



Original Article

## Dermatoglyphic Patterns in Type 2 Diabetes Mellitus: A Cross-Sectional Study from North India

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### ABSTRACT

**Background:** Type 2 Diabetes Mellitus (T2DM) is a rapidly increasing global health problem with significant morbidity and mortality. Early identification of individuals at risk remains a major challenge, particularly in resource-limited settings. Dermatoglyphics, the study of epidermal ridge patterns, has been explored as a simple, non-invasive marker reflecting genetic and intrauterine influences associated with various diseases, including diabetes.

**Objective:** To study the dermatoglyphic patterns in patients with Type 2 Diabetes Mellitus and analyze their distribution across different digits and demographic variables.

**Methods:** A cross-sectional observational study was conducted among 100 diagnosed T2DM patients attending the Medicine OPD of Integral Institute of Medical Sciences and Research. Fingerprint impressions of all ten digits were collected using the standard ink method and classified into loops, whorls, and arches. Data were analyzed using descriptive statistics and the Chi-square test to assess associations between fingerprint patterns and variables such as age, sex, hand, and digit.

**Results:** A total of 1000 fingerprint impressions were analyzed. Loop pattern was the most predominant (62.7%), followed by whorls (25.0%) and arches (12.3%). Loop predominance was observed across all digits, with the highest frequency in the thumb and ring finger. No statistically significant association was found between fingerprint patterns and hand ( $p = 0.572$ ), sex ( $p = 0.694$ ), age group ( $p = 0.918$ ), or digit ( $p = 0.659$ ). Bilateral comparison also showed no significant differences between right and left hands ( $p > 0.05$ ).

**Conclusion:** The study demonstrates a predominance of loop patterns in T2DM patients with no significant variation across demographic or anatomical variables. Dermatoglyphic analysis may serve as a simple, non-invasive adjunct tool for diabetes research; however, further large-scale comparative studies with control groups are required to establish its role as a predictive marker.

**Keywords:** Type 2 Diabetes Mellitus, Dermatoglyphics, Fingerprint Patterns, Genetic Markers, Non-Invasive Screening.

### INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. It represents one of the most significant global health challenges of the 21st century. According to the International Diabetes Federation, approximately 589 million adults were living with diabetes in 2024, and this number is projected to rise to 853 million by 2050 [1]. India bears a substantial share of this burden, with nearly 89.8 million cases reported in 2024, making it one of the countries most affected by diabetes worldwide.

Rapid urbanization, sedentary lifestyles, dietary transitions, and genetic susceptibility contribute significantly to the increasing prevalence, particularly in North Indian regions such as Uttar Pradesh.

Early identification of individuals at risk for T2DM is crucial to prevent long-term complications, including microvascular complications such as retinopathy, nephropathy, and neuropathy, and macrovascular complications such as cardiovascular disease and stroke<sup>[2]</sup>. Conventional diagnostic tools, including fasting plasma glucose, oral glucose tolerance test (OGTT), and glycated hemoglobin (HbA1c), are effective but may not always be feasible for large-scale screening, especially in resource-limited settings. Therefore, there is a growing need for simple, non-invasive, and cost-effective methods for early risk identification.

Dermatoglyphics, the scientific study of epidermal ridge patterns on fingers, palms, and soles, offers a promising approach in this regard. The term was introduced in 1926 by Harold Cummins and Charles Midlo, who established its scientific basis in medical research in 1943<sup>[3]</sup>. These ridge patterns are formed during the early stages of intrauterine life, specifically between the 10th and 19th weeks of gestation, and remain unchanged throughout an individual's lifetime<sup>[4]</sup>. Because they are genetically determined and influenced by intrauterine environmental factors, dermatoglyphic patterns serve as permanent markers of early developmental events.

A biological link between dermatoglyphics and T2DM has been proposed based on their common ectodermal origin. Both epidermal ridges and pancreatic  $\beta$ -cells develop during a similar embryological period, suggesting that genetic or environmental disturbances during this critical phase may affect both ridge formation and metabolic pathways<sup>[5,6]</sup>. As a result, dermatoglyphic variations have been studied extensively in various genetic and multifactorial diseases, including Down syndrome, hypertension, schizophrenia, and diabetes mellitus<sup>[7]</sup>.

Previous studies investigating dermatoglyphics in T2DM patients have reported varying findings. Several studies have demonstrated a higher frequency of loop patterns and wider ATD angles among diabetic individuals<sup>[8,9]</sup>. In contrast, some Indian studies have reported a predominance of whorl patterns in diabetic populations, indicating regional and ethnic variability<sup>[10,11]</sup>. These inconsistencies highlight the need for population-specific studies to establish reliable dermatoglyphic markers.

Despite increasing research interest, there is a relative paucity of data from North Indian populations, particularly from the Lucknow region. Given the high burden of diabetes and potential genetic diversity in this population, it is important to explore dermatoglyphic characteristics in this context. Therefore, the present study aims to analyze dermatoglyphic patterns in T2DM patients attending Integral Institute of Medical Sciences and Research and evaluate their potential role as a simple, non-invasive screening tool.

## **MATERIALS AND METHODS**

### ***Study Design***

The present study was conducted as a cross-sectional observational study to evaluate dermatoglyphic patterns in patients diagnosed with Type 2 Diabetes Mellitus (T2DM). The design was chosen to provide a descriptive analysis of fingerprint pattern distribution in a defined population at a single point in time.

### ***Study Setting***

The study was carried out in the department of Anatomy in collaboration with department of Medicine, Integral Institute of Medical Sciences and Research, Integral University, Lucknow after seeking Ethical clearance from IRC and IEC.

### ***Study Population***

The study population consisted of patients diagnosed with Type 2 Diabetes Mellitus attending the Medicine OPD during the study period. All participants were recruited on a voluntary basis after obtaining informed consent.

### ***Inclusion Criteria***

Participants were included in the study based on the following criteria:

- Diagnosed cases of Type 2 Diabetes Mellitus
- Both male and female patients
- Patients of all age groups
- Patients attending the OPD during the study period
- Patients willing to provide written informed consent

### ***Exclusion Criteria***

Participants were excluded if they met any of the following conditions:

- Patients diagnosed with Type 1 Diabetes Mellitus
- Individuals unwilling to participate or not providing consent
- Patients with deformities, injuries, burns, or dermatological conditions affecting fingertips

- Patients residing outside the study region

### Materials Used

Ink pad, White paper sheets, Cotton and tissue paper, Glass slab, Magnifying lens, Needle, Wet wipes for post-procedure cleaning

### Procedure for Data Collection

Participants were instructed to wash and dry their hands before fingerprint collection. Each finger was gently pressed on an ink pad and rolled on paper to obtain clear impressions. Prints of all five digits of both hands were collected. After the procedure, participants cleaned their hands using wet wipes, and the collected prints were labeled, dried, and preserved for analysis.

### Dermatoglyphic Parameters Assessed

The dermatoglyphic patterns were classified into the following categories:

- **Loops:** Ridges that enter from one side, recurve, and exit on the same side
- **Whorls:** Circular or spiral patterns with two or more triradii
- **Arches:** Ridges that pass from one side to the other without recurving

Additional parameters such as Total Ridge Count (TRC) and Pattern Intensity Index (PII) were considered wherever applicable.

### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical methods.

- Categorical variables were expressed as frequency and percentage
- Continuous variables were expressed as mean  $\pm$  standard deviation
- The Chi-square ( $\chi^2$ ) test was used to assess associations between fingerprint patterns and variables such as hand, sex, age group, and digit
- A p-value of less than 0.05 was considered statistically significant.

## RESULTS

A total of 100 patients diagnosed with Type 2 Diabetes Mellitus were included in the study. Dermatoglyphic patterns of all ten digits (total = 1000 prints) were analyzed and classified into loops, whorls, and arches.

### Demographic Characteristics of Study Participants

**Table 3.1: Sex Distribution of Study Participants (n = 100)**

Sex	Frequency	Percentage (%)
Male	41	41.0
Female	59	59.0
<b>Total</b>	<b>100</b>	<b>100.0</b>

### Interpretation:

The study population showed a female predominance, with 59% females and 41% males. This suggests that a higher proportion of female diabetic patients attended the OPD during the study period.

**Table 3.2: Age Distribution of Study Participants (n = 100)**

Age Group (Years)	Frequency	Percentage (%)
40–49	34	34.0
50–59	32	32.0
60–69	34	34.0
<b>Total</b>	<b>100</b>	<b>100.0</b>

Mean  $\pm$  SD = 54.45  $\pm$  8.67 years

### Interpretation:

Participants were almost evenly distributed across all age groups, with the majority belonging to the middle-aged and elderly population. This reflects the typical age profile of Type 2 Diabetes Mellitus.

### Distribution of Dermatoglyphic Patterns by Digit

**Table 3.3: Distribution of Fingerprint Patterns in Thumb (Digit I)**

Pattern	Right n (%)	Left n (%)	Total n (%)
Loop	61 (61.0)	70 (70.0)	131 (65.5)
Whorl	28 (28.0)	25 (25.0)	53 (26.5)
Arch	11 (11.0)	5 (5.0)	16 (8.0)

<b>Total</b>	100 (100)	100 (100)	200 (100)
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**Interpretation:**

Loops were the predominant pattern in the thumb, especially on the left side (70%). Arches were the least common pattern.

**Table 3.4: Distribution of Fingerprint Patterns in Index Finger (Digit II)**

Pattern	Right n (%)	Left n (%)	Total n (%)
Loop	59 (59.0)	60 (60.0)	119 (59.5)
Whorl	26 (26.0)	26 (26.0)	52 (26.0)
Arch	15 (15.0)	14 (14.0)	29 (14.5)
<b>Total</b>	100 (100)	100 (100)	200 (100)

**Interpretation:**

Loop pattern predominated in both hands with nearly equal distribution, while arches were relatively more frequent compared to the thumb.

**Table 3.5: Distribution of Fingerprint Patterns in Middle Finger (Digit III)**

Pattern	Right n (%)	Left n (%)	Total n (%)
Loop	62 (62.0)	62 (62.0)	124 (62.0)
Whorl	22 (22.0)	25 (25.0)	47 (23.5)
Arch	16 (16.0)	13 (13.0)	29 (14.5)
<b>Total</b>	100 (100)	100 (100)	200 (100)

**Interpretation:**

The middle finger showed symmetrical distribution between both hands with loops as the dominant pattern.

**Table 3.6: Distribution of Fingerprint Patterns in Ring Finger (Digit IV)**

Pattern	Right n (%)	Left n (%)	Total n (%)
Loop	69 (69.0)	59 (59.0)	128 (64.0)
Whorl	22 (22.0)	27 (27.0)	49 (24.5)
Arch	9 (9.0)	14 (14.0)	23 (11.5)
<b>Total</b>	100 (100)	100 (100)	200 (100)

**Interpretation:**

The ring finger exhibited one of the highest frequencies of loops, particularly on the right side.

**Table 3.7: Distribution of Fingerprint Patterns in Little Finger (Digit V)**

Pattern	Right n (%)	Left n (%)	Total n (%)
Loop	67 (67.0)	58 (58.0)	125 (62.5)
Whorl	20 (20.0)	29 (29.0)	49 (24.5)
Arch	13 (13.0)	13 (13.0)	26 (13.0)
<b>Total</b>	100 (100)	100 (100)	200 (100)

**Interpretation:**

Loops remained the most frequent pattern, although the left hand showed a slightly higher proportion of whorls.

**Overall Distribution of Dermatoglyphic Patterns**

**Table 3.8: Overall Distribution of Fingerprint Patterns (n = 1000 prints)**

Pattern	Frequency	Percentage (%)
Loop	627	62.7
Whorl	250	25.0
Arch	123	12.3
<b>Total</b>	<b>1000</b>	<b>100.0</b>

**Interpretation:**

Loops were the predominant dermatoglyphic pattern overall, followed by whorls and arches. This indicates a clear dominance of loop patterns among diabetic patients.

**Association Between Fingerprint Pattern and Variables**

**Table 3.9: Association Between Fingerprint Pattern and Study Variables (Chi-square Test)**

Variable	$\chi^2$	df	p-value
Hand	1.116	2	0.572

Sex	0.731	2	0.694
Age Group	0.942	4	0.918
Digit	5.892	8	0.659

#### Interpretation:

No statistically significant association was observed between fingerprint patterns and hand, sex, age group, or digit ( $p > 0.05$ ). This indicates that the distribution of dermatoglyphic patterns was consistent across all variables.

#### Bilateral Comparison of Fingerprint Patterns

**Table 3.10: Comparison of Right and Left Hand Patterns by Digit**

Digit	$\chi^2$	df	p-value
Thumb	3.038	2	0.219
Index	0.043	2	0.979
Middle	0.502	2	0.778
Ring	2.378	2	0.304
Little	2.301	2	0.316

#### Interpretation:

No significant bilateral differences were observed for any digit ( $p > 0.05$ ). This suggests that dermatoglyphic patterns were symmetrical between the right and left hands.

### DISCUSSION

The present study was undertaken to evaluate dermatoglyphic patterns in patients with Type 2 Diabetes Mellitus (T2DM) attending the Medicine OPD of Integral Institute of Medical Sciences and Research. The findings revealed a clear predominance of loop patterns across all digits, followed by whorls and arches, with no statistically significant association between fingerprint patterns and variables such as sex, age group, hand, or digit.

The overall predominance of loop patterns (62.7%) observed in the present study is consistent with several international studies. For instance, Tadesse et al. (2022) reported a higher frequency of loop patterns (65.8%) among T2DM patients in Ethiopia, along with reduced whorl patterns<sup>[8]</sup>. Similarly, Abdul et al. (2025) in Kuwait observed that loop patterns were more common in diabetic individuals, whereas whorls predominated among controls. These findings support the hypothesis that loop-dominant dermatoglyphic configurations may be associated with diabetic predisposition in certain populations<sup>[9]</sup>.

However, the literature is not entirely consistent. Several Indian studies have reported contrasting findings, with whorl patterns being more frequent in diabetic subjects. Shrivastava et al. (2017), in a North Indian population, observed a predominance of whorls in diabetic patients, while loops were more common in non-diabetic controls<sup>[10]</sup>. Likewise, Pasha et al. (2012) reported increased whorl patterns and decreased loops among diabetic individuals<sup>[11]</sup>. These discrepancies suggest that dermatoglyphic patterns in T2DM may vary according to genetic background, ethnicity, and geographical factors. Such variability emphasizes the importance of region-specific studies, particularly in a genetically diverse country like India.

The biological plausibility of the association between dermatoglyphics and T2DM lies in their common embryological origin. Both epidermal ridges and pancreatic  $\beta$ -cells are derived from ectodermal tissues and develop during the same critical period of intrauterine life (10th–19th weeks of gestation). Disturbances during this period—whether genetic or environmental—may simultaneously affect ridge formation and metabolic programming, leading to long-term susceptibility to diabetes (Vilahur et al., 2012; Yohannes, 2015)<sup>[5,6]</sup>. Dermatoglyphic patterns, therefore, can be considered a “fossil record” of early developmental influences.

In the present study, arches were consistently the least common pattern (12.3%), which is in agreement with most previous studies. Tadesse et al. (2022) reported arches in only 6.57% of diabetic participants<sup>[8]</sup>, while Rakate and Zambare (2013) also observed low frequencies of arches in diabetic populations. This consistency across studies suggests that arches are generally less influenced by diabetic predisposition compared to loops and whorls<sup>[12]</sup>.

Another important observation in the present study was the absence of statistically significant differences between the right and left hands for any digit. This finding indicates bilateral symmetry in dermatoglyphic patterns among diabetic patients. Similar symmetry has been reported in earlier studies, where ridge patterns remained stable across both hands (Tadesse et al., 2022)<sup>[8]</sup>. This supports the concept that dermatoglyphic traits are genetically determined and relatively unaffected by postnatal environmental influences.

The study also found no significant association between fingerprint patterns and sex. Although some studies have reported sex-specific variations—such as higher loop frequencies in males and increased whorls in females (Sudagar Muthusamy et al., 2019)—the present findings did not demonstrate such differences<sup>[13]</sup>. This may be due to sample size limitations or

the relatively uniform distribution of patterns in the study population. Similarly, no significant association was found between age and fingerprint patterns, which is expected, as dermatoglyphic patterns are established prenatally and remain unchanged throughout life [4].

Despite the consistency of loop predominance in the present study, it is important to acknowledge certain limitations. The absence of a control group prevents direct comparison between diabetic and non-diabetic individuals. Consequently, it cannot be conclusively stated whether the observed loop predominance is specific to diabetic patients or reflects the general population pattern in the region. Previous comparative studies have demonstrated that differences between cases and controls are essential for establishing dermatoglyphics as a predictive marker by, Tadesse et al., (2022); Abdul et al., (2025) [8,9].

Furthermore, the present study focused primarily on qualitative dermatoglyphic patterns and did not include quantitative parameters such as Total Finger Ridge Count (TFRC), Absolute Finger Ridge Count (AFRC), or ATD angle. Several studies have reported significant differences in these quantitative measures among diabetic patients, suggesting that they may provide stronger predictive value (Lekshmi et al., 2021; Jha et al., 2019) [14,15]. Future studies incorporating both qualitative and quantitative parameters may offer more comprehensive insights.

From a clinical perspective, dermatoglyphics offers several advantages as a screening tool. It is non-invasive, inexpensive, and easy to perform, making it suitable for large-scale screening in resource-limited settings. In regions with high diabetes burden, such as Uttar Pradesh, dermatoglyphic analysis could potentially complement existing risk assessment tools. However, given the variability in findings across different populations, its use should be considered as an adjunct rather than a standalone diagnostic method.

## CONCLUSION

The present study demonstrates that loop patterns are the predominant dermatoglyphic feature in patients with Type 2 Diabetes Mellitus, followed by whorls and arches. No statistically significant association was observed between fingerprint patterns and variables such as age, sex, hand, or digit, indicating a uniform distribution across the study population. These findings suggest that dermatoglyphic analysis may serve as a simple, non-invasive adjunct tool in diabetes research. However, due to the absence of a control group and population variability, further large-scale, comparative studies are required to establish its role as a reliable screening or predictive marker for Type 2 Diabetes Mellitus.

## REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 11th ed. Brussels: International Diabetes Federation; 2025.
2. American Diabetes Association. Standards of medical care in diabetes—2024. *Diabetes Care*. 2024;47(Suppl 1):S1–S350.
3. Cummins H, Midlo C. Fingerprints, palms and soles: an introduction to dermatoglyphics. Philadelphia: Blakiston; 1943. p. 11–15.
4. Bhat GM, Mukhdoomi MA, Shah BA, Ittoo MS. Dermatoglyphics: in health and disease—a review. *Int J Res Med Sci*. 2017;2(1):31–37.
5. Vilahur N, et al. Ectodermal markers of early developmental impairment. *Psychiatry Res*. 2012;200(2–3):251–256. doi:10.1016/j.psychres.2012.05.011.
6. Yohannes S. Dermatoglyphic meta-analysis indicates early epigenetic outcomes in type 2 diabetes. *J Diabetes Metab Disord*. 2015;14:72. doi:10.1186/s40200-015-0198-4.
7. Masthan KMK, Babu NA, Krupaa RJ, Anitha N. Dermatoglyphics—a review. *Biomed Pharmacol J*. 2015;8(Spec Iss).
8. Tadesse A, Gebremickael A, Merid M, Wondmagegn H, Melaku T, Ayele T, et al. Evaluation of dermatoglyphic features of type 2 diabetic patients as compared to non-diabetics attending hospitals in Southern Ethiopia. *Diabetes Metab Syndr Obes*. 2022;15:1269–1280. doi:10.2147/DMSO.S356728.
9. Abdul NS, Alenezi FM, Al-Mutairi AA. Dermatoglyphics: a forensic tool to predict type 2 diabetes mellitus and gender identification among Kuwaiti population: a cross-sectional observational study. *J Pharm Bioallied Sci*. 2025;17(Suppl 2):S1389–S1392. doi:10.4103/jpbs.jpbs\_1687\_24.
10. Shrivastava R, Indurkar P, Singh P, Singh A. Comparative study on dermatoglyphic pattern among diabetic (type 2) and non-diabetic adults in North Indian population. *Eur J Pharm Med Res*. 2017;4(8):456–460.
11. Pasha MI, et al. A study of dermatoglyphic pattern in diabetic subjects in North India. *J Anat Soc India*. 2012;61(1):45–50.
12. Rakate NS, Zambare BR. Comparative study of dermatoglyphic patterns in type II diabetes mellitus patients and non-diabetics. *Int J Med Res Health Sci*. 2013;2(4):955–959.
13. Sudagar Muthusamy S, Ilankathir Sridharan I, Rajan Thangarasu R, Sridhar Krishnamoorthy S, Sowmiya Ganesan S. A descriptive study on dermatoglyphics in type II diabetic patients. *MedPulse Int J Anat*. 2019;12(1):1–3. doi:10.26611/10011211.
14. Lekshmi PA, Srimathi T, Anandarani VS. The palmar dermatoglyphic patterns in type II diabetes mellitus cases: a study in South Indian population. *Biomed Pharmacol J*. 2021;14(1):123–130. doi:10.13005/bpj/2137.
15. Jha A, et al. A comparative study of palmar and digital dermatoglyphic patterns among type-II diabetic and non-diabetic adults: a meta-analysis. *Kidney Int Rep*. 2019;4(Suppl 1):S386.