DERMATOGLYPHICS: A COMPARATIVE CASE STUDY IN PATIENTS WITH DIABETES, HYPERTENSION AND HYPERCHOLESTEROLEMIA

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Abstract

Dermatoglyphics is the art and science of the study of surface markings and patterns of ridges on the skin of the fingers, palm, toes and soles. Dermatoglyphics patterns are unique for a given individual and it depends on the genetic makeup of an individual, hence can be used as a tool for investigations into disease conditions with a suspected genetic basis. The aim of the present study was to evaluate the dermatoglyphic features and the specific variations which were to be used as diagnostic tools for an economic and early detection of diabetes, hypertension and hypercholesterolemia conditions. The present study was conducted on 200 patients each (50) with confirmed diagnosis of Diabetes Mellitus (DM), Hypertension (HBP) and Hypercholesterolemia (HCL) and combination cases of DM, HBP and HCL who visited as outpatient in the Welcare hospital Palakkad near Mercy College. 50 subjects were taken as controls and it was seen that they do not suffer from any relevant disease and are not on any relevant medication randomly selected from the population of Palakkad region. Hypertensive (HBP) patients of this study group exhibited highest TFRC values in female (146±16.4), highest a-b ridge count in males(31.52±4.3) and highest atd angle (67.8±9.2) than control and other affected population. Ulnar loop (3.56) pattern was dominant in DM patients' but whorl pattern in HBP (2.32) and HCL(2.1) patients. The patients with DM, HBP & HCL ulnar loop dominates (2. 37) but almost same whorl pattern was noticed and no radial loop. No significant variation was found in the PII Value between male and female controls as well as in DM, HBP patients. This study helped us to find out an association of palmar and digital dermatoglyphic parameters between diabetes, hypertension and hypercholesterolemia patients in comparison with controls. The study proves that there occurs pattern change in affected population. The existence of such relation might be important in the screening program for prevention of diseases like Diabetes, hypertension and hypercholesterolemia and cardiac complications arise due to this condition.

Keywords: Dermatoglyphics, Diabetes, hypertension, hypercholesterolemia

INTRODUCTION

Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand including fingers and plantar region of foot including toes. This study of papillary ridges of hands and feet started with the work of Purkinje (1823) [1]. Galton (1892) [2] explained the

hereditary aspect of finger print. Cumins and Midlo (1926) [3] coined the term dermatoglyphics. The dermatoglyphic traits are polygenically controlled and have less susceptibility for alteration than other single gene trait. [4] The epidermal ridges are formed between the 11th and 24th week of foetal development and remain unchanged throughout the life. [5] They can be used as indicators of genetic abnormalities. [6] These friction ridge formations which appear on the finger, palms of the hands and soles of the feet are formed by genetic regulation and control during early intrauterine life. Thus, fingerprints are unique to each person and they are not altered during life time due to disease, age or any other reason. Fingerprints are classified into three basic types: whorls, loops and arches. As genetic or chromosomal abnormalities might be reflected as alterations in dermal ridges, they can be used as an easily accessible tool in the study of genetically influenced diseases. Diabetics mellitus, hypertension and hypercholesterolemia are the three most common lifestyle diseases and its prevalence increase in Kerala. The type II Diabetes mellitus is heterogeneous disorder that results from an interaction between genetics and environmental factor. In many diabetic people, the genes are involved in controlling insulin secretion and action. Hypertension (HBP) is a long-term medical condition in which the blood pressure in the arteries is persistently elevated. Long-term high blood pressure is a major risk factor for coronary artery disease, stroke, heart failure, atrial fibrillation, peripheral arterial disease, vision loss, chronic kidney disease, and dementia. Studies shown that genetic factors play a major role in the pathogenesis of essential hypertension.[7] By analysing dermatoglyphics of normotensive individuals at an early age, we can try to identify particular patterns strongly associated with development of hypertension and thereby modify other risk factors at an earlier stage in these susceptible individuals. This can form a basis for primary prevention and control of hypertension. Fingerprint patterns can be reliably used to identify individuals likely at risk for hypertension, and accordingly, preventive measures can be targeted. [8]

Hypercholesterolemia is a condition in which LDL-cholesterol greater than 190 mg/dL or greater than 160 mg/dL with one major risk factor, or greater than 130 mg/dL with two cardiovascular risk factors. The commonest cause is polygenic hypercholesterolemia which results from an interaction of unidentified genetic factors compounded by a sedentary lifestyle and an increased intake of saturated and trans-fatty acids. Secondary causes include hypothyroidism, nephrotic syndrome, cholestasis, pregnancy, and certain drugs like cyclosporine, thiazide, and diuretics. The knowledge of dermatoglyphics can be globally utilized for the prevention and screening of major causes of mortality in the present-day scenario like coronary artery disease.

The aim of the present study is to evaluate the dermatoglyphic patterns in Diabetes mellitus (DM), Hypertension (HBP) and Hypercholesterolemia (HCL)and combination of DM, HBP and HCL patients who visited as outpatient unit in the Welcare hospital Palakkad near Mercy College.

MATERIALS AND METHODS

Source of data

The present case control study was conducted among the patients of Diabetes melletus, Hypertensive and Hypercholesterolemia and combination of DM, HBP and HCL patients attending the outpatient department of Welcare Hospital, Palakkad during a period of 6 months from January 2022 to June 2022.

Sampling procedure

Informed consent was taken from the subjects in a prescribed format after explaining the whole procedure and its outcome to the patient in his/her own vernacular language and stating that the prints will only be used for research purposes. The Indian Ink method [3] was used for taking impressions. Patients will be asked to wash their hands with soap and water. Prints of hands and 10 fingers were pressed upon stamp pad and impressed on a white duplicating paper. The prints are examined with the help of a magnifying lens.

Inclusion criteria

Clinically diagnosed cases of DM, HBP , HCL and combination cases DM,HBP and HCL were taken from the age group of 20 to 80 years.

Exclusion criteria

1. Any deformities of finger, palm and infected hand.
2. Chromosoaml abnormalities like klinefelter's syndrome, Turner's syndrome etc.
3. Deep burns of fingers and palms leading to scars.

Sample

For this study hand Prints of 200 patients (50 males and 50 females) diagnosed withDM, (50 males and 50 females) diagnosed with HBP, (50 males and 50 females) diagnosed withHCL and (50 males and 50 females) diagnosed with DM, HBP and HCL were taken from the age group of 20 to 80 years. Controls (50 males and 50 females) were randomly selected from the population of Palakkad region. The analysis include finger print pattern (whorls, loops and arches), Total finger ridge count (TFRC), a-b- ridge count, atd angle and percentage intensity index (PII).

Statistical analysis

In the study mean and Standard Deviation was calculated and for significant unpaired t-test was applied $p < 0.05$ was considered as significant.
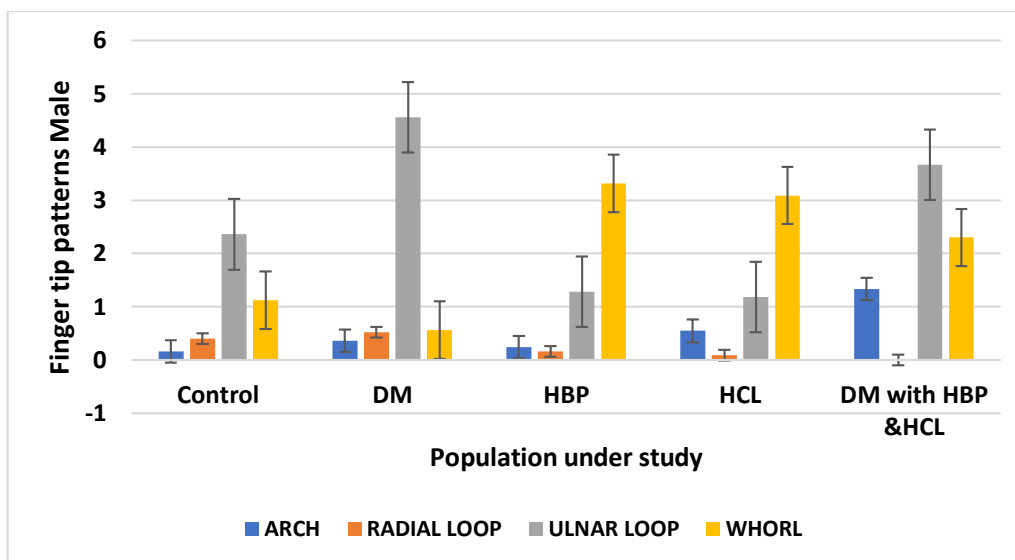
RESULT

Digital ridge patterns

The digital patterns like ulnar loop dominates in DM patients (4.56), whorls in HBP (3.32) and HCL (3.09) both ulnar loop (2.6) and whorl (2.3) in almost equal proportion among the patients with DM, HBP&HCL as compared to controls patients where ulnar loop dominates (2.36) (Table.1a& Fig.1a). No radial loop among the patients with DM, HBP&HCL.

Table. 1a. Fingertip patterns of male comparison of control and affected Population.

PARAMETERS	CONTROL	DM	HBP	HCL	DM, HBP&HCL
ARCH	0.16±0.005	0.36±0.01	0.24±0.02	0.54±0.03	1.33±0.05
RADIAL LOOP	0.4±0.07	0.52±0.03	0.16±0.006	0.09±0.04	0
ULNAR LOOP	2.36±0.9	4.56±0.8	1.28±0.05	1.18±0.5	2.6±0.8
WHORL	1.12±0.8	0.56±0.02	3.32±0.9	3.09±0.7	2.3±0.008

Fig.1a. Fingertip patterns of male control and affected population
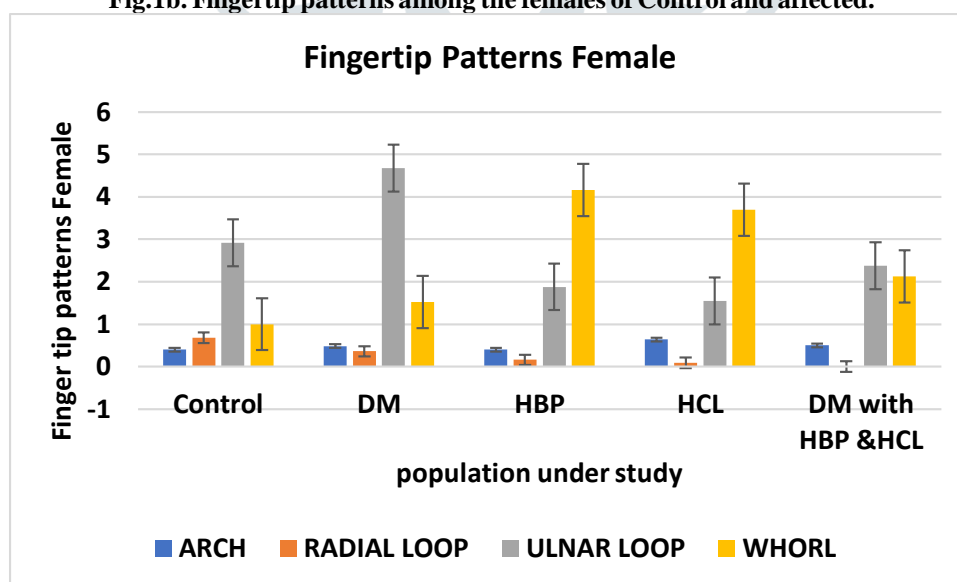

In female the digital patterns like ulnar loop dominates in DM patients (4.68) ,whorls in HBP (4.16) and HCL(3.7) both ulnar loop(2.37) and whorl(2.12) in almost equal proportion among the patients with DM, HBP&HCL and no radial loop as compared to controls patients where ulnar loop dominates(2.9)(Table.1b& Fig.1b).

Table.1b. Fingertip patterns among the females of Control and affected.

Parameters	Control	DM	HBP	HCL	DM, HBP&HCL
ARCH	0.4±0.1	0.48±0.002	0.4±0.01	0.63±0.01	0.5±0.053
RADIAL LOOP	0.68±0.05	0.36±0.01	0.16±0.02	0.09±0.03	0
ULNAR LOOP	2.92±0.4	4.68±0.03	1.88±0.2	1.5±0.5	2.375±0.3
WHORL	1.0±0.09	1.52±0. 6	4.16±0.7	3.7±0.8	2.125±0.6

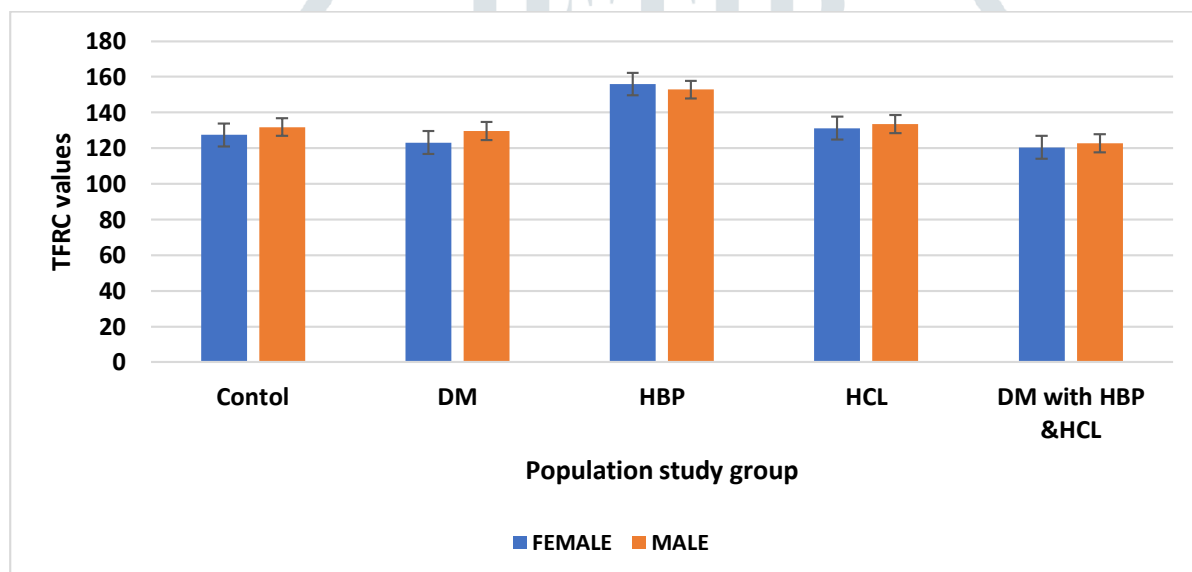**Fig.1b. Fingertip patterns among the females of Control and affected.**

TFRC values

TFRC values was found to be significantly higher in hypertensive patients (156.0 &152.8) than control (127.4&131.8). In DM and DM with HBP &HCL patients TFRC value was found to be lesser than control. In HCL the TFRC values slightly greater than control but lesser than HBP patients (Table .2 & Fig.2).

Table .2. TFRC values among the females and males affected population

PARAMETERS	FEMALE	MALE
Control	127.4±1.0	131.88±1.2
DM	123.16±2.3	129.64±2.1
HBP	156.0±3.2	152.84±2.2
HCL	131.27±5.7	133.455±2.5
DM with HBP &HCL	120.5±0.8	122.667±2.3

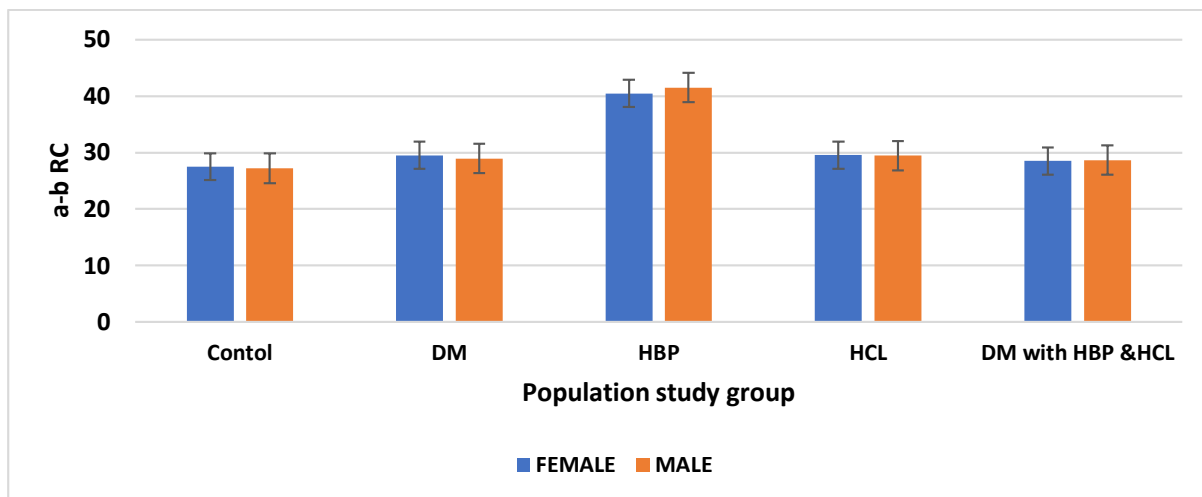**Fig.2. TFRC values among the females and males affected population**

a-b ridge count

Among the study groups a-b ridge count value was found to be significantly high in hypertensive population (40.48 and 41.52). No significant variation noticed in DM, HCL and in patients with DM with HBP &HCL compared to control (Table.3&Fig.3).

Table.3. a-b ridge count among affected and control population

PARAMETES	FEMALE	MALE
Control	27.48±6.1	27.2±4.1
DM	29.52±3.9	28.96±2.3
HBP	40.48±4.7	41.52±4.3
HCL	29.54±2.5	29.46±1.6
DM with HBP &HCL	28.5±4.2	28.66±1.6

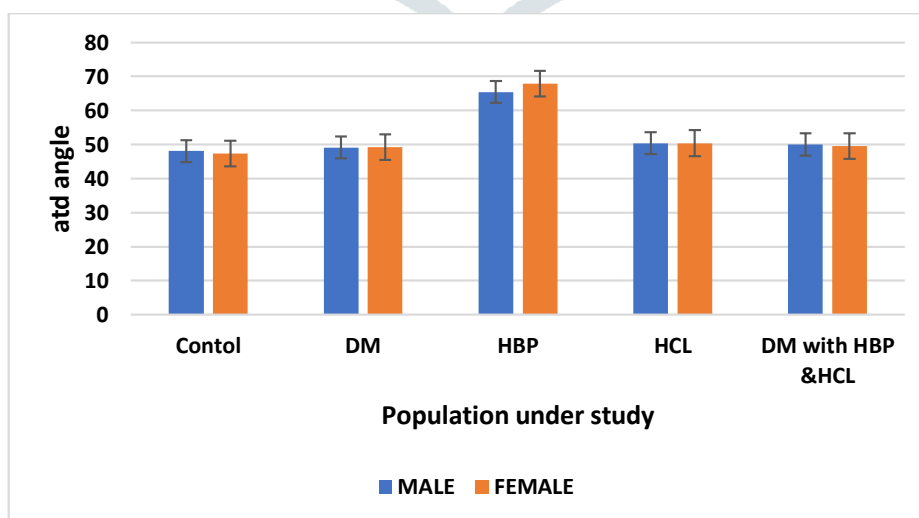**Fig.3. a-b ridge count among affected and control population**

atd angle

Significantly wider atd angle was noticed in hypertensive (67.88and 65.54), DM (49.28 and 49.12),HCL (50.48 and 50.36) and combination (50.0 and 49.5) patients than control (48.08 and 47.36). No significance difference between male and female (Table.4&Fig.4).

Table.4. Comparison of atd angle among females and males of Control and affected.

PARAMETERS	MALE	FEMALE
Control	48.08±1.8	47.36±2.9
DM	49.12±2.2	49.28±2.6
HBP	65.44±9.8	67.88±3.2
HCL	50.48.35±3.6	50.36±2.3
DM with HBP &HCL	50.0±3.6	49.5±2.1

$P < 0.05$

Fig.4. Distribution of atd angle among females and males of Control and affected.
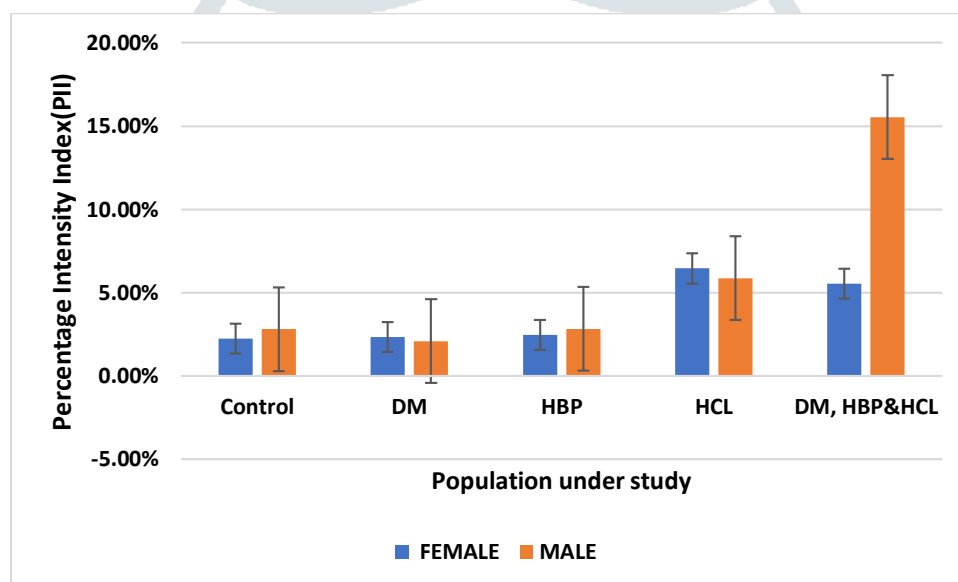
Percentage Intensity Index(PII)

Percentage intensity index was found to be significantly high in DM, HBP&HCL male patients(15.54%) and lesser in female but higher than control (5.54%). In HCL male and female also the value is higher than control (2.83% and 2.46%). No significant difference was noticed in other study groups like DM and HBP with the control population.

Table.5. Percentage Intensity Index distribution

PARAMETERS	FEMALE	MALE
Control	2.24%	2.80%
DM	2.34%	2.08%
HBP	2.46%	2.83%
HCL	6.45%	5.87%
DM, HBP&HCL	5.54%	15.54%

Fig.5.Distribution of percentage intensity index

DISCUSSION

Dermatoglyphics as a diagnostic tool is now well established in a number of diseases which have strong hereditary basis. The type of finger print is unique based on the genetic characteristics of each individual. In addition of predictive value of finger prints in various diseases dermatoglyphics is used in identification of an individual. Identification is a set of physical characteristics, functional or psychic, normal or pathological that defines an individual [9]. In the present study the digital patterns like ulnar loop dominates in DM patients (4.56), whorls in HBP (3.32) and HCL (3.09) both ulnar loop (2.6) and whorl (2.3) in almost equal proportion among the patients with DM, HBP&HCL as compared to controls patients where ulnar loop dominates (2.36). No radial loop among the patients with DM, HBP&HCL.

Kulkarni SKG et al [10] reported in their studies hypertensive females and males have high whorl and low ulnar loop in both hands and quantitative trait, the atd angle lowers in both hands of females and males, and both sexes have high TFRC in both hands.

Total finger ridge counts and absolute finger ridge counts showed no significant difference in Type 2 Diabetic Patients [11]. Diabetes mellitus (DM) is a complex metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both [12]. In recent years, Dermatoglyphics is claimed as a screening aid in patients with type 2 diabetes mellitus (T2DM) [13]. The recent evidences showed genetic factors in diabetes mellitus hence dermatoglyphics play essential role in early diagnosis [14].

In the present study, HCL patients reported increased percentage of whorl pattern. Rashad and MI (1975) [15] observed significantly higher frequency of whorls in myocardial infarction patients. Anderson MW et al (1981) [16] reported increase in the whorl pattern in MI but had not significantly differed from controls. Dhall et al (2000) [17] reported significant increase in the whorl pattern in MI when compared to controls. Jalali et al (2002) [18] also revealed slight increase in the frequency of whorls in MI. Hemlata Dhanraj (2010) [19] also found out that percentage of whorls is increased in all digits of CAD in both sexes.

On studying dermatoglyphic patterns in hypertensive cases and comparing the same with those of normotensive controls, of this study found that the mean "atd" angle was higher in female(67.88) and male (65.44) than control(47.36). This might also indicate a higher value of mean "atd" angle in an individual (67.88, Fig.4), with a higher likelihood of developing hypertension in future. Hemlata Dhanraj (2010) [19] noted increase in the mean value of atd angle in both sexes and in both hands as compared to controls with statistically significant increase in CAD males. The increase in the mean value of total finger ridge count (TFRC) in MI patients and the mean value of ab ridge count in MI is 39 and in controls it is 40 and there is no significant decrease in the mean value of ab ridge count in male patients of MI, but significant decrease is observed in female patients when compared to controls [20]. Increased 'atd' angle in our study coincide with the studies of Polat HM et al , Palyzova D et al and Pasha et al, [21,22,23].

In males the TFRC value (133.84±18.4) found to be higher in hypertensive patients (HBP) than others and control in the present study. Lowest TFRC value was found (122.6±21) in patients who suffer from DM with HBP & HCL. In hypertensive females TFRC values found to be higher (156±16.4) than control and other affected population. Low TFRC values of 120.5±10.4 noticed in patients who suffer from DM, HBP and HCL.

In type 1 DM there is increased frequency in whorls, and decreased ulnar loop, increased frequency of Sydney line, and increased incidences of arches in females.[24]In Maturity onset diabetes mellitus, there is decrease in mean value of TFRC, AFRC, increase in arches and decrease in whorls[25]. Correlation of dermatoglyphics pattern have been found to Alzhemeir's, Tuberculosis, Diabetes, Cancer, Heart disease [26]. There is increase in TFRC, decreased frequency of axial triradius 't' in right palm of females and 't and t' in right palm of male, decreased atd angle and absence of axial of triradii in 10% cases of essential hypertension [27]. Finger dermatoglyphics has been used as a genetic marker that contributes to the detection of sports talents and the establishment of predisposition to develop elevated BP in young athletes. [28]. Studies of Santhosh Kumar highlights the usefulness of dermatoglyphics as a diagnostic tool for many systemic conditions in the field of medicine especially dendistry[29].

Analysis of diseases those arises with aging like hypertension, type 2-diabetes and arthritis from a fingerprint by analyzing their patterns correlation with blood group and age of an individual was done.[30] According to the study by Verbov[31]female diabetics showed a decreased frequency of finger whorls and an increased frequency of arches, whereas male diabetics showed a high frequency of patterns in the fourth interdigital area. Taiwo et al[32] evaluated the association between dermatoglyphics and type 2 diabetes mellitus. Total finger ridge count (TFRC) was significantly higher in diabetic subjects than in non-diabetics and the dermatoglyphic patterns were associated with type-2 diabetes. In the study by Ravindranath et al [33] among diabetes mellitus patients, males exhibited increase in radial and ulnar loops and arches, decrease in whorls whereas females demonstrated increase in ulnar loops and decrease in whorls in the left hand. A study on Russian children with diabetes mellitus revealed pattern asymmetry, reduced incidence of loop patterns and increased incidence of double-delta patterns. Boys had increased frequency of arches, coils and decreased frequency of loops. Girls had no arches and decreased frequency of radial and ulnar loops[34]. According to the study by Zeigler et al[35] Type 1 diabetic patients showed a lower third finger ridge count, a-b ridge count, higher transversality of the main lines, higher frequency of palmar axial t' and t" tri-radii and a lower frequency of 'true' patterns in the fourth interdigital and thenar area. It was concluded that dermatoglyphics can be used as a screening tool for Type 1 diabetes. In another

study, patients with diabetes mellitus had frequent WD on the fingers and low pattern intensity. High TRC value was present in both girls and boyswith diabetes mellitus[36].

Patil et al [37] investigated the fingerprint patterns of patients with lifestyle-based diseases like hypertension, type2-diabetes and arthritis and found statistically significant difference in dermatoglyphic patterns of patients with systemic diseases when compared to the healthy controls. Chakravathy et al [38] found a significant increase in whorls, and increase in Mean "atd" angle in hypertensives when compared with their controls. Thus, it was stated that fingerprint patterns can be used to identify individuals at risk of developing hypertension and preventive measures can be initiated. In the study by Wijierathne et al [39], increased frequency of whorl patterns, and higher mean total ridge count was present in hypertensive patients than the control group. In the study by Brijendra et al [40], there was increase in whorls with decrease in loop pattern, difference in the mean total finger ridge count (TFRC), widened mean atd angle, and higher mean ab, mean bc ridge, mean cd ridge, mean ad ridge counts in the various type of congenital cardiac disease patients as compared to that of controls. Ahuja et al [41] in their study reported that there was a considerable decrease in the t-d ridge count in all the categories of congenital heart disease studied, showing a distal displacement of the axial triradius to the t' position.

All the authors stated that dermatoglyphics can be used for early identification of risk group individuals for surveillance purposes. It is important that methods to be developed to identify the person who are either at risk or already have a given illness in the most cost-efficient manner without compromising quality of care. The use of dermatoglyphics is a rather unique approach and cost effective for identification in such individuals. Health care professionals, dental professionals and researchers should adopt this approach of dermatoglyphics for an early diagnosis, treatment and better prevention of many genetic disorders and other diseases whose aetiology may be influenced directly or indirectly by genetic inheritance. Dermatoglyphic characters are highly variable not only between individuals of a population, but also between populations. These variations are heritable. It's not the end but an opening to a new arena, where in near future detecting these diseases at an early stage will be possible using dermatoglyphics as a diagnostic tool. Dermatoglyphics pattern may provide a means of identifying the genetically determined fraction of patients of disease like Diabetes, hypertension and hypercholesterolemia and also can be used for predisposition of disease outbreak in a population.

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