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A STUDY OF FINGER AND PALM PRINT PATTERNS OF THELODHA POPULATION OF WEST MEDINIPUR, WEST BENGAL, INDIA

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Abstract: The scientific study of the pattern of epidermal ridges is known as dermatoglyphics. The ridge pattern of fingerprints develops in intrauterine life and remains the same until death before being altered by decomposition. Dermatoglyphics can be used for various purposes, especially in personal identification and population variation studies. A cross-sectional study was conducted to understand the fingertip patterns, angle, ridge count, and different indices among the Lodha population of Paschim Medinipur, West Bengal, India. A total of 103 (male-48; female-55) individuals were selected for this study using the purposive sampling method. Interview, schedule, and ink method (Cummins and Mildo, 1943) were used to collect data directly from the participants. A higher percentage of arch and composite patterns can be observed among the male participants (4.16% and 7.5%, respectively) compared to the females (2.18% and 3.45%). Females had a higher percentage of loops and whorls (52.9% and 41.45%, respectively) than males (49.58% and 38.75%, respectively). The difference between fingertip patterns of male and female Lodha participants was statistically significant ($\chi 2=12.124$; $p\leq 0.05$). While no statistically significant difference between male and female participants was found in atd angle, ridge count and in other indices. More studies are necessary to understand the finger and palmprint profiles of the Lodha population.

Keywords: Dermatoglyphics, atd angle, Ridge cound, Pattern Intensity Index, Furuhata Index

Introduction

The scientific study of the pattern of epidermal ridges is known as dermatoglyphics, which is derived from the Greek words "derma" (skin) and "glyphics" (curving). Sir Francis Galton (1822-1911) is one of the most important pioneering figures in the study of finger and palm print patterns (Francis Galton and Fingerprints, 2024) and wrote a book titled "Finger Prints" (Galton, 1892). Dr. Harold Cummins (1893-1960) is considered the "Father of Dermatoglyphics" for his immense contribution towards the development of dermatoglyphic study (Tulane University Libraries, 2024). In 1788, JCA Mayer was one of the first to write about the basic tenets of fingerprint analysis and concluded that the dermatoglyphic pattern is never duplicated in two individuals (Barnes, 2004). The ridge pattern of fingerprints develops in intrauterine life and remains the same until death before being altered by decomposition (Pillay, 2003). One of the first to propose fingerprint classification was E.R. Henry (1900) in his book "Classification and Uses of Fingerprints". Many others contributed to advancing dermatoglyphics (Jain and Pankanti, 2001; Hawthorne, 2009; Mundorff et al., 2014).

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The importance of fingerprints in the modern world is enormous and not restricted to forensic and criminal applications only. The subject is developing its importance in everyday life because of the unveiling of various unknown aspects of dermatoglyphics (Mollik, 2011). Fingerprints are individual-specific and highly heritable (Temaj et al., 2009), and they play an essential role in human biology research and population studies in medical and genetic studies (Gutierez et al., 2012). Though it is not proven, many speculations suggest peculiar dermatoglyphic patterns among people from different geographic locations (Anyanwu, 2020). From the study's inception, ethnohistoric data has been obtained from dermatoglyphics (Mohammed et al., 2014) and, more recently, used in tracing ancestry (Fournier and Ross, 2015).

Research on gender differentiation using fingerprints is an ongoing and evolving field. Dermatoglyphic studies on sexual dimorphism have focused on pattern and metric variation among a variety of geographic populations. Acree (1999) reported higher fingerprint ridge densities in females among Caucasian and African American populations. Using the same technique, Nayak et al. (2010B) and Nithan et al. (2011) found statistically significant sexual dimorphism in ridge density among different Indian populations. Gungadin also reported similar observations in the Indian population (Gungadin, 2007). Many other studies have been conducted among different populations in different areas of the world (Cummins, 1936; Cummins and Midlo, 2005; Singh and Mishra, 2015; Prakash et al., 2021). Despite the importance of the finger and palm print pattern study and the numerous studies conducted, the availability of dermatoglyphics data in many communities remains limited. For instance, the dermatoglyphics data of the current study community, the Lodha, are not widely available available.

Objectives

Considering the above-mentioned facts, the present study aims to understand the dermatogliphic profile of theLodha population. The specific objectives are as follows:

1. To understand the finger tip patterns of the Lodha population
2. To examine the atd angles, ridge counts and different indexes of the participants
3. To compare the findings between male and female participants

Methodology

The present research is a cross-sectional study. For the present study, the Phulpahari region of West Medninipur district was selected due to the availability of the participants. Fingar prints and other data for this study were collected directly from the participants during the first half of 2022. A total of 103 (male-48 and female-55)

individuals were selected for this study using the purposive sampling method.

Data were collected by the first author herself from the participants. The interview and schedule methods were used for data collection. Finger and palm prints were collected using the ink method, which was first undertaken in research in 1880 by Henry Faulds and suggested and well-known by the works of Cummins and Mildo (1943).

First, the proper procedure was explained step by step to each and every participant. Then, palms and fingerprints were taken following standard procedure. Palm and fingerprints were taken on the specific page prepared with the schedule. Then, the ink was removed by repeated hand washing. At the time of studying the palm and finger impressions, a magnifying lens was used to identify the fingertip patterns and subpatterns as arches (plain arch, tented arch), loops (radial loop, ulnar loop, twin loop and whorls as per Galton's threefold classification (1982), ridge count and to draw and measure the ATD angle on the palm. The analysis of the ridge counting is done with a sharp needle, and a protractor is used to measure the ATD angle.

All the data was then entered into a datasheet and analyzed using SPSS (Statistical Package for Social Science) 16.0 version. Four indices, Pattern Intensity Index(PII), Dankmeijer's Index(DI), Poll's Index(PI), and Furuhata's Index(FI) were calculated. Appropriate statistical tests were also performed to understand the sexual dimorphism.

Findings

The present study was conducted among the Lodha community to understand finger and palm print patterns and sexual dimorphism. **Table 1** shows the fingertip patterns of both hands of male and female participants' hands. A higher percentage of arch and composite patterns can be observed among the male participants (4.16% and 7.5%, respectively) compared to the females (2.18% and 3.45%). Meanwhile, the percentage of loops and whorls was higher among the females (52.9% and 41.45%, respectively) than males (49.58% and 38.75%, respectively).To understand the sexual dimorphism in fingerprint patterns, the $\chi 2$ test was performed. The difference in fingertip patterns of male and female Lodha participants was statistically significant ($\chi 2=12.124$; $p\leq 0.05$).

Fingerprint pattern	Male(n=48)	Female(n=55)	Total(n=103)	$\chi 2$
	n (%)	n (%)	n (%)	
Arch	20(4.16)	12(2.18)	32(3.10)	12.1242*
Loop	238(49.58)	291(52.90)	529(51.35)	
Whorl	186(38.75)	228(41.45)	414(40.19)	
Composite	36(7.5)	19(3.45)	55(5.33)	
Total	480(100)	550(100)	1030(100)	

Table 1:Finger tip patterns in both hands of Lodha population

*p value = <0.05

	Fingerprint pattern	Male(n=48)	Female(n=55)	Total(n=103)	$\chi 2$
		n (%)	n (%)	n (%)	
Right Hand	Arch	8(3.32)	5(1.82)	13()	2.7559
	Loop	121(50.41)	152(55.31)	273()	
	Whorl	99(41.24)	109(39.6)	208()	
	Composite	12(5.0)	9(3.27)	21()	
	Total	240(100)	275(100)	515()	
Left Hand	Arch	12(4.99)	7(2.54)	19()	11.617*
	Loop	117(48.73)	139(50.53)	256()	
	Whorl	87(36.23)	119(43.24)	206()	
	Composite	24(10.0)	10(3.63)	34()	
	Total	240(100)	275(100)	515()	
$\chi 2$		5.6414	1.4053	4.7537	

Table 2: Left and Right hand finger tip patterns of Lodha Population

*p value = <0.05

Table 2 shows hand-wise (left and right hand) fingertip patterns. In right-hand tip patterns, the difference between male and female participants was not statistically significant ($\chi 2$=2.7559; p>0.05), but the difference was statistically significant in left hand($\chi 2$=11.617; p≤0.05). In Table 3, subtypes of different fingerprint patterns are shown. Most arches are tented among male participants, while most are plain among female participants. Ulnar loops are predominant among both male and female participants. In the case of whorls, the simple sub-type is predominant among male and female participants. The differences in subtypes of fingertip patterns between male and female participants are statistically significant.

Fingerprint pattern	Fingerprint sub patterns	Male(n=48)	Female(n=55)	Total (n=103)	
		n (%)	n (%)	n (%)	
Arch	Plain	9(1.87)	9(1.63)	18	2.7429
	Tented	11(2.29)	3(0.54)	14	
Loop	Ulna	219(45.62)	278(50.54)	497	10.0868*
	Radial	15(3.12)	4(0.72)	19	
	Twin	4(0.83)	9(1.63)	13	
Whorl	Simple	103(21.45)	116(21.09)	219	3.3498
	Central Pocket	24(5.0)	39(7.09)	63	
	Spiral	33(6.87)	33(6.0)	66	
	Symmetrical	10(2.08)	18(3.27)	28	
	Double Loop	16(3.33)	22(4.0)	38	

Table 3:Fingerprint patterns and sub-types according to sex inLodha population

*p value = <0.05

Fingers												
	Male					Female						
	Arch n(%)	Loop n(%)	Whorl n(%)	Comp n(%)		Arch n(%)	Loop n(%)	Whorl n(%)		Com. n(%)		
Right hand	**I**	1(2.1)		24(50)	21(43.8)	2(4.2)		1(2.8)	27(49.1)	22(40.0)		5(9.1)
	II	2(4.2)		21(43.8)	21(43.8)	4(8.3)		2(3.6)	25(45.5)	26(47.30)		2(3.6)
	III	3(6.3)		29(60.4)	14(29.2)	2(4.2)		2(3.6)	41(74.5)	11(20.0)		1(1.8)
	IV	1(2.1)		15(31.3)	30(62.5)	2(4.2)		0	15(27.3)	38(69.1)		2(3.6)
	V	1(2.1)		32(66.7)	13(57.1)	2(4.2)		0	40(72.7)	12(21.8)		3(6.5)
Lefthand	**I**	1(2.1)		23(47.9)	16(33.3)	8(16.7)		0	23(41.8)	25(45.5)		7(12.7)
	II	5(10.4)		21(43.8)	17(35.4)	5(10.4)		4(7.3)	23(41.8)	24(43.6)		4(7.3)
	III	3(6.3)		29(60.4)	14(29.2)	2(4.2)		1(1.8)	40(72.7)	13(23.6)		1(1.8)
	IV	2(4.2)		11(22.9)	27(56.3)	8(16.7)		0	15(27.3)	38(69.1)		2(3.6)
	V	1(2.1)		29(60.4)	13(27.1)	5(10.4)		2(3.6)	33(60.0)	19(39.5)		1(1.8)

Table 4: Digit wise fingerprint patterns in males and females participants

Table 4 shows digit-wise finger-tip patterns in the right and left hands among the study participants. The largest number of arches can be observed in the II digits, followed by the III digits among both the male and female participants. In

male and female participants, the number of loops is highest in III digit and in V digit, respectively. The number of whorls is highest in IV degit in both male and female participants. At the same time, composite patterns were widely distributed in different fingers. However, it must be mentioned that the composite pattern is higher in the left hand than in the right hand. **Table 5** shows the mean, standard deviation, and differences in mean values between male and female participants in atd angle, ridge count, and indifferent indices. There were no statistically significant sex differences in the mean values of any of the mentioned variables.

atd angle						
	Right hand- atd angle		t value	Left hand- atd angle		t value
	Mean	Std	0.875	Mean	Std	
Male	42.33	3.52	42.62	3.65		0.755
Female	43.05	4.66	43.21	4.24		
Total	42.71	4.16		42.94	3.97	
Ridge count						
	Abslout Finger Ridge Count (AFRC)		t value	Total Finger Ridge Count (TFRC)		t value
	Mean	Std	0.140	Mean	Std	
Male	107.45	38.43	143.20	68.03		0.111
Female	108.6	31.94	141.85	55.65		
Total	108.14	34.96		142.48	61.42	

Different indices					
Indices		Male(48)	Female(55)	Total (103)	t value
Pattern Intensity index (PII)	Mean	0.0173	0.0182	0.017811	1.807
Std	0.0031	0.00002	0.002676		
Furuhata's Index (FI)	Mean	148.9763	137.3607	142.7738	0.271
Std	249.6787	24.8002	216.02728		
Dankmeijer's Index (DI)	Mean	8.3333	2.1211	5.0161	0.994
Std	45.3512	1.2274	31.64295		
Poll's Index (PI)	Mean	27.7663	4.8656	4.5572	0.165
Std	181.2128	2.8822	20.36921		

Table 5:Ridge count, atd angle, and different indices among the Lodha population

*p value = <0.05

Discussion

Dermatoglyphic traits are inherited and show slow changes in the frequencies

of digital patterns within a population due to the genetic admixture of different ethnic groups. The present study was on the Lodha population of West Bengal. In this study, the most common fingerprint pattern in this population was the loop (51.35%), followed by the whorl (40.19%) and the composite (5.33%) types of fingertip prints. A previous study by Purkait (2003) also suggested a higher frequency of loops and whorls among the Lodha population (Junaid et al., 2021; Kumar and Suresh, 2020; Binorkar and Kulkarni, 2017). The least observed pattern was arch (3.10%). According to the Fingerprint World –map, the global distribution of whorls, loops, and arches and ulnar loops are the most frequent finger patterns worldwide, supported by 28 populations out of 33. However, whorls are higher than loops out of 33 populations in only five populations, and also more among the Chinese and Malaysia.

Further, from the perspective of Darwin's theory of evolution, whorls are less present in humans than in primates (Mensvoort, 2015The ulnar loop had the highest frequency in the present study followed by whorls. The pattern findings in this study are similar to those of many other studies conducted among different South Asian populations (Marigoudar et al., 2020; Nithin, 2009; Kanchan, 2006; Singh, 2004; Mukherjee, 1988; Krishna, 1984), which also found loop patterns to be the most common. Though loops were most common in most populations, Chakravartti (1960) found a higher frequency of whorls among the Shanthals (another indigenous community from the same area). Similarly, Biswas (2011) and Ghosh et al. (2011) found a higher frequency of whorls among the Dhimals of North Bengal and Sunni Muslims of West Bengal, respectively. The current study area lacks documentation and academic research on the fingerprint patterns of the Indigenous population. The existing studies in this community primarily focus on socio-economic development and nutritional deficiency due to their urgent nature. In both loop and whorl patterns, female participants show a higher frequency than male participants, and the difference is statistically significant. The bilateral differences are statistically significant between males and females in the case of the left hand, similar to the findings of Prakash's(2021) work on a tribe in Andhra Pradesh. If we show the result of pattern type on different fingers, the highest frequency of arch pattern is found on the left hand's 2nd digit of both male and female participants. In comparison with a previous study by Verma et al. (1995), it was observed that the highest distribution of loop patterns was found on the 5th digits of the right hand and the 3rd and 5th digits of the left hand for both males and females. The 4th digit of both hands showed a higher frequency of whorl pattern in both male and female members of the present study population. These findings were similar to those observed by Kapoor and Badiye (2015), Verma et al. (1995), and Namouchi (2011).

Conclusion

Though there are many similarities in finger and palm print patterns among populations, there are also many differences. Dermatoglyphics has many applications

including its importance in the study of population variation. Loops are the most frequent among the Lodha population, followed by whorls, composites, and arches. AFRC, PII, and angle values are higher among the female population than males. Meanwhile, males have higher TFRC, FI, DI, and PI. More in-depth studies are necessary better to understand the dermatoglyphic profile of the Lodha Population.

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