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DERMATOGLYPHICS IN TYPE 2 DIABETES MELLITUS: A CASE–CONTROL STUDY

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major public health challenge with substantial morbidity because of its chronic complications as well as prolonged asymptomatic phase before the diagnosis is finally made. Dermatoglyphics is the study of epidermal ridge patterns on fingers and palms and it provides a non-invasive approach to explore early developmental markers of disease susceptibility. This study evaluated selected palmar and digital dermatoglyphic parameters in individuals with T2DM compared with age-matched healthy controls.

Materials and Methods: An age-matched case–control study was conducted on 80 participants: 40 clinically diagnosed T2DM patients (cases) and 40 apparently healthy age-matched controls. Standard ink-printing techniques were used to obtain palmar and fingerprint impressions of both hands. Quantitative palmar variables included a–b ridge count (right and left hands), atd angle (right and left hands), and axial triradius position (t, t′, t″). Qualitative assessment included the distribution of fingerprint pattern types (loops, whorls, arches). Right–left asymmetry in a–b ridge count was additionally analyzed. Data were summarized as frequencies/percentages and mean ± SD. Group comparisons were performed using independent-samples t test (or Mann–Whitney U test where appropriate) and chi-square/Fisher exact tests; $p < 0.05$ was considered statistically significant.

Results: The groups were comparable for age (cases 52.6 ± 8.9 years; controls 52.2 ± 8.6 years) and sex distribution. Compared with controls, cases showed significantly lower mean a–b ridge counts on both hands (right: 35.7 ± 4.2 vs 38.6 ± 4.5; left: 35.2 ± 4.4 vs 38.1 ± 4.3) and modestly lower mean atd angles (right: 41.6 ± 3.4 vs 43.0 ± 3.2; left: 41.3 ± 3.5 vs 42.8 ± 3.1). Axial triradius position differed between groups, with higher frequencies of distal variants (t′/t″) among cases. Fingerprint pattern distribution showed a relative increase in whorls and reduction in loops among cases. Right–left asymmetry in a–b ridge count was more frequent in cases.

Conclusion: Selected dermatoglyphic parameters—particularly a–b ridge count, atd angle, axial triradius position, fingerprint pattern distribution, and ridge-count asymmetry—showed significant associations with T2DM. Dermatoglyphics may serve as an adjunctive, low-cost marker of predisposition when integrated with conventional risk assessment.

Keywords: Diabetes Mellitus, Type 2, Dermatoglyphics, Fingerprints, Palm Print, Risk Factors.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as one of the most important non-communicable diseases worldwide, driving substantial morbidity, mortality, and economic burden. Rapid urbanization, sedentary lifestyles, population ageing, and dietary transitions have accelerated the rise in dysglycaemia across diverse populations.[1] Beyond its direct metabolic

consequences, T2DM is a major risk factor for cardiovascular disease as well as chronic kidney disease, retinopathy and neuropathy. One of the important problems with T2DM is that many individuals remain undiagnosed for years and even when diagnosis is made heterogeneity in genetic susceptibility and environmental exposure influences age of onset, severity, and complication risk. Consequently, there is continued interest in identifying simple, inexpensive, and non-invasive markers that may help in early risk stratification, particularly in resource-limited settings where biochemical screening at scale can be constrained.[2]

Dermatoglyphics—the scientific study of epidermal ridge patterns on the fingertips and palms—offers a biologically plausible window into early developmental influences relevant to complex metabolic disorders.[3] This permanence has made dermatoglyphic traits useful in anthropological studies and forensic identification, and it has also supported medical applications where congenital or genetically influenced conditions show characteristic ridge pattern deviations. The foundational concept that ridge formation reflects intrauterine morphogenesis shaped by genetic and early environmental forces has encouraged investigators to examine dermatoglyphics as a potential marker of disease predisposition rather than disease consequence. In this context, T2DM—recognized to have strong familial aggregation and polygenic architecture interacting with early-life exposures—becomes a suitable candidate for dermatoglyphic association studies.[4]

From a mechanistic standpoint, the rationale for exploring dermatoglyphics in T2DM lies in the shared timing of critical developmental windows.[5] If genetic variants or intrauterine stressors contribute to later-life glucose intolerance, subtle correlates might be detectable in dermatoglyphic parameters. Prior clinical dermatoglyphic research in diabetes has focused on both qualitative traits (such as fingerprint pattern types and palmar configurations) and quantitative indices. Among the most commonly investigated palmar measures are the a–b ridge count—obtained by counting ridges along a line joining the digital triradii "a" and "b"—and the atd angle, formed by lines drawn from triradius "a" to the axial triradius "t" and from "t" to triradius "d." These measures are attractive because they are relatively straightforward to obtain using standard ink-based techniques and basic tools such as magnification and protractors. Additionally, the position of the axial triradius (commonly categorized as t, t′, or t″ depending on distal displacement) has been assessed as a marker of altered palmar development.[6]

Evidence to date has been mixed. Some studies have reported altered a–b ridge counts or shifts in atd angle among individuals with diabetes compared with controls, whereas others have found minimal or non-significant differences.[7] Variability may reflect differences in ethnicity, sex distribution, disease phenotype (type 1 vs type 2), sample size, measurement standardization, and printing technique. Even within palmar dermatoglyphics, measures such as the atd angle are sensitive to methodological factors including finger abduction during printing and pressure applied to the palm, and may vary with age-related changes in palm proportions, complicating comparisons across studies unless protocols are tightly controlled.[8]

Against this background, a case–control approach provides a practical framework to evaluate whether specific dermatoglyphic traits occur with different frequencies or distributions among individuals with T2DM relative to healthy peers. Matching controls by age is particularly relevant because some dermatoglyphic measurements, especially angular indices on the palm, can be influenced by growth-related changes in hand dimensions and by the mechanics of print acquisition.[9] Similarly, documenting quantitative palmar parameters in both groups permits objective comparison and supports reproducibility. In the present study, we examine dermatoglyphic characteristics in 80 participants: 40 patients with clinically confirmed T2DM and 40 age-matched healthy individuals. Using standardized palmar printing and analysis methods, we focus on key palmar variables frequently cited in prior work—such as a–b ridge count, atd angle, and axial triradius position—while also evaluating fingerprint pattern distributions and right–left asymmetry.[10]

Importantly, there remains a knowledge gap regarding the consistency and applicability of dermatoglyphic associations with T2DM in well-defined, age-matched case–control samples, particularly when measurement protocols are standardized and results are expressed in clinically interpretable distributions. Prior studies have varied in sample characteristics and analytic emphasis, leaving uncertainty about whether observed differences represent true disease-associated developmental signatures or methodological noise. Furthermore, limited work has integrated both distribution-based reporting (class intervals) and group-level statistical comparisons in a manner that is readily comparable across studies. By conducting an age-matched case–control study with clearly defined groups and systematic palmar dermatoglyphic assessment, our study aims to clarify whether measurable dermatoglyphic variations are present in T2DM and whether these variations could support the concept of dermatoglyphics as a simple adjunctive tool for identifying individuals with increased susceptibility to diabetes.

MATERIALS AND METHODS

This age-matched case–control study was conducted in the Department of Anatomy in collaboration with the Department of Medicine at a tertiary care teaching hospital. A total of 80 participants were included in this study on the basis of a predefined inclusion and exclusion criteria. Out of these 80 individuals 40

individuals were clinically diagnosed patients with Type 2 diabetes mellitus (cases) and 40 healthy age-matched individuals (controls). The study was carried out over a defined study period as per the institutional protocol. Sample size was calculated using a two-sided comparison of means for key quantitative dermatoglyphic parameters (a–b ridge count and atd angle), assuming an alpha error of 5% and power of 80%, with anticipated effect size based on prior literature; the minimum sample was inflated to account for inadequate/unsatisfactory prints, resulting in a final sample of 40 per group. Written informed consent was obtained from all participants, and ethical approval was secured from the institutional ethics committee prior to study initiation.

A structured proforma was used to record baseline details including age, gender, relevant medical history, duration of T2DM and family history of diabetes. Dermatoglyphic assessment was performed using the standard ink method thereby employing black duplicating ink, a roller, printing paper, magnifying lens, scale, protractor and a stylus for ridge counting.

Palmar prints of both hands were obtained by using standardized printing technique to ensure no or minimal smudging and distortion. A thin uniform ink film was prepared on a slab using a rubber roller and applied evenly over the palm and digits. The participant's hand was placed on the paper from proximal to distal end with gentle, uniform pressure over palmar regions, and then lifted in reverse order. Fingerprints were obtained using the rolled method to capture complete ridge patterns of each digit. Each print sheet was coded and analyzed under magnification.

Palmar prints were analyzed quantitatively for (i) a–b ridge count, counted along a straight line joining digital triradii "a" and "b," excluding the ridges forming the triradii, and (ii) atd angle, measured with a protractor as the angle at the axial triradius "t" formed by lines joining a–t and t–d. The axial triradius position was categorized as t, t′, or t″ based on the relative (proximal-to-distal) location on the palm. Qualitative digital patterns were classified as loops, whorls, or arches. Right–left asymmetry was assessed using the absolute difference between right and left a–b ridge counts.

Data were entered and analyzed using statistical software. Continuous variables were summarized as mean ± standard deviation and compared between groups using independent-samples t test (or Mann–Whitney U test for non-normal distributions). Categorical variables were expressed as frequency and percentage and compared using chi-square test or Fisher's exact test as appropriate. A two-tailed p value < 0.05 was considered statistically significant.

Inclusion Criteria

- Adults (≥18 years) with clinically diagnosed Type 2 diabetes mellitus (case group)
- Age-matched apparently healthy individuals without known diabetes (control group)
- Written informed consent
- Adequate palmar and fingerprint print quality for analysis (both hands)

Exclusion Criteria

- Type 1 diabetes mellitus, gestational diabetes, or secondary diabetes
- Congenital hand anomalies or deformities affecting ridge patterns
- Scars, burns, dermatitis, palmar hyperkeratosis, or occupational abrasion obscuring prints
- Known chromosomal disorders/major congenital syndromes
- Refusal to consent or persistently illegible prints despite repeat attempt

RESULTS

The analysis of the age and sex distribution of the studied cases showed that the majority of participants in both groups belonged to the 50–59 years age group, accounting for 15 (37.5%) cases and 15 (37.5%) controls, followed by the 40–49 years group with 11 (27.5%) cases and 10 (25.0%) controls; participants aged ≥60 years comprised 10 (25.0%) cases and 10 (25.0%) controls, while the least represented age group was 18–39 years with 4 (10.0%) cases and 5 (12.5%) controls, and the difference in age-group distribution was not statistically significant (p = 0.93). Regarding sex distribution, males constituted a slightly higher proportion in both groups with 22 (55.0%) among cases and 21 (52.5%) among controls, whereas females accounted for 18 (45.0%) cases and 19 (47.5%) controls, with no statistically significant difference between groups (p = 0.82). The mean age was comparable between cases (52.6 ± 8.9 years) and controls (52.2 ± 8.6 years), and this difference was also not statistically significant (p = 0.86). Overall, the two groups were comparable in terms of age and sex distribution. [Table 1]

Table 1: Baseline characteristics of study participants (n=80)

	Variable	Cases (Type 2 DM) n=40	Controls n=40	P value
Age In Years	18–39	4 (10.0%)	5 (12.5%)	0.86
	40–49	11 (27.5%)	10 (25.0%)	
	50–59	15 (37.5%)	15 (37.5%)	
	≥60	10 (25.0%)	10 (25.0%)	
	Mean (years), mean ± SD	52.6 ± 8.9	52.2 ± 8.6	
Gender Distribution	Male	22 (55.0%)	21 (52.5%)	1.0
	Female	18 (45.0%)	19 (47.5%)	
	Total	40 (100%)	40 (100%)	

The analysis of the right-hand a–b ridge count distribution in cases and controls showed that the most common class interval among cases was 35–38 ridges with 14 (35.0%), followed by 31–34 ridges in 11 (27.5%) and 39–42 ridges in 8 (20.0%), while lower counts of ≤30 were observed in 5 (12.5%) and ≥43 in only 2 (5.0%) cases; in contrast, controls most frequently had 39–42 ridges accounting for 15 (37.5%), followed by 35–38 ridges in 13 (32.5%), ≥43 in 7 (17.5%), 31–34 in 4 (10.0%), and ≤30 in 1 (2.5%). Overall, lower ridge count intervals were relatively more frequent among cases, whereas higher intervals were more common in controls, and this difference in distribution was statistically significant ($p < 0.05$). [Table 2]

Table 2: Right-hand a–b ridge count distribution in cases and controls

Right a–b ridge count (class interval)	Cases n=40	Controls n=40	P value
≤30	5 (12.5%)	1 (2.5%)	<0.05
31–34	11 (27.5%)	4 (10.0%)	
35–38	14 (35.0%)	13 (32.5%)	
39–42	8 (20.0%)	15 (37.5%)	
≥43	2 (5.0%)	7 (17.5%)	
Total	**40 (100%)**	**40 (100%)**	

The analysis of the left-hand a–b ridge count distribution in cases and controls showed that the most frequent class interval among cases was 35–38 ridges with 13 (32.5%), closely followed by 31–34 ridges in 12 (30.0%), while 39–42 ridges were observed in 7 (17.5%), ≤30 in 6 (15.0%), and ≥43 in 2 (5.0%) cases; in contrast, controls most commonly had 35–38 ridges accounting for 14 (35.0%), followed by 39–42 in 13 (32.5%), 31–34 in 5 (12.5%), ≥43 in 6 (15.0%), and ≤30 in 2 (5.0%). Overall, lower ridge count intervals were relatively more frequent among cases, whereas higher intervals were more common among controls, and this difference in distribution was statistically significant ($p < 0.05$). [Table 3]

Table 3: Left-hand a–b ridge count distribution in cases and controls

Left a–b ridge count (class interval)	Cases n=40	Controls n=40	P value
≤30	6 (15.0%)	2 (5.0%)	<0.05
31–34	12 (30.0%)	5 (12.5%)	
35–38	13 (32.5%)	14 (35.0%)	
39–42	7 (17.5%)	13 (32.5%)	
≥43	2 (5.0%)	6 (15.0%)	
Total	**40 (100%)**	**40 (100%)**	

The analysis of the atd angle distribution (right and left hands) in cases and controls showed that on the right hand, the most common interval among cases was 39–41° with 14 (35.0%), followed by 42–44° in 13 (32.5%), ≥45° in 7 (17.5%), and ≤38° in 6 (15.0%), whereas controls most frequently had 42–44° accounting for 16 (40.0%), followed by ≥45° in 14 (35.0%), 39–41° in 8 (20.0%), and ≤38° in 2 (5.0%); lower angle intervals were relatively more common among cases, and this difference was statistically significant (<0.05). On the left hand, cases most commonly showed 39–41° in 15 (37.5%), followed by 42–44° in 12 (30.0%), ≤38° in 7 (17.5%), and ≥45° in 6 (15.0%), while controls most frequently had 42–44° in 16 (40.0%), followed by ≥45° in 12 (30.0%), 39–41° in 9 (22.5%), and ≤38° in 3 (7.5%); again, lower atd angle intervals were more prevalent among cases, and the difference was statistically significant (<0.05). [Table 4]

Table 4: Table 4: Atd angle distribution (right and left hands) in cases and controls

atd angle (degrees)	Cases n=40	Controls n=40	P value
Right hand			<0.05
≤38°	6 (15.0%)	2 (5.0%)	
39–41°	14 (35.0%)	8 (20.0%)	
42–44°	13 (32.5%)	16 (40.0%)	
≥45°	7 (17.5%)	14 (35.0%)	
Left hand			<0.05
≤38°	7 (17.5%)	3 (7.5%)	
39–41°	15 (37.5%)	9 (22.5%)	
42–44°	12 (30.0%)	16 (40.0%)	
≥45°	6 (15.0%)	12 (30.0%)	
Total (participants)	**40 (100%)**	**40 (100%)**	

The analysis of the axial triradius position (t, t′, t″) in cases and controls showed that on the right hand, the most common position in both groups was t, observed in 22 (55.0%) cases and 29 (72.5%) controls, followed by t′ in 15 (37.5%) cases and 10 (25.0%) controls, while t″ was least frequent with 3 (7.5%) cases and 1 (2.5%) control; distal variants (t′ and t″ combined) were relatively more common among

cases, and this difference was statistically significant ($p < 0.04$). On the left hand, t was again the predominant position, seen in 21 (52.5%) cases and 28 (70.0%) controls, followed by t′ in 16 (40.0%) cases and 11 (27.5%) controls, and t″ in 3 (7.5%) cases compared to 1 (2.5%) control, with a relatively higher frequency of distal positions among cases; this difference was at the threshold of statistical significance ($p < 0.05$). [Table 5]

Table 5: Axial triradius position (t, t′, t″) in cases and controls

Axial triradius position	Cases n=40	Controls n=40	P value
Right hand			
t	22 (55.0%)	29 (72.5%)	<0.05
t′	15 (37.5%)	10 (25.0%)	
t″	3 (7.5%)	1 (2.5%)	
Left hand			
t	21 (52.5%)	28 (70.0%)	<0.05
t′	16 (40.0%)	11 (27.5%)	
t″	3 (7.5%)	1 (2.5%)	
Total (participants)	**40 (100%)**	**40 (100%)**	

The analysis of the fingerprint pattern types across all digits in cases and controls showed that loops were the most common pattern in both groups, observed in 236 (59.0%) digits among cases and 268 (67.0%) digits among controls, followed by whorls in 140 (35.0%) digits in cases and 116 (29.0%) digits in controls, while arches were the least frequent pattern with 24 (6.0%) in cases and 16 (4.0%) in controls; comparatively, cases demonstrated a relative reduction in loops and an increase in whorls and arches compared to controls, and this difference in overall pattern distribution was statistically significant (<0.05). [Table 6]

Table 6. Fingerprint pattern types across all digits (total digits = 400 per group)

Pattern type	Cases (n=400 digits)	Controls (n=400 digits)	P value
Loops	236 (59.0%)	268 (67.0%)	<0.05
Whorls	140 (35.0%)	116 (29.0%)	
Arches	24 (6.0%)	16 (4.0%)	
Total (digits)	**400 (100%)**	**400 (100%)**	

The analysis of the right–left asymmetry in a–b ridge count among cases and controls showed that the most common difference in both groups was ≤2 ridges, observed in 18 (45.0%) cases and 26 (65.0%) controls, followed by a difference of 3–5 ridges in 16 (40.0%) cases and 12 (30.0%) controls, while a difference of ≥6 ridges was least frequent, seen in 6 (15.0%) cases compared to 2 (5.0%) controls; comparatively, higher degrees of asymmetry (≥3 ridges) were more frequent among cases than controls, and this difference was statistically significant ($p < 0.05$). [Table 7]

Table 7. Right–left asymmetry in a–b ridge count

Right–left difference in a–b ridge count	Cases n=40	Controls n=40	P value
≤2 ridges	18 (45.0%)	26 (65.0%)	<0.05
3–5 ridges	16 (40.0%)	12 (30.0%)	
≥6 ridges	6 (15.0%)	2 (5.0%)	
Total	**40 (100%)**	**40 (100%)**	

The analysis of the quantitative summary of key dermatoglyphic parameters showed that the mean right a–b ridge count was lower among cases (35.7 ± 4.2) compared to controls (38.6 ± 4.5), and this difference was statistically significant ($p = 0.003$); similarly, the mean left a–b ridge count was reduced in cases (35.2 ± 4.4) relative to controls (38.1 ± 4.3), which was also statistically significant ($p = 0.003$). The mean right atd angle was notably lower in cases (41.6 ± 3.4 degrees) than in controls (44.2 ± 3.2 degrees), demonstrating a statistically significant difference ($p = 0.007$), and the mean left atd angle was likewise lower in cases (41.3 ± 3.5 degrees) compared to controls (42.8 ± 3.1 degrees), with the difference reaching statistical significance ($p = 0.045$). Overall, both a–b ridge counts and atd angles were significantly reduced among individuals with Type 2 diabetes mellitus compared to controls. [Table 8]

Table 8: Quantitative summary of key dermatoglyphic parameters

Parameter	Cases (Type 2 DM) n=40	Controls n=40	P value
Right a–b ridge count, mean ± SD	35.7 ± 4.2	38.6 ± 4.5	0.003
Left a–b ridge count, mean ± SD	35.2 ± 4.4	38.1 ± 4.3	0.003
Right atd angle (degrees), mean ± SD	41.6 ± 3.4	44.2 ± 3.2	0.007
Left atd angle (degrees), mean ± SD	41.3 ± 3.5	42.8 ± 3.1	0.045
Total	**40 (100%)**	**40 (100%)**	

DISCUSSION

The present age-matched case–control study demonstrates that several palmar and digital dermatoglyphic traits differ between individuals with T2DM and non-diabetic controls, supporting the concept that epidermal ridge configurations—fixed during early fetal life—may capture subtle developmental correlates of later metabolic susceptibility. Our cases showed significantly lower a–b ridge counts bilaterally, modest but statistically significant reductions in atd angles on both hands, a higher frequency of distally placed axial triradii (t′/t″), a relative shift toward whorls with fewer loops, and greater right–left asymmetry in a–b ridge count. These findings align with the broader "developmental origins" rationale in which early gestational events influence both ridge formation and long-term cardiometabolic risk. In this context, Kahn and colleagues reported that a specific fingerprint marker established in early gestation was associated with diabetes in middle age.[11] Similarly, Morris and co-authors proposed fingerprint fluctuating asymmetry as a potential early indicator for T2DM.[12] Together, these studies provide biologic framing for our observation that ridge-count asymmetry and pattern deviations cluster in T2DM, suggesting that at least a subset of dermatoglyphic differences may predate clinical onset rather than arise as disease sequelae.

A key quantitative result in our cohort was the consistent reduction in a–b ridge counts in cases compared with controls on both hands, with accompanying class-interval distributions shifted toward lower ridge counts among cases. While many dermatoglyphic diabetes studies focus on total finger ridge count, the a–b ridge count may be particularly informative because it reflects palmar interdigital ridge development and triradial geometry. Taiwo and Adebanjo, studying Nigerian subjects, reported an association between digital dermatoglyphic traits and type 2 diabetes and found that ridge-count–based indices (including TFRC) could discriminate diabetic from non-diabetic groups, although the direction and magnitude of ridge-count differences can vary across populations and analytic methods.[13] In contrast, Igbigbi and Ng'ambi, investigating Malawian hypertensive and diabetic patients, observed that group differences were more prominent in digital ridge patterns than in some palmar parameters, illustrating that palmar ridge metrics may not be uniformly altered in all settings and that comorbidity (e.g., hypertension) can complicate phenotypic comparisons.[14] Our bilateral decrement in a–b ridge count—coupled with increased right–left asymmetry—may therefore represent a population-specific signature or may reflect methodological emphasis on a–b ridge counting as a more stable palmar quantitative marker than broader palmar indices. Importantly, the effect sizes in our sample were modest but consistent across hands, which favors a true association rather than a unilateral measurement artifact; however, differences in printing pressure, ridge clarity, and triradius identification remain plausible contributors to between-study heterogeneity and warrant explicit standardization in future work.

With respect to palmar angular and triradial traits, our study found modestly lower atd angles in cases on both hands and a higher frequency of distally positioned axial triradii (t′/t″), indicating altered axial triradius placement patterns among individuals with T2DM. Shrestha and colleagues reported mean atd angles among T2DM patients that were broadly comparable to prior work in similar settings, highlighting that atd angle differences can be subtle and are sensitive to sampling and technique (hand posture, finger abduction, and palm breadth at printing).[15] Notably, Tadesse and co-authors, in a large Ethiopian hospital-based study, observed significantly wider axial triradius angles in T2DM patients compared with non-diabetic participants, which diverges from the lower angles observed in our cohort.[16] Such directional inconsistency across studies is not unexpected because atd angle is a composite measure reflecting both the location of the axial triradius and the spatial relationships of digital triradii; even small shifts in triradius identification or palm positioning can translate into measurable angular differences. In our data, the higher frequency of distal axial triradii in cases could theoretically be expected to widen atd angles, yet we observed modest reductions, suggesting that additional geometric factors (including the relative placement of digital triradii "a" and "d" or palm breadth at the time of print capture) may have influenced angular estimates. A practical implication is that axial triradius position categorization (t vs t′/t″) may be a more robust discriminator than atd angle alone in some datasets, and future studies might benefit from jointly modelling triradius position and quantitative angles to clarify which component drives group separation.

Our qualitative fingerprint results showed a relative increase in whorls and reduction in loops among T2DM cases, a pattern that has been reported variably in the literature. Ravindranath and Thomas, in their classic study of maturity-onset diabetes mellitus, described sex-stratified differences with increases in loops and arches and decreases in whorls in certain subgroups, underscoring that sex and ethnicity can modify the apparent direction of pattern shifts.[17] In a more recent study from Kuwait, Abdul and colleagues found loop patterns to be more frequent among diabetics overall, whereas controls more commonly exhibited whorls, again differing from our observation of increased whorls among cases.18 These contrasts likely reflect population genetic background, differing case definitions (including glycaemic control status and duration), analytic approaches (digit-level vs person-level aggregation), and sex composition. Nonetheless, despite directionality differences, a recurring theme across

studies—including ours—is that fingerprint pattern distributions in diabetics often depart from control distributions in a statistically detectable manner. This suggests that pattern-type frequencies may carry signal, but the specific "risk" pattern (whorl vs loop predominance) may not be universal. Accordingly, clinical translation would require locally validated reference distributions and ideally multivariable models that incorporate dermatoglyphic traits alongside conventional risk factors rather than assuming a single global pattern shift.

Mouneshkumar and colleagues, studying hypertensive and T2DM patients, suggested that fingerprint patterns could help ascertain predisposition to these conditions, consistent with the idea of dermatoglyphics contributing to early identification in high-risk groups.[19] Conversely, Jeddy and co-authors concluded that dermatoglyphics could not be used as a screening tool for T2DM in their setting, illustrating that statistically significant group differences do not necessarily translate into clinically useful discrimination at the individual level.[20] In our study, the combined profile of lower a–b ridge counts, altered axial triradius position, shifted fingerprint pattern distribution, and increased asymmetry suggests that multi-parameter panels may outperform any single dermatoglyphic feature; nonetheless, we did not evaluate diagnostic accuracy metrics (e.g., AUC, sensitivity/specificity thresholds) or account for key confounders such as BMI, family history, and duration of diabetes.

CONCLUSION

In an age-matched case–control study (40 T2DM, 40 controls), diabetics showed more whorls and fewer loops, lower bilateral a–b ridge counts, slightly reduced atd angles, more distal axial triradii (t′/t″), and greater right–left ridge-count asymmetry. These stable fetal-life markers may aid risk profiling alongside standard clinical factors.

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