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Sexual dimorphism of dermatoglyphic features in Type 2 diabetes mellitus patients of West Bengal: A cross-sectional study

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ABSTRACT

Background: Dermatoglyphics is the study of epidermal ridge patterns on the fingers, palms, and soles. Correlation of dermatoglyphic patterns with many chromosomal abnormalities and genetic predisposing diseases such as diabetes mellitus, hypertension, schizophrenia, and bronchial asthma is evidenced by many researchers. Literature on sexual dimorphism of dermatoglyphic patterns revealed it as an important characteristic feature. **Aims and Objectives:** The aim of the study is to study the variance of ridge patterns among male and female patients of Type 2 diabetes mellitus patients of West Bengal and determine the sex-specific digital and palmar ridge patterns in Type 2 Diabetes mellitus. **Materials and Methods:** A cross-sectional study has been done on 100 male and 100 female Type 2 diabetes mellitus patients. Digital and palmar prints were taken by the traditional ink method. Digital ridge pattern, pattern intensity index, total finger ridge count (TFRC), absolute finger ridge count (AFRC), and a-b ridge count were studied. The data on these patterns was recorded and statistically analyzed by Chi-square test and Student's t-test. **Results:** The frequency of ulnar loop is higher in female diabetics in comparison to male diabetics. Statistically significant increase in mean TFRC and mean AFRC is seen in male diabetics. **Conclusion:** Our study exhibits that dermatoglyphic pattern significantly differs in male and female diabetics. The knowledge and reference range of dermatoglyphic parameters among male and female diabetics are essential in the use of this study as a screening tool or diagnostic tool in Type 2 diabetes mellitus.

Key words: Dermatoglyphic study; Type 2 diabetes mellitus; Sexual dimorphism; West Bengal

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INTRODUCTION

Dermatoglyphic is the study of the ridge pattern of the skin of fingers, palms, and soles. In 1926, Dr. Harold Cummins proposed the word dermatoglyphics (derived from derma-skin and glyphae-carve).[1] These epidermal ridges appear in the fetus during 3rd month of intrauterine life and do not change after birth. These phenotypic features can be used to diagnose diseases which have strong genetic causation background. Many researchers have found the association of specific dermatoglyphic features with diabetes mellitus, hypertension, schizophrenia, and down's syndrome.[2-5] Some of the researchers concluded that dermatoglyphic features can be used as screening tests for genetically predisposed diseases as the pattern remains unchanged after birth. All literature has mentioned the comparison in dermatoglyphic patterns between diabetes patients and control. No researchers have mentioned the sexual variance of the pattern of dermatoglyphic features in Type 2 diabetes mellitus patients especially from the Eastern region of India.

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Aims and objectives

The aim of our study is to see the variance of ridge patterns among male and female Type 2 diabetes mellitus patients of West Bengal and determine the sex-specific dermatoglyphic features in Type 2 diabetes mellitus.

MATERIALS AND METHODS

This was a cross-sectional, hospital-based study, that was done on 100 male and 100 female patients of Type 2 diabetes mellitus of 40–65 age groups in 1-year duration period. The disease was confirmed by history, clinical examination, and standard recommended blood glucose level. The approval of the study was taken from the Institutional Ethics Committee of a Government Medical College of West Bengal and the Board of Studies of West Bengal University of health sciences [Ref. No: OG/UHS (synop)/721]. Study subjects were chosen from the diabetic clinic and medicine OPD of three Government Medical Colleges of West Bengal. Informed consents were obtained from study participants.

Minimum sample size calculation using the following formula:[6]

$N = Z^2 \times p \times q/d^2 = (1.96)^2 \times 0.068 \times (1–0.068)/0.05^2 = 97$

Where, Z = 1.96 (confidence interval at 95%)
p = 0.068 (prevalence is 6.8%)[7]
q = (1- p) = 0.932
d = margin of error 5%
N = 97.

The following factors were considered exclusion criteria for the study:

- Deformity of hand
- Ridge aplasia, Ridge hypoplasia, Ridge destruction by injury
- Presence of diseases such as hypertension, Type 1 diabetes mellitus, Congenital anomalies, Carcinoma, Psychiatric disease, bronchial asthma, and thalassemia.

Finger ridge prints and palmar prints were obtained by traditional ink method on slightly glazed paper with the help of Roller, Kores duplicating ink.[8] Necessary precautions have been taken during the inking of the hand and taking the finger and palmar prints on the slightly glazed paper.[9]

Prints were examined with the help of a hand lens. In our study, we examine the pattern type of digital prints, pattern intensity index (PII), finger ridge count-total finger ridge count (TFRC), absolute finger ridge count (AFRC), and a-b ridge count of 100 male and 100 female diabetic patients. We tabulated the data in a Microsoft Excel sheet in two parts. The variables of digital prints were represented as percentages, whereas other variables were represented as mean and standard deviation. Chi-square statistics was used for the evaluation of variance of digital prints among study participants and paired student's t-test was used for PII, TFRC, AFRC, and a-b ridge count. Statistical analysis of the data was done with the help of Microsoft Excel and Graph pad Prism 6 software. $P \leq 0.05$ is considered statistically significant.

Operational definitions:[10]

- Pattern of digital prints (Figure 1)
    - Loop (Radial loop, Ulnar loop): Has one triangular plot-delta/triradius. Ulnar loop open toward the ulnar margin of hand, radial loop open toward the radial margin of hand
    - Arch: Has no delta
    - Whorl: Has two deltas.
- PII: Number of deltas present on the fingers of an individual
- Ridge count: Number of ridges intervening between delta and central part of pattern - core
- TFRC: The sum of a single count of ridges of fingers of an individual. In the case of Whorl, the higher number was considered
- AFRC: Here double ridge count of the fingers (as present in whorl) is counted
- a-b ridge count: Number of ridges present in the second InterDigital area between digital tri radius or triangular plot a and b (Figure 2).

RESULTS

In this study, we have observed the variation of the digital pattern, PII, TFRC, AFRC, and a-b ridge count of both hands of 100 male and 100 female Type 2 diabetes mellitus patients. All data were tabulated, compared, and analyzed.

The incidences of radial loops, whorls, and arches were more in the case of male diabetics compared to female diabetics,

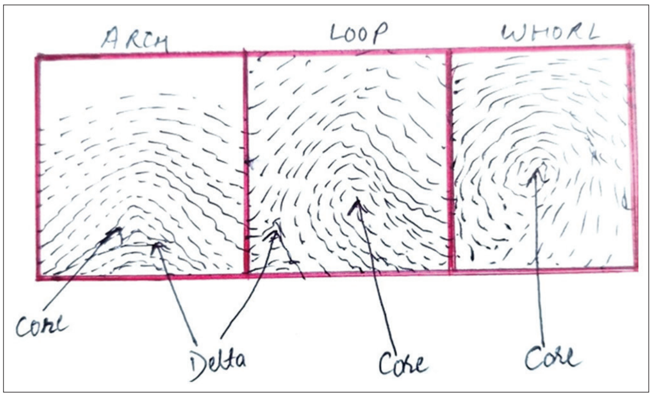


Figure 1: Arch, loop, and whorl fingertip pattern

whereas the incidence of ulnar loop was more in female diabetics (69.3%) compared to male diabetics (63.7%). We used the Chi-square test for statistical significance and found that the digital patterns are statistically significant as the *P*<0.05 and x^2 is 11.67 at d.f 3 (Table 1 and Graph 1).

PII

Table 2 shows the mean PII is 11.4±0.19 with SD 1.98 in males, whereas in females, it is 11.54±0.18 with SD 1.86. The sex difference of PII is statistically insignificant because the *P*-value is more than 0.05.

TFRC

The mean TFRC of male diabetic patients is 139.29±1.56 with SD 15.65, whereas in female diabetic, it is 128.85±2.55 with SD 25.52. The calculated t-value is 3.52 at d.f 99. The paired t-test shows that the study is statistically significant because the two-tailed *P*-value is quite small (Tables 3 and 4 and Graph 2).

Figure 2: Palmar print a, b, c, and d denote digital tri-radius

AFRC

The above (Table 4) compares the AFRC of male and female diabetic patients. The mean AFRC in male diabetic patients is 186.55±3.82 with SD 38.26, whereas in female diabetics, it is 170.5±4.35 with SD 43.55. The calculated t-value is 2.915 at d.f 99. The paired t-test shows that the study is statistically significant because the two-tailed *P*-value is quite small.

a-b ridge count

The mean a-b ridge count of the left hand of male diabetic patients is 36.67±0.35 with SD 3.54, whereas in female diabetics, it is 36.63±0.31 with SD 3.10. The calculated t-value is 0.09 at d.f 99. The paired t-test shows that the study is statistically insignificant because the two-tailed *P*>0.05 (Table 5 and Graph 3).

The mean a-b ridge count of the right hand of male diabetic patients is 35.6±0.29 with SD 2.91, whereas in female diabetic patients, it is 35.11±0.18 with SD 1.83. The calculated t-value is 1.34 at d.f 99. The paired t-test shows that the study is statistically insignificant because the two-tailed *P*-value is 0.18 which is >0.05 (Table 6 and Graph 3).

We have observed that the frequency of ulnar loop is higher in female diabetics in comparison to male diabetics and the frequency of radial loop, whorl, and arch is higher in male diabetics as compared to female diabetics. A statistically significant increase in mean TFRC and mean AFRC is seen in male diabetics. There is no statistically significant difference observed in PII, a-b ridge count of left and right hand of male and female diabetic patients.

DISCUSSION

We studied the major parameters of dermatoglyphic features in Type 2 diabetes mellitus patients and compared

Table 1: The sex variations of digital patterns in Type 2 diabetes mellitus patients

Subjects	Number of individuals (n)	Ulnar loop (%)	Radial loop (%)	Whorl (%)	Arch (%)	Chi-square	*P*-value	Remark
Diabetic male	100	63.7 (637)	2.9 (29)	23.6 (236)	9.8 (98)	11.67	0.008	Significant
Diabetic female	100	69.3 (693)	2.7 (27)	21.9 (219)	6.1 (61)			

Table 2: Sex variation in the digital PII in Type 2 diabetes mellitus patients

Subject	No of individuals (n)	Mean PII	±SE	SD	t-value	d.f	*P*-value	Remarks
Diabetic male	100	11.4	0.19	1.98	0.54	99	0.58	Insignificant
Diabetic female	100	11.54	0.18	1.86				

PII: Pattern intensity index

Table 3: Sex variation in the TFRC in Type 2 diabetes mellitus patients

Subject	No of individuals	Mean TFRC	±SE	SD	t-value	d.f	*P*-value	Remarks
Male diabetics	100	139.29	1.56	15.65	3.52	99	0.007	Significant
Female diabetics	100	128.85	2.55	25.52				

TFRC: Total finger ridge count

Table 4: Sex variation in the absolute finger ridge count (AFRC) in Type 2 diabetes mellitus patients

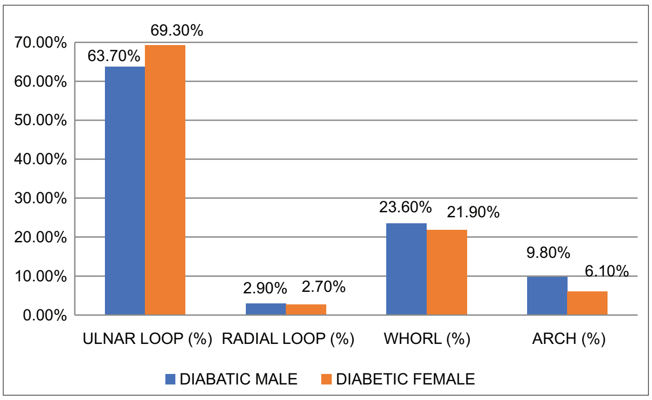
Subject	No of individuals	Mean AFRC	±SE	SD	t-value	d.f	*P*-value	Remarks
Male diabetics	100	186.55	3.82	38.26	2.915	99	0.004	Significant
Female diabetics	100	170.5	4.35	43.55				

Table 5: Sex variation in the a-b ridge count of the left hand in Type 2 diabetes mellitus patients

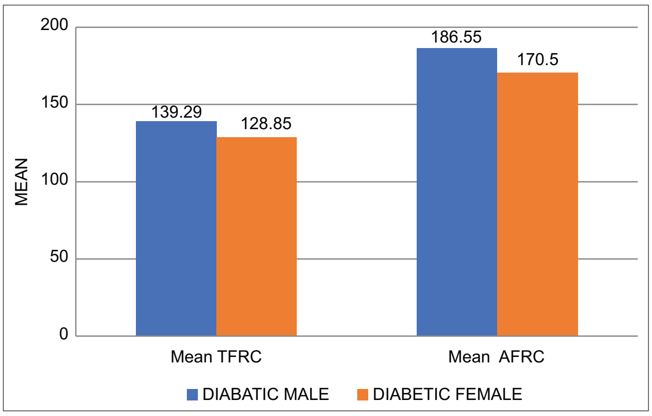
Subject	No of individuals (n)	Mean a-b ridge count	±SE	SD	t-value	d.f	*P*-value	Remarks
Male diabetics	100	36.67	0.35	3.54	0.09	99	0.92	Insignificant
Female diabetics	100	36.63	0.31	3.1				

Table 6: Sex variation in the a-b ridge count of the right hand in Type 2 diabetes mellitus patients

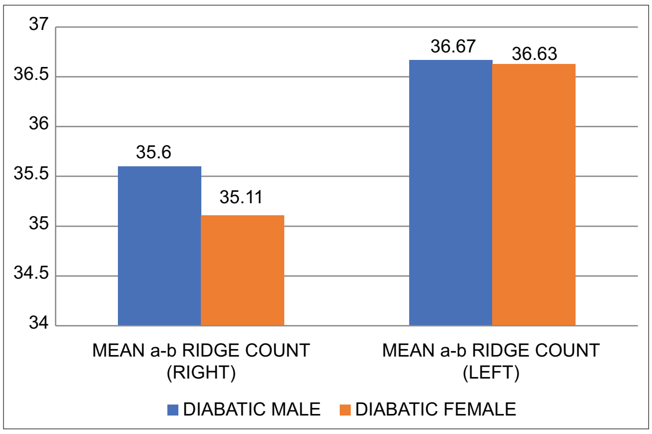
Subject	No of individuals	Mean a-b ridge count	±SE	SD	t-value	d.f	*P*-value	Remarks
Male diabetics	100	35.6	0.29	2.91	1.34	99	0.18	Insignificant
Female diabetics	100	35.11	0.18	1.83				



Graph 1: The sex variations of digital patterns in Type 2 diabetes mellitus patients



Graph 2: The sex variation in total finger ridge count and absolute finger ridge count in Type 2 diabetes mellitus patients



Graph 3: The sex variation in the a-b ridge count of left and right hand in Type 2 diabetes mellitus patients

the features in both sexes. We observed the statistically significant sexual dimorphism in digital ridge pattern, AFRC, and TFRC of dermatoglyphic features in Type 2 diabetes mellitus patients, whereas the PII and a-b ridge counts did not reveal statistically significant changes.

Few researchers mentioned sex-specific dermatoglyphic characteristic changes in diseases. Panda et al.,[11] found an increase in the radial loop in both male and female diabetic patients when compared with the control group. Sanyaolu et al.,[12] observed more whorl patterns in autistic male children than in females among the Nigerian population. Sachdev[13] conducted a study on the tribal population of

Rajasthan and observed that the loop and arch pattern was more common in male diabetics and whorl was more common in female diabetics and they did not mention the statistical significance of these data. Rakate and Zambre[14] observed that in male diabetic whorl pattern and female diabetic ulnar loop pattern were the most common type of digital pattern and TFRC was quite similar in both male and female diabetes patients. They did not comment on the statistical significance of the findings. In our study, the ulnar loop pattern was more common among female diabetes patients in respect to male diabetes patients. TFRC and AFRC were significantly higher in male diabetics in comparison to female diabetics. Hence, the pattern of digital ridges in female diabetics is similar in both studies. Rest of the findings are different in both studies. In our study, we found that the TFRC and AFRC mean among male East Indian diabetes patients was 139.29±15.65 and 186.55±38.26, whereas among female patients it was128.85±25.52 and 170.5±43.55.

Srivatsava and Burli[15] reported a higher incidence of whorl digital pattern in both male and female diabetic patients when compared with the control group among the population of Southern India. PII of both male and female diabetic patient was higher than the control group in their study. The TFRC and AFRC were higher in male diabetics than in female diabetics but they did not mention the statistical significance. Mehta and Mehta[16] reported higher frequency of whorl pattern in male and female diabetics and loop pattern in male and female controls. In our study, the ulnar loop pattern was more common in male and female diabetics. We have also found that the incidence of the ulnar loop was higher in male diabetics as compared to female diabetics. We did not find any significant difference in PII of male and female diabetic patients, though TFRC and AFRC were significantly higher in male diabetics than in female diabetics.

Srivastava and Rajasekar[17] reported that whorl pattern was the most common type and it was more in males (48.2%) in comparison to females (43.7%) followed by an ulnar loop which was more in males (43.5%) in comparison to female diabetic (37.9%). They did not report the statistical significance of these changes. Tadesse et al.,[18] observed more loop patterns in diabetic males than in females. In our study, the most common pattern was the ulnar loop followed by the whorl pattern. The frequency of the whorl pattern in males (23.6%) was higher in comparison to female diabetics (21.9%), whereas the incidence of the ulnar loop was more in females (69.3%) in comparison to male diabetics (63.7%). Our study revealed that digital pattern variance was statistically significant in male and female diabetics. Srivastava and Rajasekar[17] conducted the study in medical colleges of Puducherry, so, it is assumed that they did the study among the south Indian population.

Jaiyeoba-Ojigho et al.,[19] observed the dermatoglyphics pattern in two ethnic groups in Nigeria and reported that frequency of ulnar loop and arch was higher in female and radial loop and whorl was higher in male diabetic patients in Itsekiri population which was quite similar to our result, whereas in Urhobo population ulnar loop was more in male and arch and radial loop was more in female diabetics. In Itsekiris, TFRC was significantly higher in males, whereas in Urhobos also males had higher TFRC than females but it was statistically insignificant. In our study, we observed that the ulnar loop was more common in female than male diabetics and TFRC was higher in males as compared to females. Our result is in concurrence with the Jaiyeoba–Ojigho et al.,[19] for the Itsekiri population, whereas for the Urhobo population, the ulnar loop was more in male diabetics. These differences of dermatoglyphic features were seen among two different ethnic populations.

Our study is in concurrence with the study by Bala et al.,[20] as they reported mean PII was less in females as compared to male diabetics but we did not observe any statistically significant difference in mean PII between male and female diabetics. The mean TFRC and AFRC in Bala et al.,[20] study was higher in male than in female diabetics which was like our study findings but the mean value differs. The a-b ridge count was significantly higher in males than in female diabetics, but in our study, we did not observe any statistically significant difference in a-b ridge count between male and female diabetics. The difference in features was seen among two different regional area populations as Bala et al.,[18] performed the study in the hilly region of Sikkim and our study population is Eastern region of India.

Sharma and Sharma[21] found that TFRC, AFRC, and a-b ridge count in each hand was higher in male diabetics in comparison to female diabetics. Singh et al.,[22] also reported higher mean a-b ridge count in male than in female diabetics. However, they did not mention the statistical significance of the findings among the male and female diabetes mellitus patients. The pattern of a-b ridge count, AFRC, and TFRC of our study was quite similar to the studies of Sharma and Sharma,[21] however, the mean values differ. The number of study participants was different in both studies.

Das et al.,[23] studied palmar a-b ridge count in E-β thalassemia patients in populations of West Bengal, India, and found that the distribution of total a-b ridge count was highest in males as compared to females in both E-β thalassemia patients and other population, but in our study, we did not find any statistically significant difference between male and female diabetic patients. Although the study population was similar, they have taken thalassemia patients and, in our study, we have included Type 2 diabetic mellitus patients.

The other researchers have found these patterns among the patients attending the OPD of other geographical regions. Our study population was mainly from the Eastern region of India and of Type 2 diabetes mellitus. These two are the most important explanation behind the sex and disease-specific features of our dermatoglyphic study.

At present, dermatoglyphics is extensively used in research studies to find its association with geographical distribution, temperament, health, intelligence, heredity, etc.[24]

Despite the increasing use of dermatoglyphics in research studies over the past few years, there is a lack of consensus in the literature regarding its distribution and pattern of sexual dimorphism. Most of the studies reported the features among the case and control groups of the population. Thus, this article will offer new research perspectives and highlighted the need to understand the application of sex-specific features of dermatoglyphics in Type 2 diabetic mellitus patients.

Strengths and weakness of the study

This study is an original study conducted on the population of the Eastern region of India and it includes several parameters of dermatoglyphics trait on Type 2 diabetic mellitus, which is broadly used as indicators for several human's biological and anatomical aspects. This study is cost-effective and less time-consuming. The collective data on other parameters of dermatoglyphic traits will enhance the possibilities of consideration of the dermatoglyphic study as a screening tool or diagnosis of Type 2 diabetes mellitus. In this study, we collected data from the patients visiting the various medical colleges of Kolkata and the surrounding region of the state of West Bengal. Conducting the study in different geographical populations, different ethnicities, and different genetic conditions will provide a clearer idea about the usefulness of dermatoglyphic study as a screening tool.

Limitations of the study

The collective data of larger sample size from different geographical locations on various parameters of dermatoglyphic traits like finger ridge pattern, ridge count, and palmar angles will enhance the reliability of the study as a screening or diagnostic tool for type 2 diabetes mellitus.

CONCLUSION

Our study exhibits that dermatoglyphic pattern significantly differs in male and female diabetics. The knowledge and reference range of dermatoglyphic parameters among male and female diabetics are essential in the use of this study as a screening tool or diagnostic tool in Type 2 diabetes mellitus.

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SS- Conceptualization, study design, the definition of intellectual content, literature search, data acquisition, data analysis, statistical analysis, drafting of the manuscript; **BP**- Conceptualization, study design, manuscript editing, and review; **PKS**- Study design, the definition of intellectual content, data acquisition, manuscript editing and review; **SSK**- Definition of intellectual content, literature search, data analysis, statistical analysis, drafting of the manuscript; **SB**- Literature search, data acquisition, manuscript editing and review; **AS**- Data acquisition, manuscript editing and review.

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