of digital pattern in both sexes by Igbigbi P. S. and Msamati B. C. research of dermatoglyphics on indigenous black Zimbabweans, followed by whorls in men and arches in women [7].

The recent study confirmed the findings of the aforementioned study, with the exception of female arch. However, the current research shows that males are more likely to have arches than females.

Loops (57.11%), whorls (27.19%), and arches (15.00%) were found to be the most prevalent types of basic finger patterns in the general population by Gangadhar. M. R, Rajashekara Reddy. K reported with a significant sex difference but an insignificant bilateral difference [8].

Purkait R. conducted a study comparing the fingerprint patterns of the Mundas and Lodhas, two different tribal groups from the Midnapur area in West Bengal, and found that the Mundas had a higher frequency of whorl and loop patterns, while the Lodhas have a larger frequency of loops [9].

Igbigbi P. S., Msamati B. C conducted another study on dermatoglyphics on indigenous black Zimbabweans, they found that ulnar loops were the most predominant digital pattern type in both sexes, followed by whorls in males and arches in females [10].

These results are almost exactly in line with those of the current investigation, which found that whorls followed loops.

The results of the earlier study concur with those of the current investigation. Ulnar loop is the most common fingerprint pattern across the entire population (both males and females) evaluated in the current study. The Ulnar loop frequency, out of 6000 analyzed digits, was found to be 2620. The frequency of the ulnar loop varies by gender in the current study as well (more in Females than in Males).

The distributional tendency of the three main pattern kinds, which include low arches, moderate whorls, and occasional loops, was described by Arabind Basu [11].

In comparison to the previous study, our investigation indicates the identical results, with the exception that central pocket loops take the role of arches. It is believed that each person's fingerprint is unique, although there is evidence of sexual dimorphism and regional diversity in fingerprint patterns after evaluating the findings of our observation and other studies.

## 5. Conclusion

Based on the analysis of fingerprints, the following conclusions were made:

- 1) Each person's fingerprints are unique and can be used to

positively identify a person.

- 2) There is no observable sexual dimorphism in fingerprints.
- 3) Ulnar loop is the most prevalent pattern among the people in the Varanasi region, both in terms of total population and sex distribution.

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