The distribution of fingerprint patterns with gender in Delhi, India Population –A Comparative Study

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Abstract:

Dactylography or Dactyloscopy is the study of fingerprints for the purpose of Identification. It is a progressing science and new methods are recording and developing. The potential for the examination to determine the sex and identification of an individual has been well documented and recorded. Identification using fingerprints is absolute and infallible. Few studies have been conducted and published using fingerprint patterns for the identification of distribution of fingerprint patterns among males and females. The aim of the present study is to establish the prevalent character in both sexes (male and female) in accordance to Indian population (North Delhi region) and then comparison was performed between the fingerprint patterns of the population. Material and Methods-This present study was conducted on 100 males and 100 females of Indian (North Delhi) population aged between 25-40 years. Rolled fingerprints were recorded using ink pad, and the identification of patterns was performed. Each subject was suggested to press their fingers uniformly on the ink stamp pad and then transfer the prints onto plain white paper. The major pattern and their subtypes were identified and analyzed for finding differences in gender. The data were tabulated and represented in graphical form.

Results and Conclusion -Loops were found to be of most common type of pattern in both males and females followed by whorls. Ulnar loops are predominant in finding in population. Further in the present study the patterns and their subtypes were compared and then tabulated which reveals a significant difference for each pattern.

Key Words: *Dactyloscopy, Ulnar loops, Gender Identification, fingerprint, fingerprint patterns*

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Introduction

Skin is the most important and largest organ of the body from which the entire human body is covered. Different functions were performed by skin throughout the life of an individual such as it protects and safe guards the body from unpredictable weather conditions, balance or maintains the temperature and it also prevents skin from external injuries. The appearance and texture of the skin which entirely covers the palmer surface of hand and planter surface of foot is completely different from rest of the human body. According to Hawthorne, 2009 fingerprint is an impression or reproduction left on any surface by the friction skin of the fingers. Fingerprints are considered as the most versatile and frequently found evidence at the crime scene, they can easily be found in many type of criminal cases such as burglary, murder, theft, rape etc. It is considered as a very significant and valuable evidence as this can be used in the Personal Identification for determining the suspect's identity, missing persons, victims of amnesia, mass disaster victims and insane persons etc. The elevated portion of the skin that left impression or reproduction is called friction ridges and furrows are the skin portion lower and between the ridges. Due to its permanency and uniqueness, fingerprints has highly individualistic nature, even twins do not have the same fingerprint pattern. Dermatoglyphics is the scientific study of friction ridges and their patterns produced on the palmer and the planter surfaces or the study of fingerprints that is done for the identification purpose is called as Dactylography. (Ranjan et al).The term Dermatooglyphics was first termed by Cummins and Midlo (1926) and William Herschel (1858) was the first who performed experiment with fingerprints for the Identification of an individual in India. This science is progressing and new methods are developing for recording, lifting under different field conditions in cases of deceased and living bodies (Sam et al 2015).Dr. Henry Faulds established the importance of fingerprints and an article was published in Nature 1880 and the first explainable study was performed by Sir Francis Galton in 1892 who is an English Anthropologist. The Galton's detail was further improved and classified by Sir Edward Richard Henry, Inspector General of Police for practically applying in the field of identification in 1890s (Ranjan et al, 2015).

The formation of pattern of human friction ridges starts forming when the fetus is in the womb at about 8th week of gestation and completely formed at 17th week. Sweat gland ducts start coming out or project upwards from the bottom of the primary friction ridges at 14th week. The formation of primary ridge formation ceases after 19th week and the appearance of secondary ridges are in the form of folds present in between the primary ridges. Between all primary ridges secondary ridges starts forming by 24th week of pregnancy and the space was invaded by dermal papillae in the space between primary and secondary ridges, that forms double rows. With the development of friction ridges, perspiration glands form. Then fingerprints starts becoming visible on the skin surface and the ridge system geometry does not change anymore for lifetime (Siegel and Mirakovits, 2016).Fingerprints can be used as the purpose of personal Identification because of three principles,

1. Uniqueness of fingerprint
2. Permanency nature of fingerprints unless there is a damage to the skin dermal layer
3. Classification of fingerprint patterns. (James et al, 2014).

Fingerprints show unique characters as no two individuals can have an identical pattern, even for twins as they share same DNA profiles. Galton in 1892 performed research work on anatomy, classification, heredity and racial variation and he classified the distal phalanges of the fingertips into three classes, Arch, Loop and Whorl. The chances of having identical finger patterns of two individuals is 1:64 billion. (Ranjan et al, 2015). After this division the fingerprint patterns are subdivided into five classes: - Arch, loop, whorl, Accidental (No specific pattern) and Composites.

Whorl   Loop   Arch

Figure no.1- Patterns of fingerprint (Original)

As per according to Abdullah et al, 2015 that two type of details in fingerprints are found referred to as global feature and local feature. The global characteristics gives the idea about the fingerprint pattern from which class it belongs and local ridges and the detail of valley gives information about the peculiarity of fingerprints. In this present study the global features found on the tips of finger were found and the fingerprints class was investigated. The pattern of fingerprint comprises of ridges and valleys, the black lines are ridges and the remaining is the white area between two adjacent ridges.

The fingerprints can be associated with criminology and in 1975, it has been used and accepted as an evidence for the purpose of recognizing the sex of a person. The gender identification of criminals from the scene of crime is a vital issue in narrowing down the suspects in forensic science (Abdullah et al, 2015).The determination of gender from fingerprints has been well documented and few studies have been conducted on the basis of fingerprint patterns for population identification. The frequency of fingerprint pattern distribution can describe the group or population (Koneru, et al, 2014).

Through this collection of fingerprints, database is made and then fingerprints from these database was compared with another person especially in case of criminal ,fugitives, missing persons etc. Currently, many studies have been carried out to recording and matching of fingerprints through computational software and this study is planned to determine the association between gender and the fingerprint ridge pattern and to validate that women or men tends to have high number of fingerprint patterns. The distribution of fingerprint patterns in males and females among Indian people especially in North India region was also studied. The objective of this study was to observing the distribution of pattern on different phalanges in case of males and females and to find out if any difference occur among both sexes for both hands.

Materials and Methods

Subjects

The study was carried out among 200 subjects (100 males and 100 females) of Indian population from Delhi belonging to the age group 25-40 years of age who has voluntarily participated in the study. The informed verbal consent was taken from each and the clearance of any ethical issue was obtained to carry out the study. The subjects who were having permanent scars on their thumb or fingers, with any deformities or disease due to injury, congenital defects or any disease or having any extra finger, webbed finger or bandaged finger were excluded from the study.

Figure 2 - Materials required for examination (originals)

Recording of fingerprints

For recording of fingerprints, Ink method was suggested by Cummins was used. Each subject was requested to wash hands with soap and water, wiped and dried using a towel to remove any type of dirt, grease or any foreign material. Then the subject was recommended to press fingertip on the ink pad or ink slab or stamp pad and then the inked fingerprint impression was transferred to the paper. The method was repeated in the same manner for fingers of both hands. On the fingerprint card, there is a separate section for rolled and plain prints so these impressions of fingerprints were taken on the respective blocks on the same sheet of paper. Care must be taken while recording or printing like avoiding sliding of fingers to prevent smudging of the print. After the fingerprints were obtained of all ten fingers as and were acquired details such name, sex and age were noted.
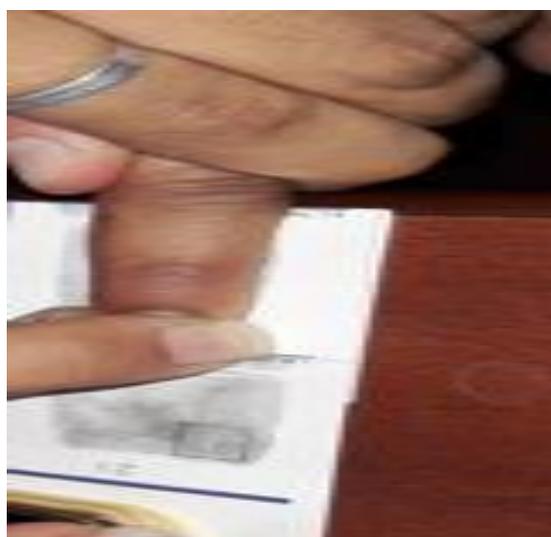

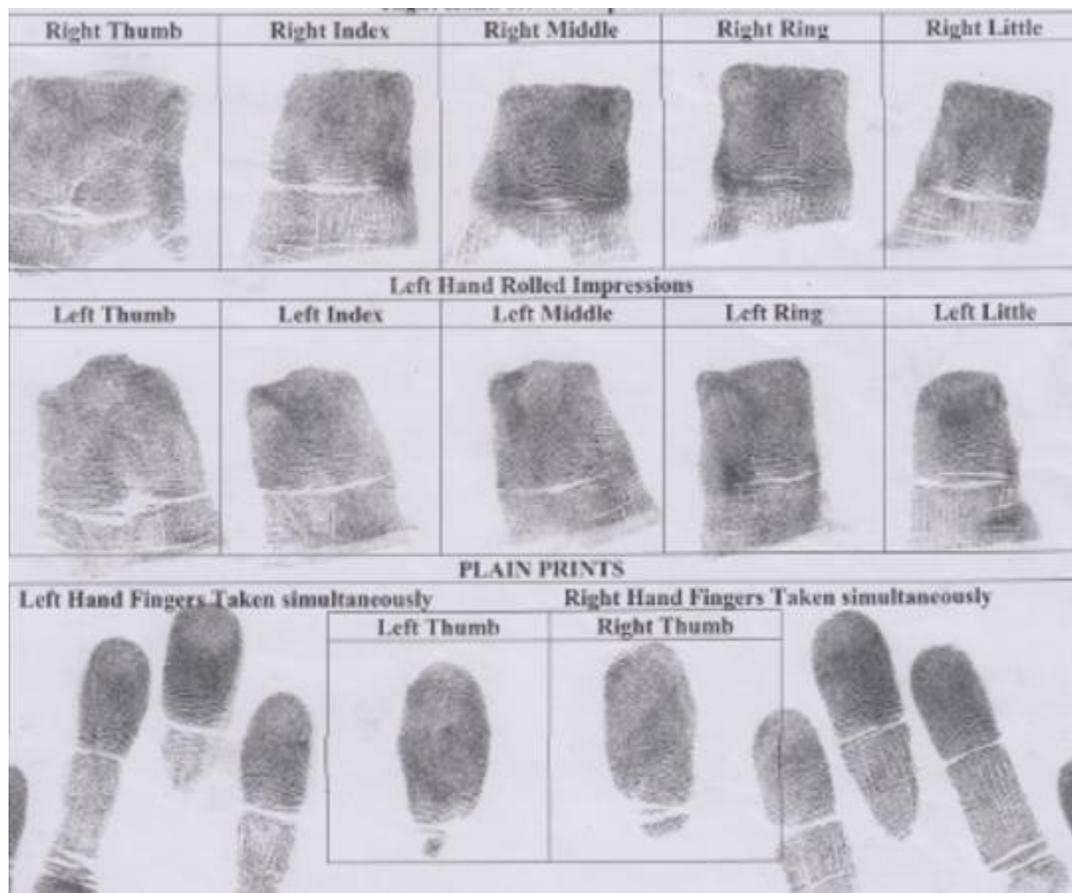**Figure 3-Method of recording fingerprints**

Figure 4 –Recorded fingerprints (Original)

Examination of fingerprints

The pattern of fingerprints were studied by using magnifying lens and were established as: Loop, Whorls and Arch that were studied on the basis of appearance of re curving ridges according to the Henry's system of classification. This system of Henry appoints a number to each finger according to the sequence in which it is positioned in the hand that begins with the right thumb (RT) as number 1 and ending at the little finger of left hand (LL) as number 10.The sequential distribution of fingerprint patterns in both hands of individuals and its linkage with sex of particular individual was evaluated and analyzed statistically. The data was prepared in a tabular form as the table contains different sections of Right Thumb, Right Index , Right Middle , Right Ring ,Right Little ,Left Thumb, Left Index, Left Middle , Left Ring ,Left Little fingers and the assign each section a pattern that a particular finger have.

Results

Rolled and plain impressions of fingerprints were collected of ten fingers of all the 200 subjects and a total of 200 samples were obtained. These 2000 samples were analyzed and the details of the pattern and their types are recorded for the appropriate determination. Among the 2000 fingerprint samples, 1130 were loops, 625 were whorl, 125 were Composites and 120 are arch pattern. The male and female fingerprint pattern distribution were examined and also recorded for further data arrangement. Out of 1130 patterns of loop obtained in this study, 1070 (94.69%) were Ulnar loop and 60 prints (5.31%) were belongs to Radial loop. And the same observation was observed and collected in case of both males and females.

In this study the obtained prints, out of 625 whorl patterns,383 were spiral whorls (61.28 %) ,157 were circular whorls (25.12 %) ,52 were double core whorls (8.32 %) and 33 (5.28%)were elliptical whorls.

The patterns of composite was also studied and recorded, out of 125 Composite patterns, 63 were twinned loop (50.4%) , 42 were lateral pocket loop

(33.6%) , 15 were accidental (12.00%) and 5 were central pocket loop (04.00%).

In cases of Arch pattern, out of 120 Arch pattern, 115 were Plain Arch (95.83%) and 05 were Tented Arch (4.16%).

As per according to this study, In males, the composite pattern that was not much observed is the Central pocket loop and the most observed pattern in the case of females was lateral pocket loop (9.4%).The tabulated description describes the distribution of fingerprint patterns in gender of an individual.

Table No. 1 –The distribution of fingerprint patterns

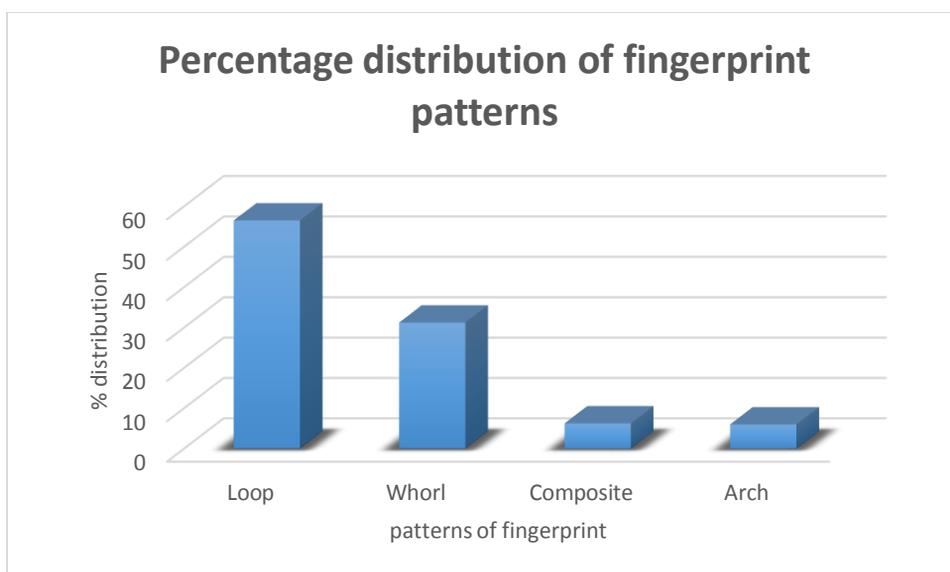| Fingerprint pattern	Occurrence of patterns	%
Loop	1130	56.5
Whorl	625	31.25
Composite	125	6.25
Arch	120	6.00
Total	2000	100

Figure 5 –Graph represents the percentage distribution of fingerprint patterns

Table No. 2-Distribution of fingerprint patterns in males and females

Fingerprint pattern	Male	Female
Loop	550 (48.67%)	580 (51.32%)
Whorl	325(52.00%)	300 (48.00%)
Composite	72 (57.6 %)	53 (42.4%)
Arch	53(44.16 %)	67 (55.83%)
Total	1000	1000

Percentage distribution of fingerprint patterns in males and females
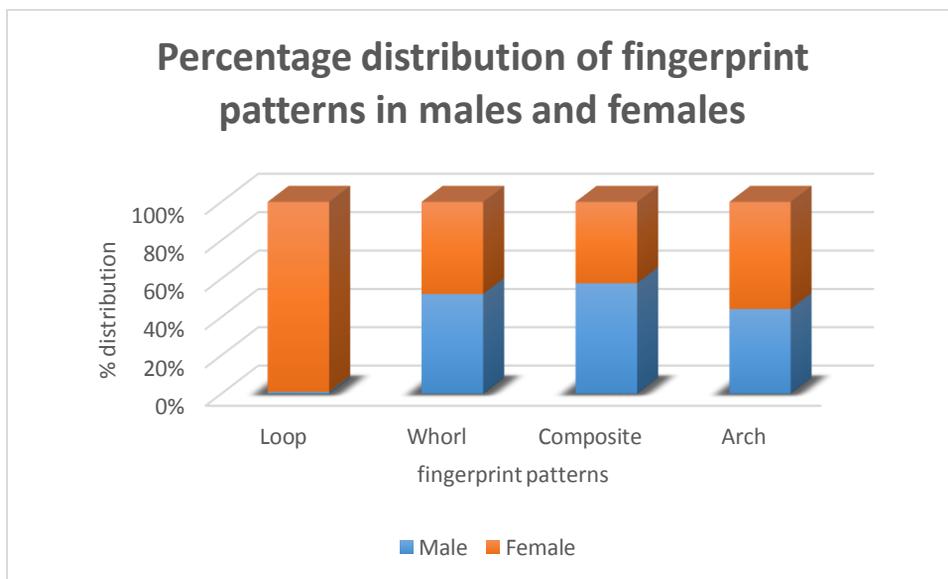

Figure 6 – Graph represents the percentage distribution of Fingerprint patterns in males and females

Table No.3 Distribution of loop patterns

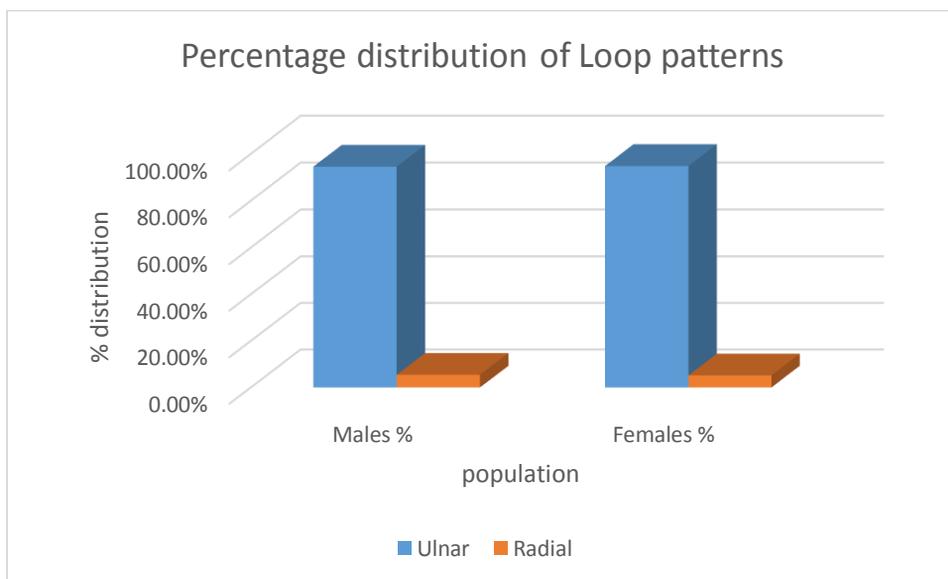| Loop pattern	Males %	Females %	Total
Ulnar	520 (94.54%)	550(94.82%)	1070
Radial	30 (5.45 %)	30 (5.17%)	60
Total	550	580	1130

Figure 7– Graph represents the Percentage distribution of loop patterns

Table No. 4 Distribution of Whorl patterns

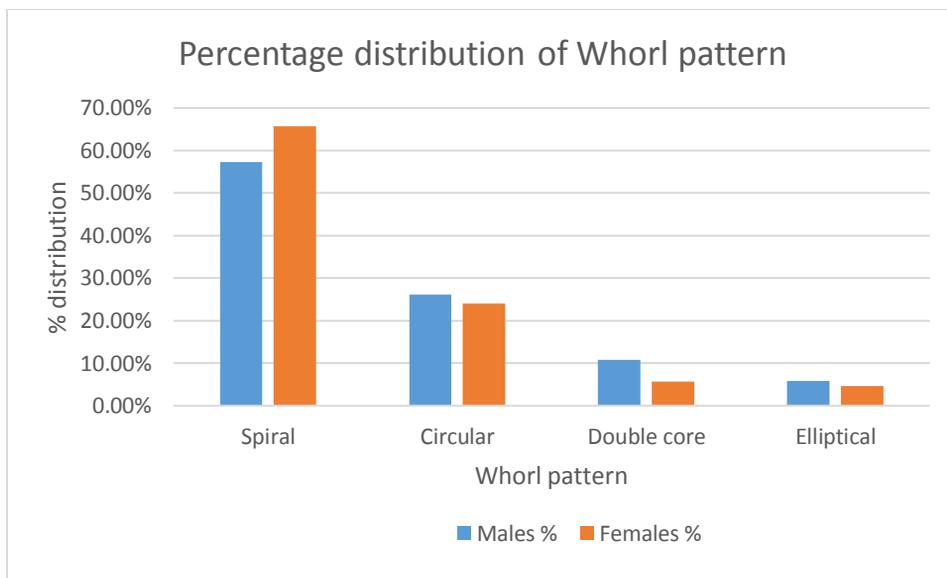| Whorl type	Males %	Females %	Total
Spiral	186 (57.23%)	197 (65.66%)	383
Circular	85(26.15%)	72 (24%)	157
Double core	35 (10.76%)	17 (5.66%)	52
Elliptical	19 (5.84%)	14(4.66%)	33
Total	325	300	625

Figure 8 – Graph represents the Percentage distribution of Whorl pattern

Table No. 5 Distribution of Composite pattern

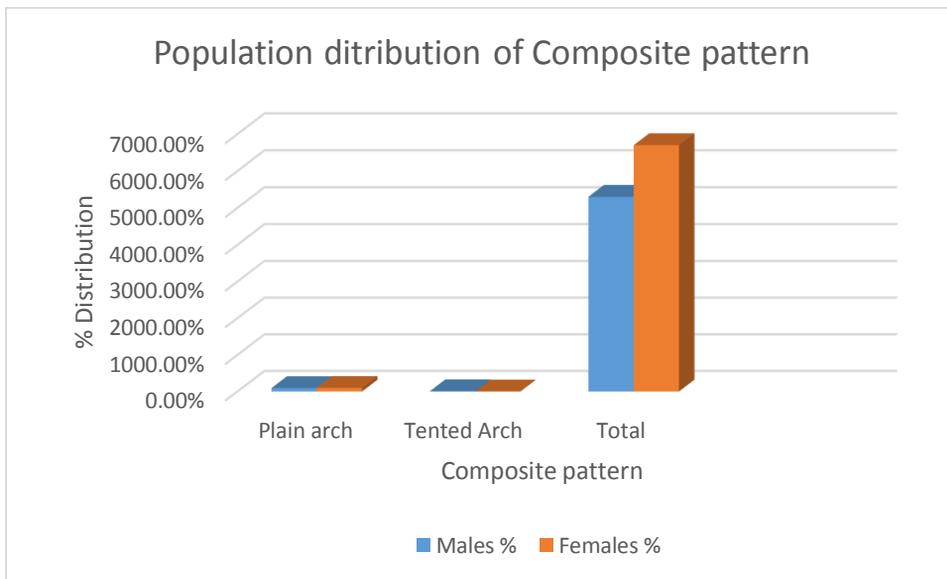| Composite pattern	Males %	Females %	Total
Twinned loop	46(63.88%)	17(32.07%)	63
Lateral Pocket loop	19(26.38%)	23(43.39%)	42
Accidental	07(9.72%)	08(15.09%)	15
Central Pocket loop	00(0%)	05(9.43%)	05
Total	72	53	

Figure 9 – Graph represents the percentage distribution of Composite pattern

Table No. 6 Distribution of Arch pattern

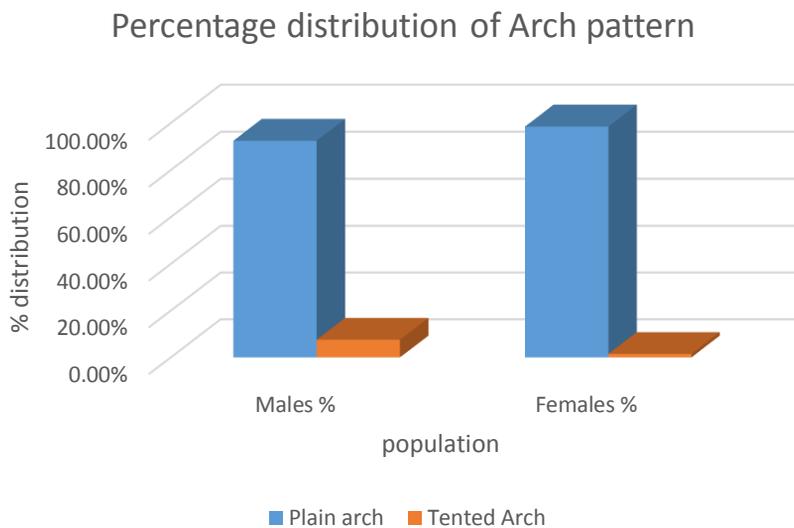| Arch pattern	Males %	Females %	Total
Plain arch	49(92.45%)	66(98.50%)	115
Tented Arch	04(7.54%)	01(1.49%)	05
Total	53	67	120

Figure 10- Graph represents the percentage Distribution of Arch patterns

Discussion

The objective of the study is to observe patterns of fingerprint patterns and their sequential distribution in Indian (North Delhi region).According to the study the more common type of pattern was found to be loop and the least common pattern was arch. Other studies were also published which deals with the prevalence of fingerprints and were compared with the present study. After comparing the previous data with the present database it was found that loop patterns are the most common patterns.

According to other researchers, the ubiquity of loop patterns is about 60-70% and the prevalence of loop patterns in case of Sam et al 2017, was 57.1% which is slightly a large figure in comparison to the present study i.e., 56.5%.

According to Sam et al 2017, The ubiquity of whorl and arch pattern is 28.9% and 7.2% respectively whereas the frequency of whorl and arch patterns is 31.25% that is greater and 06.00% that is lesser than Sam et al research.

The prevalence of composite patterns is found to be 6.25% which in comparison to other research are in between 1-5% and found higher in this study.

While determining the pattern distribution among males and females, the loop patterns are considered to be the predominant type of pattern. In males, the composite and arch are the second last and least common type of patterns.

The present study is being compared with the other studies, According to Nithin et al , 2009 who studies the distribution of fingerprint patterns in South Indians of Mysore observed and recorded the most common prevalence of Ulnar loops, followed by whorl, then composite, then arch pattern and the same study was observed in this study.

Gangadhar et al, 1993 researched the population of Karnataka state in accordance to fingerprint patterns

who reported that the predominance of loop patterns followed by whorls, by Jaga and Igbigbi in Ijaw subjects of Southern Nigerians,Igbigbi and Msamati in Kenyan and Tanzanian subjects and by Eboh in Anioma and Urhobo population of Southern Nigeria where ulnar loop followed by whorls and arches patterns were reported that was same reported in this present study.

According to Ching Cho in New Zealand,who observed that whorl pattern in the population predominates (60.6%) followed by Ulnar loops (38.65%) which disagrees with this present study as this study reports that loop patterns (56.5%)are present in most of the population followed by whorls (31.25%).Ghosh et al,2011 in Sunni Muslim population of Bengal ,Karmakar et al. in Muzziena Bedouin ,Singh et al in Rajputs of Himachal Pradesh studies the same as the occurrence of whorl pattern is common.

According to this present study the arch patterns were predominantly found in females and composite pattern are found in lesser amount in comparison to males.

Conclusion

In this present study, the distribution of fingerprint patterns and their sub divisions was made from which it was concluded that loop patterns are prevalent and predominant type in both males and females and Arch pattern are the least common type. The data was concise in tabular form and the graph was plotted to show the distribution of fingerprint patterns among males and females. The subtype of loop i.e., Ulnar loop were considered as the commonest fingerprint pattern in both males and females. Central pocket loop are the least common type of patterns in males whereas in females composite and tented arch are found to be the least common. This study enhances the necessity of fingerprint as an infallible tool for establishing Identity..

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