International Journal of Community Medicine and Public Health
Safi S et al. Int J Community Med Public Health. 2026 Jun;13(6):3053-3059
https://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20261796

Original Research Article

Comparative analysis of palmar dermatoglyphics in diabetic and non-diabetic individuals of Nashik

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Received: 31 March 2026
Revised: 17 May 2026
Accepted: 18 May 2026

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ABSTRACT

Background: Dermatoglyphics, the scientific analysis of epidermal ridge configurations on the fingers and palms, has been increasingly explored as a potential tool in medical research due to its strong genetic basis and lifelong stability once established during fetal development. Type 2 diabetes mellitus is a multifactorial metabolic disorder characterized by chronic hyperglycaemia resulting from impaired insulin secretion, insulin action or both. It represents a major and growing global public health concern, particularly in developing countries such as India, where rapid urbanization, lifestyle changes and population aging have contributed to its rising prevalence.

Methods: This case-control study was conducted to evaluate dermatoglyphic patterns in individuals with type 2 diabetes mellitus. The study included 25 clinically and laboratory- confirmed cases of type 2 diabetes mellitus and 25 apparently healthy control subjects selected from local residents of Nashik. Palmar and digital prints of both hands were recorded using the standard ink and pad technique.

Results: The study shows that there is no significant difference in the arches, loops and whorls observed among the study group (diabetic mellitus type 2 patients) and control group (non-diabetic individuals), but the axial tri radius angle shows that the angle is increased in diabetic mellitus type 2 patients than the control group.

Conclusions: It is concluded that the arches, loops and whorl patterns are independent of diabetic and non-diabetic patients, while the a-t-d angle is useful for the prediction of diabetes by dermatoglyphic studies.

Keywords: Arches, A-T-D angle, Dermatoglyphics, Diabetes mellitus, Loops, Whorls

INTRODUCTION

Type 2 diabetes mellitus, commonly referred to as diabetes, represents a heterogeneous group of metabolic disorders of multifactorial ethology characterized primarily by chronic hyperglycemia resulting from defects in insulin secretion, insulin action or both. It is a complex metabolic condition influenced by genetic, environmental and lifestyle factors.[1]

Over recent decades, diabetes has emerged as one of the most significant global public health challenges, affecting both developed and developing nations. Rapid urbanization, sedentary lifestyles, dietary transitions and population aging have contributed substantially to its increasing prevalence. Epidemiological projections have highlighted the alarming rise in the burden of diabetes worldwide. It has been estimated that by the year 2030, the number of individuals affected by diabetes will reach approximately 366 million globally. These projections are supported by reports from leading international organizations such as the World Health Organization, International Diabetes Federation, European Association for the Study of Diabetes and EURODIAB, which predict that diabetes will rank among the foremost causes of morbidity and mortality in the coming decades. In countries such as India, the rapid increase in prevalence has created an urgent need for early detection strategies and preventive interventions.[2-4] Increasing attention has been directed towards identifying non-invasive, economical and easily applicable methods for early risk assessment of genetically influenced diseases. Dermatoglyphics, the scientific study of epidermal ridge patterns and their configurations, represents one such approach. The term is derived from the Greek words derma (skin) and glyph (carving), referring to the systematic analysis of fingerprints and palmar ridge patterns.[5]

Dermatoglyphics has gained importance in medical research because dermal ridge patterns are genetically determined and remain unchanged throughout life once established. The formation of epidermal ridges begins during early fetal development, typically around the third month of intrauterine life and is completed by the fourth month. This period coincides with critical phases of organogenesis.

Any disturbances in fetal growth during this time whether genetic or environmental may influence ridge alignment and configuration, particularly in the hands and feet.[5] Since ridge patterns are established during early embryogenesis and remain constant thereafter, they may serve as permanent markers of prenatal developmental events. Ridge configuration is therefore influenced partly by hereditary factors and partly by intrauterine environmental conditions.

Numerous studies have demonstrated associations between dermatoglyphic variations and certain genetic and chromosomal disorders. Because some diseases arise from abnormalities in the genetic constitution, such alterations may be reflected in characteristic dermatoglyphic patterns. As a result, dermatoglyphic analysis has been utilized in the study of hereditary conditions, twin diagnosis, disputed paternity and various congenital anomalies.[6]

Type 2 diabetes mellitus has a well-established genetic component, with familial aggregation and polygenic inheritance patterns contributing significantly to disease susceptibility. Considering that dermatoglyphic patterns are genetically influenced and formed during a critical developmental window, it is plausible that individuals predisposed to type 2 diabetes mellitus may exhibit distinctive dermatoglyphic features. Therefore, the study of dermatoglyphic parameters may provide valuable insight into early identification of individuals at increased risk, offering a simple, non-invasive and cost-effective screening adjunct.

In this context, the present study was undertaken to compare the dermatoglyphic patterns of patients belonging to Nashik, with type 2 diabetes mellitus with those of normal individuals from the same geographical region. Furthermore, the findings were analyzed in relation to previously reported studies in order to evaluate the consistency and potential clinical relevance of dermatoglyphic parameters in the prediction of type 2 diabetes mellitus. Types of patterns in fingerprint.

Arches

These are characterized by a slight rise (elevation) in the ridges which enter on one side of the fingerprint pattern and exit on the opposite side. The arches lack delta in the fingerprint. The arches are divided into two types: Plain arch and tented arch.

Loop

The pattern in which one or more ridges enter from one side of the impression, make a re-curve and exit or tend to exit on the same side of the.

Whorl

A whorl is characterized by a circular pattern having one or more ridges revolve around the core making a complete circle. It may be either plain or composite

The axial tri-radii angle

The a-t-d angle is a key palm-print measurement in dermatoglyphics (study of epidermal ridges) formed by drawing lines from the digital tri-radii at the base of the index finger (a) and little finger (d) to the axial tri-radius (t) in the palm's center.

The three types of axial tri-radii position are generally classified as: t: Less than 45° (proxi mal/normal). t': Between 45° and 56° (intermediate). t'': Greater than 56° (distal/higher).

Hypothesis formulations

Hypothesis for patterns of fingerprints

Null hypothesis (H0)

The distribution of fingerprint patterns (Arches, Loops and Whorls) is independent whether a patient is Diabetic and Non-Diabetic.

Hypothesis one (H1)

There is a statistically significant difference in dermatoglyphic patterns between individuals diagnosed with type 2 diabetes mellitus and non-diabetic controls.

Hypothesis for axial tri-radii angle

Null hypothesis (H0)

There is no significant difference in a-t-d angle in palmar dermatoglyphics between individuals diagnosed with type-2 diabetes mellitus and non-diabetic controls.

Hypothesis one (H1)

There is a statistically significant difference in a-t-d angle in palmar dermatoglyphics between individuals diagnosed with type-2 diabetes mellitus and non-diabetic controls.

METHODS

Study design and participants

The present case–control study was conducted on 20 patients diagnosed with type 2 diabetes mellitus, confirmed through detailed clinical evaluation and laboratory investigations. The control group comprised 25 apparently healthy individuals selected from local residents of Nashik city, Maharashtra state of India. The total sample size is 45 comprising the diabetic and non-diabetic controls. Both cases and controls were included only after obtaining a brief medical history to rule out known genetic disorders or any deformities affecting the fingers, palms or dermatoglyphic patterns. Individuals with congenital abnormalities or dermatoglyphic deformities were excluded from the study. Obtained fingerprints are marked with D (diabetic) and ND (non-diabetic) to differentiate between diabetic patients and non-diabetic controls.

The statistical analysis is done by using Fisher's exact test and standard deviation. The study is conducted in the local residencies from January 2026 to March 2026.

Ethical considerations

The purpose and objectives of the study were clearly explained to all participants in both groups. Detailed information regarding the procedure for recording dermatoglyphic prints was provided. Written informed consent was obtained from all participants prior to data collection.

Dermatoglyphic printing

Method of recording

Palmar and fingerprint impressions of both hands were obtained using the standard ink and pad method as described by Harold Cummins and Charles Midlo (1961).

Equipment used

The following materials were used for recording the prints: ball of cotton, muslin cloth, white bond paper, camel ink and ink pad.

Procedure for collection and analysis of palm prints

Prior to print collection, the participants were instructed to wash their hands thoroughly with soap and sufficient water to remove dirt and grease. The hands were then dried using a clean towel. An adequate quantity of printer's ink was placed on a cotton ball and manually spread on the palm of the subjects. Each finger was individually covered with ink with the help of cotton ball from one lateral side to the other to ensure complete coverage of the palmar surface. The inked finger was then pressed onto a crystal white bond paper in a single, firm motion to obtain a clear print. For palm prints, ink was evenly applied over the entire palmar surface. The participant's palm was then carefully pressed onto the printing sheet. Firm and uniform pressure was applied over the dorsum of the hand and the interdigital areas to ensure complete and clear impression of all regions. The palm was lifted gently from the radial end toward the ulnar end to prevent smudging. Each print was properly labelled with the identity details of the respective subject. The collected prints were examined using a magnifying lens to analyze the dermatoglyphic patterns.

Observation

Changes of fingerprint patterns

In our study the fingerprint patterns of thumbs of both the hands are observed in non-diabetic subjects and diabetic patients. The notable change seen in the diabetic patients is the difference between the thumb patterns of an individual's right hand and left hand (e.g., a diabetic patient has arches pattern in the left hand's thumb and loop pattern in the right hand's thumb). Such differences were observed more in diabetic patients than non-diabetic subjects. The patterns which are frequently observed were the loops and whorls. The non-diabetic subjects show significantly less differences in the thumb pattern of individuals. The pattern difference can be seen in Figure 1 and Figure 2 respectively.

Differences in a-t-d angle

The a-t-d angle differences are observed in the non-diabetic subjects. The a-t-d angle of some non-diabetic subjects' measure showing more angle than the other non-diabetic subjects. The mean a-t-d angle of diabetic patients observed is 40.615 and non-diabetic subjects are 38.274. In some subjects the value of a-t-d angle is higher as compared to other non- diabetic subjects. In such cases, if the subject gets diagnosed with diabetes mellitus Type 2 it can be said that the observable difference seen in a-t-d angle can be used as a marker for prediction of early diagnosis of diabetes mellitus. The differences in a-t-d angle in non-diabetic subjects can be seen in Figure 4.

RESULTS

The results of the study are as follows

In the Nashik district, Total 25 individuals that were diagnosed as diabetes mellitus Type 2 and 25 individuals as control (non-diabetic), ranging in age group from 40 years to 70 years and above were taken for the study. The analysis was made on various parameters such as the total no. of arches, loops and whorls were counted by taking both diabetic and non-diabetic patients' fingerprints on a crystal white paper. Statistical analysis was done using Standard deviation and Fisher's Test. The results conclude that the average no. of arches, loops and whorls in diabetic does not show any statistically significant differences compared to non- diabetic patients. The results are shown in Table 1 and Figure 1. Therefore, we support the null hypothesis (H0).

Fingerprint patterns

The fingerprint patterns on the right and left hand's thumb of diabetic and non-diabetic were recorded (Figure 5). As shown in Table 2 the standard deviation values show no significant difference in both diabetic and non-diabetic individuals.

Figure 1: Differences between patterns of thumbs in diabetic patients.

Figure 2: Differences between patterns of thumbs in non-diabetic patients.

Figure 3: A-T-D angle observed in diabetic subjects.

Figure 4: Higher a-t-d angle observed in non-diabetic subjects.

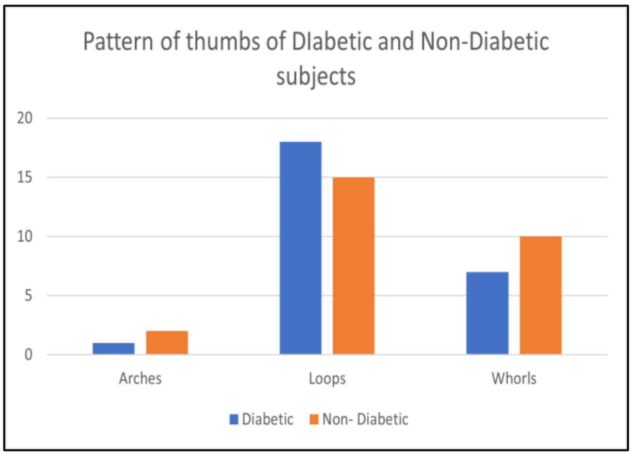

Figure 5: Comparative analysis of patterns of thumbs of diabetic and non-diabetic individuals.

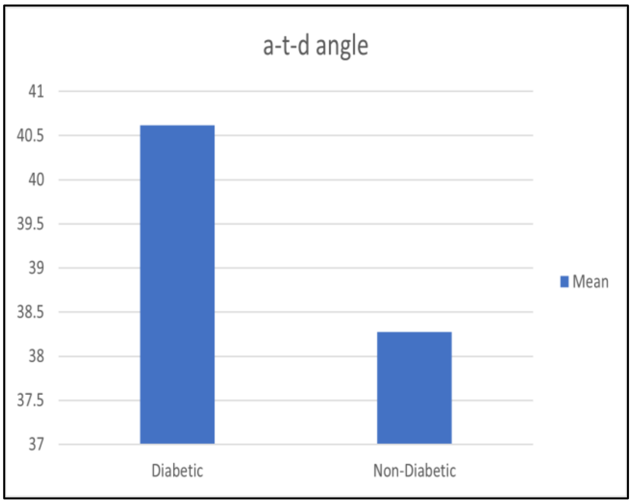

Figure 6: Comparative analysis of a-t-d angle of diabetic and non- diabetic individuals.

A-T-D angle

Along with the fingerprints, the a-t-d angle of both diabetic and non-diabetic individuals was measured. The mean a-t-d angle as shown in Table 3 and Figure 6, suggests that the a-t-d angle shows significant differences between the diabetic and non-diabetic individuals.

Result

The p value of 0.732954545 for patterns of fingerprint observed in the thumb is significantly greater than 0.05, indicating that there is no statistical association between the diabetic and non-diabetic status and the fingerprint patterns in this study. While the p-value of 0.047836 for a-t-d angle observed in individuals is significantly smaller than 0.05, indicating that there is statistical association between the diabetic and non-diabetic status and the observed a-t-d angle in the study.

Table 1: Frequency of socio- dermatoglyphic characteristics of diabetic and non-diabetic individuals.

Gender	Age (in years)	Diabetic patients	%	Non- diabetic patients	%
Male	40-50	2	10.00	2	8
	50-60	4	20.00	1	4
	60-70	3	15.00	1	4
	>70	1	5.00	1	4
		∑=10	∑=50	∑=5	∑=20
Female	40-50	2	10.00	13	52
	50-60	5	25.00	4	16
	60-70	2	10.00	3	12
	>70	1	5.00	0	0
		∑=10	∑=50	∑=20	∑=80

Table 2: Patterns of finger print impressions in diabetic and non-diabetic individuals.

Patterns	Diabetic	Standard deviation	Non-diabetic	Standard deviation
Arches	1	13.43503	2	16.26346
Loops	18	1.414214	15	7.071068
Whorls	7	9.192388	10	10.6066

Table 3: A-T-D angle among diabetic and non-diabetic individuals.

Arm	Diabetic	Non-diabetic
Right	40.445	39.36
Left	40.785	37.188
Mean	40.615	38.274

Table 4: Fisher's exact test.

Patterns	Diabetic	Non-diabetic	Row totals
Arches	1	2	3
Loops	18	15	33
Whorls	7	10	17
			∑ =53
			p=0.732954545

DISCUSSION

Arches

Panda et al found there was an increase in arches in diabetic patients as compared to control subjects.[7] Pattern frequency was not statistically significant in the diabetic group in the study done by Rajanigandha et al, Mandasescu et al and Sant et al pointed out a significant increase in the arch pattern in female diabetics only.[8-10]

In the study the arches were not statistically significant. The arches in diabetic are less than in non-diabetic individuals.

Loops

Panda et al and Ravindranath et al found an increase in radial loops in diabetics of both sexes.[7,11] Panda et al found there was increase in ulnar loops in their study but pattern frequency was not statistically significant in the diabetic group in the study done by Rajanigandha et al, Mandasescu et al and Sant et al. In the study there was no significant difference seen in the patterns of loops considering both ulnar loop and radial loop.

Whorls

Sant et al reported a significant increase in the frequency of whorls in diabetics of both sexes. However, Ravindranath et al and Panda et al found a decrease in whorls of diabetic as compared to controls. Pattern frequency was not statistically significant in the diabetic group in the study done by Rajanigandha et al and Mandasescu et al. In the study the no of whorl patterns present in the diabetic and non-diabetic individuals does not give any significant differences and are at par with the results obtained by Rajanigandha et al and Mandasescu et al.

A-T-D angle

Rajanigandha et al showed a statistically significant increase in the 'a-t-d' angle in diabetics of both sexes when compared with controls who showed acute angles. In a study by Mandasescu et al right hand 'a-t-d' angle was significantly lower in male diabetics only. In the study the mean a-t-d angle of diabetic patients were increased as compared to non- diabetic population. These results are in line with above mentioned previous studies.

The above study explains the differences in the dermatoglyphics patterns (arches, loops and whorls) of fingertips does not give any significant difference in both diabetic and non- diabetic population. The further analysis of a-t-d angle shows a significant difference between the diabetic and non- diabetic control group. The a-t-d angle was significantly higher in diabetes patients as compared to non-diabetic control groups. This is shown in Figure 2 and Table 4.

CONCLUSION

It can be concluded that the qualitative analysis of fingertips patterns like loops, whorl and arches revealed no statistically significant association between the diabetic and non-diabetic status and the fingerprint patterns in this sample.

The differences observed between the group are likely due to chance. Hence, we accept the null hypothesis (H0) from the hypothesis formulation for the fingerprint patterns. There is a significant difference in the a-t-d angle of diabetic and non-diabetic patients. Hence the study supports alternative hypothesis (H1) from hypothesis Formulation for a-t-d angle.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Schaumann B, Alter M. Dermatoglyphics in medical disorders. Springer Verlag. 1976;2:75-9.
2. Wild S, Roglic G, Green A. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care. 2004;27(5):1047–53.
3. Kahn R, Buse J, Ferrannini E, Stern M. The metabolic syndrome: time for a critical appraisal: joint statement from the American diabetes association and the European association for the study of diabetes. Diabetes Care. 2005;28(9):2289-304.
4. World Health Organization. Definition, diagnosis and classification of diabetes mellitus and its complications: report of a WHO consultation. Part 1, Diagnosis and classification of diabetes mellitus. World Health Organization. 1999.
5. Somogyi A, Schubert A. Correlation between national bibliometric and health indicators: The case of diabetes. Scientometrics. 2005;62(2):285-92.
6. Cummins H, Midlo C. Finger prints, palms and soles: an introduction to dermatoglyphics. New York: Dover Publications. 1961.
7. Panda M, Chinara PK, Nayak AK. Dermatoglyphics in diabetes mellitus. J Anatom Soc India. 2004;53:33–66.
8. Rajanigandha V, Mangala P, Latha P. Digito–palmar complex in diabetes. Turkish Journal of Medical Sci. 2006;36:353–5.
9. Mandasescu S, Richards B, Cadman J. Detection of pre-diabetics by palmar prints: a computer study leading to a low-cost tool. InXIV Int Congress Fed Med Inform. 1999;31:421.
10. Sant SM, Vare AM, Fakhruddin S. Dermatoglyphics in diabetes mellitus. J Anatom Soc India. 1983;32:127–30.

11. Ravindranath R, Thomas IM. Finger ridge count and fingerprint pattern in maturity onset diabetes mellitus. Indian J Med Sci. 1995;49:153–6.

Cite this article as: Safi S, Dhumal KT. Comparative analysis of palmar dermatoglyphics in diabetic and non-diabetic individuals of Nashik. Int J Community Med Public Health 2026;13:3053-9.