The Journal of Anatomical Sciences
Email: journalofanatomicalsciences@gmail.com

J. Anat Sci 16(1)

Submitted: August 28th, 2024
Revised: February 7th, 2025
Accepted: February 9th, 2025

The Role of Palmar Dermatoglyphics in Preventive and Diagnostic Medicine: A Review

Busuyi Kolade Akinola [1]*, Gabriel Sunday Oladipo [2], Michael O. Oyakhire [2],

[1]Department of Human Anatomy, School of Basic Medical Sciences, Federal University of Technology Akure; [2]Department of Anatomy, University of Port Harcourt, Nigeria.

***Corresponding Author:** Email**:** bkakinola@futa.edu.ng, Tel: +2348032073693

ABSTRACT

The study of the patterns of the epidermal ridges of the finger, palm, and sole can help screen a variety of diseases, especially those caused by chromosomal aberrations, which are frequently accompanied by pattern distortion, as well as other genetically and non-genetically determined diseases. This review aimed to elucidate the potential role of dermatoglyphics as a screening tool in clinical medicine. Relevant literature was searched using the databases of PubMed, Scopus, Web of Science, and Google Scholar to assess peer-reviewed articles using a combination of Medical Subject Headings (MeSH) terms. Although the exact mechanism of inheritance is unknown, dermatoglyphic patterns are thought to be genetically controlled which explains their unique significance as a perfect marker for individual identification and population studies, as well as the detection of abnormalities caused by intra-uterine anomalies in the early weeks of pregnancy. Studies have linked dermatoglyphic variations to chromosomal disorders and predisposition to certain diseases hence accentuating the possible role of palmar dermatoglyphics in the prevention and diagnosis of a variety of medical conditions such as diabetes, hypertension, schizophrenia, sickle cell disease, autism, and Down syndrome. This review therefore explores the significance of palmar dermatoglyphics in early disease detection, risk assessment, and personalized medicine, highlighting its potential as a non-invasive, cost-effective tool in clinical practice.

Keywords: Dermatoglyphics, Medicine, Genetics, Diseases, Diagnosis

INTRODUCTION

Palmar dermatoglyphics is the study of distinctive patterns of epidermal ridges on the volar surfaces of the palms. It is a unique durable identifier of identification as well as a significant tool in the detection of congenital deformities that develop in the womb. Palmar prints are collectible, international, original, and everlasting. An aberrant dermatoglyphic pattern can emerge from any form of disturbed growth during the early stages of fetal life development[1]. Dermatoglyphics has long been a valuable method for identifying gene-related abnormalities and disorders [2]. A dermatoglyphic relationship has been found in several studies to be associated with a wide range of genetic diseases [3]. The fact that each person's ridge configurations are unique has been widely used as a type of personal detection, especially by law enforcement agencies. Ridge patterns are genetically determined and cannot be altered by external factors. Except for size, dermatoglyphic traits do not change with age or environment. The lines are continuous and the separation occurs early. As a result, dermatoglyphics has become one of the most important factors in the notion of patient characteristics, and it is now used to screen mentally retarded infants on a broad scale [4]. Palmar dermatoglyphic factors such as fingerprint patterns, palmar print patterns, palmar angles, palmar ridge counts, and palmar crease patterns are commonly used in scientific studies of dermatoglyphics.

Fingerprint Patterns

Marcello Malpighi was the first to formally record fingerprints under a microscope in 1686. He was an anatomy professor at the University of Bologna. He noted the ridges, spirals, and loops in fingerprints but made no mention of their potential for identification [5]. Malpighi layer is a 1.8 mm thick layer of skin named after him.

In the 1870s, Dr. Henry Faulds was the British Surgeon-Superintendent of Tsukiji Hospital in Tokyo, Japan. He became interested in "skin furrows" after seeing finger impressions on "prehistoric" pottery fragments. In 1880, Faulds devised a categorization system. In an article published in the scientific journal Nature, he described fingerprints as a way of personal identification and the usage of printer ink as a method for acquiring fingerprints [5].

John E. Purkinje was the first to categorize the finger ridge pattern and create nine different print types in 1823. He began by scientifically categorizing the various finger patterns[6]. Transverse curves, Central longitudinal stria, Oblique strip, Oblique loop, Almond whorl, Spiral whorl, Ellipse, Circle, and Double whorl were the nine categories he suggested for fingerprint categorization. Sir Francis Galton, an anthropologist and Charles Darwin's cousin, conducted extensive research into the significance of skin ridge patterns in 1892 and published a book titled "Fingerprints" in which he established the individuality and permanence of fingerprints as well as the first classification system for fingerprints. Arches, loops, and whorls were his key classifications for fingerprint patterns. The degree of curvature of the ridges was the key determinant. Simple or tented arches, radial or ulnar loops, and spirals or double-loop whorls are all possibilities[7]. The epidermal ridges on the median regions of the digits, as well as countless other locations on the palm, create distinct local architecture.

Arch (A): On fingers, an arch is the most basic design. Ridges that enter on one side of the print and depart on the other make up this pattern. There aren't any deltas. It is made up of more or less parallel ridges that go across the pattern region, create a proximally concave curve, and pass the fingertip without recurving.[8] The curvature is soft in the low arch and straight in the high arch. Except when the tented arch is present (fig. 1), which will have a triradii point near its midline, these patterns do not normally demonstrate the existence of triradii.[8]

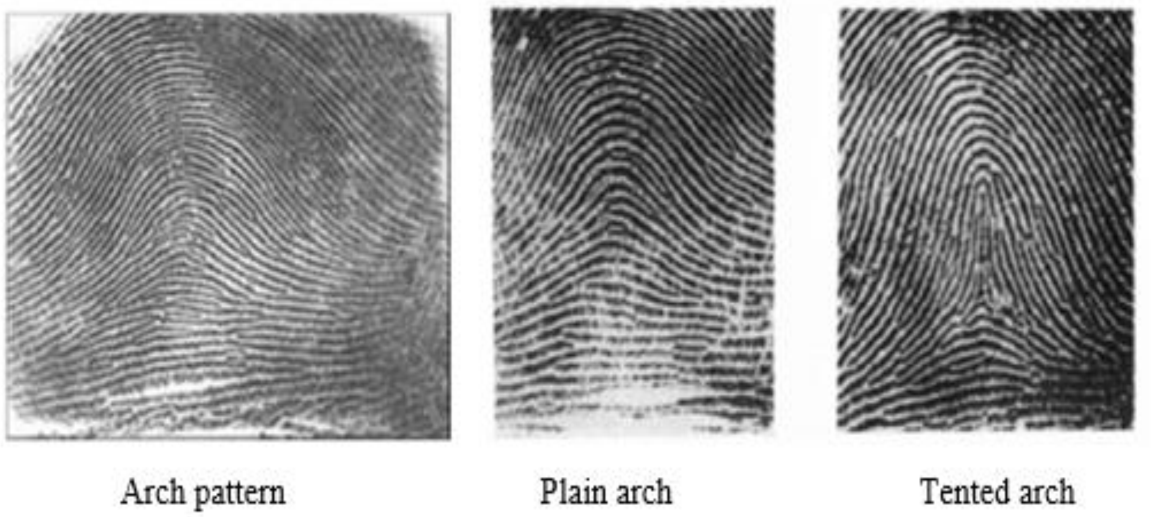

Figure 1: Arch pattern on fingers [9]

Loops (L): The most prevalent pattern for fingertip patterns is the loop [10]. One delta and one or more ridges that enter and exit on the same side must be present in a loop [9]. The ridges begin on one side, travel in parallel lines, and then return to their original side. The ridges in a loop form a triradius. The triradius is always found on the side where the loop is closed, and it is found on the fingertip. The ulnar and radial loops are two different sorts. If ridges open on the ulnar side, the loop is ulnar. On the radial side, the ridges expand up. On a fingertip, the loop is the most common pattern. 'Transitional' loops, resembling whorls or intricate patterns, can occasionally occur [11].

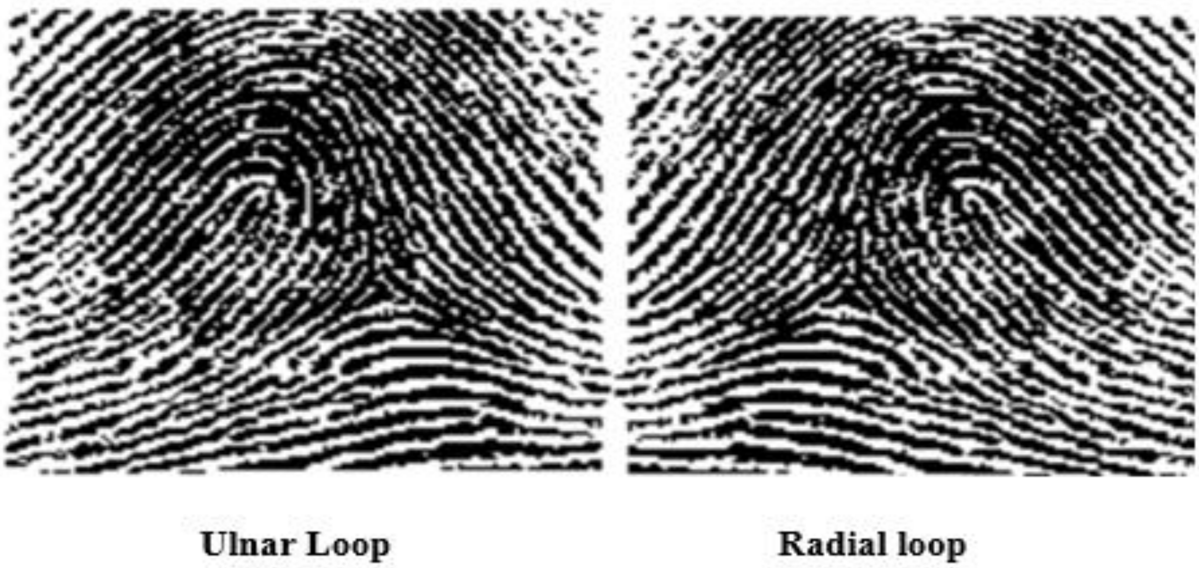

Figure 2: Loop pattern on fingers.[9]

Whorls (W): The ridges in this design start on one side and go all the way around.[7] Whorl is any ridge formation having two or more triradii, according to Galton's taxonomy of 1892. Whorl is a ridge arrangement in which ridges ring the center and more complicated patterns known as Composites are generated, according to Henry's categorization from 1900.[12] The whorl pattern is characterized by Henry as an epidermal structure in which ridges ring a central core, with more complicated patterns referred to as "composites." The circular pattern makes it stand out. Around the center, the bulk of the ridges form circuits. Two triradii are common in true whorls. Composite patterns are those in which two or more designs are combined in a single pattern area. There are two or more triradii on them.[13] In a whorl, multiple circular or oval ridges run spirally around each other, or a single ridge travels spirally in several rounds. In a whorl, there are two or more Triradii.

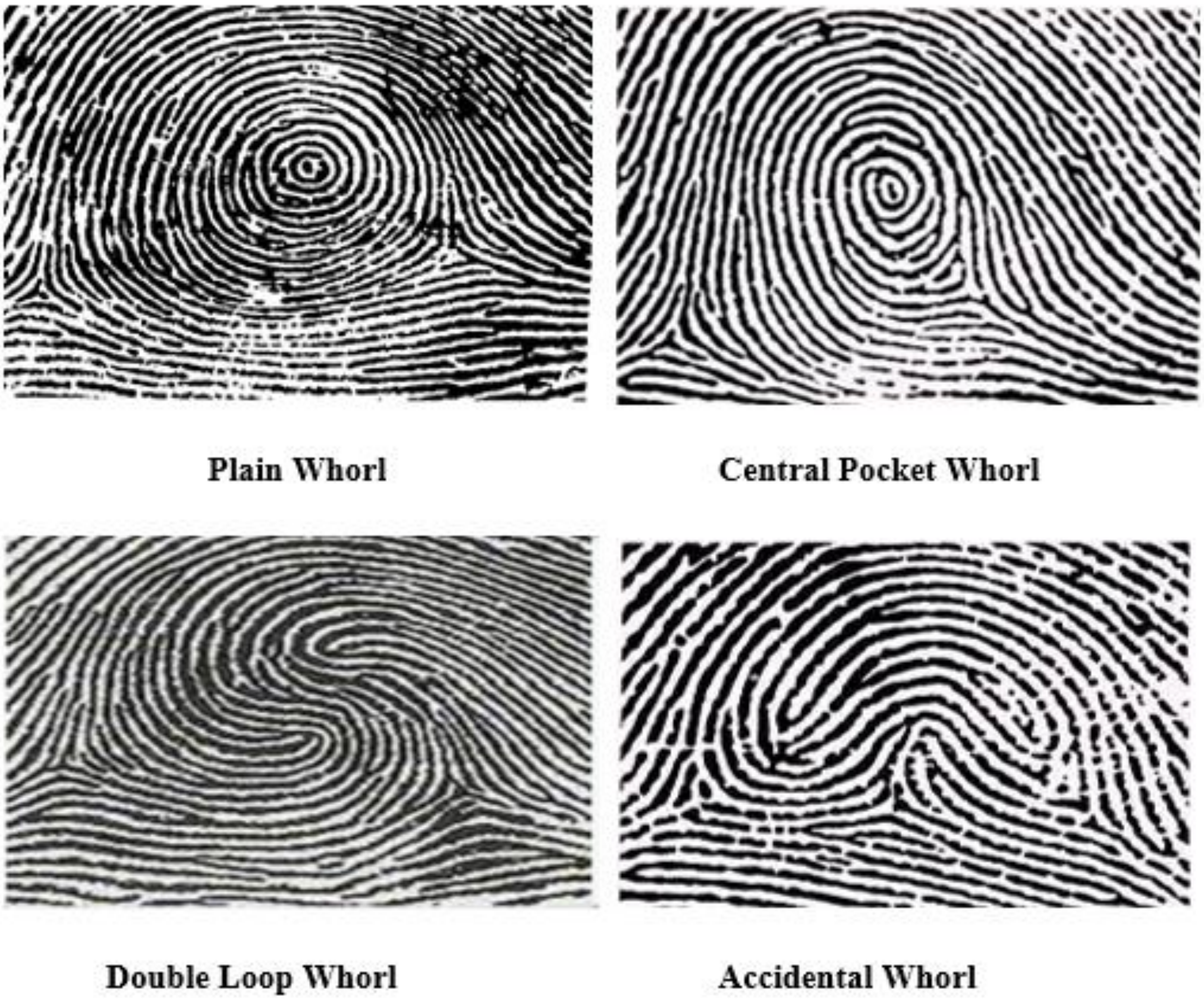

Figure 3: Whorl patterns and their variety. [13]

Triradius: A triradius is generated by the convergence of three ridged systems, and the geometric centre of the triradius is the triradial point [14]. It is, in theory, the meeting point of three ridges that create a 120° angle with one another [15]. The triradial point can be represented by a very small, dot-like ridge termed an island, or by a ridge terminating, or it can lie on a ridge towards the centre of the divergence of the three innermost ridges if the ridges fail to meet. In the study of fingerprints, the triradius has a twofold purpose: first, the ridges that extend from this point are triradiant, and second, it serves as a marker for ridge counting and tracing. A triradial point must be specified as the triradius center.

Figure 4: Arrows pointing at a triradius.[13]

Core: It is located at the pattern's approximate centre. Different forms for the core are possible. The centre of a loop pattern is commonly depicted as a straight, rod-like ridge, or a succession of two or more such parallel ridges, which are passed over by other recurving ridges. The innermost recurving ridge is defined as a core if the straight ridge in the loop's centre is missing.[16] The core of a whorl can be fashioned as a circle or an ellipse at the pattern's centre, or it can be shaped as a dot or short ridge [17].

Figure 5: Arrow pointing at a core point [18]

Radiants: They are ridges that radiate from the triradius and surround the pattern region.[19] The skeleton framework of the pattern region is made up of these ridges [17].

Palmar Pattern Configuration

To conduct a dermatoglyphic examination, the palm was separated into many anatomically well-differentiated sections. Thenar (Th), interdigital (ID), and hypothenar (Hypo) regions are also included.[15] The locations of embryonic volar pads are approximated in these places. Sulci and ridges produce diverse patterns in 10 different locations of the typical hand. The fine pads of the digits, the four interdigital regions, and the single hypothenar eminence are the areas in question. The thenar eminence joins the first interdigital area.

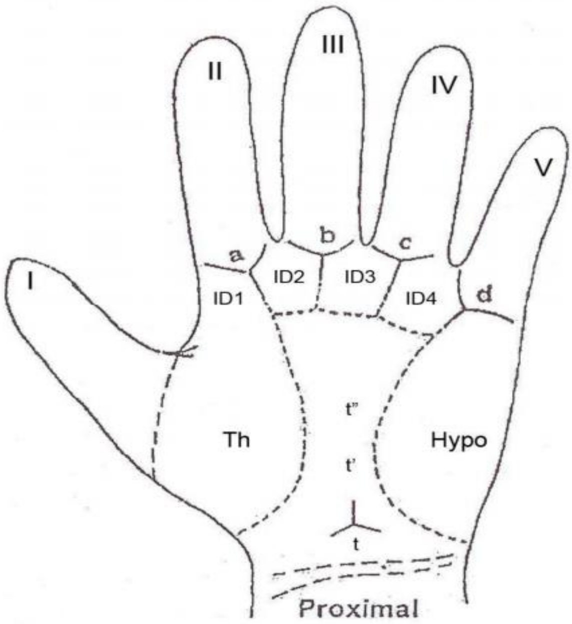

Figure 6: Palmar Pattern Configuration [20]

Thenar and First Interdigital Area (Th/I1): - Because these two sections are physically linked, they are treated as a single entity. In the majority of instances, there is no pattern in the Th/I1 region. Because they lack a genuine pattern, this structure is referred to as a vestige pattern when loops are present. Whorls are an unusual occurrence.

Interdigital Areas

In the distal palm, around the heads of metacarpal bones, the first, second, third, and fourth interdigital areas (ID1, ID2, ID3, ID4) can be discovered. A digital triradii surrounds each of them on the sides. Starting with the second number, the digital triradii are identified as a, b, c, and d. ID1 is located between 'Th' and 'a,' ID2 is located between 'a' and 'b,' ID3 is located between 'b' and 'c,' and ID4 is located between 'c' and 'd.' If there isn't a digital triradius, the midpoint of the corresponding digits' base can be used to divide interdigital regions.

Second, Third & Fourth Interdigital Area (ID2, ID3 ID4)

These regions can be discovered at the heads of the metacarpal bones in the distal palm. The digital triradii are labelled a, b, c, and d, starting from the triradius at the base of digit II and moving towards the triradius associated with digit V. The second interdigital area (ID2) is located between triradii a and b, the third interdigital area (ID3) is located between triradii b and c, and the fourth interdigital area (ID4) is located between triradii c and d. Loops, whorls, remnants, and open fields are ridge structures encountered in the interdigital regions. The most typical pattern in the distal palm is a loop, which might be followed by an auxiliary triradius. Whorls are found only rarely in the interdigital configurations, which do not represent true patterns but consists usually of a series of straight parallel or converging ridges having a direction different from the neighbouring ridged skin. They create an impression of ridge configurations encountered in the distal palm. There are no patterns in these areas, which are produced by almost parallel ridges. True patterns are uncommon in the ID2 region, while they are prevalent in the ID3 and ID4 regions. Patterns in ID3 and ID4 show a significant negative connection, and patterns in ID2 and ID3 have a greater frequency of patterns on the right palm, but ID2 patterns have a higher frequency on the left palm.

Quantitative Dermatoglyphics

Ridge Counting: It denotes the size of the design. Counting is done along the straight lines that connect the triradial point with the core point. The count excludes the ridges enclosing the point of the core and the triradial point. Ridges are frequently counted between two digital triradii. In the event of a whorl with two triradii and at least one point of core, two counts are performed, one from each triradii. Each count is conducted along a line drawn from the triradial point to the core's nearer point. The two counts are known as the first radial and second ulnar counts, respectively.

Finger Ridge Count (FRC): The number of ridges crossed by a line between the triradial point and the point of the core is known as the Finger Ridge Count (FRC). In a pattern with many potential counts, only the largest count is scored since ridge counts are employed to describe pattern size. There are no Counts in both plain and tented arches. A loop gets a 12 on average, but whorls get a 19 on average. This index has the benefit of being age-independent, unlike direct measurements.

atd angle: The atd angle is the most often utilized approach. It indicates the degree of distal displacement of the axial triradius, with the angle increasing as the triradius moves further away. Since its introduction by Penrose in 1949, it has been widely employed in dermatoglyphic assessment. Lines drawn from the digital triradius 'a' to the axial triradius 't' and from the axial triradius 't' to the digital triradius 'd' construct the shape. The bigger the atd angle, the further 't' is from the origin. The most common method for interpreting the position of triradius 't' is the atd angle. Though a useful and quick measurement, the atd angle has the problem of changing with age due to hand development. It also changes somewhat depending on how much pressure is used to make a palm print.

dat angle: A line is drawn from the digital triradius 'd' to the digital triradius 'a,' and then from 'd' to the axial triradii 't.' The dat angle is affected by the location of 't'.

adt angle: From the digital triradius 'a' to the digital triradius 'd,' then from 'd' to the axial triradii 't,' a line is formed. The adt angle is affected by the location of 't'. On the palm, the angles atd, tda, and dat are measured using the palm's most proximal "t" triradius.

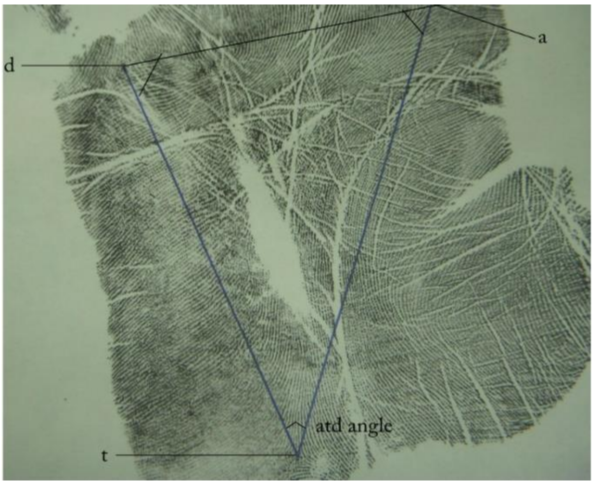

Figure 7: Palmar Angles.[6]

Palmar dermatoglyphics have been widely studied for their potential role in medical diagnostics and disease prediction[21]. These unique ridge patterns as described above, established during early fetal development, serve as stable genetic markers that have been linked to various congenital, metabolic, and neurological disorders[22,23]. While numerous studies have explored the association between dermatoglyphic patterns and specific diseases, there remains a gap in consolidating these findings into a comprehensive narrative review. This review aims to synthesize existing literature on the diagnostic and preventive applications of palmar dermatoglyphics, highlighting its potential as a non-invasive, cost-effective biomarker in modern medicine. By providing an updated perspective, this work seeks to bridge the gap between dermatoglyphic research and clinical practice, guiding future investigations and potential medical applications.

MATERIALS AND METHODS

This narrative review was conducted to synthesize existing literature on the role of palmar dermatoglyphics in preventive and diagnostic medicine. Given the broad scope of the topic, a comprehensive literature search was performed using multiple scientific databases. A systematic literature search was carried out in PubMed, Scopus, Web of Science, and Google Scholar to identify relevant peer-reviewed articles published between 2000 and 2023. The search was conducted using a combination of Medical Subject Headings (MeSH) terms and free-text keywords, including: *"Dermatoglyphics", "Palmar dermatoglyphics", "Fingerprint patterns", "Genetic markers", "Disease susceptibility", "Biomarkers in medicine"*. Boolean operators (AND, OR) were used to refine the search strategy. For example, the search query used in PubMed was: ("Dermatoglyphics"[MeSH] OR "fingerprint patterns") AND ("diagnostic medicine" OR "preventive medicine" OR "biomarkers") AND ("genetics" OR "disease susceptibility")

Inclusion criteria:

- Original research articles, review articles, and meta-analyses.
- Studies assessing the relationship between palmar dermatoglyphics and medical conditions.
- Publications in English.

Exclusion criteria:

- Case reports, editorials, and conference abstracts.
- Studies lacking a clear methodology or insufficient sample size (<50 participants).
- Articles focusing on forensic dermatoglyphics without medical implications.

Two independent reviewers screened the titles and abstracts for relevance. Full texts of potentially eligible studies were retrieved and assessed. The following information was extracted from each selected article:

- Study characteristics (author, year, study design, sample size).
- Dermatoglyphic parameters studied (arches, loops, whorls, total ridge count).
- Medical conditions assessed (e.g., diabetes, hypertension, genetic disorders).
- Key findings and conclusions.

The quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies[24]. Only studies meeting at least 5 out of 8 quality criteria were included in the discussion.

Ethical consideration

Since this review is based on previously published literature, no ethical approval was required. However, efforts were made to ensure the use of high-quality, peer-reviewed sources to maintain academic integrity.

RESULTS/THEMATIC REVIEW

Dermatoglyphics in Preventive and Diagnostic Medicine

Dermatoglyphics and Hypertension

Among the various applications of dermatoglyphics, various studies are beginning to notice a link between palmar dermatoglyphics and hypertension. Essential hypertension (also known as primary hypertension or idiopathic hypertension) is the most prevalent kind of hypertension, affecting 95 percent of hypertensive individuals. It is often hereditary and is thought to be caused by a combination of environmental and genetic factors [25]. In a study by Aktar *et al*.[26] the relationship between dermatoglyphic angle and blood pressure was investigated in 200 subjects from an Indian population. It was discovered that the left hand 'atd' was significantly higher in hypertensive subjects, implying that the left atd angle could be a predictor of high blood pressure. In a comparable research conducted among indigenes of Rivers State, Nigeria, Oladipo *et al*.[2] discovered that hypertensive people had considerably higher frequencies of whorl pattern on both hands than normotensive participants, as well as a total digital ridge count of greater than

1000. According to Ahmad and Pimpalkar [27], the percentage of whorl pattern was highest on the first, second, third, and fourth digits in both sexes among hypertensive patients; however, the frequency of whorl was higher in male hypertensive than females in both hands. The mean value of total finger ridge count (TFRC) and average finger ridge count (AFRC) was similarly found to be greatest in hypertensive patients. These and other recent research back up dermatoglyphics' importance in predicting and preventing hypertension. Once the individual's risk of developing hypertension has been determined, healthcare givers may begin educating them on how to make lifestyle changes to prevent or delay the onset of essential hypertension. Table 1 shows a summary of relevant studies relating hypertension with dermatoglyphics.

Table 1: Summary of selected studies on dermatoglyphic patterns in hypertension

SN	Author	Research Study	Findings
1.	Chakravathy *et al*.[28]	Association of palmar dermatoglyphic parameters and hypertension.	Mean "atd" angle and Whorls were found to be higher in cases than in controls. The distribution of dermatoglyphic patterns was statistically significant in cases than in controls.
2.	Wijerathne *et al*.[29]	Association between Dermatoglyphic pattern and hypertension.	Hypertensive individuals have a higher frequency of whorl patterns on their fingertips compared to controls. There is also a higher mean total ridge count in the digital dermatoglyphics of hypertensive subjects.
3.	Anita *et al*.[30]	Correlation between palmar and digital dermatoglyphic patterns in essential hypertensive patients and normal individuals	Loop Patterns were observed to be significantly higher in the right hand of hypertensive cases, but not significantly increased in the left hand of hypertensive cases. Arch Patterns were also significantly higher in both the right and left hands of hypertensive cases. Whorl patterns were significantly higher in both hands of controls. The mean 'atd' Angle was significantly increased in both hands of hypertensive cases.
4.	Lahiri *et al*.[31]	Relationship between palmar Dermatoglyphics and hypertension.	Double loop and arch were shown to be significantly more among hypertensive patients in both males and females while whorl, ulnar loop and radial loop are less. The average ridge counts per finger and corrected atd angles were also high.
5.	Umana *et al*.[32]	Dermatoglyphics and cheiloscopy pattern in hypertensive patients.	A marked and significantly higher loop, slightly higher whorl and low arch patterns were observed in female hypertensive patients in both hands.
6.	Oladipo *et al*.[2]	Relationship between palmar dermatoglyphics pattern and	The percentage frequency of the whorl digital pattern was higher in hypertensive than non-hypertensive and

	essential hypertension among Rivers indigene	whorls in the right hand were strongly associated with hypertension with the first right digit of males & females showing a percentage occurrence of 100% and 80.77% respectively. Concurrently a total ridge count greater than 1000 was strongly associated with hypertension.

Dermatoglyphics and Diabetes mellitus

By 2035, it is anticipated that 592 million people globally will have diabetes. According to the International Diabetes Federation, there are presently over 400 million diabetics worldwide. This has resulted in a massive illness burden on several countries throughout the world. Diabetes mellitus is caused by a combination of factors, including genetics, metabolism, and a sedentary lifestyle. New ways of diagnosis, prevention, and therapy are still being investigated. When applied to diabetes, dermatoglyphics appears to be showing fascinating tendencies that, if effectively harnessed, might assist in greatly reducing the incidence, morbidity, and death associated with diabetes mellitus. Diabetes patients had a significantly higher absolute ridge count in their palms than the general population [33]. Perumal [34] found a significantly increased level of left atd angle in female diabetic subjects when compared to normal females in his thesis on a dermatoglyphic study on type 1 and 2 diabetes mellitus. He also discovered that the overall ridge count of both sexes was dramatically lower compared to normal people. In a related study by Mouneshkumar *et al*.[35], cheiloscopic patterns analysis revealed that male diabetic subjects had branched, straight, intersected, reticular, and undifferentiated patterns in decreasing order of frequency, whereas female diabetic subjects had branched, intersected, straight, and reticular patterns with no undifferentiated patterns. The ulnar loop, on the other hand, was shown to be more common in both males and females. Among an Indian population, Tarigoppula *et al*.[36] discovered a greater prevalence of ulnar loops and atd angle in diabetics. In a research done by Srivatsava and Burli [37] in a Bangalore-based population of India, diabetics of both sexes had a considerably greater prevalence of spiral whorls in both hands, as well as a significantly higher fingertip ridge count. Shrivastava *et al*.[37] discovered that diabetes individuals have a greater incidence of whorl pattern than normal people in another investigation. Mukherjee *et al*.[38] discovered that diabetics have a greater frequency of whorls pattern than the other research participants in their work on dermatoglyphics as a credible risk factor. In a study of dermatoglyphics patterns in diabetes mellitus in the South Eastern Nigerian population, Oladipo *et al*.[39] reported higher left atd angle and a-d ridge count values in diabetics than non-diabetics. Dermatoglyphics is becoming a genuine screening tool for hypertension and diabetes mellitus, thanks to advancements in the fields of anthropometry and anthropology. The fact that it is a simple, quick, non-invasive technique requiring little experience is even more intriguing. Table 2 highlights the relationship between dermatoglyphics patterns and diabetes in some research findings.

Table 2: Summary of selected studies on diabetes milletus and dermatoglyphic patterns

SN	Author	Research study	Findings
1.	Tadesse *et al*.[40]	Dermatoglyphics as a predictive marker for type 2 diabetes mellitus.	The study found that the Loop pattern was more frequent in type 2 DM compared to non-diabetic study participants. Whorl type was more common than arch type in non-diabetic patients compared to type 2 DM groups. The result also showed triradius angle is significantly wider in diabetic groups in both hands.
2.	Yohannes *et al*.[41]	Correlation between dermatoglyphic patterns and the predisposition to type 2 diabetes.	The research shows that ulnar loops and whorls are more common in patients with diabetes than in healthy controls. It was found that diabetes patients had a lower total ridge count than healthy controls.
3.	Sharma and Sharma,[42]	Dermatoglyphics as a diagnostic tool to predict diabetes	The ‘tad’ and the ‘tda’ angles on both sides of the hands in all the groups were lower in the patients except in males (left ‘tda’), but they differed only significantly in the females (left ‘tad’, right ‘tda’) and in the overall groups (right ‘tda’) The whorl, loop and arch digital frequencies in females and in the overall groups (except loop) were increased. The vestige and the spiral whorl pattern were restricted to the thenar and the hypothenar areas of the male patients respectively as compared to the controls. Except for an increase in the radial variety and the absence of the proximal variety, other C-line patterns were decreased in diabetics than in the controls.
4.	Sudagar *et al*.[43]	Study of palmar patterns in diabetic patients.	There is a slight decrease in the mean value of the atd angle in diabetic patients. The frequency of t is also decreased among diabetic patients.
5.	Eswariah and Bali,[44]	Pattern of Palmer flexion creases and dermatoglyphics among diabetic patients.	Palmer flexion creases patterns were observed to be more frequent in diabetic patients than in control subjects. There was an altered dermatoglyphics pattern among diabetics marked by an increased number of whorls and a decrease in the total ridge count.

6.	Trivedi *et al.*[45]	Correlation of atd angle with Non-Insulin Dependent Diabetes Mellitus in Gujarati population.	Mean atd angle was higher in right hand of cases than in controls while Mean atd angle was higher in the left hand of cases than in controls.
7.	Sachdev[46]	Relationship between dermatoglyphic patterns and diabetes in a population of tribal people in Rajasthan,	It was observed from the findings that diabetic patients had a higher percentage of ulnar loops and arches, while non-diabetic patients had a higher percentage of whorls.

Dermatoglyphics and Dentistry

Researchers in the field of dermatoglyphics have recently noticed changes in fingerprints among patients with various dental ailments such as periodontitis, dental caries, and certain types of congenital anomalies such as cleft lip and palate, which has piqued their interest and encouraged them to learn more about the role of dermatoglyphics in various dental diseases [47]. Table 3 highlights several studies' results on various dental problems.

Table 3: Summary of selected studies on dental diseases and dermatoglyphic patterns.

SN	Author	Dental Disease	Findings
1.	Scott *et al.*[48]	Syndromic cleft lip and palate in Philipines and Chinese	Increase in the number of radial and ulnar loops
2.	Matthew *et al.*[49]	Cleft lips in Indians	Increased number of ulnar loop
3.	Balgir *et al.*[50]	Cleft lip and palate	Wider atd angle
4.	Saxena *et al.*[51]	Cleft lip and palate	Increased frequency of loop and arch pattern with decreased frequency of whorls, mean total ridge count.
5.	Atasu *et al.*[52]	Dental caries	Increased whorls pattern in extensive caries
6.	Atasu *et al.*[52]	Periodontal disease	Decreased frequencies of twinned and transversal ulnar loops on all fingers of patients with juvenile periodontitis Decreased frequencies of double loops on all fingers Increased frequencies of radial loops on the right second digit of patients with rapidly progressive. Increased frequency of concentric whorls and transversal ulnar loops on all the fingers of patients with adult periodontitis. Increased frequency of triradii on the palms of patients with juvenile periodontitis.
7.	Tikare *et al.*[53]	Malocclusion	Increased frequency of arches and radial loops with decreased frequency of ulnar loops.

8.	Polat *et al*.[54]	Bruxism	Increased whorls, loops and triradii. Decrease in frequency of ulnar loops and atd angle.
9.	Polat *et al*.[55]	Oral tumours	Increase in frequency of arch patterns

Kadam et al.[47] (Adapted)

The application of dermatoglyphics in oral health as a diagnostic and prognostic technique is extremely promising. To verify the accuracy of these findings, further studies are required.

Dermatoglyphics, Autism and Schizophrenia

Various scholars have investigated the link between dermatoglyphics and psychiatric disorders, with intriguing results. In a study of autistic children in an Iranian community, Kazemi *et al*.[56] found a substantial increase in loop counts and a significant drop in ridge counts on the right and left thumb and index fingers of patients when compared to normal controls. The importance of early identification and intervention options for schizophrenia is growing. Dermatoglyphic patterns, such as fingerprint asymmetry, have been proposed as indirect indicators of early aberrant developmental processes that might contribute to later psychiatric diseases such as schizophrenia. In a study conducted in Taiwan by Wang et al.[57] to determine the relationship between dermatoglyphics and schizophrenia using fingerprint asymmetry measures, it was discovered that the patient group had a consistently higher degree of asymmetry than the control group, implying that this feature could be used to distinguish the patient from the control.
Igbigbi *et al*.[58] found a substantial rise in loops and a decrease in arches in schizophrenia patients compared to controls in their research of dermatoglyphic patterns in a Nigerian community. A substantial rise in mean total finger ridge count (TFRC) was also seen in male patients. While trying to extract the key aspects of dermatoglyphics related to schizophrenia and its clinical subtypes, Oyunchimeg *et al*.[59] discovered that schizophrenic patients had a higher percentage frequency of arches pattern on the right ring finger than controls.
In schizophrenia, Bhusaraddi *et al*.[60] discovered a statistically significant decrease in the frequency of arches when compared to the control group. However, while findings on fingerprint patterns among schizophrenia patients have been varied, the majority of studies agree that there is constant asymmetry (the absolute difference in dermatoglyphic characteristics between counts of left and right hands) among schizophrenic patients. These findings show that dermatoglyphics can be used to screen for schizophrenia and other psychiatric conditions.

Dermatoglyphics and other Medical Conditions

Below is a summary of other medical conditions in which various studies have tried to elucidate the potential benefit of dermatoglyphic characteristics

Down's syndrome: The ulnar loops on the fingers are nearly always increased in the dermatoglyphics of people with Down's syndrome [61].

Cleft lip and cleft palate: Increased radial and ulnar loops have been reported in Cleft lip and palate patients. According to Balgir, [62] he observed a high and wider atd angle (more than 30^o).

Dental caries: Sharma and Somani [63] discovered a highly significant difference in loops between the subject (Caries) and control groups, as well as a substantial difference in microbial proliferation between the subject and control groups.

Cancer studies: In squamous cell carcinoma of the head and neck patients, one research revealed substantially less ($P<0.05$) radial loop patterns on the first, second, third, and fourth digits of the left hand, and the second digit of the right hand. In another research, males and females with acute myelogenous leukaemia had more radial loops on their right hands, as well as more atd angle and hypothenar patterns on their left palms. In patients with breast cancer, research in India discovered a considerably greater value of loops and whorls in the index and ring fingers of the right hand, respectively.[6] Table 4 highlights several studies' results on the relationship between palmar dermatoglyphics and other medical conditions.

Table 4: Summary of selected studies on palmar dermatoglyphics and medical conditions.

SN	Author	Research study	Findings
1.	Lu *et al*.[64]	Relationship between hand dermatoglyphic traits and azoospermia	The prevalence rate of radial loops in both hands was markedly higher in the azoospermia patients than in the normal controls
2.	Sakineh and Mina[65]	Dermatoglyphic patterns on fingers and gynaecological cancers.	Arch and loop patterns significantly changed in the cases group as compared to the control. The odds ratio suggested that a loop pattern in 6 or more fingers might be a risk factor for developing gynaecological cancers.
3.	Lu *et al*.[66]	Dermatoglyphic patterns in coronary artery disease	There was a significant difference in the digital frequency of whorls and ulnar loops in patients in both hands as compared to controls. The A-B ridge counts were significantly higher in coronary artery disease compared with controls on the right palm. However, the mean ATD angle values were significantly higher in cases than those of normal on both hands.

CONCLUSION

Distinct illnesses are connected with different fingerprint patterns. Several independent studies as presented in this review have confirmed this. A large variety of diseases have been linked to fingerprint irregularities, including cancer, heart disease, and diabetes. Our findings in this review showed that specific dermatoglyphic patterns are peculiar to certain disease conditions such as diabetes milletus, hypertension, schizophrenia, dental diseases and others. Although there is a need for more research to validate these findings in different populations, we can conclude that dermatoglyphics if explored is a reliable non-invasive screening tool in clinical practice. Dermatoglyphics has progressed from obscurity to acceptance in medicine as a screening, preventive, and diagnostic tool. The use of dermatoglyphics in clinical practice as a screening tool for prevention rather than cure should be advocated.

REFERENCES

1. Abhilasha S, Balreet K, Nidhi P, Ajitpal S. Palmar dermatoglyphics: mass screening tool for hypertension. Int J Anat Res. 2017;5(2.2):3850-4.
2. Oladipo GS, Bobmanuel I, Ugboma H, Sapira M, Ekeke O. Palmar dermatoglyphics in essential hypertension amongst Rivers indigenes. Aust J Basic Appl Sci. 2010;4:6300-5.
3. Sharma MK, Sharma H. Dermatoglyphics: A diagnostic tool to predict diabetes. J Clin Diagn Res. 2012;6(3):327-32.
4. Allen R, Sankar P, Prabhakar S. Fingerprint identification technology. In: Biometric Systems. Springer; 2005. p. 22-61.
5. Abue AD, Rose C, Courage N. Analyses of dermatoglyphic patterns in Ntamante, Boki Local Government Area (LGA) of Cross River State, Nigeria. Adv Anthropol. 2018;8(3):83-90.
6. Karthikeyan G. A study on dermatoglyphic pattern in women with breast cancer [dissertation]. Chennai: Madras Med Coll; 2013.
7. Achalli S, Patla M, Nayak U, Soans C. Dermatoglyphics and orthodontics. Int J Orthod Rehabil. 2016;7(4):144.
8. Nezam S, Khan SA, Singh P, Nishat R, Kumar A, Faraz SA. Correlation of dental caries and dermatoglyphic patterns: A study in pediatric population. J Fam Med Prim Care. 2020;9:2980-4.
9. Jennifer S, Nidhi. Dermatoglyphics: an introduction and historical review. J Int Multidiscip Acad Res. 2015;3(8):178-87.
10. Rastogi P, Pillai KR. A study of fingerprints in relation to gender and blood group. J Indian Acad Forensic Med. 2010;32(1):11-4.
11. Masthan KMK, Babu NA, Krupaa RJ, Anitha N. Dermatoglyphics: a review. Biomed Pharmacol J. 2015;8:417-20.
12. ArunKumar KR, Manoranjitham R, Shalini R, Ravivarman C. Study of fingerprint patterns among medical students. Int J Anat Res. 2016;4(2):2273-6.
13. Sharma A, Sood V, Singh P, Sharma A. Dermatoglyphics: a review on fingerprints and their changing trends of use. CHRISMED J Health Res. 2018;5:167-72.
14. Soni A, Singh SK, Gupta A. Implications of dermatoglyphics in dentistry. J Dentofac Sci. 2013;2:27-30.
15. Prabhu N, Issrani R, Mathssur S, Mishra G, Sinha S. Dermatoglyphics in health and oral diseases - a review. JSM Dent. 2014;2(4):1044.
16. Bhasin MT, Bhasin P, Singh A, Bhatia N, Shewale AH, Gambhir N. Dermatoglyphics and malocclusion - a forensic link. Biotechnol J Int. 2016;1-12.
17. Cheena S, Parvathi M. Dermatoglyphics: The ever lasting impressions. Int J Dent Oral Sci. 2015;2(7):111-4.
18. Ambadiyi SA, Ng SK, Ismail MS. Dermatoglyphic patterns and core point

analysis in type 2 diabetes mellitus. J Diabetes Metab Disord. 2015;14(1):1-7.
19. Paliwal RO, Dhule PS. Dermatoglyphics in diabetic cataract patients: a case-control study. Int J Innov Res Med Sci. 2018;3(3).
20. Lakshmana M, Pavan S, Kumar P. Palmar pattern configuration in type 2 diabetes mellitus. J Clin Diagn Res. 2017;11(9).
21. Bhat GM, Mukhdoomi MA, Shah BA, Ittoo MS. Dermatoglyphics: in health and disease—a review. Int J Res Med Sci. 2014;2(1):31–7.
22. Kanchan T, Krishan K. Significance of dermatoglyphics in medico-legal investigations. Int J Forensic Sci Criminol. 2017;5(2):176–80.
23. Purkait R, Mukherjee DP. Dermatoglyphics and its role in medical disorders: a review. Int J Anat Res. 2016;4(4):2954–9.
24. Joanna Briggs Institute. Checklist for Analytical Cross-Sectional Studies [Internet]. Adelaide: JBI; 2020: 1-5. [https://jbi.global/sites/default/files/202008/Checklist_for_Analytical_Cross_Sectional_Studies].
25. Nandhini S. Essential hypertension - a review. J Pharm Sci Res. 2014;6(9):305-307.
26. Akhtar S, Verma V, Singla R. A study of correlation between dermatoglyphic angle and blood pressure in an Indian population. J Evol Med Dent Sci. 2020; 9(13): 1040-1044. DOI:10.14260/jemds/2020/224.
27. Ahmad M, Pimpalkar D. Study of palmar dermatoglyphics in hypertension. Int J Sci Res. 2015;6(3):719-724.
28. Chakravathy PG, Shirali A, Chowta KN, Ramapuram JT, Madi D, Raj Singh Chouhan R. A “Handy” tool for hypertension prediction: Dermatoglyphics. Indian Heart J. 2018;70(3):S116-S9.
29. Wijerathne BT, Meier RJ, Agampodi TC. Dermatoglyphics in hypertension: a review. J Physiol Anthropol. 2015; 34:29.
30. Anitha N, Harisha P, Vijaykishan B, Chandra P. Palmar and digital dermatoglyphic patterns in essential hypertension – A study in Puducherry population. Indian J Clin Anat Physiol. 2020; 7(2):164-168.
31. Lahiri K, Mukhopadhyay B, Das M. Relationship between palmar dermatoglyphics and hypertension. J Clin Diagn Res. 2013;7(9):1738-40.
32. Umana G, Chakraborty S, Bhattacharya S. Dermatoglyphics and cheiloscopy pattern in hypertensive patients. J Clin Diagn Res. 2014;8(8):723-45.
33. Elena R, Giovanni P. Dermatoglyphic patterns in type 2 diabetes mellitus. J Diabetes Complications. 2000;14(2):75-9.
34. Perumal A. Comparative qualitative and quantitative dermatoglyphic study on type 1 and type 2 diabetes mellitus [thesis]. Tamilnadu, India: Vinayaka Missions University; 2016.
35. Mouneshkumar CD, Anand S, Shilpa RH, Haidry N, Kulkarni P. Dermatoglyphics and cheiloscopy patterns in hypertensive and type 2 diabetes mellitus patients: an observational study. J Family Med Prim Care. 2021;10(3):1177.
36. Tarigoppula RTVN, Syamala M, Raheem AMB, Patil SK. Evaluation of the role of dermatoglyphics, oral micronuclei and ABO blood grouping in determining type 2 diabetes – a multi-parameter approach. J Clin Diagn Res. 2018;12(10):345-61.
37. Srivatsava S, Burli S. A study of palmar dermatoglyphics in type 2 diabetes mellitus in a Bangalore-based population. Indian J Clin Anat Physiol. 2019;6(1):118-25.
38. Mukherjee S, Ray S, Ghosh S. Dermatoglyphics as a risk factor in diabetes mellitus: a cross-sectional study. J Clin Diagn Res. 2018;12(9).

39. Oladipo G.S., Ogunnowo, B.M. Dermatoglyphic Patterns in Diabetes Mellitus in a South Eastern Nigerian Population. African Journal of Applied Zoology & Environmental Biology, 2004; 6: 6-8.
40. 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;15:1269-80.
41. Yohannes A, Alebie G, Assefa L. Dermatoglyphics in diabetes: a prospective diagnostic aid and early preventive tool. Pract Diabetes. 2015;32(2):124-8.
42. Sharma MK, Sharma H. Dermatoglyphics: a diagnostic tool to predict diabetes. J Clin Diagn Res. 2012;6(3):327-32.
43. Lekshmi PA, Srimathi T, Anandarani VS. The palmar dermatoglyphic patterns in type II diabetic mellitus cases- A study of South Indian population. J Biomed Pharma. 2021;14(1):379-383.
44. Eswariah G, Bali RS. Palmer flexion creases and dermatoglyphics among diabetic patients. Am J Phys Anthropol. 1977;47(1):11-3.
45. Trivedi PN, Singel TC, Kukadiya UC, Satapara VK, Rathava JK, Gohil MM. Correlation of atd angle with non-insulin dependent diabetes mellitus in Gujarati population. J Res Med Dent Sci. 2014;2(2):47-51.
46. Sachdev B. Biometric screening method for predicting type 2 diabetes mellitus among select tribal population of Rajasthan. Int J Curr Biol Med Sci. 2012;2(1):191-4.
47. Kadam S, Biswas D, Vijayalaxmi N, Landge B. Dermatoglyphics in dental disorders: a review. Int J Eth Trauma Victimology. 2019; 5(1):39-44.
48. Scott NM, Weinberg SM, Neiswanger K, Brandon CA, Daack-Hirsch S, Murray JC. Dermatoglyphic fingerprint heterogeneity among individuals with non-syndromic cleft lip with or without cleft palate and their unaffected relatives in China and the Philippines. Hum Biol. 2005;77(2):257-66.
49. Mathew L, Hegde AM, Rai K. Dermatoglyphic peculiarities in children with oral clefts. J Indian Soc Pedod Prev Dent. 2005;23(4):179-82. doi: 10.4103/0970-4388.19005.
50. Balgir RS. Dermatoglyphics in cleft lip and cleft palate anomalies. Indian Pediatr. 1993; 30(3):341-6.
51. Saxena RS, David MP, Indira AP. Dermatoglyphic evaluation in subjects and parents of cleft lip with and without cleft palate. Cleft Palate Craniofac J. 2013;50(6):105-10.
52. Atasu M, Kuru B, Firatli E, Meriç H. Dermatoglyphic findings in periodontal diseases. Int J Anthropol. 2005;20(1-2):63-75.
53. Tikare S, Rajesh G, Prasad KV, Thippeswamy V, Javali SB. Dermatoglyphics—A marker for malocclusion? Int Dent J. 2010;60(4):300-4.
54. Polat MH, Azak A, Evlioglu G, Malkondu OK, Atasu M. The relation of bruxism and dermatoglyphics. J Clin Pediatr Dent. 2000;24(3):191-4.
55. Polat MH, Gululmser P, Banu K. Dermatoglyphic findings in patients with oral cancers. J Stomatol. 2004;8:105-8.
56. Kazemi M, Fayyazi-Bordbar MR, Mahdavi-Shahri N. Comparative dermatoglyphic study between autistic patients and normal people in Iran. Iran J Med Sci. 2017;42(4):392.
57. Wang J, Lin C, Yen C. Determining the association between dermatoglyphics and schizophrenia by using fingerprint asymmetry measures. Int J Pattern Recognit Artif Intell. 2008;22(3):601-16.
58. Igbigbi PS, Ominde BS, Oyibojoba O. Dermatoglyphic patterns of

schizophrenic patients in a Nigerian population. Int J Anat Res. 2018;6(2.1):5114-21.
59. Oyunchimeg N, Tsend-Ayush A, Lkhagvasuren N, Jav S. Main Characteristics of dermatoglyphics associated with schizophrenia and its clinical subtypes. PLoS One. 2021;16(6):e0252831. doi: 10.1371/journal.pone.0252831.
60. Bhusaraddi PS, Pavan PH, Pramod R, Shaik HS. The study on correlation of dermatoglyphics and schizophrenia. Artigo IMSEAR sea-198625. 2019.
61. Bryant JI, Emanuel I, Huang SW, Kronaml R, Lo J. Dermatoglyphs of Chinese children with Down's syndrome. J Med Genet. 1970;7(4):338-44.
62. Balgir RS. Dermatoglyphics in cleft lip and cleft palate anomalies. Indian Pediatr. 1993;30(3):341-6.
63. Sharma A, Somani R. Dermatoglyphic interpretation of dental caries and its correlation to salivary bacteria interactions – An in vivo study. Indian Soc Pedod Prev Dent. 2009;27:17-21.
64. Lu H, Wang L, Li KK, Bai CY, Huo ZH. Hand dermatoglyphic traits and azoospermia in the Chinese Han males in Ningxia area. Zhonghua Nan Ke Xue. 2018;24(10):878-82.
65. Sakineh A, Mina R. Dermatoglyphic patterns on fingers and gynecological cancers. Eur J Obstet Gynecol Reprod Biol. 2018;222:39-44.
66. Lu H, Qian W, Geng Z, Sheng Y, Yu H, Ma Z, et al. Dermatoglyphs in coronary artery disease among Ningxia population of North China. J Clin Diagn Res. 2015;9(12):AC01-4.