

**Original Research**

Statistical Analysis of Ridge Densities in Fingerprint as a Parameter for Identification of Sex

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Aman KumarEmail: dramankumarfmt@yahoo.in**Abstract**

Introduction: Study of fingerprint is known as Dactylography. It is the process of taking impression of papillary ridges of the fingertips.

Objective: The present study is based on Dactylography in which ridge densities in fingerprints is studied as a parameter for identification of sex.

Material and Method: The study was conducted on 500 healthy people (250 male and 250 female) between ages of 18 and 60 years. Fingerprints were taken using Glass slab inking roller method. The type of fingerprint pattern and ridge density in these patterns was analyzed for sex identification.

Results: The loop pattern of fingerprint was found in in majority (61.20%) of cases. This study also revealed that fingerprint ridge density in female is 13.42 in comparison to male 11.97.

Conclusion: The highest frequency of fingerprint pattern among male and female is Loop (61.20%), and Ridge density in female is more than male.

Keywords: Fingerprint, ridge density, identification.

Introduction

Identification means fixation of Individuality of a person. It is classified as complete (Absolute) or Incomplete (Partial). The criterion for Identification has been termed as Primary & Secondary. The Primary criteria include Fingerprints, DNA, dental characters. The secondary criteria include deformity, marks & scars, X-Rays, personal effects & distinctive

clothing. Fingerprint system is the most reliable method for identification. Study of fingerprint is known as Dactylography or Dactyloscopy. Dactylography is the process of taking the impression of papillary ridges of the fingertips. The present study is based on Dactylography in which ridge densities in fingerprints is studied as a parameter for Identification of sex.

Aim & objectives

1. To observe the ridge densities in fingerprints pattern in the person residing in IGIMS, Patna
2. To observe any pattern correlation with gender
3. To observe the gender variation in respect of ridge count

Material & Method

The study was conducted on 500 healthy people, 250 male & 250 female, residing in the campus of IGIMS Patna, Age between 18 years & 60 years. Consent was taken from people.

Exclusion criteria: Person outside of IGIMS, Patna, who refuse consent, Age less than 18 yrs.& more than 60 yrs., evidence of disease or injury leading to change in fingerprint pattern & students studying in IGIMS, Patna were not included in the study.

Materials

1. Cotton Swab
2. Glass plate
3. Fingerprint pads with black Ink
4. Ink roller
5. Magnifying glass
6. Fingerprint ridge counter
7. Measuring ruler

Participants were asked to wash their hand with soap and water and keep his/her arm relax to avoid smearing. The finger bulbs were rolled out on the fingerprints pads in Fingers out Thumb in method.

In this way for each and every individuals the entire prints ten fingers were obtained in the allotted space for that finger on the Proforma. The upper portion of the radial side of the central core region of the prints was chosen for Analysis. A 5mm x 5mm area was drawn on a transparent film & placed on fingerprint samples in the chosen area. The epidermal ridge from corner of the square to the diagonally opposite corner was counted in square only & fingerprints pattern was observed in whole impression.

Results

A Total 500 (250 male + 250 female) person participated in this study. Loop pattern of fingerprint is the most common 306 (61.20%), followed by whorl 140 (28.20%), Arches 42(8.40%) & composite was found in 11(2.20%) participants. Mean fingerprint ridge density 125 mm² in female is 13.97 & 11.97 in male. In Table 3 & figure 3 shows the observation & t value of fingerprint ridge density in Right hand thumb, index, middle, ring & little finger (male & female) is 14.02, 11.79, 11.09, 9.91, 8.39 respectively, which is statistically significant (p value < 0.001). In Table 4 & figure 4 shows the observation & t value of fingerprint ridge density in Left hand , thumb, index, middle, ring, & little finger is 13.95, 13.69, 10.38, 11.79, 16.62 respectively which is statistically significant (p value < 0.001). In Table 5 shows the comparison of mean fingerprint ridge density in male & female was statistically significant with t – value of 30.996.

Table.1 Pattern of Fingerprint

Pattern	Male	Female	total
Loop	152 (30.4%)	154 (30.8%)	306 (61.2%)
Whorls	69 (13.8%)	72 (14.4%)	141 (28.2%)
Arches	23 (4.6%)	19 (3.8%)	42 (8.4%)
Composite	6 (1.2%)	5 (1%)	11 (2.2%)
	250 (50%)	250 (50%)	500 (100%)

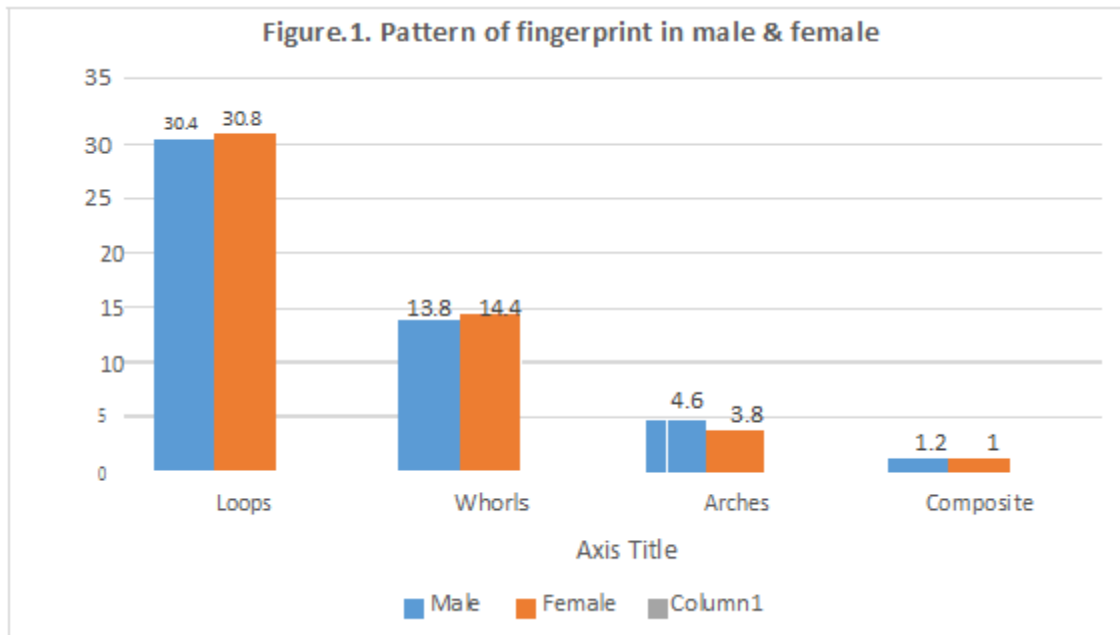


Table.2 Mean fingerprint ridge density in male and female

Gender	Mean FP ridge density/25 mm ²
Male	11.97
Female	13.42

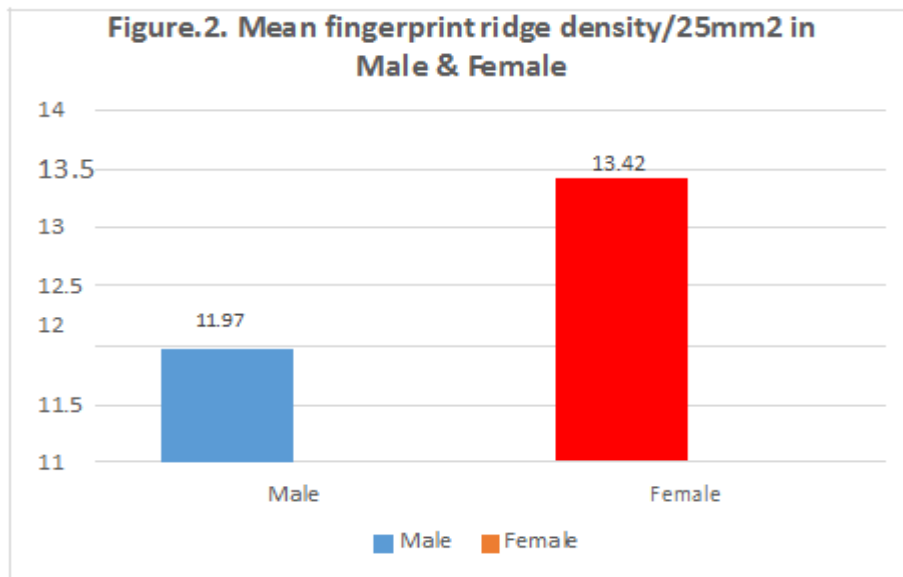


Table.3. Comparison of fingerprint ridge density (right fingers)

Finger	Mean density		t value	P value
	Male	Female		
Thumb	12.16 ± 1.22	13.51 ± 0.91	14.02	<0.001
Index	12.28 ± 1.24	13.28 ± 0.78	10.79	<0.001
Middle	12.33 ± 1.28	13.40 ± 0.83	11.09	<0.001
Ring	12.37 ± 0.99	13.20 ± 0.88	9.91	<0.001
Little	12.44 ± 1.60	13.48 ± 1.13	8.39	<0.001

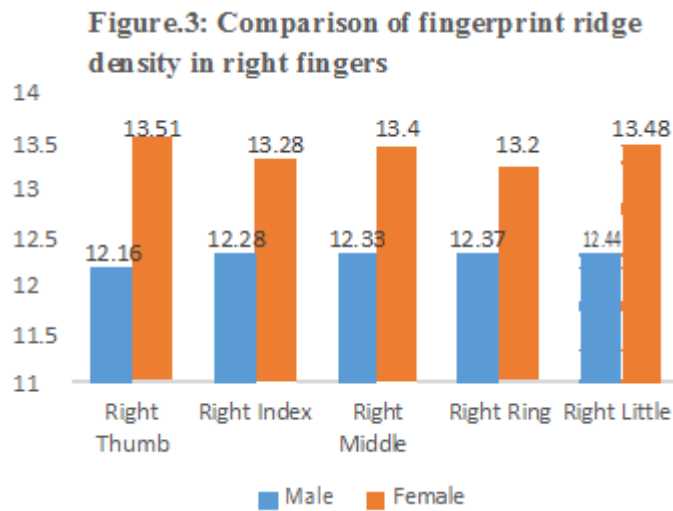
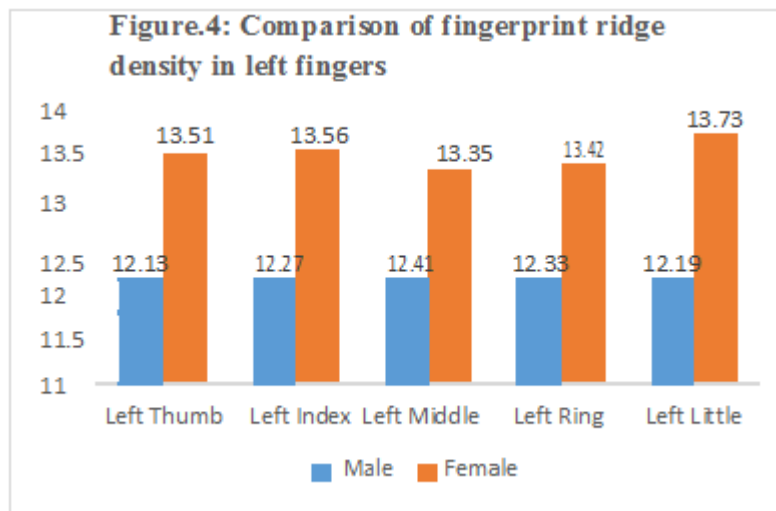


Table 4 Comparison of fingerprint ridge density in left fingers

Finger	Male	Mean density	t value	P value
		Female		
Thumb	12.13 ± 1.25	13.51 ± 0.94	13.95	<0.001
Index	12.27 ± 1.21	13.56 ± 0.87	13.69	<0.001
Middle	12.41 ± 1.18	13.35 ± 0.81	10.38	<0.001
Ring	12.33 ± 1.23	13.42 ± 0.79	11.79	<0.001
Little	12.19 ± 1.20	13.73 ± 0.84	16.62	<0.001



Discussion

Study of fingerprint is called Dactylography. At the end of 20th week of gestation period fingerprints are permanently developed, while it starts to develop in 13th week of gestation. Fingerprint pattern distribution has been estimated that chances of 2 persons having identical fingerprint impression are about one in sixty four thousand Million population of the World. And even the fingerprints of identical twins are not similar. In Ancient India, ridge pattern study was known as “Samudra Shastra”. The epidermal ridge

pattern was classified into “Chakra, Shankya and Padma” which corresponds with the Whorl, Loop, and Arch system of modern classification.

The present study showed the Loop pattern was most frequently observed followed by Whorl, Arches, Composite (Table 1 & figure 1). Gangadhar. M.R, Rajashekhara Reddy.K et al reported that Loop pattern (57.11%) were more common followed by whorls (27.89%) and Arches (15.00%) in general population with significant sex difference. A comparative estudy conducted by Prukit R et al, on Tribal population of Midnapur

district in West Bengal found that Mundas having higher frequency of whorl and loop patterns while loops are more common in Lodhas. Nithin V et al found in his study that ulnar loop fingerprint pattern is the most common in total population along with the sex wise distribution. These findings are similar with the present study findings loop, followed by whorl, Arches and Composite. In respect to gender wise mean ridge density in male and female: In our study found that females having ridge density of 13.42/mm² whereas males having 11.97/25 mm² (Table 2 & figure 2). Similar to this study Nayak VC et al reported on Malaysian and Chinese population that Malaysian male having 11 or less ridge density and 13 ridge density in female, where as in Chinese population ridge density of 12 are more likely of males and 13 or more ridge density are of females. Dr. Sudesh Gungadin concluded in his study that mean ridge count of 13 in male and 14 ridge count in female, which is again similar to this study. A study conducted by Sandeep V. Binorkar et al in Nanded district of Maharashtra concluded that in females the distance between the two ridges is less and or thin as compared to male therefore responsible for higher ridge density in comparison to males, which is similar to present study. Contrary to this study, Sayed Yunus Khadri et al concluded that the mean ridge count in male (12.4) is slightly more than female⁽¹²⁾. Reddy observed that mean ridge count in male is 13.41 and 12.04 in female, in comparison to this study, our study differs. A study conducted on Spanish Caucasian revealed that ridge density in male is less than 16 and in female equal or more than 17, again supported this study as female has more ridge count than male.

Conclusion

The uniqueness of fingerprint pattern is more reliable method of Identification. The fingerprint pattern studied among 500 persons in IGIMS Patna is as follows: The highest frequency of fingerprint pattern among male and female is Loop (61.20%) and Composite (2.20%). Mean ridge density in female is more (13.42) in comparison to male

(11.97). Thus it is concluded that ridge density in fingerprint pattern is the best parameter for identification of sex.

References

1. Vij K. Textbook of Forensic medicine, principles and practice 1st Ed. New Delhi: Churchill Livingstone Pvt; 2001:62.
2. Nandy A principles of Forensic medicine 1stEd. Kolkata: New Central Agency 1995; 92.
3. Kahn HS, Graff M, Stein AD, Zybert PA, McKeague IW, Lumey LH. A fingerprint characteristic associated with the early parental environment. AM J Hum Biol. 2008; 20(1): 59 – 65.
4. Payne – James, Jones, Karch, Marlove. Simpson's forensic medicine. 13th Ed, New York; CRC Press, 2014:36.
5. Modi JP, Modi's Medical Jurisprudence and Toxicology, 22nd Ed. Noida: Lexis Nexis Butterworths; 2002:37, 39, 40 & 72.
6. Gangadhar. M. R, RajashekaraReddy.K (1983) – Fingerprint Dermatoglyphics of Adikarnatakas: A Scheduled caste population of Mysore city, Karnataka, man in India 83(1 & 2): 183 – 193.
7. Prukit R fingerprint classification; A comparative study among Mundas & Lodhas. JMFT 2003 vol. 14, no.1; 31-32.
8. Nithin V study of fingerprint classification and their gender distribution among South Indian population Journal of Forensic and legal medicine. 2009; 16 (8): 460 – 463.
9. Nayak VC et al. sex differences from fingerprint ridge density in Chinese and Malaysian population. Forensic. Sci. Int. 2010; 197 (1): 67 – 69.
10. Gungadin S. sex determination from fingerprint ridge density. Internet Journal of Medical update. 2007; 2(2): 4 – 7.
11. Sandeep V Binorkar. Study on fingerprint pattern and gender distribution in and around Nanded district of Maharashtra state. Eur J Forensic Sci, Jan-Mar 2017, Vol 4, Issue 1

12. Sayed Yunus Khadri et al. A study of fingerprint pattern and gender distribution of finger print in and around Bijapur. Al Ameen J Med. Sci. 2013; 6 (4): 328 – 331.