

# Dermatoglyphics and Cheiloscopy patterns in hypertensive and type 2 Diabetes mellitus patients: An observational study

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## ABSTRACT

**Background:** Essential hypertension is a type of hypertension which bears no etiological reasons. It is found to affect approximately 90 to 95 percent of hypertensive individuals. Similarly, type 2 diabetes or diabetes mellitus is a genetically determined systemic condition with a close relation to familial medical history. Both of these conditions or diseases are closely linked with the process of ageing among various other inherited and genetically determined factors. Importantly, a positive family history increases disease risk manifolds. As there is increased risk of hypertension and development of type 2 diabetes in individuals with family history because of genetic factors, the study of co-relation between dermatoglyphics and hypertension can aid in early identification of individuals with a genetic predisposition towards developing hypertension and type 2 diabetes. **Aim:** The aim and objectives were as follows: (1) Analyze dermatoglyphic finger patterns; (2) Analyze cheiloscopy patterns; (3) Comparison of cheiloscopy and dermatoglyphic patterns with hypertension and type 2 diabetes; and (4) to determine if dermatoglyphics and/or cheiloscopy patterns can be used as tool(s) for pre-identification of inherited diseases. **Materials and Methods:** Total 300 study participants age range above 40 years were selected after obtaining informed consent. Lip patterns were recorded using a dark-colored lipstick and a transparent cellophane tape while finger print patterns were recorded using stamp ink-pad and by applying uniform finger pressure on blank paper sheet. **Results and Observations:** Cheiloscopy patterns analysis showed that the branched, straight, intersected, reticular followed by undifferentiated patterns were present in decreasing frequency among male patients while among female patients, branched, intersected, straight and reticular patterns were observed. However, no undifferentiated pattern was observed in female subjects. These findings were consistent with both diabetic as well as hypertensive patients. On the other hand, finger pattern analysis showed that ulnar loop was most frequently observed in both male and female patients with either hypertension or type 2 diabetes. Also, this was followed in decreasing order by arch type pattern, radial loop pattern and whorl pattern in both genders. **Conclusion:** It can be surmised from the study that both the finger prints and lip patterns can be used to ascertain predisposition to type 2 diabetes and hypertension.

**Keywords:** Finger print patterns, hypertension, lip patterns, type 2 diabetes

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## Introduction

The term 'Dermatoglyphics' is derivation from two Greek words, 'derma' meaning skin and 'glyphics' which means carving. It has been formulated by Professor Harold Cummins. This science deals with epidermal ridge patterns' analysis on soles, toes, fingers and palms. These patterns begin development during sixth to seventh weeks of intrauterine life and undergo complete development by second trimester. Galton in 1892 first used ridge patterns in finger prints for studying various patterns formed by them. These patterns are genetically determined and hence correlated with many diseases with genetic background. Hypertension or increased blood pressure is largely influenced by both genetic and environmental factors. It has been proposed that probability of development of hypertension, is also genetically determined, hence it can be ascertained by studying dermatoglyphic patterns. The prevalence of hypertension cases is 59.9 5 and 69.9% per 1000 subjects among male and female subjects, respectively.<sup>[1]</sup>

The study of fingerprint patterns for purpose of identification is also known as 'Dactylography' or 'Dactyloscopy' or 'Henry-Galton' classification system.<sup>[2]</sup> Lip prints are also known as 'sulci labiorum'.<sup>[3]</sup> The study of lip prints or grooves is termed as 'cheiloscopia'. Both cheiloscopic and dermatoglyphic pattern analysis are closely related to genetics, biology, medicine, forensic sciences and evolutionary history. Classification for analysis of cheiloscopia was suggested by Suzuki and Tsuchihashi. It is as under-<sup>[4]</sup>

- a. Type i- Complete vertical grooves running across vermilion zone of lip
- b. Type ii- Branched grooves
- c. Type iii- Reticular grooves
- d. Type iv- Intersected grooves
- e. Type v- No morphological differentiation of grooves

Classification of dermatoglyphic patterns as suggested by Henry-<sup>[4]</sup>

- a. Type I- Loop pattern
- b. Type II- Whorl pattern
- c. Type III- Arched pattern

The dermatoglyphic print patterns have also been classified as follows-<sup>[5]</sup>

- a. Arch form: This is the simplest form of print pattern. It is formed by one or more than one ridge which enters from one end, produces a central elevation and exits from another end. It is further two types-
  1. Plain pattern: This pattern shows slight elevation towards its center.
  2. Tented form: This pattern demonstrates tent-like elevation in their center.
- b. Loop form: this pattern is comprised of a core and a delta. It enters and exits from one side to another side and undergoes recurving in the center. It is also further subdivided into two types-
  1. Radial pattern: In this finger print pattern, the pattern recurves and undergoes an exit towards the thumb.

2. Ulnar pattern: In this finger print pattern, the finger print pattern undergoes recurving and exits towards the little finger.
- c. Whorl pattern: This type of pattern is composed of two deltas and a core. It can be further subclassified into four types-
  1. Plain pattern: This pattern is formed by a loop arranged in concentric rings surrounding a central core.
  2. Central pocket: This type of finger pattern is formed by a small loop that comprises of two delta loops.
  3. Double-loop pattern: This print pattern is comprised of two loops and two delta loops.
  4. Composite whorls: This pattern is comprised of two deltas enclosing a central core.

There are various stages in development of finger print patterns following conception as follows-

Six to eight weeks following conception, the development of volar pads begins which after ten to twelve weeks undergo shrinkage. Ridge patterns start becoming visible 13 weeks later following conception and completion of patterns takes place by 21 weeks. Besides this, various inherited cardiovascular conditions have also been demonstrated associated with finger print patterns.<sup>[6,7]</sup>

Whorls are formed by epidermal ridges encircling a core. 'Concentric whorls' are sequence of concentric ridges that are arranged as simple whorls while a 'spiral' or 'double whorl' has a central core with a clockwise or anticlockwise orientation.<sup>[8]</sup>

Dermatoglyphic landmarks observed in finger tips are as follows: (a) Tri-radii; (b) Cores and (c) radiants. The tri-radii are formed by confluence of ridge systems at an angle of 120 degrees. The core constitutes the centre of a print pattern and radiant print pattern which undergoes diversion from the tri-radius while enclosing the pattern.<sup>[9]</sup>

Various researchers have demonstrated that subjects diagnosed with essential hypertension (more than 140/90 mm Hg arterial pressure) possess unique dermatoglyphic pattern characteristics.<sup>[10]</sup> Generally, a trend towards an increased incidence of whorl pattern has been observed.<sup>[11,12]</sup>

The term 'cheiloscopia' has been derived from Greek 'cheilos', lips; e skopein, to see. It has been defined as "a method used for personnel identification depending upon characteristic lines and grooves on vermilion zone of lips". Importance of lip print patterns has been emphasised upon by Edmond Locard along with Le Moyne Snyder pertaining to their stable and permanent nature and ability to resist climatic change. Various dyes have been used to record cheiloscopic prints such as- indigo, Sudan Black, Vermillion and aluminium powder. Addition of newer techniques using software to study these patterns by enlarging the digitized images and contrast adjustment for analysis have added to their technique.<sup>[13]</sup>

Aim and objectives of this study were (1) To analyze dermatoglyphic finger print pattern in general population; (2) To analyze cheiloscopy pattern in the general population; (3) To compare cheiloscopy and dermatoglyphic pattern with the prevalence of hypertension and type 2 diabetes and (4) To ascertain, if dermatoglyphics and/or cheiloscopy patterns can be used as a tool for pre-identification of inherited diseases.

## Materials and Methods

A total of 300 study participants aged above 40 years were selected for the study after obtaining consent following detailed explanation of the study purpose. The study was conducted in compliance with the protocol; ethical approval was obtained from the Institutional ethical committee (Ethical Approval Number – PDC/ETH/160/18). Inclusion criteria were: (1) Subjects with no nervous disorders, (2) Hypertensive subjects, (3) Subjects with type 2 diabetes of long duration. Exclusion criteria of the study were: (1) Subjects below 40 years; (2) Juvenile diabetes patients, (3) Pregnant females with hypertension, (4) Subjects suffering from both essential hypertension and type 2 diabetes (diabetes mellitus), (5) Subjects with hormonal disturbances, (6) subjects with any allergies specially, contact dermatitis.

Cheiloscopy patterns were recorded using a darkly colored lipstick and cellophane tape while dermatoglyphic patterns were recorded using a stamp ink-pad and by application of uniform finger pressure on a blank white paper sheet. Recording of finger prints using ink method has been commonly used to record imprints. This method was originally suggested by Cummins and Rudlo in 1926.<sup>[8]</sup>

## Results and Observations

### Cheiloscopy patterns

The branched, straight, intersected, reticular followed by undifferentiated patterns were observed in decreasing frequency among male subjects while among female subjects, branched, intersected, straight and reticular patterns were observed. However, no undifferentiated pattern was observed in female subjects [Table 1]. These findings were common to both diabetic and hypertensive subjects [Graph 1 and 2].

### Dermatoglyphic patterns (gender distribution)

The ulnar loop pattern was found to be frequently present among both male and female subjects in both hypertensives and diabetic groups. [Graph 3a and 3b] This was followed by the arch type pattern, radial loop pattern and whorl pattern among both the genders [Table 2].

## Discussion

Current study demonstrated that the ulnar loop pattern was most frequent in both genders among both hypertensive's

and diabetics. This was followed in descending order by arch, radial and whorl patterns in both genders. However, Srivastava *et al.* (2019) in their study on eastern Uttar Pradesh population found no association between dermatoglyphic patterns and predictability of disease development.<sup>[14]</sup>

Though there are studies in conformance with our findings:

Chakravarthy *et al.* (2018) in their study attempted to analyze the association of dermatoglyphic pattern on palms with hypertension. This study compared two hundred and fifty each subjects (total n = 500) in hypertensive and normotensive individuals. The dermatoglyphic finger print patterns were recorded using digital imaging and the 'atd' angle calculation was done using the 'screen protractor' software. The 'atd' angle was found to be significantly higher in hypertensive subjects when compared to normotensive individuals. Thus, this study stressed upon the need to evaluate dermatoglyphic patterns with risk of development of hypertension.<sup>[11]</sup>

Ramhari Sathawane *et al.* (2019) studied the correlation of lip and finger print patterns in patients with Type II diabetes mellitus. It was found that In diabetic patients whorls are seen as the most common prevalent pattern in both right and left hands. Reticular type of lip print pattern was significantly higher in diabetics than controls.<sup>[15]</sup>

Bala *et al.* (2015) in their study found a significant association between dermatoglyphic patterns with diabetic and hypertensive subjects. Advantage of studying lip print and dermatoglyphic print patterns are as follows: (1) It is simple technique; (2) It requires low cost; (3) It consumes less time; (4) There are no additional laboratory facility requirement and (5) These patterns are unique in every individual.<sup>[16]</sup>

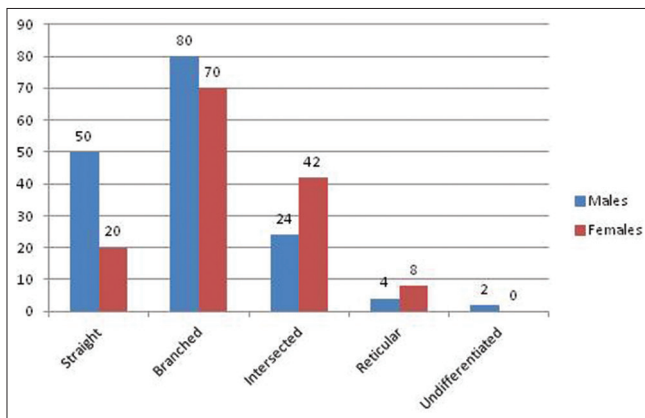
Wyethne *et al.* (2015) in their systematic review showed a consistent increase in whorl frequency along side total ridge count in subjects

**Table 1: Distribution of hypertensive and type 2 diabetes patients according to lip print pattern**

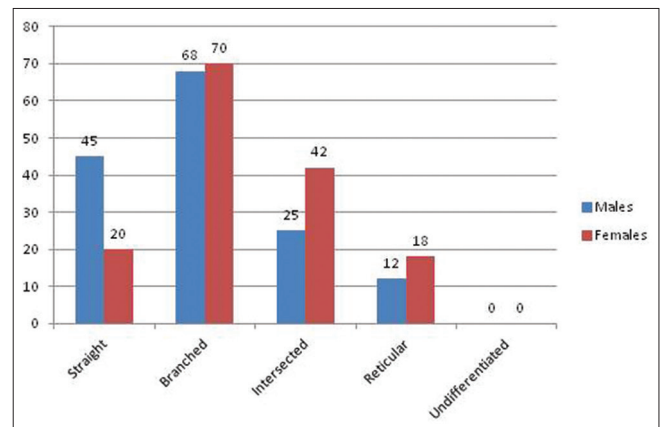
Cheiloscopy patterns	No. of subjects (n=300)	
	Males	Females
Essential hypertension		
Straight	50	20
Branched	80	70
Intersected	24	42
Reticular	4	8
Undifferentiated	2	0
Total	160	140
Type 2 diabetes		
Straight	45	20
Branched	68	70
Intersected	25	42
Reticular	12	18
Undifferentiated	0	0
Total	150	150

**Table 2: Percentage frequencies of finger print patterns (dermatoglyphics) gender-wise**

Ridge pattern	Male subjects			Female subjects		
	Left hand	Right hand	Mean	Left Hand	Right hand	Mean
Essential hypertension						
Arch pattern	15	10	12.5	17	12	14.5
Radial loop pattern	2	1	1.50	4	3	3.5
Ulnar loop pattern	82	83	82.5	82	85	83.5
Whorl pattern	1	0	0.5	4	5	4.5
Diabetes mellitus (type 2 diabetes)						
Arch pattern	12	10	11	14	12	13
Radial loop pattern	7	5	6	8	7	7.5
Ulnar loop pattern	85	83	84	76	79	77.5
Whorl pattern	0	4	2	5	6	5.5



**Graph 1:** Graph demonstrating distribution of hypertensive patients according to lip print pattern



**Graph 2:** Graph demonstrating distribution of type 2 diabetic patients according to lip print patterns

diagnosed with hypertension.<sup>[17]</sup> Srivastava and Rajasekar (2014) in their study found that the whorl print pattern were frequently observed among diabetics when compared to non-diabetic patients in both the genders (48.2% and 24.1% in diabetics and non-diabetic male subjects, respectively and 43.7% and 20% in diabetic and nondiabetic female subjects, respectively.<sup>[18]</sup>

Lahiri *et al.* (2013) in their study aimed towards determining relationship between essential hypertension and dermatoglyphic patterns found that the double-looped whorled pattern was found in greater frequency (4.57% compared to 0.44%) among hypertensive subjects when compared to normotensive individuals.<sup>[19]</sup>

Khatiman and Rosida (2013) in their study found that hypertensive subjects (n = 32) had predominantly whorl pattern (81.25% cases) while 25 of cases were normotensives.<sup>[5]</sup> Edward *et al.* (2007) have postulated that the close association between essential hypertension and whorl type of finger print pattern is probably due to organogenesis of proximities and cardiovascular system which occurs at the same time.<sup>[6]</sup> Oladipo *et al.* (2010) also found that the predominance of whorl pattern in patients suffering from essential hypertension.<sup>[20]</sup>

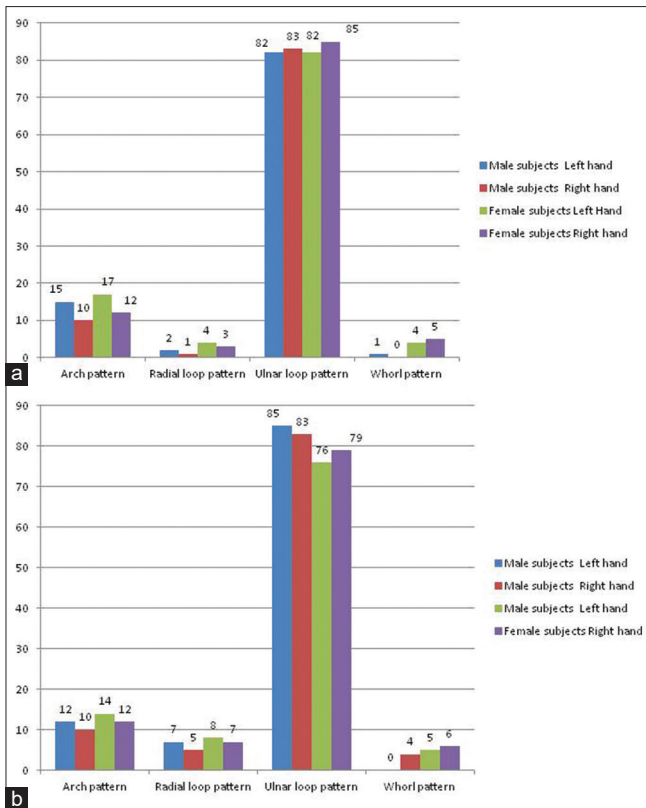
Igbigbi and N’gambi (2004) in their analysis on 165 black Malawi subjects aged from 25 to 66 years suffering from hypertension

and diabetes mellitus. It was observed that there were no whorl finger print patterns detectable in hypertensive individuals. Also, an extremely significant ( $P < 0.001$ ) increase in ulnar loop patterns frequency among hypertensive individuals female subjects was seen. Additionally, whorl pattern frequency were found to be significantly less ( $P < 0.05$ ) in female subjects suffering from both hypertensives and diabetics when compared with those suffering from only hypertension.<sup>[21]</sup>

Varsh Mokshi and Kavitha (2002) reported reduced frequency of radial loop finger print patterns type in hypertensive population.<sup>[22]</sup> Whorl finger print pattern and elevated blood pressure are definitive and distinct markers of development of foetus. However, Stevenson *et al.* (2001) found no significant association between blood pressure levels and finger print patterns.<sup>[23]</sup>

Polat *et al.* (1999) in their study on Turkish Children suffering from juvenile hypertension also demonstrated significantly lesser ulnar loop pattern and high whorl pattern in these individuals.<sup>[24]</sup> Jain *et al.* (1984) also, reported in their paper that the whorl pattern was most prevalent among hypertensives.<sup>[25]</sup>

Ahmad and Pimpalkar (2017) in their research paper surmised that there was a reduced percentage of loops in first digit of



**Graph 3: a.** Graph showing gender-wise percentage frequencies of finger print patterns in hypertensive **b.** Graph showing gender-wise percentage frequencies of finger print patterns in type 2 diabetics

hypertensive subjects while the arch pattern was found to be increased in hypertensive female study participants.<sup>[26]</sup>

### Cheiloscopic pattern

In present study, branched, straight, intersected, reticular and undifferentiated patterns were observed in decreasing frequency among male subjects while among female subjects, branched, intersected, straight and reticular patterns were seen with no undifferentiated pattern in female subjects. These findings were common to both diabetic and hypertensive subjects. Corroboration of current study findings have been reported by Umana *et al.* (2014) in their study showed that the branched lip print pattern had significantly high frequency in among hypertensives (62.29%) than compared to normotensive subjects (53.57%). Also, seen was that reticular (27.78%) and long vertical patterns (6.74%) had higher frequencies in normotensive than hypertensive individuals i.e., 16.57% and 2.97% respectively. However, intersected (14.83%) and undifferentiated (3.34%) patterns were found to be higher among hypertensive subjects when compared to normotensive subjects- 9.13% and 2.78%, respectively.<sup>[27]</sup> No studies with contradictory findings have been reported.

Nadeem Jedly *et al.* (2019) evaluated the efficacy of cheiloscropy and dermatoglyphics in screening diabetic patients and observed that Type 2 and Type 4 lip print patterns were predominant in patients with Type 2 diabetes mellitus while there was no

significant difference in fingerprint patterns between diabetics and controls. Hence, cheiloscropy can be used as a potential mass screening tool for Type 2 diabetes mellitus.<sup>[28]</sup>

Vineeth Ramanathan *et al.* (2020) analysed the lip print patterns of diabetic and nondiabetic individuals and demonstrated that Type 4 reticular pattern was significantly higher among diabetic patients. Thus lip prints may serve as a predictive tool in screening Type 2 diabetes mellitus.<sup>[29]</sup>

However, this study can be further researched upon by a larger study sample and also, by conducting the study in different geographical locations to further support or refute the findings.

### Implications for Clinical Practice

Dermatoglyphics and Cheiloscropy have proven to be a very useful, noninvasive, and economical tool for the preliminary diagnosis of diseases of suspected genetic origin. Since Type 2 diabetes mellitus and hypertension have a strong genetic consideration, these could be influenced by dermatoglyphics and lip print patterns. Dermatoglyphics and lip print patterns of an individual may serve as genetic marker. For unknown deceased persons in homicide, suicide, accidents, and most disasters, personal identification is of utmost importance. For missing persons due to amnesia and culprits hiding identity, their identification is also necessary. Thus, both the finger prints and lip patterns can be used to as a potential mass screening tool for Type 2 diabetes mellitus and hypertension.<sup>[2,29]</sup>

### Conclusion

It has been observed that analysis of dermatoglyphic finger print patterns and essential hypertension has demonstrated among adults that the whorl pattern is an infallible marker of disturbed onco-fetal growth during various pregnancy stages. Also, both of these entities have an association with elevated arterial blood pressure. Thus, it can be hypothesized that an elevated blood pressure in adults is dependent on a variety of environmental factors functional when early fetal development takes place. However, this is controversial as various investigators have proven otherwise.

Likewise, lip print patterns are also unique and are genetically determined. Just like dermatoglyphic patterns, lip prints also, do not undergo any alterations since birth till death of a person. They are permanent structures and do not undergo any change. They maintain their form along with dexterity. This study has shown that there is a definitive correlation between a specific finger print pattern along with lip print pattern in genetically determined diseases such as essential hypertension and type 2 diabetes.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have

given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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