

Cheiloscopy and dermatoglyphics in normal and obese individuals: A study in Indian subpopulation

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Abstract

Background: The prevalence of obesity has been steadily increasing worldwide. Reliable and noninvasive tools that can be used to diagnose such conditions may help us in mass screening and prevention. Finger prints and lip prints have been used as the genetic markers in some diseases such as diabetes mellitus. Studies to correlate a possible association of such markers among obese individuals have not been reported in India to date. The present study was conducted to determine and compare the lip print and finger print patterns in normal and obese individuals and also to evaluate any possible correlation between the lip prints and finger prints in both the study groups.

Methodology: Lip and finger print patterns of 100 obese and equal number of age- and sex-matched healthy individuals were analyzed. Right thumb, right index, left thumb and left index finger prints were evaluated. Gender-wise comparison was also made.

Results: Lip prints revealed no significant difference between obese and nonobese individuals. Predominant Type I lip print was observed in both the study groups. Comparison of finger prints between obese and nonobese individuals revealed a highly significant results for all the fingers. Predominant finger print patterns in the right thumb, right index, left thumb and left index among obese individuals were whorl (51%), loop (83%), whorl (79%) and arch (74%), respectively. No correlation between the lip prints and finger prints was noted.

Conclusion: Finger prints in the obese individuals showed significant differences when compared to the normal controls while lip prints failed to reveal any significant difference. Lip prints did not correlate with the finger prints. Right thumb revealed a significant gender difference among obese individuals.

Keywords: Body mass index, cheiloscopy, correlation, dermatoglyphics, finger prints, lip prints, nonobese, obese, obesity

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Submitted: 01-Aug-2019, **Revised:** 07-Jan-2021, **Accepted:** 15-Jan-2021, **Published:** 14-May-2021

INTRODUCTION

Obesity results from a complex interplay of environmental and genetic factors. It is associated with significant

morbidity and mortality. Once it was believed to occur merely as a result of excessive caloric intake, but a growing

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How to cite this article: Shivakumar HG, Nandini DB, Mohan Kumar KP, Selvamani M, Priya NK, Madhushankari GS. Cheiloscopy and dermatoglyphics in normal and obese individuals: A study in Indian subpopulation. *J Oral Maxillofac Pathol* 2021;25:61-7.

Access this article online

Quick Response Code:



Website:

www.jomfp.in

DOI:

10.4103/jomfp.JOMFP_228_19

body of evidence supports the view that obesity is caused by inherited tendencies towards subtle disorders in the weight-regulating mechanism, magnified by excessive feeding and lack of activity.^[1]

Many genetically determined and genetically inherited diseases such as congenital heart defects, schizophrenia, alopecia, mental retardation, diabetes mellitus and obesity have been found to have an association with dermatoglyphics.^[1-3]

Finger prints while unique to an individual share the basic pattern in various groups. Analogous to finger prints are lip prints that also develop at the same embryological stage as finger prints and have identifiable patterns. Cheiloscopy is widely used for personal identification, sex determination and to identify a hereditary pattern.^[4-6]

Identification of predominant lip prints and finger prints among obese individuals and a possible correlation would be a useful noninvasive tool in the early identification of individuals at risk for obesity. Such a correlation has not been done to date in the Indian population. Thus, the present study aimed at determining lip and finger print patterns in obese and nonobese individuals in the Indian subpopulation and to correlate the same.

METHODOLOGY

Source and distribution of study subjects

Individuals reporting to the outpatient department of our institute and hospitals in and around the college were included in the study. A total of 100 obese individuals and equal number of age- and sex-matched healthy controls were included in the study. Equal numbers of males and females ($n = 50$) were included in both the study groups. All participants were in the age group of 20–40 years. The sample distribution is shown in Table 1. Informed consent from all the study participants and institutional ethical clearance was also obtained.

Inclusion criteria

For case group, individuals without any other systemic diseases except obesity and individuals older than 20 years were included. For selecting obese individuals, body mass index (BMI) was recorded by measuring his or her weight in kilogram (or Kg) and height in meter (m). An individual

was considered obese if his/her BMI $>30\text{Kg/m}^2$.^[7] For controls, age- and sex-matched healthy individuals with a BMI $<25\text{Kg/m}^2$, but more than 18.5Kg/m^2 were selected.

Body mass index calculation

BMI was calculated using the following formula:

$$\text{BMI} = \text{Weight (Kg)} \text{ divided by height (m)}^2.^{[7]}$$

Exclusion criteria

Persons who were hypersensitive to lipsticks, with any congenital abnormalities, trauma, inflammatory conditions affecting lip prints and finger prints were excluded from the study.

Lip print recording and analysis

After cleaning the lips, a dark colored lip liner was applied evenly on the vermilion zone [Figure 1]. The participants were asked to rub both the lips to evenly spread the applied lip liner. The participants were asked to relax and lip impression was obtained on the sticky portion of a cellophane tape. The lip print was then transferred gently onto a white bond paper avoiding smudging [Figure 2]. This served as a permanent record. The lip prints were then visualized using a magnifying lens. The lip prints obtained were coded with a definite number while noting the name and sex of the respective individual. Lip print patterns were analyzed based on the classification given by Tsuchihashi,^[8] Sivapathasundaram *et al.*,^[9] and Acharya *et al.*^[10] Ten millimeter of the middle portion of the lower lip was taken as the study area for lip print analysis since this is said to be stable and always present when



Figure 1: Application of lip liner

Table 1: Distribution of the cases and controls in the study

Study groups	Number of subjects	Gender	Mean age (years)	Mean, BMI (kg/m ²)
Cases	100	Male=50	27.34±4.37	32.50±1.59
		Female=50	26.32±3.76	32.22±1.57
Controls	100	Male=50	25.88±4.49	21.86±1.59
		Female=50	25.40±3.70	19.76±1.52

BMI: Body mass index

compared to the lateral parts of lip prints.^[9] Lip prints were classified into Type I (A clear-cut groove running vertically across the lip), Type I' (Partial-length groove of Type I), Type II (A branched groove), Type III (An intersected groove), Type IV (A reticular pattern) and Type V (Grooves which do not fall into any of Type I–IV and which cannot be differentiated morphologically [undetermined]).^[8]

Finger prints recording and analysis

Finger prints of thumb and index finger of both hands were collected from all participants. The participants were advised to wash their hands with soap and water and dry them with a hand towel to avoid dirt from interfering with the ink prints. A stamp pad soaked with endorsing ink was used. Ensuring that the ink is thoroughly spread on the pad, patients were asked to place the finger on the ink pad and then press against a white paper gently and slowly roll finger pad from side to side to obtain clear complete finger prints. Prints were coded and analyzed using the magnifying lens. Fingerprints were analyzed using a magnifying glass according to the classification given by Kücken and Newell^[11] as arch, loop and whorls [Figure 3a-c]. The data collected were further subjected to statistical analysis



Figure 2: Transfer of lip impression onto a white bond paper

Statistical analysis

The collected data was analyzed and presented as frequencies and percentages. The Chi-square test was used to evaluate a possible association between lip prints and finger prints among the study groups. *P* < 0.05 was considered statistically significant.

RESULTS

Lip print patterns

Distribution of lip prints in the study groups

Determination of lip prints in cases revealed predominant Type I (75%), followed by Type I' (10%), Type II (8%), Type III (4%) and Type IV (3%) and in the controls predominant lip print pattern was Type I (75%), followed by Type I' (11%), Type II (9%), Type III (3%) and Type IV (2%) [Table 2]. None of the study participants displayed type V lip print.

Intergroup comparison was statistically insignificant with Type-I pattern being predominant in both the groups [Table 2].

Among the cases and controls, both males and females revealed predominant Type I lip print pattern [Table 3]. Intragroup and intergroup gender wise comparison in the cases and the controls revealed no statistically significant difference [Table 4].

Finger print patterns

Distribution of finger prints in cases and controls

Among obese individuals

Determination of finger prints in cases revealed that in right thumb, predominant pattern was whorl (51%), followed by loop (47%) and arch (2%), whereas in left thumb whorl (79%), followed by loop (19%) and arch (2%)

Table 2: Overall distribution and intergroup comparison of the finger prints and lip prints among the cases and controls

Study groups	Finger print patterns					
	Right thumb			Left thumb		
	Whorl	Loop	Arch	Whorl	Loop	Arch
Cases	51	47	2	79	19	2
Controls	73	27	0	21	73	6
Cases versus controls, <i>P</i>		0.004 (HS)			0.000 (HS)	
Study groups	Right index			Left index		
	Whorl	Loop	Arch	Whorl	Loop	Arch
Cases	9	83	8	12	14	74
Controls	5	47	48	53	45	2
Cases versus controls, <i>P</i>		0.000 (HS)			0.000 (HS)	
Study groups	Lip print patterns					
	Type I	Type I'	Type II	Type III	Type IV	
Controls	75	11	9	3	2	
Cases	75	10	8	4	3	
Cases versus controls, <i>P</i>				0.978		

P < 0.05 is significant. HS: Highly significant

were observed. In the right index finger, predominant pattern was loop (83%), followed by whorl (9%) and arch (8%), whereas in the left index finger, predominant pattern was arch (74%), followed by loop (14%) and whorl (12%) [Table 2].

Among controls

Determination of finger prints in the control group showed that in the right thumb predominant pattern was whorl (73%), followed by loop (27%) and no arch, whereas in the left thumb, loop (73%), followed by whorl (21%) and arch (6%) were observed. In the right index finger, predominant pattern was arch (48%), followed by loop (47%) and whorl (5%), whereas in the left index finger predominant pattern was whorl (53%), followed by loop (45%) and arch (2%) [Table 2]. No composite pattern of finger print was noticed in this study.

Intergroup comparison of finger prints between the cases and the controls revealed a statistically significant result for all the fingers with the right thumb ($P = 0.004$), left

thumb ($P = 0.000$), right index finger ($P = 0.000$) and left index finger ($P = 0.000$) [Table 2].

Among obese individuals, males revealed predominant whorl pattern in the right thumb and left thumb, loop in the right index, arch in the left index, whereas in females, loop pattern was predominant in the right thumb, whorl pattern in the left thumb, loop pattern in the right index, arch pattern in the left index finger [Table 3].

Among controls, males revealed predominant whorl pattern in the right thumb, loop pattern in the left thumb, arch in the right index, loop in the left index, whereas in females, whorl pattern was predominant in the right thumb, loop pattern in the left thumb, loop pattern in the right thumb, whorl pattern in the left index finger [Table 3].

Intragroup comparison of finger prints between normal males and normal females revealed significant values on the right index and left index, while between obese males and obese females revealed significant values on the right thumb [Table 4].

Intergroup comparison between normal males and obese males revealed highly significant values on right thumb, right index, left thumb and left index finger [Table 4].

Intergroup comparison between obese and nonobese females revealed significant values on right thumb, right index, left thumb and left index finger [Table 4].

No significant association between lip prints and finger prints was observed among both the study groups [Table 5].



Figure 3: Finger print patterns– Arch (a), Loop (b), Whorl (c)

Table 3: Predominant lip print and finger print patterns in cases and controls

Study groups	Finger prints				
	Lip prints (%)	Right thumb (%)	Left thumb (%)	Right index (%)	Left index (%)
Cases					
Males	Type I (70)	Whorl (78)	Whorl (76)	Loop (82)	Arch (82)
Females	Type I (80)	Loop (74)	Whorl (82)	Loop (84)	Arch (66)
Controls					
Males	Type I (74)	Whorl (72)	Loop (68)	Arch (76)	Loop (74)
Females	Type I (76)	Whorl (74)	Loop (78)	Loop (74)	Whorl (80)

Table 4: Gender-wise comparison of the lip prints and finger prints among various study groups

Print patterns	Intragroup comparison		Intergroup comparison	
	Normal males versus normal females	Obese males versus obese females	Normal males versus obese males	Normal females versus obese females
Finger print patterns				
Right thumb	0.996	0	0.972	0
Right index	0	0.439	0	0.088
Left thumb	0.732	0.926	0	0
Left index	0	0.013	0	0
Lip prints	0.997	0.604	0.888	0.99

Tukey's post hoc test. $P < 0.05$ is considered significant

Table 5: Association between the lip prints and finger prints among controls (nonobese individuals) and cases (obese individuals)

Fingerprint patterns	Nonobese individuals					χ^2	P	Obese individuals					χ^2	P
	Lip print pattern							Lip print pattern						
	I	I'	II	III	IV			I	I'	II	III	IV		
Right thumb														
Whorl	53	8	8	2	2	2.161	0.706	38	6	4	3	0	5.137	0.473
Loop	22	3	1	1	0			35	4	4	1	3		
Arch	0	0	0	0	0			2	0	0	0	0		
Left thumb														
Whorl	16	4	1	0	0	11.497	0.175	60	7	7	3	2	2.242	0.973
Loop	54	7	8	3	1			13	3	1	1	1		
Arch	5	0	0	0	1			2	0	0	0	0		
Right index														
Whorl	3	0	1	0	1	11.628	0.169	9	0	0	0	0	8.198	0.414
Loop	37	6	3	1	0			61	9	8	3	2		
Arch	35	5	5	2	1			5	1	0	1	1		
Left index														
Whorl	40	7	6	0	0	7.703	0.463	9	2	0	1	0	4.431	0.816
Loop	33	4	3	3	2			11	2	1	0	0		
Arch	2	0	0	0	0			55	6	7	3	3		

$P < 0.05$ is significant

DISCUSSION

Dermatoglyphics is proved to be an important tool in the identification of certain genetic and systemic disorders.^[2,3,5] Obesity is a disorder resulting from a complex interplay of genetic as well as environmental factors associated with significant morbidity and mortality.

Lip prints analogous to dermatoglyphics are unique to individuals and have shown to be a useful genetic marker.^[3] Both lip and finger print patterns develop during the 6th week of intrauterine life. Any genetic alterations affecting finger prints may alter or affect lip prints as well. Studies correlating lip prints and finger prints are scanty and mostly done in the normal population. Few studies in diabetics,^[2] hypertensive individuals,^[3] and individuals of different ABO blood groups^[12] have been reported.

The literature search did not reveal any previous study correlating the lip prints and finger prints among obese individuals in India to date. Hence, the present study aimed to determine and compare the lip print and finger print patterns in obese and nonobese individuals and also to correlate lip prints with finger prints in both study groups. The study also evaluated sex differences in finger print and lip print patterns in both the study groups and also correlated the same with obesity.

Cheiloscopy

In the present study, lip prints were classified according to Tsuchihashi^[8] and Sivapathasundharam *et al.*^[9] The present study revealed a predominant Type I lip print pattern among both cases and controls followed by

Type I', Type II, Type III and Type IV [Table 2]. To the best of our knowledge, our study is the first to evaluate lip prints among obese individuals. No association between lip prints and obesity could be noted in the present study. Comparison of lip prints between obese and nonobese individuals revealed no significant difference statistically ($P = 0.978$) [Table 2]. Our results could not be compared with any other study since such a comparison has not been reported to date among obese individuals.

Few studies done in the Indian population among healthy individuals have revealed type I to be the most predominant lip print pattern which was in accordance with the present study.^[13-15] On the contrary, Sivapathasundharam *et al.*^[9] reported Type III pattern to be the most common lip print pattern among the Indo-Dravidian population, whereas Type II pattern was found to be predominant in the study by Saraswathi *et al.*^[16]

Among healthy individuals, males showed predominant Type I lip print pattern in the present study. Srilekha *et al.* have also observed Type I and IV patterns more common in males.^[12] This is in contradiction to other studies which revealed Type III to be the predominant pattern among males.^[13,17,18] Vahanwala and Parekh found Type III and IV to be the most common pattern among Indian males.^[15] Type I lip print pattern was the most common pattern among healthy females in the present study. The results were similar to the findings of Narang *et al.*,^[4] Srilekha *et al.*,^[12] Multani *et al.*,^[14] Vahanwala and Parekh,^[15] and Sultana *et al.*^[17] On the contrary, a study done by Gaba *et al.*^[18] revealed Type II as the predominant pattern among females.

Although lip prints showed different patterns, a statistically significant difference was not observed in males and females of both the study groups [Table 4]. Our findings were similar to the study done in the Punjabi population which also revealed no significant difference in lip print pattern between males and females.^[19] Nagasupriya *et al.*^[6] simplified Tsuchihashi classification by combining Type I and Type-I' and Type III and IV together yet a statistically significant difference in lip prints between the genders was not found. On the contrary, numerous other studies have shown that lip prints vary with sex and can be used as a tool for sex determination.^[4,13,14] Although variation of lip prints was observed in males and females of both the study group, a significant difference was not noted in the present study.

Lip prints did not correlate with finger prints in both study groups in the present study [Table 5].

Lip print and left thumb print correlation among healthy individuals showed statistical significance in a study.^[13] However, the authors said that lip and finger prints did not reveal statistically significant results within the gender.^[13] This finding was contrary to the observations of Gaba *et al.*^[18] who reported gender variation among normal individuals in a smaller population. Ghimire *et al.*^[20] concluded that lip print patterns showed population-wise predominance. Different areas studied in lips, techniques used for recording prints, variable pressure and direction of pressure applied to these highly movable structures, seasonal variations of lip prints, open mouth and closed mouth while recording prints, smudging or spoiling of prints, presence of facial hair among men are some factors contributing to varied results. Due to the high chance of distortion, it is unlikely that lip prints can ever replace finger prints in identifying a person.

Dermatoglyphics

Finger prints, where the ridges and grooves are more prominent are confined to a smaller area and are highly bound to the underlying structures and have less chance for distortion. Evaluation of finger print was done in obese and nonobese individuals based on classification of Kücken and Newell.^[11] Right thumb, right index finger, left thumb and left index finger prints were evaluated in the present study. Highly significant differences were noted between obese and nonobese individuals for all the fingers evaluated.

The predominant pattern among obese individuals in the right thumb, right index finger, left thumb and left index finger were whorl, loop, whorl and arch, respectively. Among controls, the predominant finger print pattern

in the right thumb, right index finger, left thumb and left index finger were whorl, arch, loop and whorl, respectively [Table 2].

Gender-wise comparison of finger prints among cases and controls revealed highly significant values in left thumb and left index finger in both males and females. Right thumb and right index also showed high significant values [Table 4], but it was more evident in females in the right thumb and in males in the right index finger [Table 4].

Intragroup gender-wise comparison of finger prints among obese individuals showed a highly significant difference only in the right thumb ($P = 0.000$) [Table 4]. Males had predominant whorl pattern while females had a predominant loop pattern [Table 3]. Significant variations in the finger print pattern were noticed in the present study.

Dermatoglyphic patterns were analyzed in obese individuals of the Nigerian Ibibio population by Oladipo *et al.*^[11] The authors concluded that arch pattern was common in the first right digit in obese males (54.5%) and females (42.33%), while ulnar loop was more common in normal controls. This difference could be attributed to a difference in sample size, type of finger and ethnic group studied. Further, both radial and ulnar loops were assessed together as loop pattern in the present study.

Adamu *et al.*^[13] studied the relationship of the left thumb with various lip compartments in normal individuals. Similar to our findings, the lower median compartments did not show any association with left thumb finger print in their study. However, people with loops on left thumb had more type I lip prints in the lower median compartment which was also in accordance with our findings in the same finger. They concluded that lip prints in lower left median and lower right median compartments showed significant association with left thumb prints.

Among controls, only right and left index fingers revealed a significant difference between males and females ($P = 0.000$) [Table 4]. The predominant pattern in the right index finger was arch in males and loop in females, whereas in the left index finger, the loop pattern was most common in males and the whorl pattern in females.

A study by Karki and Singh,^[21] Rastogi and Pillai^[22] on Nepal and Karnataka population, respectively, revealed a higher incidence of whorls in males and loops in females. They concluded that there is an association between distribution of finger print patterns and gender and thus the prediction of gender is possible based on finger print

pattern. On the contrary, study by Eboh^[23] and Odokuma *et al.*^[24] in the Nigerian population and Delta state university students, Abraka, respectively, revealed no significant association between gender and finger print pattern.

CONCLUSION

Lip prints and finger prints develop at the same embryonic life and both are unique to an individual, such that these can be used as a genetic marker in identifying individuals at risk of diseases. Previous studies to find out the possible correlation between lip prints and finger prints, in diseases such as hypertension, diabetes mellitus, cleft lip and palate, have found a significant association between lip prints and finger prints. The present study revealed no significant differences in lip prints between obese and nonobese individuals. However, finger prints showed a highly significant difference between obese and nonobese individuals. No correlation between lip prints and finger prints was noted among obese and nonobese individuals in this study. Thus, we can conclude that finger prints are more reliable than lip prints. Dermatoglyphics have been used to predict the phenotype of a possible future illness in diseases with a strong hereditary background with obesity being one such disorder. Furthermore, the variation in distribution of lip and finger print may be linked to genetic influences which vary with respect to different populations or races. Similar studies with a larger sample size in the same population may provide further information.

Future scope

Obesity is a disorder with multifactorial etiology related to both genetic and lifestyle factors. Although our study did not differentiate the cases depending on etiology, evaluating the cases, especially with genetic background can reveal any possible association between the disease and cheiloscopic pattern.

Acknowledgment

We would like to thank Mr. Sangam. D.K. for the statistical analysis and Mr. Manjunath, laboratory technician, College of Dental Sciences, Davangere, Karnataka for the technical help.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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