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Sexual dimorphism in digital dermatoglyphics: A qualitative analysis of bengali hindu population, West Bengal, India

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ABSTRACT

Background: Dermatoglyphic characteristics for identification of sex play an important role in forensic and medico-legal purposes. Hence, it considered to be the most precise and reliable indicators for personal and gender identification. Such types of information on Bengali speaking Hindu population are very scanty. This was tempted the present authors to assess the sex-wise variation of digital dermatoglyphic traits in a sample from West Bengal, India.

Materials and Methods: A total 168 participants were recruited to obtain basic information and fingertip impression of the participants. Impressions were taken by using Ink method (Calcutta Ink) and examined with hand-lens.

Results: The mean age for male participants was 31.30 ±16.13 and for females it was 32.11±13.30. The loop pattern is observed more frequent (46.13%) compared to whorl (36.25%), arch (10.89%) and composite (6.72%). Females have a more loop (47.84%) and arch (12.26%) patterns than males (43.48% and 8.79% respectively. The whorl (39.85%) and composite (7.88%) patterns are observed more frequently in males as compared to females (33.92% and 5.98% respectively). Furuhata's Index is more frequent in males (91.64) than females (70.9) but both the Dankmeijer's and Poll's Index are higher in females (36.13 and 25.61 respectively) than males (22.05 and 20.21 respectively). However, in case of Pattern Intensity Index there is slightly a sex difference for males and females (12.32 and 11.57 respectively).

Conclusions: It was concluded that differences in the finger print pattern, combinations and indices can be used as an important tool for the determination of sex in medico-legal and forensic purposes.

1. Background

Dermatoglyphics is a scientific study of configuration of epidermal ridge patterns on the fingers, toes, palms of hands and soles of feet.[1] The dermatoglyphics trait is not modified by environmental factors, non- adaptive and not subjected to high rate of mutation unless any accident affecting ridge surfaces.[2] Thus, this is 'highly advantageous population markers'.[3] Only this biological variable grows in the size with age, proportionately to the growth of the individual. Even no two fingers have ever been found to possess identical ridge characteristics (minutiae).

Fingerprints have ridge characteristics that allow for efficient classification and examination which often leads to the identification or elimination of suspects involved in a crime. So, fingerprints are the most and infallible means of personal identification in forensic investigations and trials.[4] This has led to its wide use in the fields of forensic science, medicine, biological anthropology, ethnology and population genetics for their capabilities to identify racial and ethnic differences, gender, individuals as well as congenital malformations.[5] The

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scientific study of dermatoglyphics had a long history in connection its diversified arena like land disputes,[6] colonial administration,[7] individual identification.[8,9], ethnicity,[10–12], genetical abnormality[5–13] and so on. Notably, quantitative and qualitative dermatoglyphic traits of sexual dimorphism have been studied in various populations around the globe. Particularly, William Herschel (1858) was the first to implement the use of fingerprints as a tool for individual identification while he was an administrator of the Hooghly District of West Bengal.[14] It is also known that diverse populations represented different sexual dimorphic characteristics.[2–15] For example, studies on Turkmenians, Chuvasians, and Eastern European, African, Middle Eastern, and Yeminite-Jews, all demonstrate significant sexual dimorphism, but their levels of expression vary 1988).[16,17] Tiwari et al.'s[18] study on Tibetans found that whorl was the most common pattern followed by loop and arch in males. In case of females, loop pattern was the most common followed by whorl and arch. Acree (1999) found a statistically significant difference between male and female ridge density in two American populations.[19] In a more recent research similar observations are reported in spanish Caucasians.[20] A study by Karmakar et al. (2012) on Muzziena Bedouin of South Sinai observed that loop was the most common pattern in males followed by whorls and arch, whereas whorl pattern was found more frequently in females followed by loops and arch.[21] The potential of fingerprints to determine sex and personal identification has been extensively researched and documented but in case of Bengali Hindu people (residents of West Bengal, India by faith Hinduism) were lacking. By considering the fact, we were carried out such research in this area. The main objective of the present study was to investigate finger dermatoglyphic variations in both sexes. Digital pattern types and frequencies, pattern combinations of homologous fingers and pattern intensities among them were also examined to understand the sexual dimorphism.

2. Materials and Methods

The present study is a cross-sectional in nature. Two villages under Haldia Municipality and another one from Tamralipta Municipality of Purba Medinipur district, West Bengal, India were selected purposively for the present study. A total of 168 subjects (66 males and 102 females) age ranged from 19 to 69 years were non-randomly selected. Informed written consent of all subjects was taken individually with proper procedure explained to the subjects.A pre-tested structured survey schedule was framed which contained general information of the subjects (Name, Age, Sex, Address, Caste, Ethnicity etc.) and space for finger tip impression. Both the consent letter and survey schedule were printed in Bengali script which is the mother tongue of the study population under study. Then fingertip impressions were taken by using Ink method suggested by Cummins and Midlo (1943).[22] The materials used were Impression Ink (Calcutta Ink), fibre glass plate, rubber roller, spoon, white paper, scale, pencil, magnifying hand lens and hand wash liquid. Subjects were asked to wash their hands to remove sweat, oil, and dust from the skin surface by cleaning with hand wash and dry hands with towel. Ink was evenly taken from the container by a clean spoon and uniformly spread on a fibre glass plate using rubber roller.

After at least 5minutes, they were guided step wise procedure to provide fingertip impressions. With relaxed arms, the subjects were asked to roll their fingertips that are the entire area above the crease of the first phalangeal joint on the ink plate. Then carefully and slowly rolled fingertip from radial to ulnar border was obtained on the specified spaces in the survey schedule with normal pressure. The same procedure was repeated for all fingers of both the hands. Care was taken to ensure that all the fingerprints were taken only in the respective spaces provided on the schedule. Similar procedure was repeated for all the subjects. After taking impressions of all fingers, the ink was removed by using hand wash liquid. Prints were dried and then studied using a magnifying lens to identify the pattern in both hands. All the information relating to this study was collected in the months of January to March, 2020. Qualitative analysis of the fingerprints was done by classifying fingerprint patterns as arches (plain arch, tented arch), loops (radial loop, ulnar loop) and whorls as per of Galton's three fold classification (1892).[23] Distribution of fingertip patterns was done by counting frequency from all pattern types. The indices used in this study are as follows:

1. Pattern intensity index = [(2 x % whorl + % loop)/n]; where n=the total number of fingers on both sides combined.
2. Dankmeijer's index = [(% arches ÷ % whorl) x100].
3. Furuhata's index = [(% whorl ÷ % loop) x 100].
4. Poll's index = [(% arches ÷ % loop x 100]

All the details from the collected information (variables) were scrutinized and entered in a datasheet and analyzed using SPSS (Statistical Package for Social Sciences) version 16.0. Sexual dimorphism in connection with Pattern Intensity Index (PII), Dankmeijer's Index (DI), Furuhata's Index (FI) and Poll's Index (PI) were calculated by independent sample t-test. P-value <0.05 was considered as statistically significant.

3. Results

3.1. Digital pattern types

A total of 168 (66 males and 102 females) were selected for this study. So, a total of 1680 fingerprints from Bengali Hindus were analyzed for qualitative analysis of different digital patterns. The mean age of males was 31.30 years

(Sd =±16.13years) and for females it was 32.11 years (Sd =±13.30 years).

Sexual dimorphism of digital dermatoglyphic traits is presented in (Tables 1 and 2) respectively. The loop is the most frequently observed pattern in both hands of females (47.84%). Similarly, the most frequently observed pattern in both hands of males (43.48%) is also loop. However, the overall frequency of loop pattern is slightly higher in females than males. Ulnar loop is the most frequent observed sub-pattern for both males (89.54%) and females (91.80); and only 9.03% participants possess radial loop (10.44% and 8.19% for males and females respectively) (Table 2). The whorl pattern is more frequently observed in males (39.85%) compared to females (33.92%). If we look into the sub-pattern of whorl (Table 2), then it revealed that more than half (53.2%) of the whorl pattern is spiral followed by double loop whorl (16.42%), simple whorl (13.13%), symmetrical whorl (8.7%), central pocket whorl (7.55%) and only 0.98% accidental whorl. The frequency of spiral whorl (54.04%) and simple whorl (15.6%) are most frequently found among female participants, whereas symmetrical (10.65%), central pocket whorl (9.5%), double loop whorl (16.73%) and accidental whorl (1.14%) are more frequent among males. The frequency of arch pattern is more for females (12.26%) than males (8.79%)(Tables 1 and 2.) shows that tented arch (67.22%) sub-pattern is more frequent than plain arch (32.78%) and frequency of tented arch is more for females (68%) but males possess more plain arch (34.48%). Whereas in case of composite pattern, males and females represented 7.88% and 5.98% respectively. There is a significant differences between finger patterns and sexes (p=.007).

There are significant differences in the pattern types in the two hands as well as sexual dimorphism also reported based upon the pattern types alone. (Table 3) shows the symmetrical bilateral distribution of arch pattern, where highest frequency for arch (33.88 %) is on the II^{nd} finger for both sexes. The highest frequency of loop is on finger V^{th} (29.55%) of both hands and the frequency of loop pattern on finger V^{th} of females (30.53%) are slightly more than males (27.87%). Whorl pattern appears with the highest frequency on finger IV^{th} of both hands but its frequency is more for females (females: 28.99% and males: 26.02%) on left hand and males on the right hand (males: 29.29% and females: 28.25%). The composite pattern appears with highest frequency on II^{nd} fingers of males (32.69%) and on I^{st} fingers of females (32.79%). For combined five fingers of both hands, males represented equal share (50% each) of arch frequency on both hands, whereas arch frequency of females are more found on left hand (54.4%). Furthermore, loop pattern of the males are more frequently appear on left hand and in case of females slightly more on right hand. But, whorl frequency is more on right hands of the both sexes and composites on the left.

3.2. Pattern combinations

Pattern combinations between homologous fingers are presented in (Table 4). The most common combination of pattern of males is L-L (50%) followed by W-W (42.4%) in both sexes whereas, the remaining combinations are relatively rare or even absent. The greater frequency for the combination L-L is pronounced on the digital pair V-V, for W-W on IV-IV, for A-A on II-II, for A-L on I & III-III in both sexes but the combination L-W more frequent on I-I for males and on II-II for females. Similarly, combination L-C for males and females are more frequent on III-III and I-I respectively, combination W-C for males and females are mostly visible on IV-IV and I-I respectively. The greatest frequency for L-L is more among females (62.7%) than males (50%); for W-W more among males (42.4%) than females (37.3%); for L-W and L-C most frequency found among males (21.2% and 13.6%) than females (17.6% and 10.8%) respectively and for A-A in males it is 9.1% and for females 11.8%.

The pattern type frequency of individuals with monomorphic hands (bearing the same pattern) is presented in (Table 5). The majority of the individuals possess the highest frequency of combination L-W in both sexes (male 36.4% and female 32.4%). The order of magnitude of frequency of combinations for males is L+W+C>A+L+W>A+L+W+C>W only and for females L+W+C>A+L+W+C>A+L+W>A+L+C>A+L. Out of all possible combinations (14), only L, W+C and A+W+C are absent in males but combination A+W and A+C are absent in females.

A sequential order (descending) of digital dermatoglyphic pattern is estimated to know about the frequency of pattern of each finger of each hand separately (Table 6). The frequency of pattern distribution of Arch in left hands of males and females revealed a similar sequential order i.e. II>III>I>IV>V but in case of right hands sequence of males as II>IV>V>I>II and for females as II>III>I>IV>V. More arch frequency appeared on the index finger of both hands of females (left: 24.51%; right: 17.65%) than males (left: 15.15%; right: 13.64%) followed by middle finger. Loop pattern appeared more frequently appeared on little finger of each hand for both males and females but the frequency is more for females (72.55%) than males (59.85%). Other fingers those possess loop pattern are not appeared in a same sequential order as like to arch. For left hand the sequence of loop for males is as V>III>I>IV>II and for females as V>III>II>IV>I. Similarly, for the right hand the sequence of males is V>IV>I>II>III and females is V>III>I>IV>II. The frequency of whorl pattern of left hand appeared in a same descending order for both the sexes i.e. I>IV>II>III>V. But, the sequential order of whorl pattern in right hands varies for males (III>I>II>V>IV) and females (IV>I>II>III>V). From the table it also revealed that the frequency of whorl

Table 1: General distribution of primary finger print patterns in all fingers of both hands

Finger tip pattern	Male (n=66) Fingers		Female (n=102) Fingers		Total (n=168) Fingers		Significant
	N	%	N	%	N	%	
Arch	58	8.79	125	12.26	183	10.89	
Loop	287	43.48	488	47.84	775	46.13	X^2= 12.102
Whorl	263	39.85	346	33.92	609	36.25	df= 3 p= .007
Composite	52	7.88	61	5.98	113	6.73	
Total	660	100	1020	100	1680	100	

Table 2: Finger tip pattern and their sub-pattern according to sex

Finger tip pattern	Sub-Types	Male		Female		Total	
		N	%	N	%	N	%
Arch	Plain	20	34.48	40	32.00	60	32.78
	Tented	38	65.51	85	68.00	123	67.22
Loop	Ulnar	257	89.54	448	91.80	705	90.97
	Radial	30	10.44	40	8.19	70	9.03
Whorl	Symmetrical whorl	28	10.65	25	7.22	53	8.70
	Simple whorl	26	9.88	54	15.6	80	13.13
	Central pocket whorl	25	9.50	21	6.06	46	7.55
	Double loop whorl	44	16.73	56	16.18	100	16.42
	Spiral whorl	137	52.09	187	54.04	324	53.20
	Accidental whorl	3	1.14	3	0.86	6	0.98

Table 3: Frequency of finger print patterns bilaterally in males and females

Hand	Fingers	Finger Print Patterns							
		Male				Female			
		A	L	W	C	A	L	W	C
Left hand	I	6.06	50.00	39.39	04.55	08.82	36.27	45.10	09.80
	II	15.15	33.33	39.39	12.12	24.51	41.18	28.43	05.88
	III	12.12	46.97	30.30	10.61	20.59	47.06	25.49	06.86
	IV	06.06	31.82	48.48	13.64	07.84	39.22	48.04	04.90
	V	04.55	63.64	28.79	03.03	04.90	73.53	18.63	02.94
	Combined	08.79	45.15	37.27	08.79	13.33	47.45	33.14	06.08
Right hand	I	04.55	39.39	51.52	04.55	07.84	38.24	44.12	09.80
	II	13.64	28.79	43.94	13.64	17.65	35.29	39.22	07.84
	III	12.12	56.06	22.73	09.09	16.67	57.84	21.57	03.92
	IV	04.55	27.27	62.12	06.06	07.84	37.25	49.02	05.88
	V	09.09	57.58	31.82	01.52	05.88	72.55	19.61	01.96
	Combined	08.79	41.82	42.42	06.97	11.18	48.24	34.71	05.88

Table 4: Pattern combinations on bilateral homologous fingers

Sex	Pairs of Fingers	Pattern Combinations								
		A-A	L-L	W-W	C-C	A-L	A-W	A-C	L-W	L-C	W-C
Male	I-I	1(1.5)	20(30.3)	20(30.3)	0	5(7.6)	0	0	14(21.2)	3(4.5)	3(4.5)
	II-II	6(9.1)	13(19.7)	22(33.3)	4(6.1)	2(3.0)	1(1.5)	4(6.1)	9(13.6)	3(4.5)	2(3.0)
	III-III	5(7.6)	21(31.8)	10(15.2)	1(1.5)	5(7.6)	0	1(1.5)	13(19.7)	9(13.6)	1(1.5)
	IV-IV	1(1.5)	12(18.2)	28(42.4)	1(1.5)	1(1.5)	3(4.5)	1(1.5)	9(13.6)	4(6.1)	6(9.1)
	V-V	2(3.0)	33(50.0)	13(19.7)	0	4(6.1)	1(1.5)	0	10(15.2)	2(3.0)	1(1.5)
Female	I-I	6(5.9)	23(22.5)	37(36.3)	2(2.0)	4(3.9)	0	1(1.0)	14(13.7)	11(10.8)	4(3.9)
	II-II	12(11.8)	23(22.5)	23(22.5)	1(1.0)	9(8.8)	4(3.9)	6(5.9)	18(17.6)	5(4.9)	1(1.0)
	III-III	11(10.8)	40(39.2)	18(17.6)	0	11(10.8)	0	5(4.9)	12(11.8)	3(2.9)	2(2.0)
	IV-IV	4(3.9)	30(29.4)	38(37.3)	1(1.0)	4(3.9)	4(3.9)	0	15(14.7)	4(3.9)	2(2.0)
	V-V	3(2.9)	64(62.7)	11(10.8)	0	4(3.9)	0	1(1.0)	15(14.7)	2(2.0)	2(2.0)

Table 5: Frequency of pattern combinations on the ten fingers

Pattern	Male		Female		Total	
	N	%	N	%	N	%
A only	1	1.5	1	1.0	2	1.2
L only	0	0	1	1.0	1	0.6
W only	6	9.1	1	1.0	7	4.2
A+L+W+C	7	10.6	13	12.7	20	11.9
A+L	3	4.5	8	7.8	11	6.5
A+W	1	1.5	0	0	1	1.6
A+C	1	1.5	0	0	1	0.6
L+W	24	36.4	33	32.4	57	33.9
L+C	1	1.5	3	2.9	4	2.4
W+C	0	0	2	2.0	2	1.2
A+L+W	8	12.1	11	10.8	19	11.3
L+W+C	11	16.7	17	16.7	28	16.7
A+L+C	3	4.5	11	10.8	14	8.3
A+W+C	0	0	1	1.0	1	0.6
Total	66	100	102	100	168	100

Table 6: Frequency (%) of digital dermatoglyphic patterns in descending order

Pattern	Sex	Hand	Frequency of digital order of frequency in %
Arch	Male	Left	II(15.15)>III(12.12)>I(6.06)>IV(6.06)>V(4.55)
		Right	II(13.64) >IV(12.12) >V(9.09) >I(4.55) >II(4.55)
		Total	II(14.39)>IV(9.09)>III(8.33)>V(6.82)>I(5.30)
	Female	Left	II(24.51)>III(20.59)>I(8.82)>IV(7.84)>V(4.90)
		Right	II(17.65)>III(16.67)>I(7.84)>IV(7.84)>V(5.88)
		Total	II(21.08)>III(18.63)>I(8.33)>IV(7.84)>V(5.39)
Loop	Male	Left	V(62.12)>III(42.42)>I(40.91)>IV(31.82)>II(30.30)
		Right	V(57.58)>IV(56.06)>I(39.39)>II(28.79)>III(27.27)
		Total	V(59.85)>IV(43.94)>I(40.15)>III(34.85)>II(29.55)
	Female	Left	V(72.55)>III(43.14)>II(38.24)>IV(38.24)>I(31.37)
		Right	V(72.55)>III(56.86)>I(36.27)>IV(36.27)>II(34.31)
		Total	V(72.55)>III(50.00)>IV(37.25)>II(36.27)>I(33.82)
Whorl	Male	Left	I(48.48)>IV(48.48)>II(42.42)>III(34.85)>V(30.30)
		Right	III(62.12)>I(51.52)>II(43.94)>V(31.82)>IV(22.73)
		Total	I(50.00)>III(48.48)>II(43.18)>IV(35.61)>V(31.06)
	Female	Left	I(50.00)>IV(49.02)>II(31.37)>III(29.41)>V(19.61)
		Right	IV(50.00)>I(46.08)>II(40.20)>III(22.55)>V(19.61)
		Total	IV(25.00) >I(23.04) >II(20.10)>III(11.27)>V(9.80)
Composite	Male	Left	IV(13.64) >II(12.12) >III(10.61) >I(4.55) >V(3.03)
		Right	II(13.64) >IV(9.09) >III(6.06) >I(4.55) >V(1.52)
		Total	II(12.88) >IV(11.36) >III(8.33) >I(4.55) >V(2.27)
	Female	Left	I(9.80) >III(6.86) >II(5.88) >IV(4.90) >V(2.94)
		Right	I(9.80) >II(7.84) >IV(5.88) >III(3.92) >V(1.96)
		Total	I(9.80) >II(6.86) >III(5.39) >IV(5.39) >V(2.45)

pattern on thumb of left hand is more or less same in both sexes but when it consider for right hand more percentage of whorl patterns appeared on middle and ring finger for males (62.12) and females (50) respectively. There is an asymmetric sequential order of composite pattern either left or right hand or for males and females. Most frequent composite pattern of males appeared on ring and index finger of left and right hand respectively. But, for females it mostly appeared on only thumb of both hands. However, the frequency of composite pattern is slightly more for males (12.88%) than their opposite counter parts (9.8%).

3.3. Pattern index

The fingerprint pattern indices namely Pattern Intensity Index (PII), Dankmeijer's Index (DI), Furuhata's Index (FI) and Poll's Index (PI) were calculated for one individual and it compared with both sexes and hands (Table 7). The overall mean values of PII, DI, FI and PI of males are 14.09, 31.09, 89.97 and 22.79 respectively; whereas in case of females the mean of the indices are 12.98, 56.02, 65.57 and 31.84 respectively. Therefore, male respondents exhibited higher mean for PII and FI than females. On the other hand, DI and PI are higher in females than their male counterpart. Mean pattern intensity index is 141.54 (± 0.03) in males and 1.56 (± 0.03) in females. The difference between PII means of males and females was observed not to be statistically significant (t=0.246). Similarly, means of FI and PI of both sexes was not statistically significant (t=0.949 and t=0.126 respectively). The mean DI was 31.09((±1.05) in males and 56.02 (±1.25) in females. The difference between these means was significant (t=1.424; p<0.029).

Table 7: Variation in pattern indices of finger dermatoglyphics among study population

Indices	Male(X±SE)	Female(X±SE)	T	Sig.
Pattern intensity index	14.09±0.50	12.98±0.44	1.641	0.246
Denkmeijer's index	31.09±1.05	56.02±1.25	1.424	0.029*
Furuhata's index	89.97±3.07	65.57±2.57	0.605	0.949
Poll's index	22.79±5.55	31.84±7.39	0.887	0.126

X±SE= Mean and standard errors* statistically significant

4. Discussion

The present study focussed the qualitative analysis of digital dermatoglyphic of Bengali Hindu population of West Bengal. The result showed that the digital patterns of this group are in line with previous studies of other Bengali-speaking Hindu ethnic groups of West Bengal.[24,24] In the present study, among the major pattern types classified by Galton (1892), loops (46.13%) are the most predominant pattern type followed by whorls (36.25%), arches (10.89%) and then composites (6.73%) in both the sexes. Besides, the subtype ulnar loop is more frequent (90.93%) than radial loop. Similarly, the subtype of whorl pattern is dominated by spiral whorl followed by double loop whorl and simple whorl (except male where symmetrical whorl is the third most predominant sub-pattern). If we consider the frequency of pattern type on different fingers of both hands, highest frequency of arch pattern present on II^{nd} or index fingers irrespective of left and right hands of both the sexes. In comparison with earlier studies by Gupta and Gupta (2020), and Verma et al. (1995) it was observed that maximum distribution of loop pattern were present on V^{th} finger of both hands of males and females.[25,26] In the IV^{th} finger of both the sexes of Bengali Hindus were reported highest frequency of whorl pattern in accordance to the observations by Kapoor and Badiye (2015), Verma et al. (1995) and Namouchi (2011).[4–28] But bilateral asymmetry was found for composite pattern of males under study. The composite patterns of males were more frequent on IV^{th} and II^{nd} fingers of left and right hand respectively. Whereas, for females such pattern was more frequent on I^{st} fingers of both hands. The present study also shows the symmetrical digital order of arch and whorl only in left hands of both the sexes; whereas others are asymmetrical irrespective of hands and sexes.

Considering the frequency of pattern combination of left and right homologous fingers suggested more loop–loop (L-L) combinationonV (L-L) ^{h} fingers followed by whorl-whorl (W-W) on IV^{th} of both males and females respectively. Such combination pattern is also similar to a study conducted by Karmaker et al. (2002).[24] But, the frequency of L-L combination on V^{th} homologous fingers is more for female (62.7%) than their male counterpart (50%). Sexual dimorphism is also found for the combination namely L-W, L-C, W-C, C-C. Whereas, the present study shows a similar finding (Karmakar et al. 2002) on frequency of monomorphic hands, where it revealed that most common monomophic pattern is loop-whorl (L-W). For males only loop (L), whorl+composite (W+C), and arch+whorl+composite (A+W+C) monomorphic pattern were absent but for females arch+whorl (A+W), and arch+composite (A+C) pattern were also absent. So, sexual differences appeared in this study but previous study by Karmaker et al. (2002) revealed no such differences.[24] In this study, Pattern Intensity and Furuhata's Index are higher for males; whereas Denkmeijer's and Poll's Index are higher in females. Even the previous studies among Rajput,[29] Toda of Tamil Nadu,[30] Limbu of Sikkim,[31] Dhimal of North Bengal[32] also shows PII and FI are higher in males. Similarly the studies on Brahmins (Baryah and Krishan 2020),[29] Toda of Tamil Nadu (Singh and Mishra 2015),[30] Muslims of central India,[4] Dhimals of North Bengal,[32] Rengma Nagas of Nagaland,[33] Tibetan of

Tibet[18] shows higher DI among females. On the contrary, a study conducted by Wijerathne et al. (2013) on Sinhalese population, have reported all the fingerprint indices to be higher in males than females.[34]

A previous study by Baryah and Krishan on two ethnic groups namely Rajput and Brahmin (2020)[29] and another one by Kapoor and Badiye (2015) on Indian Muslim population[4] where they observed statistically insignificant results for sex differences, but, results of this study are contradictory with these for sex differences observations. Therefore, significant observations were reported for sexual dimorphism in pattern types, pattern combination and indices. Karmakar et al. (2002) conducted a study on sexual dimorphism among five ethnic/ caste groups (Brahmin, Lodha Mahishya, Muslim and Padmaraj) of West Bengal if any.[24] They found that overall homogeneity on qualitative traits was well-established among them with respect to sexual dimorphism. This study was also carried out in same geographical area and it has been suggested similar findings except very few exceptions in both sexes.

5. Conclusion

The present study is a qualitative account of dermatoglyphic traits of Bengali-speaking Hindu population of West Bengal, India. It has highlighted the sexual dimorphism of dermatoglyphic trait of said population. A number of variables of dermatoglyphic trait such as fingerprint pattern types and their sub-types, pattern combinations of left and right homologous fingers, frequency of pattern combination, pattern index of both males and females were observed. In this study, many statistically significant results were obtained and some of them were in contrast to previous studies. In conclusion, the most common fingerprint pattern observed among present study population is ulnar loop followed by whorl and arch. Particularly arch and loop pattern are more common among female participants whereas, male participants possesses more whorl and composite pattern. Pattern Intensity Index and Furuhata's Index are found to be higher in males and other two indices namely Dankmeijer's Index and Poll's Index value are more among females. To some extent, the dermatoglyphic patterns of the Bengali-speaking Hindus are quite similar to North Indians and other Indo-Aryan populations. Further, studies among different ethnic groups with larger sample size are needed to validate findings of this study.

6. List of Abbreviations

A= Arch, L= Loop, W= Whorl, C= Composite, I= Thumb, II= Index finger, III= Middle finger, IV= Ring finger, V= Little finger, PII=Pattern Intensity Index, DI= Dankmeijer's Index, FI= Furuhata's Index, PI= Poll's Index

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9. Conflict of Interest

None.

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