Research Article

Dermatoglyphics: The Future of Screening Type 2 Diabetes Mellitus?

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Background: Dermatoglyphics is a very old technique utilized for identity and distinguishing purposes, as it is firmly related to genetics. Researchers are attempting to utilize fingerprints to diagnose various diseases. This study was aimed at determining the percent distribution of fingerprint patterns and to find out any potential variation between the fingerprints of diabetic and healthy individuals.

Methods: A comparative study was carried out on 200 individuals at Diabetic Clinic of a tertiary care hospital. 100 participants were patients with uncontrolled diabetes mellitus type 2 (cases) and 100 healthy individuals (controls) were enrolled. Fingerprints of participants were obtained with care on white sheets following the "Cummins and Midlo" method and then categorized as whorls, loops, and arches using Henry's categorization methodology. Fingerprint patterns were compared among both groups, and statistical analysis was done to compare variations.

Results: The mean age of participants was 57.5 ± 9.2 years, and there were 48% males and 52% females. Whorl patterns were found to be more common in both cases and controls (56.2% and 60.8%), followed by loops (38.8% and 31.6%), and then arches (7.6% and 5%). Overall, we found that loops were more prevalent in all fingers of diabetics except the thumbs (57%), where loops were significantly lower (40%). Similarly, whorls were more common in the fingers of healthy individuals (53%), except in the thumbs, where whorls were less prevalent (42%).

Conclusion: Present investigation proposes that finger patterns in thumbs can be helpful in differentiating between diabetics and non-diabetics, however, it is difficult to use Henry's classification for mass screening of diabetes mellitus, but there is a beam of hope that further patterns identification and itemized investigations can help us use dermatoglyphics in screening of different diseases.

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Introduction

Every human is distinct and perceptible in such a manner that they exhibit a unique set of characteristics. There are some notable embedded strategies for human recognition and one of the most intriguing developing techniques for human identification is human dactyloscopy[1]. Dermatoglyphics is a scientific approach for evaluating the lines and edges of the fingers, palm, and sole. The term dermatoglyphics was first presented in 1926 by Cummins and Midlo in the 17th century. Even among twins, fingerprints are not similar and have characteristic features. Dermatoglyphic patterns are inherited and can be used to aid in the identification of a variety of hereditary illnesses[2]. Fingerprints can be utilized for an individual's identity since they are unique for humans and do not change over time. It has been confirmed that fingerprints recuperate after experiencing adjustments, for example, minor injuries, aggravation, and diseases, and that the manner and type of wrinkles don't differ with environmental factors[3].

The word "dermatoglyphics" is of Greek origin, which is derived from "derma," meaning skin, and "glyphae," meaning carving[4]. It is the science and specialty of the investigation of surface markings of edges on the skin of the fingers, palms, toes, and soles. During fetal development, when the epidermal edges are shaped, they turn into a trustable marker of the genetic indicator of the person[5]. As we know that many genes are responsible for forming a fingerprint pattern, it is possible that fingerprints may show a familial trait. According to recent research, unusual dermatoglyphic patterns have been found in a few non-chromosomal hereditary diseases and other disorders whose etiology may be influenced by hereditary legacy[6].

Diabetes mellitus (DM) is a group of metabolic disorders described by hyperglycemia because of imperfections in insulin release, insulin activity, or both. DM is a worldwide problem, and its pervasiveness is expanding, especially in poor countries[7]. Other than this, as demonstrated by the most recent gauges of the World Health Organization (WHO) in 2019, 463 million individuals in the world had diabetes, and the number is projected to increase by 25% (578 million) in 2030 and 51% (700 million) in 2045[8]. The exact prevalence of DM in Pakistan has not yet been determined. However, studies conducted in Pakistan in the last 2 decades have reported a prevalence of DM of between 0.95% and 32.9%[9]. There are two main types of diabetes: type I diabetes mellitus (T1DM) and type II diabetes mellitus (T2DM). No doubt, in the 21st century, T2DM has become an epidemic. Finding people with undiscovered T2DM is a general health need of the day. T2DM symptoms vary, and people make fewer

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efforts to check their biochemical level of glucose in their blood and urine. Besides, the cost associated with these appraisals is quite high. It is reported that in about half of the diseased individuals, the illness is unknown[6]. So, it is essential to screen the high-risk population for diabetes in an effective way. This study was conducted to support the previous pieces of evidence correlating fingerprint patterns with the occurrence of diabetes among the general population.

Methods

A cross-sectional study was conducted at a diabetic clinic of a tertiary care hospital in Islamabad, Pakistan. The study duration was six months (July to December 2023). A total of 200 participants were enrolled, who were presented to the Diabetic Clinic of a tertiary care hospital situated in Islamabad. 100 patients who were already diagnosed with T2DM were included in the study as cases. The criteria for T2DM were based on the American Diabetes Association guidelines, which stated that diabetes is diagnosed when fasting plasma glucose is 7.0mmol/L, or the 2-hour oral glucose tolerance test (OGTT) is 11.1mmol/L, or HbA1c is 6.5%. However, patients with other chronic metabolic disorders such as, cushing syndrome, acromegaly, thyroid disease, osteoporosis, ankylosing spondylitis, rheumatoid arthritis, hyperparathyroidism, liver failure, chronic kidney disease, and other similar conditions were deemed ineligible for the study. Patients who were on corticosteroids or synthetic hormones were also excluded from the study. Only individuals with no substantial comorbidities or chronic metabolic problems were chosen for participation as healthy controls (N =100). The control population consisted of patients who presented with mild acute infections or minor injuries but did not have any chronic disorders. As it is evident that T2DM is mostly diagnosed after the age of 40 years, so all controls were over the age of 40 years. A detailed history and clinical examination were performed, and the patient's files were reviewed in detail to strictly meet the inclusion criteria. Participants were informed about the nature and purposes of the study, and a written consent form was also signed. All participants were assured of their confidentiality and were given the option to withdraw from the research at any time. Furthermore, no monetary remuneration was provided to individuals for their participation in the study. Ethical Approval was granted by Institutional Review Board of Quiad e Azam International Hospital, Islamabad (Ref No. QIH/IRB/23/0012). Informed written consent was obtained from participants for the use and publication of their data.

A fingerprint collection procedure devised by "Cummins and Midlo" was used in this study[4]. Before taking fingerprints, the subjects were requested to properly wash their hands with soap and water and then dry them with a paper towel. A Dollar 2M stamp pad was used to take the fingerprints by rolling the finger from radial to ulnar direction, and then the imprints were recorded on a printed A4 sheet with designated boxes for each finger. The procedure was used to record the fingerprints of both the right and left hand. Fingerprints were analyzed using a Deli Magnifier 60mm (2 Glass) (E9091) magnifying glass. The pattern of each imprint was observed and classified into loops, arches, and whorls according to Henry's system of classification. The findings of two independent researchers were cross-matched to exclude chances of any errors. Data entry, and analysis were done using SPSS version 23.0 (SPSS Inc., Chicago, IL). Data entry was performed by research assistants and was cross-checked by other authors of the study for any potential errors. Where appropriate, descriptive statistics were presented as means, standard deviations, and percentages. For statistical significance, a p-value of < 0.05 and a 95% confidence interval were considered significant. This study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.

Results

The mean age of participants was 57.5 ± 9.2 years. Gender wise, there were 96 (48%) males and 104 (52%) females (Table 1). The fingerprints of each finger were analyzed separately as well as collectively. Fingerprints of all ten digits were considered and percent distribution and deviation of finger patterns in cases and controls were observed. Collectively, the whorl pattern was found in 117 (58.5%) of the study population, while loops and arches were 70 (35.2%) and 13 (6.3%), respectively. In controls, whorls were 61%, loops were 32%, and arches were 7%. In cases, whorl patterns were observed in 56% of the participants, whereas loops and arches were found in 39% and 5%, respectively.

Variable	Gender	Frequency	Age
Healthy	Male	44	57.09 ± 9.33
	Female	56	56.57 ± 9.31
Diabetic	Male	52	57.32 ± 8.89
	Female	48	59.12 ± 8.86

Table 1. Demographic variables of the analyzed subjects.

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Variable	Type	Arches	Loops	Whorls	p-value
Little Finger					
	Healthy	4	36	60	0.841
	Diabetics	4	40	56	
Ring Finger					
	Healthy	8	20	72	0.389
	Diabetics	6	28	66	
Middle Finger					
	Healthy	10	28	62	0.244
	Diabetics	6	38	56	
Index Finger					
	Healthy	6	32	62	0.123
	Diabetics	4	46	50	
Thumb					
	Healthy	2	54	44	0.035
	Diabetics	4	36	60	

Table 2. Finger patterns distribution in right hand

Variable	Type	Arches	Loops	Whorls	p-value
Little Finger					
	Healthy	4	34	62	0.487
	Diabetics	6	40	54	
Ring Finger					
	Healthy	8	20	72	0.082
	Diabetics	6	34	60	
Middle Finger					
	Healthy	14	22	64	0.001
	Diabetics	4	46	50	
Index Finger					
	Healthy	18	20	62	0.001
	Diabetics	6	46	48	
Thumb					
	Healthy	2	50	48	0.046
	Diabetics	4	34	62	

Table 3. Finger patterns distribution in left hand

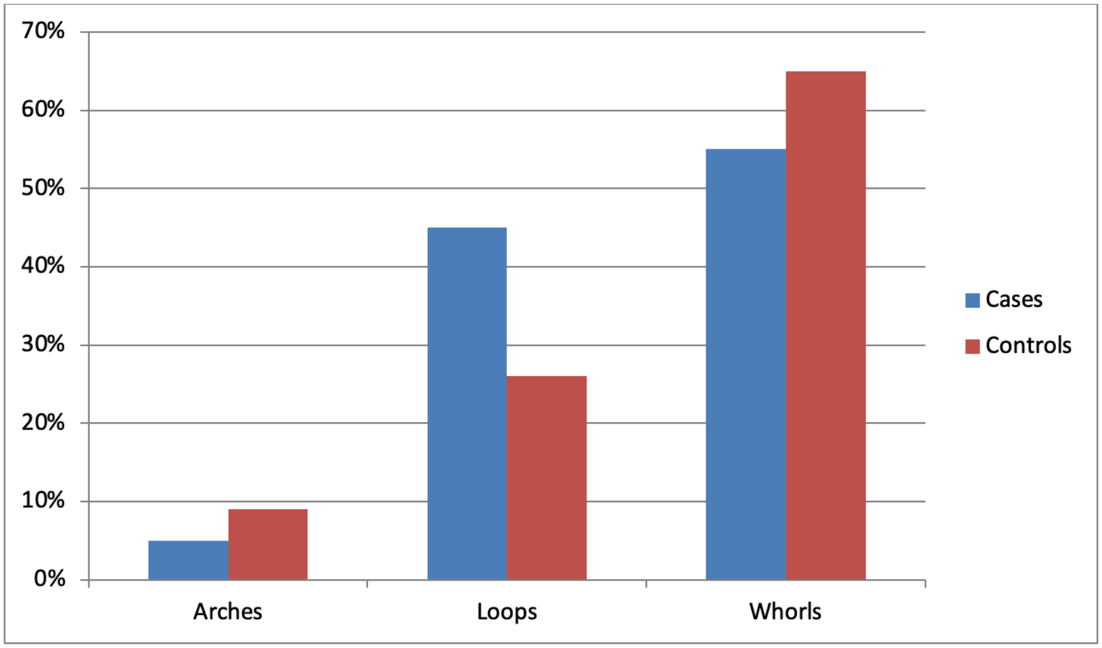

Figure 1. Finger patterns frequency (percentage) in eight fingers (except thumbs)

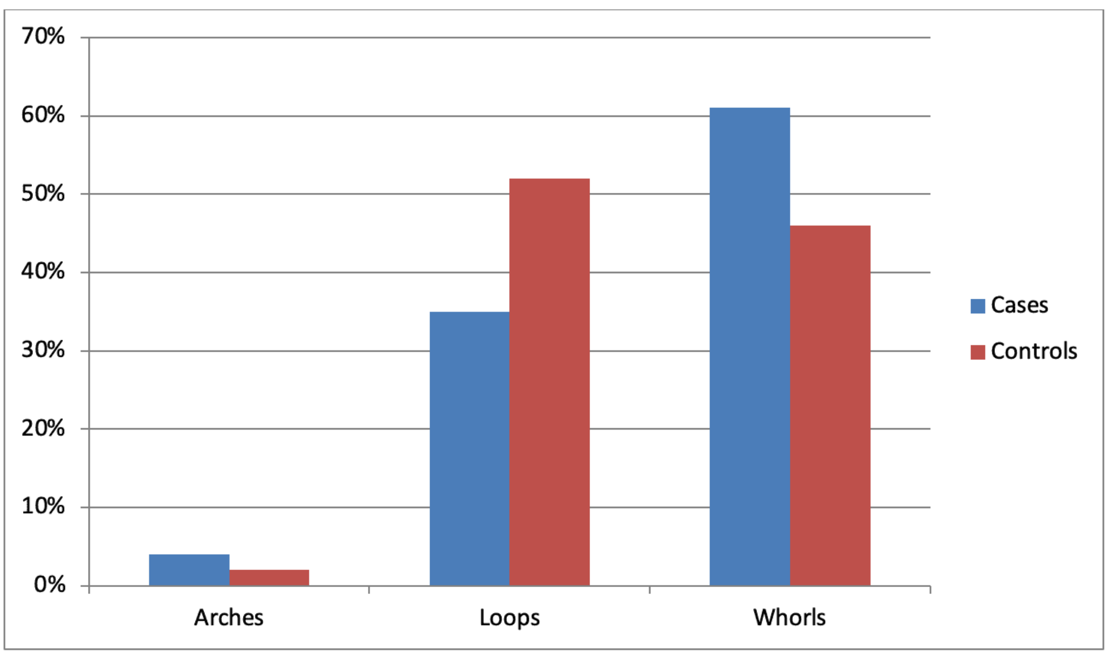

Figure 2. Finger patterns frequency (percentage) in right and left thumb

The finger print distribution is shown below (Tables 2 & 3). As the results demonstrate, healthy individuals and diabetic patients have more whorls in almost every digit. But if we only consider loop patterns, then they are increasingly common in the diabetic group. However, we also observed a distinctive pattern that shows that in both right and left thumbs, the loops are significantly more pervasive in the healthy group (p-value < 0.05). This fingerprint type is quite opposite to the trend observed in other fingers.

From the above results, it is evident that whorl patterns are more common in both cases and controls, but in comparison of only loops, cases have a tendency to have more loops than controls. However, there is an exception when we observe the thumbs. While our findings indicate some differences in fingerprint distribution between cases and controls, the small sample size and multiple comparisons warrant cautious interpretation. The observed variation in thumb patterns (p-value < 0.05) may warrant further investigation, but larger studies with adjustments for potential confounders are needed to determine if this is a robust association.

Discussion

Every human being is unique and distinguished in the way that they exhibit their own pattern of attributes. The genetic makeup of all human beings is unique and is even distinctive in monozygotic twins. There are some notable implanted strategies for human identification and among them, one of the easiest approaches to distinguishing humans is through analyzing the differences in fingerprints and fingerprints[10]. In fact, various diseases are emphatically linked to genetics that appear in later life, such as T2DM, some degenerative disorders, and psychiatric problems[11]. This study aimed to find any correlating patterns in fingerprints with the occurrence of diabetes among the general population.

Fingerprints are acquired by a complex pool of hereditary material which furnishes every person with a distinguished pattern that is developed in the early stages of life and persists throughout later life as these unique patterns are permanent and can thus be used for identification purposes[12]. Genetic factors influence both fingerprint formation and susceptibility to metabolic disorders such as type 2 diabetes mellitus. While some studies have explored potential associations between fingerprint patterns and disease risk, further research is needed to establish whether these relationships have diagnostic or predictive value[13]. So, there is a chance that these variations give us some insight into diseases that appear in later stages of life in patterns of fingerprints, lip prints, or footprints. This idea has given dermatoglyphics a very important place in the diagnostic world[14]. The most common, generalized, and easiest method of classification of fingerprints is "Henry's Classification," which classifies fingerprints into three distinctive patterns that are whorls, loops, and arches. The same classification system is used in the current study. However, some other complex finger patterns have been designed and studied, such as AUC scores, wavelet asymmetry scores, TFRC and AFRC scores, atd angle, tda angle, and tad angles[6][15].

T2DM was previously considered an infirmity of older individuals. However, now it is influencing an ever-increasing number of individuals. The unprecedented pace of the growing number of diabetic patients has made it a major pandemic issue. Developing countries as well as developed countries are affected by this disease. Some experts call this problem a global and local public health emergency[16]. T2DM is a matter of deep concern because the complications associated with it are life-threatening or at least cause some sort of life-changing disability. Peripheral neuropathy, retinopathy, kidney diseases, and cardiac problems are commonly associated with diabetes mellitus[17].

Current worldwide insights indicate that more than 450 million of the world's population are suffering from diabetes and that this number will grow to 700 million by 2045[8]. Pakistan is also burdened with T2DM as statistics show that the prevalence of T2DM is more than 16%, which is quite high in contrast to global T2DM prevalence, which is around 9%[18]. Another problem Pakistan is facing is that due to the increased cost of authentic screening tests and gold-standard diagnostic tests, very few people are diagnosed at the right time and, lamentably, most patients are diagnosed at the right time with serious complications[19]. Given the high prevalence of undiagnosed type 2 diabetes mellitus, the development of accessible screening methods is an important research priority. Some studies have explored potential associations between fingerprint patterns and diabetes risk, but further research is needed to assess whether such an approach could be clinically viable.

In our current investigation, it was found that when seen individually, each finger demonstrated the highest percentage of whorl pattern in both cases and controls, though the results were not statistically significant in all digits. However, the thumbs of the healthy group had more loops than whorls (p-value < 0.05). The overall whorl pattern was most common with a value of 58.5%, while loops were 35.2% and arches were 6.3%. A study from Iran also in accordance with current outcomes reveals that whorls were the most common pattern (44.1%) followed by loops (43%) and then arches (12%)[20]. A study by Rastogi P also suggested that in males, the percentage of whorls was 56%, which is almost similar to our results[21]. An additional report also concluded that, overall, diabetic patients' whorls were more prominent[22]. A recent study additionally suggests that the prevalence of arches was found to be in 7.9% of the

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population, which is the same as our results, but this study contradicts our results in the distribution of loops (56.6%) and whorls (33.7%)[23]. However, a recent study on the Indian population suggests that the loop pattern is predominant (57%)[24]. Other studies conducted in Morocco and India reported similar results with loops predominating (58.9% and 58%) followed by whorls (29.6% and 32%)[25][26]. Findings in the diabetic group are consistent with the results of an investigation carried out in Pakistan which demonstrates that 50% of the diabetic patients had whorl patterns, 45% had loops, while the remaining belonged to arches[22].Even so, there are a few studies which contradict our findings. A study indicated that fingerprint distribution among diabetics was comprised of whorls (24.3%), loops (66.9%) and arches (8.8%), whereas in the control group, percent distribution was whorls (23.2%), loops (65%) and arches (12.3%)[27]. Another case-control study also reports that more loops were found in both cases and controls, followed by whorls, and then arches, but we didn't discover a similar pattern[23].

Aside from these trends and appropriations, we discovered that the number of loops in both the right and left thumbs increased in the healthy group (controls). This trend is unique and inverse to every other digit, and this difference is also statistically significant ($p\text{-value} < 0.05$). We have also observed that in the index finger and middle finger of the left hand, the frequency of arches was significantly higher in the healthy group than in the case group. This study has not found a very strong correlation between fingerprints and types of diabetes mellitus, but a significant difference between the patterns of both groups is observed, which can fortify the literature and pave the way for new studies to reach a conclusive point.

Strengths and Limitations

In the current study, finger print patterns of diabetic patients were assessed and compared with those of healthy people in an effort to use dermatoglyphics as a tool for screening Type 2 diabetes mellitus. We reported a significant difference in fingerprint patterns between cases and controls, which is encouraging for future research and the development of a validated and reliable screening test. As a foundation for future research, this study could be a brilliant addition to the literature. The present study does have limitations. The cross-sectional design of the study and the limited sample size constrain the generalizability of the current results. In addition, we employed Henry's system of finger print classification, which allowed us to categorize finger print patterns into just three main categories. A key limitation of this study is that all participants were recruited from a single tertiary care hospital in Islamabad, which may limit generalizability to other populations. Additionally, we did not control for

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genetic background, family history of diabetes, or other metabolic factors that could influence fingerprint patterns. Further research on evaluating complex finger print patterns is required for the development of a reliable screening tool.**Conclusion**

The present study suggests that dermatoglyphic patterns may have some association with type 2 diabetes mellitus, but further large-scale studies are needed to determine whether this association has clinical utility in screening. While our findings suggest that specific finger patterns, particularly in the thumbs, may help differentiate between diabetic and non-diabetic individuals. With advancements in AI model training, this concept could be developed into a predictive tool for early identification of high-risk individuals, enabling timely preventive interventions and improved screening strategies.

Statements and Declarations

Conflicts of Interest

Authors declare no conflict of interest.

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Declarations

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