



**PREVALENCE OF DERMATOGLYPHIC PATTERNS AND
PALMAR CREASES AMONG DIABETIC AND NON-DIABETIC
PATIENTS AT GOVERNMENTAL HOSPITALS, EAST GOJJAM
ZONE, NORTH WEST ETHIOPIA, 2019**

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COLLEGE OF HEALTH SCIENCE
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Prevalence of dermatoglyphic patterns and palmar creases among diabetic and non-diabetic patients at governmental hospitals, East Gojjam zone, North West Ethiopia, 2019

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Acronyms

AAU	-	Addis Ababa University
AOR	-	Adjusted Odds Ratio
COR	-	Crude Odds Ratio
DM	-	Diabetes Mellitus
IDDM	-	Insulin Dependent Diabetes Mellitus
NIDDM	-	None Insulin Dependent Diabetes Mellitus
RBS	-	Random Blood Sugar
SPSS	-	Statistical Package for Social Science
WHO	-	World Health Organization

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Abstract

Introduction: Dermatoglyphics is the scientific study of the skin ridge patterns on the fingers, palms and soles of human. Dermatoglyphics patterns are genetically determined and affected by physical, topographical and environmental factors in intrauterine life. There are lines in the palm known as palmar creases. A normal human palm contains three major creases. The patterns of the epidermal ridges and palmar creases serve as a diagnostic tools in a number of diseases that have genetic backgrounds. Diabetes mellitus is one such of diseases with a strong genetic basis and certain dermatoglyphics and palmar crease variations are expected to occur.

Objectives: The aim of this study is to determine the prevalence of digital dermatoglyphics and palmar crease patterns of the hand among diabetics and non-diabetics patients in governmental hospitals, East Gojjam zone, 2019

Methods: Institution based cross-sectional study was conducted by both observation and interview methods. Bilateral palmar and fingerprints were taken by mobile camera from selected volunteers of diabetic and non-diabetic subjects attending East Gojjam zone government hospitals. A Pearson chi-square test, bivariable, and multivariable multinomial logistic regression models were employed using SPSS version 20. Odds ratio with 95% confidence interval was computed and p-values less than 0.05 were considered significant.

Result: In both diabetics and non-diabetic subjects loop type was the most frequent followed by whorl and arch types. Their prevalence were respectively 66.9% [95% CI: 65.4, 68.3], 28.4% [95%CI: 27, 29.8], and 5.1% [95% CI: 4.1, 5.4] in diabetics and 63.4% [95% CI: 61.9, 64.8], 32% [95%CI: 30.5, 33.4] and 4.7% [95% CI: 4.0, 5.3] in non-diabetic subjects. Being male was nearly 1.4 times likely to have loop type (AOR= 1.385 95%CI 1.120, 1.714) and whorl type (AOR=1.359 95%CI 1.090, 1.696) than arch type of dermatoglyphics patterns. Normal type of palmar crease has nearly similar distribution between diabetic and non-diabetic subjects. From aberrant creases simian had a bit higher distribution in diabetics compared to non-diabetics study participants.

Conclusion: The study showed that there was significant difference in the distribution of fingerprint patterns between the diabetics and the non-diabetic subjects. The findings in the palm showed that normal crease was the most frequent creases. In addition, there was significant association with sex, body side and symmetry in the pattern of fingerprint distribution between the diabetics and non-diabetic subjects.

1. Introduction

1.1. Background

The scientific study of dermal ridges of the hands and feet of human was first begun in 1823 by Evangelista Purkinje (1). Dermatoglyphics is a science that deals with the scientific study of epidermal ridge patterns on the palmar and plantar aspect of fingertips, palms and soles of human. The term 'Dermatoglyphics' was coined by Cummins and Midlo (1926) (2) and was derived from the Greek words 'derma' means skin and 'glyphics' means carving (3).

Dermatoglyphics consist of patterns formed by parallel ridges on the skin of fingertips and palms. The skin on the palmar surfaces of human beings though is not smooth, it is grooved by ridges, which form a variety of configurations (4). The dermatoglyphics patterns of dermal ridges are formed during the early intra-uterine life, between 7th and 21st week of gestation and mature at about 7 months of fetal development (5-7). Dermatoglyphics, once formed, are not changed throughout the life of an individual and are not affected by either the environmental or, age-related factors in the postnatal life of an individual (5, 7). However, dermatoglyphics pattern may be affected by environmental and genetic factors in intrauterine life (8).

The ridge patterns on the palm and fingers are divided into three groups: Arches, loops and whorls (4, 9). Arches are formed by a succession of more or, less parallel ridges, which traverse the pattern area. The arch patterns are sub-divided into simple and tented types: The simple (plain) arch pattern is composed of ridges that cross the fingertips from one side to the other without recurving, while the tented arch is composed of ridges that meet at a point so that their smooth sweep is interrupted (4, 9). Loop pattern is composed of a series of ridges that enter the pattern area on one side of digit recurve and leave the pattern area on the same side. If the ridges open-up on the ulnar side, the resulting loop is termed as ulnar loop when they open-up towards the radial margin, it is termed as a radial loop (4, 9). The ridges in a simple whorl are commonly arranged as a succession of concentric rings. Such patterns are described as concentric whorls. In addition they might be seen in a different configuration with spirals around the core in either a clockwise or, a counter clockwise direction and this type of pattern is called as a spiral whorl. A

central pocket whorl contains a loop within which a smaller whorl is located. Complex patterns, which cannot be classified as one of the above patterns, are called accidentals (4, 9).

Finger and palmar prints are permanent variables and inherited, differ amongst parents and their children, siblings and even in, monozygotic, identical twins. Because of these qualities, dermal ridges play a very important role in the personal identification of an individual, for forensic purposes, in twin diagnosis, racial variation and have applied values in various diseases and syndromes (10).

There are lines in the palms of human known as palmar creases (1). A normal human palm contains three major creases. The radial or longitudinal crease begins at or slightly below the proximal transverse crease at the radial border of the palm (11). The proximal transverse crease begins at the radial side of the palm curves proximally and ends at the medial border of the hypothenar area. The distal horizontal crease is found closest to the fingers, beginning at the interdigital space between the second and third fingers, curving gently wrist ward toward the ulnar side of the palm (11).

Palmar creases are classified more clearly in the work of Park et al. as: normal when proximal and distal transverse crease do not meet each other; simian when proximal and distal transverse crease meet to cross the palm; swon when proximal and distal transverse crease meet, accompanied by accessory proximal transverse crease; and sydney when proximal and distal transverse crease meet, accompanied by accessory distal transverse crease. Simian, swon and sydney creases are anomalous palmar creases that may seek medical attention because it is known that their presences correlate strongly with several human chromosomal abnormalities and diseases (1). Dermatoglyphics have been therefore accepted as a simple, noninvasive and inexpensive method for deciding whether individual would have a particular gene linked disorder or, chromosomal defect (12).

Diabetes mellitus is a metabolic disorder in which a person has high blood glucose level, either because, the pancreas does not produce enough insulin, or because cells resist to the insulin produced. The etiology of diabetes mellitus is multi factorial with the genetic makeup of individual playing major role (13). There are two major forms of diabetes mellitus known as

type 1 and type 2 diabetes. In the type 1 diabetes, the beta cells are progressively destroyed and secrete little or no insulin; injections of exogenous insulin are thus required to sustain the person's life. Type 1 accounts for only about 10% of the known cases of the disease. Type 2 diabetes mellitus results from insulin resistance; it is a condition in which cell fail to utilize insulin properly. About 90% of the people who have diabetes have type 2, it is usually diagnosing in people over the age of 40. Type 2 diabetes develops slowly, is hereditary, and occurs most often in people who are overweight (14).

1.2. Statement of the problem

Epidermal ridges and palmar creases are formed early in the intrauterine life and remain unchanged thereafter in the postnatal life of an individual. They are affected by environmental and genetic factors in utero, and so, it has potential to predict various genetic and acquired disorders with a genetic influence (8). Epidermal ridge patterns show significant associations with patients of diseases with a strong or partial genetic background (15). Epidermal lines or dermatoglyphics analysis is now a valuable companion to other methods used for diagnosis of some genetic diseases and syndromes genetically determined (16). It has been clearly established that conditions like diabetes and hypertension have genetic background, which is why there may show distinct findings in diseases which have genetic predisposition (15). Globally diabetes prevalence is similar in men and women, although it is slightly higher in men above 60 years of age and in women at older ages. Early diagnosis and treatment of diabetes are essential in preventing long-term complications. Most sufferers are asymptomatic and hence early diagnosis is usually difficult (17).

Diabetes is a multisystem metabolic disorder that affects many organs of the body (18). It has become a major health challenge worldwide (19). According to the WHO estimation, a significant amount of the health budget goes to diabetes health care and related disabilities (20). In 2030, it is estimated that the total number of diabetes-affected people would reach 366 million. This idea is also supported by the fact that, annually 3.2 million persons die of diabetes, which means 8,700 die every day, or 6 persons die every minute. As anticipated by WHO, International Diabetes Federation, European Association for the Study of Diabetes and European Diabetes Care Predictors, in the future diabetes will be on the top of the mortality and morbidity causes (21).

Diabetes is increasing in several parts of the world, especially in developing countries. The total number of diabetics are projected to rise from 171 million in the year 2000 to 366 million in 2030 (19, 22). According to 2019, International Diabetes Federation estimation a total of 463 million people are estimated to be living with diabetes, representing 9.3% of the global adult population (20-79 year). This number is expected to increase to 578 million (10.2%) in 2030. Diabetes mellitus is a disease on the rise in developing countries (15). According to 2017

estimation of International Diabetic Federation, more than 15 million people in Africa have diabetes mellitus. The prevalence of diabetes vary across Ethiopia, ranging from 0.3% at Debre Berhan Referral Hospital to 7% in Harar town (23). It is a disease, which causes multiple organs damage with time. It requires extensive care and drug management (24). Diabetes gives rise to complications if not under control. Since it is a condition with a genetic background, one can assume there might be certain findings on dermatoglyphics and palmar crease specific to diabetic mellitus patients.

1.3. Significance of the study

Dermatoglyphics is related to individual genetics; as the diabetes mellitus has also a genetic background; one can assume that there might be certain dermatoglyphics findings specific to diabetic patients. In clinical medicine, the importance of dermatoglyphics is that it can help in predicting the phenotype of a possible future illness. Early identification of at-risk individuals using simple screening tools like dermatoglyphics, which is user friendly and economically viable, would greatly help in preventing the onset of diabetes and thus reducing the burden on the community and the nation as a whole. Hence, this study gives the positive correlation between diabetes mellitus and dermatoglyphics. This study will also help to inform policy makers for future design and implementation of policies for screening and prevent the delay of diagnosing diabetes mellitus. Finally, this study will contribute to the global on-going discussion on the use of dermatoglyphics pattern as an indicator for routine screening and diagnostic purpose of certain disease.

1.4. Literature review

Dermatoglyphics is the study of the epidermal ridge configuration on fingers of palms and soles. It represents the genetic makeup of an individual. The procedure of recording epidermal ridge configurations is simple, non-harm and inexpensive. Diabetes Mellitus is a disease with an established genetic background and hence it is safe to assume there might be significant dermatoglyphics findings in such cases. Various dermatoglyphics studies are carried out related to diseases like diabetes, hypertension, cancerous conditions of the breast, prostate, thyroid, and other structures. It is also studied in various infectious conditions like autoimmune conditions including psoriasis, hashimotos thyroiditis and rheumatoid arthritis (8,17,25). Once characteristics of dermatoglyphic findings of a particular disease are noted, they can be used as markers to predict the disease in general population and can be used as a screening tool (15).

Various studies have analyzed the finger print patterns between diabetics and non-diabetic subjects. In most studies the prevalence of the different types of the finger prints were more frequent for the loops followed by the whorls and then the arches. The prevalence of each of the different types of the ridges showed variations among different studies. The prevalence of loops was 59.23% for diabetics and 58.2% for non-diabetics as reported by Sharmila et al. (26), 56.6% in diabetics and 57.3% for non-diabetics subjects (27), 66.9% in diabetics and 64.5% for non-diabetics (28) and a study in Nigeria revealed that 61.15% of diabetics and 64.1% of non-diabetic subject had loop type patterns (29). A pattern of increased occurrence of loops was also seen in the diabetics as compared to the non-diabetics, by a study in West Uganda and Nigeria population although this was not statistically significant (24, 30).

Literatures reported that the prevalence of whorl pattern was 29.54% in diabetics and 29.1% for non-diabetic subjects (26), also increase the frequency of whorl pattern as compared to non-diabetics (27), Ataman et al. in Nigeria also revealed by his study for the non-diabetic group whorl type pattern was 23.2% and for diabetic subject whorl type pattern was 24.3% (30). As stated by Ronkey Bello et al. frequency of whorl type pattern was decreased in diabetics as compared to non-diabetic subject (29).

The other finger print pattern observed in this study was arch showed variation between diabetic and non-diabetic subjects as revealed by Sharmila et al. 11.23% for diabetic and 12.75% for non-diabetic subjects (26), 8.8% of diabetic and 12.3% non-diabetics was arch type pattern as Ataman et al. in Nigeria reported (28). Sudagar et al. also showed that decrease in the frequency of arch pattern as compared to non-diabetics but it was not statistically significant (27).

As Supraja Srivatsava et al. reported there was no significant difference between diabetic and non-diabetic subjects with respect to simian and sydney line (31). On the other hand, a study by Floris et al. revealed that simian and sydney line were higher in diabetic subjects than controls but no significance difference between groups (32). In another study, there was increase in simian and sydney line in patients with diabetes mellitus compared to controls and significant difference was observed in case of female diabetic patients in simian line but no significant difference was observed in case of either hand, combined or separate in both sexes in sydney line (33). A study done in Ethiopia by Mekbebe A. from relatively healthy subjects simian crease (6.3%) was most frequent followed by suwon (4.1%) and sydney (3.5%) from aberrant creases (34).

Dermatoglyphics and palmar creases have associated with sex, body side and symmetry between digits and palms. Different literatures revealed there were variations in dermatoglyphics and palmar creases in diabetics and non-diabetics with respect to sex, body side and symmetry between digits and palms. As Sharmila et al. report loop type pattern was more common among male in both diabetic and non-diabetic subjects (26). The same with Sharmila et al. a study in Nigeria by Atman et al. also revealed loop pattern was common in diabetics (68.6%) and non-diabetics (64.4%) male than female diabetic (65.2%) and non-diabetic subjects (64%) (28). In another study in Nigeria by Ronkey Bello et al. the prevalence of loop pattern was higher in diabetic female (29).

As literature reported that the prevalence of whorl pattern was more common in female diabetics (33.6%) and non-diabetics (32.6%) than male diabetics (25.45%) and non-diabetics (25.6%) (26). Study in Nigeria also reports that whorl pattern was more common in diabetics female than male diabetics group (28). A pattern of increased occurrence of the arch was seen in the diabetics and non-diabetics females as compared to male subjects (28, 29).

The fingerprint pattern distribution of diabetics and non-diabetic group showed variations between right and left hand digits. The distribution of loop pattern was 66.8% of diabetics and 62.8% of non-diabetics on right digits whereas 70.4% of diabetics and 67.2% of non-diabetic subjects showed loop pattern on left digits (28). 64.40% of diabetics and 61.9% of non-diabetics subject showed loop pattern on right digits whereas 63.5% diabetics and 60.4% in non-diabetic subjects showed loop on the left digits (29). A study in Western Uganda population on variations in dermatoglyphics patterns showed differences of pattern distribution between right and left digits of study participants (35).

Researchers showed that whorl pattern also vary in body side as Atman et al. in Nigeria stated that for right-hand digits 26.8% of diabetic and 27.2% non-diabetics was whorl pattern, whereas, in left-hand 21.20% and 21.20% for diabetics and non-diabetics groups respectively (28). In right hand 26.5% of non-diabetic and 25.8% of diabetic while for left hand 24.6% for non-diabetic and 23.7% for diabetic was whorl patterns (29).

The distribution of arch was reported to show variations between right and left hands as Atman et.al. stated also showed variations; on right hand 10.00% of non-diabetics and 6.40% of diabetics was arch, whereas, on left hand 11.60% in control and 8.40% in diabetics were arches (28). Similar study also report variations of arch pattern distribution between right and left hand digits (29, 35). A study done in Russia revealed that asymmetric distribution of patterns were higher in diabetic subjects than non-diabetic study participants (36).

1.5. Justification of the study

Dermatoglyphics and their components are genetically determined and the arrangement of ridges remains constant throughout life. As a result, the peculiar patterns of the epidermal ridges serve as a diagnostic tool in a number of diseases that have a strong hereditary background. Diabetes mellitus is one of such diseases with a strong genetic basis and certain dermatoglyphics variations are expected in DM. Hence, dermatoglyphics variation could be an essential investigation for its early diagnosis. Dermatoglyphics patterns in diabetic patient are not studied in Ethiopia. Research on dermatoglyphics pattern in diabetes mellitus patient and information are necessary to develop programs to reduce the incidence of diabetes mellitus and to give care for their impacts. To this effect, it is important to conduct a study which investigates if the state of dermatoglyphics pattern varies between diabetic and non-diabetic patient.

2. Objectives

2.1. General objective

To determine prevalence of dermatoglyphics patterns and palmar creases of hands among diabetic and non-diabetic patients at governmental hospitals, East Gojjam zone, 2019

2.2. Specific objectives

To determine prevalence of dermatoglyphics pattern of diabetics and non-diabetic subjects.

To assess palmar crease prevalence of diabetic and non-diabetic group.

To investigate associated factors of dermatoglyphics patterns and palmar creases.

3. Methods and materials

3.1. Study design and period

An institution based cross-sectional study was conducted from May to August 2019.

3.2. Study area

The study was conducted in East Gojjam zone governmental hospitals. East Gojjam (or "Misraq Gojjam") with capital of Debre Markos is a zone in the region of Amhara. East Gojjam is bordered on the south by the Oromia region, on the west by West Gojjam, on the north by South Gondar, and on the east by South Wollo; the bend of the Abay River defines the zone's northern, eastern and southern boundaries. Based on the 2007 census conducted by the central statistical agency of Ethiopia, this zone has a total population of 2,153,937 with an area of 14,004.47 square kilometers. The largest ethnic group reported in East Gojjam was Amhara (99.82%); all other ethnic groups made up 0.12% of the population. Amharic is spoken as a first language by 99.81%; the remaining 0.19% spoke all other primary languages reported. 97.42% of the population said they practiced Ethiopian Orthodox Christianity, and 2.49% were Muslim.

3.3. Population

3.3.1. Source population

All patients who visit governmental hospital of East Gojjam zone during study period.

3.3.2. Study population

Patients who visit outpatient and/or inpatient department of the selected hospitals.

3.4. Inclusion and exclusion criteria

3.4.1. Inclusion criteria for diabetic group

1. Individual with no hand deformity
2. Individual with high blood sugar level
3. Known diabetics on medication even with normal blood sugar values
4. Diabetic patient without any known genetically related disorder.

3.4.2. Inclusion criteria for non-diabetic group

1. Individual with no hand deformity
2. Normal blood sugar levels
3. No family history of diabetes mellitus
4. Individual with no known other genetically related diseases

3.4.3. Exclusion criteria

1. Individual with known genetically related disease other than diabetes mellitus
2. Individual with deformed hand
3. Individual with injured hand
4. Non-genetic related diabetes mellitus

3.5. Sample size determination and sampling procedure

3.5.1. Sample size determination

The sample size to determine the prevalence of palmar crease and digital dermatoglyphics pattern configuration was calculated by population proportion formula for diabetics and non-diabetics population i.e.

$$n = (Z_{\alpha/2})^2 pq \div d^2$$

Where, n = the required sample size for the study

d = margin of tolerable sampling error commonly used 0.05

Z = confidence interval, the most common one is 1.96 for 95%

p = proportion of prevalence of palmar crease and dermatoglyphics pattern of hand in diabetics is = 50%

$$q = 1-p \text{ which is } 1 - 0.5 = 0.5$$

$$n = \frac{(1.96)^2(0.5 \times 0.5)}{(0.05)^2} = 384$$

By assuming 10%, non-response rate the final sample size will be 422.

Therefore 422 diabetic patients and 422 non-diabetic volunteers are involved in the study.

3.5.2. Sampling procedure

From ten hospitals in East Gojjam zone three hospitals were selected as a study area by lottery method. Subjects who are diabetics and non-diabetic group were selected from patients who visit Debre Markos referral, Motta hospital and Bechena hospital for follow-up and /or admitted patient from May to August. Systematic random sampling with sampling interval of three (1266/422) was used to collect the determined sample. The calculated sample size was collected proportionally from selected three hospitals for diabetic and non-diabetic subjects. Non-diabetic subject also collected proportionally from admitted patients of three hospitals.

Table 1. Sample size distribution of diabetic patients in selected hospitals.

Hospitals	No. of diabetic patients	No. of samples per hospitals
Debre markos referral hospital	579	193
Shegaw Motta primary hospital	429	143
Bechena primary hospital	258	86
Total	1266	422

3.6. Study variables

3.6.1. Dependent variable

Palmar crease and dermatoglyphic patterns

3.6.2. Independent variables

Sex, Body side, DM, Symmetryness

3.7. Operational definitions

DM; Symptoms (polyphagia, polydipsia, polyuria) of diabetes plus Random blood glucose concentration ≥ 200 mg/dl (Random is defined as without regard to time since the last meal.) Or Fasting plasma glucose ≥ 126 mg/dl (Fasting is defined as no caloric intake for at least 8 h) Or Two-hour plasma glucose ≥ 200 mg/dl (The test should be performed using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water) (13) .

A normal human palm contains three major creases. The radial or longitudinal crease begins at or slightly below the proximal transverse crease at the radial border of the palm (11). The proximal transverse crease begins at the radial side of the palm curves proximally and ends at the medial border of the hypothenar area. The distal horizontal crease is found closest to the fingers, beginning at the interdigital space between the second and third fingers, curving gently wrist ward toward the ulnar side of the palm (11).

Core; is the approximate center of the pattern.

Body Sides -the palm/digit, which found on the ipsilateral right or left the side of the body

Symmetry-the occurrences of specific creases or pattern type on both palms or digits.

Asymmetry –the presence of specific type of crease or pattern type on one palm or digits.

3.8. Data collection procedures

Diabetic and non-diabetic groups were asked all the necessary information by face-to-face interview method, then, the palms and digits were cleansed by hand wash with soap. After cleansed dry by cotton cloth, and were taken a picture by mobile camera of bilateral palms and digits of hand of the volunteers by trained nurse and laboratory professionals. Socio-demographic characteristics (age and sex) data of patients were collected from volunteers. The adapted questionnaires were used to collect information where data collector interviewed subjects. The questionnaire was first be prepared in English and translated to Amharic and back to English to keep its consistency.

3.9. Data processing and analysis

The collected data were checked for completeness and clarity before entered in to software. Epi Info software version 3.01 was used and exported to SPSS version 20 Software to clean edit and analyze. The cleaned data was statistically analyzed by using the chi square test for determine the frequency and variables that were valid for assumption of chi square test were analyzed using bivariable and multivariable multinomial logistic regression to investigate the association between factors and outcome variables. The association and strength between outcome and independent variable was present by adjusted odds ratio with 95% confidence interval. A p-value was computed by using chi square test and less than 0.05 was considered as significant. The result was presented in the form of tables, figures and text using frequencies and summary statistics such as percentage to describe the study population in relation to relevant variable.

3.10. Data quality control mechanisms

The data quality aspect was done in the whole data collection process. This was made by possible intensive training of the data collectors with giving emphasis on data quality. Close supervision of these data collectors was lead to the use of appropriate interviewing techniques. The data was also checked as soon as it is collected to ensure that all the information is properly collected and recorded. The principal investigator of the study was control the overall activity. Data quality was assured through designing a proper data collection material and through continuous supervision. All completed data collection form was examined for completeness and consistency during data management, storage and analysis. The entered data was cleaned by investigators before analysis.

3.11. Ethical consideration

Ethical approval for this study was obtained from the Department Research Ethics Review Committee, before the start of the study. A formal supporting letter was obtained to hospitals from department. After getting consent from hospitals, the objectives of this study were explained to the study participant's, those willing to participate in the study were included and their consent was obtained. Participation in the study was voluntary and refusal was possible. The study was not involve harmful procedure. To ensure confidentiality of data, study subjects were identified using codes and unauthorized persons were no access to the collected data.

3.12. Dissemination of results

The final report of the study was disseminated to Addis Ababa University, College of Health Science, School of Medicine department of Anatomy, hospitals and to all relevant institutions and health department. The finding of this study was finally disseminated through publication for the scientific community, presentation on annual scientific meetings and conferences.

4. Result

4.1. Socio demographic characteristics of study participants

In present study, a total of 800 subjects were enrolled; of these 400 were non-diabetics and 400 were diabetics subjects; out of which, maximum number 267(66.8%) of diabetic patients were male and 133(33.2%) were female. Among non-diabetics maximum number 225(56.2%) were male, 175(43.8%) were female. The age range of diabetics group was from 10-75 years and non-diabetics group belongs to 10 -80 years.

4.2. Prevalence of digital dermatoglyphics patterns

Among the total of 8000 digits analyzed for distribution of digital dermatoglyphic patterns four thousand for each of diabetics and non-diabetic subjects, the loop type was most frequent, followed by whole and arches. The respective values of these were (66.9%) [95% CI: 65.4, 68.3], (28.4%) [95%CI: 27, 29.8], and (5.1% [95% CI: 4.1, 5.4]) for the diabetics, as compared to (63.4% [95% CI: 61.9, 64.8]), (32% [95%CI: 30.5, 33.4]), and (4.7% [95% CI: 4.0, 5.3]) non-diabetic subjects.

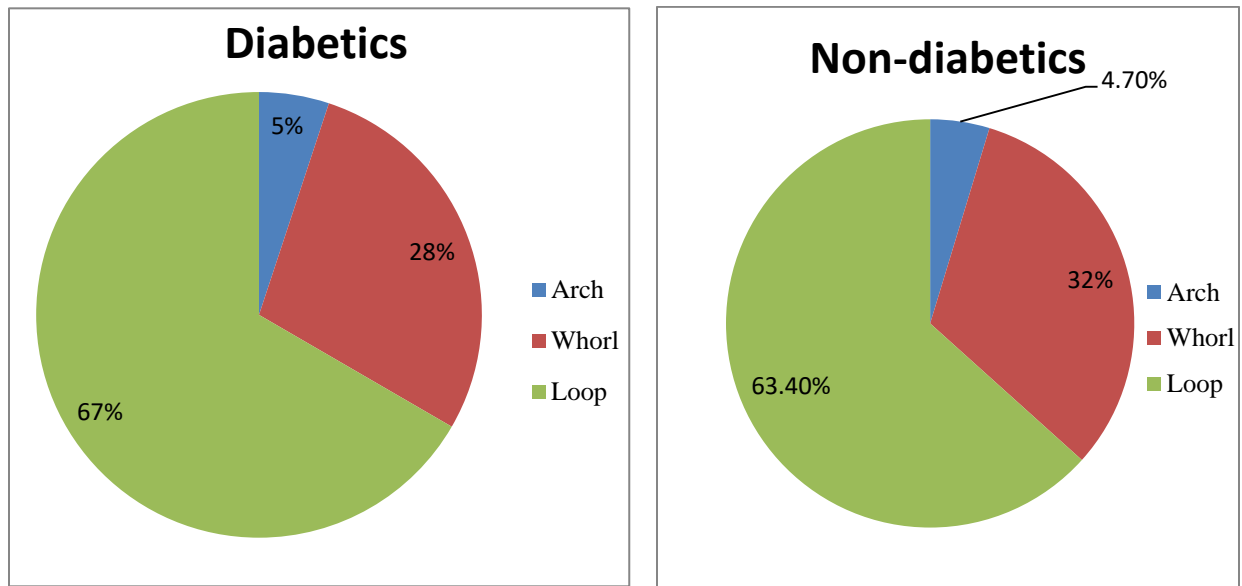


Figure1. Frequency distribution of digital dermatoglyphics pattern among diabetic and non-diabetic patients in East Gojjam zone governmental hospitals, North West Ethiopia, 2019

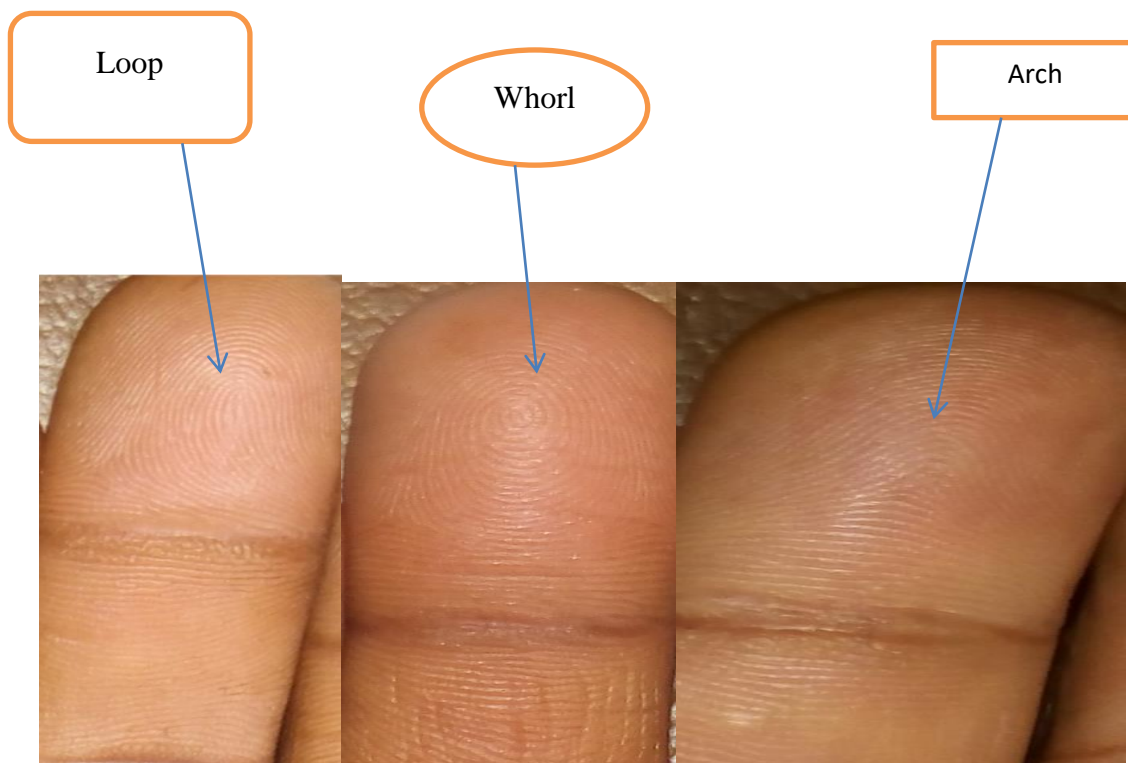


Figure 2. Types of dermatoglyphic patterns among diabetic and non-diabetic patients of East Gojjam zone governmental hospitals, North West Ethiopia, 2019

4.3. Factors associated with digital dermatoglyphics patterns

All independent variables of the study such as sex, body side, and symmetryness fulfill the assumption of chi square test. As shown in Table 1 and 2 in male finger print patterns in diabetics and non-diabetics were, 68.12% and 63.07% loop, 28.01% and 32.44% whorl, and 3.85% and 4.49% arch, respectively. On the other hand, in females the values for diabetics and non-diabetics were, 64.36% and 63.83% loops, 29.17% and 31.31% whorl, 6.46% and 4.86% arch, respectively. The distribution of arch pattern was insignificantly lower in diabetic group in male but higher in female compared to non-diabetic group. The loop was though predominant in diabetic patients of both sex but significant difference was found only in male compared to non-diabetic subjects. Distribution of whorl pattern was significantly lower in male diabetic group as compared to non-diabetic subjects.

A total of 8000 finger print patterns on the right and left hand of study group were assessed. As shown in table 1 and 2 below right hand finger print patterns in diabetics and non-diabetics were; loop 67.15% and 64.4 %, whorl 28.6% and 32.55% and arch 4.25 and 3.05% respectively. On the left hand the results were; 66.6% and 62.4% loop, 28.2% and 31.35% whorl, 5.2% and 6.25% arch types respectively in diabetic and non-diabetics groups. The findings revealed that the distribution of arch pattern was significantly higher in right hand of the diabetics compared to non-diabetic group and lower in left hand. The loop pattern was though predominant in both hands of the diabetics compared to non-diabetic group, but it was significant only in left hands of the subjects. There was lower and significant difference in distribution of whorl pattern in both hands of the diabetic group as compared to non-diabetic subjects.

A total of 8000 finger print patterns were assessed for symmetry between right and left digits for diabetic and non-diabetic subjects and the following results were found: from diabetics study participants who had symmetrical pattern distribution 75.43% was loop pattern, 21.25% was whorl pattern and 3.3% was arch patterns. On the other hand, subjects who had asymmetrical pattern distribution 57.16% were whorl, 32.41% were loop and 10.42% were arches. For non-diabetic study group who had symmetrical pattern distribution 52.79% were loops, 42.85% were whorl and 4.36% were arches, whereas, from those who had asymmetrical pattern distribution 70.98% were loops, 17.29% were whorls and 5.04% were arch type of patterns. The finding showed that symmetrical distribution of loop pattern was significantly higher in diabetics when compared to non-diabetic study subjects. However, symmetrical pattern distribution of whorls ($p>0.05$) and arches were lower ($P<0.05$) in diabetics than non-diabetics study subjects. Whereas study subjects who had asymmetrical distribution of loop was lower ($p<0.05$) and arch was, higher ($p<0.05$) in diabetics than non-diabetics study participants but asymmetrical distribution of whorl was higher ($p>0.05$) in diabetics individuals as compared to non-diabetics subjects.

Table 1. Prevalence and chi square test of factors associated with dermatoglyphics pattern among diabetes mellitus patient in East gojjam zone governmental hospitals, North West Ethiopia, 2019

Independent variables		Dermatoglyphics patterns					
		Arch =189		Loop=2670		Whorl=1136	
		No	%	No	%	No	%
Sex*	Male	103	3.85	1819	68.12	748	28.01
	Female	86	6.46	856	64.36	388	29.17
Body side	Right	85	4.25	1343	67.15	572	28.6
	Left	104	5.2	1332	66.6	564	28.2
Symmetries* z	Symmetry	106	3.3	2417	75.43	681	21.25
	Asymmetry	83	10.42	258	32.41	455	57.16

- *Indicates p value <0.05

Table 2 .The distribution and chi-square test of factors associated with dermatoglyphics pattern in non-diabetic subjects

Independent variables		Dermatoglyphics patterns					
		Arch=186		Loop=2536		Whorl=1278	
		No	%	No	%	No	%
Sex	Male	101	4.49	1419	63.07	730	32.44
	Female	85	4.86	1117	63.83	548	31.31
Body side*	Right	61	3.05	1288	64.4	651	32.55
	Left	125	6.25	1248	62.4	627	31.35
Symmetries*	Symmetry	100	4.36	1211	52.79	983	42.85
	Asymmetry	86	5.04	1325	70.98	295	17.29

- *Indicate p value <0.05

4.4. Prevalence of palmar creases among diabetic and non- diabetic patients

Among 800 palms of diabetic patients the frequency distribution of palmar crease showed that (98.6% [95% CI: 97.8, 99.4]) was normal palmar crease followed by simian (1% [95% CI: .4, 1.8]), sydney (0.25[95% CI: .0, 0.6]) and swuon (0.12 % [95% CI: .0, 0.4]). In non-diabetic patients, among 800 palms (98.4% [95% CI: 97.5, 99.3]) was normal followed by simian (0.8% [95% CI: 0.3, 1.2]), sydney (0.5% [95% CI: 0.1, 1.1]) and swuon (0.3% [95% CI: .0, 0.9]).

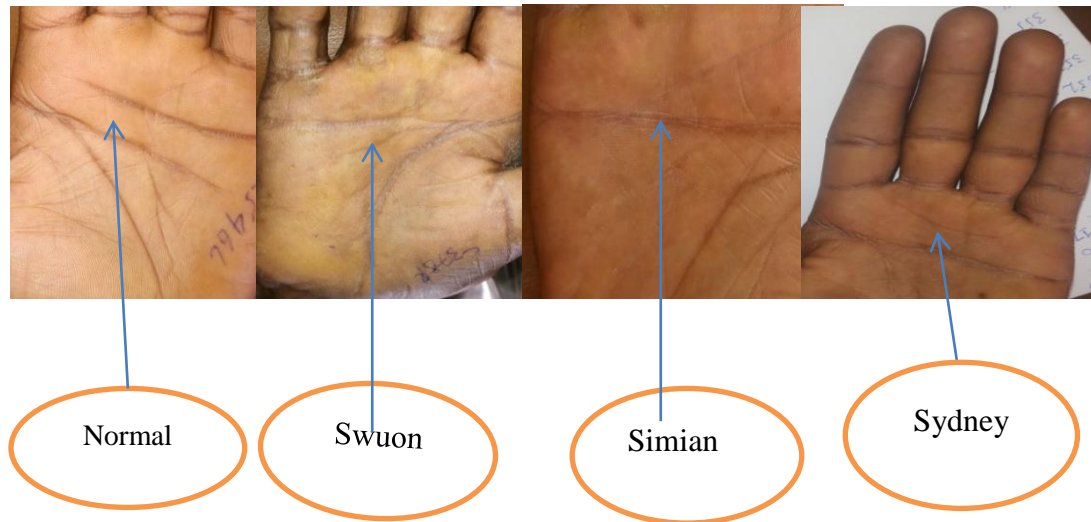


Figure 3. Types of palmar crease pattern among diabetic and non-diabetic patients of East Gojjam zone governmental hospital, North West Ethiopia, 2019

4.4.1. Factors associated with palmar creases among diabetes and non-diabetic subjects

Factors of palmar crease such as sex, body side and symmetry in both diabetics and non-diabetics group did not satisfy the assumption of chi square test.

Table 3. Frequency and associated factors of palmar crease in diabetic subjects

Independent Variables		Diabetics							
		Types of palmar creases							
		Normal		Simian		Sydney		Swuon	
		N	%	N	%	N	%	N	%
Sex	Male	527	98.68	5	0.93	1	0.18	1	0.18
	Female	262	98.49	3	1.12	1	0.37	0	0
Body side	Right	395	98.75	4	1	0	0	1	0.27
	Left	394	98.5	4	1	2	0.5	0	0
Symmetry	Symmetry	294	97.67	4	1.33	2	0.66	1	0.33
	Asymmetry	495	99.2	4	0.8	0	0	0	0

Table 4. Frequency and associated factors of palmar crease in non-diabetic subjects

Independent Variables		Non –diabetics							
		Palmar crease type							
		Normal		Simian		Sydney		Swuon	
		N	%	N	%	N	%	N	%
Sex	Male	440	97.7	6	1.33	2	0.44	2	0.44
	Female	347	99.14	0	0	2	0.57	1	0.28
Body side	Right	393	98.25	4	1	2	0.5	1	0.25
	Left	394	98.5	2	0.5	2	0.5	2	0.5
Symmetry	Symmetry	590	98	5	0.83	4	0.66	3	0.5
	Asymmetry	197	99.5	1	0.5	0	0	0	0

As shown in table 3 and 4 above among both diabetic and non-diabetic male and female subjects more than 97% of the palm creases were normal. Among the variant types, simian crease was the most frequent in all except, non-diabetic females where it was absent. In diabetic and non-diabetic males, swuon and sydney had same frequency distribution.

In the right side, shown in table 3 and 4 above the frequency distributions of palmar creases in both diabetics and non-diabetics, more than 98 % were normal. From the variant types, simian crease was most frequent followed by sydney and swuon with same frequency. Sydney crease was absent in diabetics group. On the other hand, in left hand normal crease had the same frequency (98.5%) in both diabetics and non-diabetics. In diabetics group from variant types simian was most frequent followed by sydney with no swuon crease type. In non-diabetics, variant creases had the same frequency.

From diabetics and non-diabetics study, participants who had symmetrical crease distribution most frequent was normal followed by simian, sydney and swuon crease types. On the other hand, subjects who had asymmetrical palmar crease distribution normal crease was the most frequent followed by simian.

4.5. Bivariable and multivariable multinomial logistic regression analysis of digital dermatoglyphics patterns

Variables including sex, body side, symmetry and diabetes mellitus fulfilled the assumption of chi-square test and were analyzed using bivariable multinomial logistic regression. All of these values showed that p value less than or equal to 0.2 in bivariable analysis and then taken to multivariable analysis. On multivariable analysis body side, sex, Symmetry and diabetes mellitus had statistically significant association with one or more types of digital dermatoglyphics patterns.

Being male was nearly 1.4 times likely to have loop type (AOR= 1.385 95%CI 1.120, 1.714) and whorl type (AOR=1.359 95%CI 1.090, 1.696) than arch type of dermatoglyphics patterns.

Right body side was nearly 1.6 times more likely to have loop type (AOR=1.570 95%CI 1.266, 1.947) and whorl type (AOR=1.586 95%CI 1.269, 1.982) than arch type dermatoglyphics pattern.

The odds of having asymmetrical patterns between digits of hands was 0.5 times likely to have loop (AOR=0.519 95% CI [0.416, 0.647]) and whorl (AOR =0.512 95% CI [.407, .645]) than arch pattern types.

Subjects who have no diabetes mellitus have 1.2 times more likely to have loop type (AOR=1.179 95%CI .946, 1.469) and 1.4 times more likely to have whorl type (AOR=1.398 95%CI 1.112, 1.757) than arch type dermatoglyphics patterns.

Table 5. Bivariable and multivariable analysis of multinomial logistic regression of associated factors with digital dermatoglyphics pattern

Outcomes		Explanatory variables	COR[95%CI]	AOR [95% CI]	p-value	
Loop	Sex	Male	1.376[1.114, 1.698]	1.385[1.120, 1.714]	0.0*	
		Female				
	Body side	Right	1.59[1.291, 1.982]	1.570[1.266, 1.947]	.000*	
		Left				
		Asymmetry	0.532[.431, 0.658]	0.519[0.416, 0.647]	.000*	
	Symmetry		Symmetry			
	DM	No DM	0.963[0.781, 1.188]	1.179[.946, 1.469]	.143	
DM		DM				
Whorls	Sex	Male	1.324[1.063, 1.648]	1.359[1.090, 1.696]	.007*	
		Female				
	Body side	Right	1.611[1.289, 2.012]	1.586[1.269, 1.982]	.000*	
		Left				
		Asymmetry	.549[.440, .685]	.512[.407, .645]	.000*	
	Symmetry		Symmetry			
	DM	NO DM	1.143[0.920, 1.421]	1.398[1.112, 1.757]	0.04*	
DM		DM				

* Indicates p value < 0.05

5. Discussion

Dermatoglyphics is the study of the epidermal ridge configuration on fingers and toes of palms and soles. It represents the genetic makeup of an individual and is easily recordable. The procedure of recording epidermal ridge configurations is simple, non-invasive and inexpensive. Diabetes Mellitus is a disease with an established genetic background and hence there might be significant dermatoglyphics findings in such cases. For this reason, various dermatoglyphics studies are carried out related to diseases like diabetes, hypertension, cancerous conditions of the breast, prostate, thyroid and other structures, infectious conditions like autoimmune conditions including psoriasis, hashimotos thyroiditis and rheumatoid arthritis (8, 17, 25). Once characteristic dermatoglyphics findings of particular diseases are noted, they can be used as markers to predict the disease in general population and can be used as a screening tool.

The findings from this study showed that the distribution of the finger print patterns is in line with other studies with the order of occurrence mostly loop, followed by whole and arches types in both diabetic and non-diabetic subjects, as well as gender. When the pattern type was analyzed between diabetic and non-diabetic subjects, loop pattern was significantly higher in the diabetics (66.9% [95% CI: 65.4, 68.3]) as compared to the non-diabetic group (63.4% [95% CI: 61.9, 64.8]). Such finding of a higher loop pattern was consistent with a study by Ataman et al. (28) Sharmila et al. (26), Sudagar et al. (27) and Eberechi et al. (24). On the other hand study by Ronkey Bello et al. (29) and Marera et al. (35), had reported that non-diabetic group had higher loop pattern than diabetic groups.

The result from the current study revealed that the frequency of whorl pattern in diabetics (28.4% [95%CI: 27, 29.8]) was significantly lower than non-diabetics groups (32% [95%CI: 30.5, 33.4]). This study was similar with study by Sudagar et al. (27), Eberechi et al. (24), Ronkey Bello et al. (29) and Marera et al. (35). On the other hand study by Sharmila et al. (26) and Ataman et al. (28) reported that diabetic group had higher whorl type pattern than non-diabetic group.

In this study, the prevalence of arch type pattern in diabetic group was insignificantly (5.1% [95% CI: 4.1, 5.4]) higher than non-diabetic group (4.7% [95% CI: 4.0, 5.3]). This is in agreement with studies by Sudagar et al. (27), Dike Eberechi et al. (24), Ronke Bello et al. (29)

and Marera et al. (35). However, Sharmila et al. (26) and Ataman et al. (28) have reported that diabetic group had lower arch type pattern than non-diabetic groups.

This discrepancy can be explained by ethno-historic and geographic variations between different human populations. Dermatoglyphics polymorphism results from the co-operation of genetic, ethno-historic and environmental factors. This may explain the lack of homogeneity observed between various studies (37, 38).

Regarding the sex distribution of fingerprint patterns, the occurrence of loop type, respectively in diabetics and non-diabetic groups occurred as 1819 (68.12%) and 1419 (63.06%) in males, and 856 (64.36%) and 1117 (63.82%) in females. Such findings are consistent with the study of Ataman et al. (28) and that of Sharmila et al. (26) in both sex. They also go along with study also similar with a study carried out by Sudagar et al. (27) and Marera et al. (35) in males. On the other hand Ronkey Bello et al. (29) in both sex, Sharma et al. (30) in male, Sudagar et al. (27) and Marera et al. (35) in female subject have reported that non-diabetic groups had higher loop pattern than diabetic groups.

In this study the prevalence of whorl type, respectively in diabetic and non-diabetics were 748 (28.01%) and 730 (32.44%) in the males, and 388 (29.17%) and 548 (31.31%) in the females. This are comparable with studies done by Ataman et al. (28), Sharmila et al. (26), Sudagar et al. (27) and Ronkey Bello et al. (29) in both sex. As Marera et al. in females reported that diabetic group had higher whorl pattern than non-diabetic subjects (35). Sharma et al. (30) had reported that male diabetic had higher whorl patterns.

In the current study, the prevalence of arch type respectively in diabetic and non-diabetics were 3.85% and 4.48% in males and 6.46% and 4.85% in females. This study was similar with Sudagar et al. (27) in both sex and Ataman et al. (28) in male and Marera et al. (35) in females. However, the study done by Sharmila et al. (26), Ronkey Bello et al. (29) Marera et al. (35) and Sharma et al. (30) in male had reported that diabetic group had higher arch distribution than non-diabetic study subjects.

A total of 8000 finger print patterns on the right and left hand of study groups were analyzed. From right hand the following result were found: loop 67.15% in diabetic and 64.4 % in non-diabetic group. This result was consistent with Ataman et al. (28). However, the study by

Ronkey Bello et al. reported that loop pattern was higher in non-diabetics than diabetics (29). Whorl was 28.6% in diabetic and 32.55% in non-diabetic groups, which is in line with the study done by Ataman et al. (28) and Ronkey Bello et al. (29).

In addition, arch was 4.25% in diabetics and 3.05% non-diabetic group. This is comparable with a study done in Nigeria by Ronkey Bello et al. (29). However study by Ataman et al. reported that arch was higher in non-diabetic than diabetics subject in the right hand (28).

On the left hand in present study, the occurrence of loop type was 66.6% in diabetic and 62.4% in non-diabetic groups. This finding was similar with Ataman et al. (28), although Ronkey Bello et al. observed that non-diabetic subjects had higher distribution of loop pattern on the left hand (29). The occurrence of whorl type was 28.2% and 31.35% in diabetics and non-diabetic group respectively. The result revealed that whorl type was higher in non-diabetic than diabetics group. These findings go along with the studies done by Ataman et al. (28) and Ronkey Bello et al. (29). Arch type pattern (5.2% and 6.25%) was lower in diabetic than non-diabetic group. Again, this finding was similar with Ataman et al. (28). On the other hand, a study by Ronkey Bello et al. had reported that diabetics subjects had higher arch as compared to non-diabetics study subjects (29).

In the current study the prevalence of palmar creases among diabetic and non-diabetics subject were respectively, 98.6% and 98.4% normal followed by 1% and 0.8% simian, 0.3% and 0.5% sydney, and 0.1% and 0.3% swuon. This study revealed that aberrant crease (simian) was a bit higher in diabetic subjects when compared to non-diabetics. This was similar with studies done in India by Supraja Srivatsava et al. (31) and Floris, et al. (32). This study also found that the occurrence of aberrant crease patterns were lower than a study done in Ethiopia from relatively healthy individual by Afework (34). In the current study most subjects had symmetrical digital dermatoglyphics pattern in diabetics patient unlike a study done in Russia who reported that most of the diabetic subject had asymmetrical dermatoglyphics patterns (36).

Dar et al have earlier submitted that race, sex, study designs and inadequate sample size are factors that influence the expression of palmar crease patterns. Hence such lack of homogeny is not unusual, accentuate the importance of undertaking parallel study on every human population where possible (37).

5.1. Limitation

The current study depends on hospital patients who live in the same geographical area and same ethnicity. Consequently, population from different ethnicity and relatively healthier individual were not included.

6. Conclusion

The study showed loop and arch patterns were more frequent in diabetics compared to non-diabetics subjects, while whorl pattern was lower in diabetics compared to non-diabetic subjects. The finding in the palm also showed that normal crease was most frequent from all creases. However, simian was a bit frequent among variant creases. There were significant difference in the distribution of fingerprint patterns between the diabetics and the non-diabetic subjects. Additionally, there was significant association with symmetry, sex and body side in the pattern of fingerprint distribution between the diabetics and non-diabetic subjects. Thus, the inference from the study is that fingerprint may be a definitive predictive tool for diabetes mellitus.

7. Recommendations

Based on the findings of this study, it is recommended that community-based study including all ethnic groups of Ethiopia with a large sample size should be conducted. Researcher should conduct research by doing predictive model to screen gene related diseases. A case-control study should also need to assess gene related diseases and syndromes as well as gestational exposure status, which may have an association with them. Researchers should also conduct researches by delineating types of diabetes mellitus and study them separately.

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9. Annex 1 Informed consent

Dear respondents!

My name is.....I am here as a data collector participate in Yihun Tefera doing master of science in anatomy at Addis Ababa university. In order to get information about prevalence of palmar crease and digital pattern among diabetic and non-diabetic patients, we are conducting a research in this hospital. This research approved and reviewed by Department Research Ethics Review Committee. I assure you that all your response will be completely confidential and none of your response will be report separately to anybody. Remember your name is not record and no one will be able to find out who fill this questioner and your palmar and digital print. It is your full right to participate or refuse in the study. You do not have to answer any question that you do not want to answer and you may end this interview at any time without any punishment and benefit loss. There are no risks associated with participation in this study. There is no incentive to be given being participated in the study. We would greatly appreciate your help in responding to this survey. If you need clarification, you can ask the facilitator.

Please give only what you are asked to answer for each question by writing or encircling the letter.

Are you willing to participate in this study?

Yes-----, no-----

Thank you for your participation!

10. Annex 2 Questionnaire

Part I: questions on socio demographic characteristics of students.

S.No. Questions Response

Q001 Sex A Male B Female

Q002 How old are you? I am..... year old

Q003 What is your ethnicity? A. Amhara B Oromo C Tigre D Guragie E Other(specify)

Body side; Right palm

- Types of palmar crease of right hand ...? A normal B simian C Sydney D swuon

Body side; Left palm

- Types of palmar crease of left hand?
A normal B simian C Sydney D swuon

Finger print pattern

Right digit

- Circle pattern type and corresponding sub type

Digit 1: A) Arch : 1 simple 2 tented

B) Loop : 1 ulnar 2 radial

C) Whorls : 1 simple 2 spiral 3 central pocket 4 accidental

Digit 2: A) Arch : 1 -simple 2- tented

B) Loop: 1 -ulnar 2- radial

C) Whorls: 1 -simple 2 –spiral 3 central pocket 4 accidental

Digit 3: A) Arch : 1 -simple 2- tented

B) Loop : 1 -ulnar 2 –radial

C) Whorls : 1- simple 2 –spiral 3 central pocket 4 accidental

- Digit 4: A) Arch: 1- simple 2- tented
B) Loop : 1- ulnar 2- radial
C) Whorls: 1 -simple 2- spiral 3 central pocket 4 accidental
- Digit 5: A) Arch : 1- simple 2- tented
B) Loop : 1- ulnar 2- radial
C) Whorls: 1- simple 2- spiral 3 central pocket 4 accidental

Finger print pattern

Left digit

- Circle palmar pattern type and corresponding sub type

Digit 1: A) Arch 1 simple 2 tented

B) Loop ; 1 ulnar 2 radial

C) Whorls; 1 simple 2 spiral 3 central pocket 4 accidental

Digit 2: A) Arch ; 1 simple 2 tented

B) Loop; 1 ulnar 2 radial

C) Whorls; 1 simple 2 spiral 3 central pocket 4 accidental

Digit 3: A) Arch ; 1 simple 2 tented

B) Loop ; 1 ulnar 2 radial

C) Whorls ; 1 simple 2 spiral 3 central pocket 4 accidental

Digit 4: A) Arch ; 1 simple 2 tented

B) Loop ; 1 ulnar 2 radial

C) Whorls ; 1 simple 2 spiral 3 central pocket 4 accidental

Digit 5: A) Arch ; 1 simple 2 tented

B) Loop ; 1 ulnar 2 radial

C) Whorls ; 1 simple 2 spiral 3 central pocket 4 accidental

