A Cross Sectional Study of Correlation of ATD Angle with Body Fat Distribution in North Indian Population

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Abstract

Introduction: Obesity is associated with significant global morbidity and mortality. The prevalence of obesity is on the rise, especially in low- and middle-income countries and there is a need for a tool for the prevention of this disease As per the available pieces of evidence, dermatoglyphics can be utilized for this purpose to some extent. **Dermatoglyphics** is a study of configurations of epidermal ridges on certain body parts, namely, palms, fingers, soles, and toes.. The term is derived from ancient Greek: derma = skin, glyph = carving. **Dermatoglyphic** patterns begin to develop in the 10th week of gestation and are complete by the 24th week.

Aim: The primary objective of this study was to investigate the correlation of the "atd angle"(a dermatoglyphic parameter) with the body fat distribution (or obesity).

Methods: This cross sectional study was conducted in the department of anatomy, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala). It included 400 participants (200 males and 200 females) from students and employees of the college. All demographic and anthropometric parameters along with the hand imprints were obtained using standard procedures. For determining statistical significance of difference among various variables qualitative data was analyzed by Pearson's Chi square test and quantitative data by student's independent t-test and one way ANOVA .P-value of < 0.05 was considered significant. All analysis was done using SPSS version-20.

Results: Overall 24% of subjects (32% of males and 16% of females) were found to be obese (BMI≥25kg/m^2).A statistically significant difference was observed in the values of both right and left hand"atd angle"for the comparison of obese and non-obese subjects($p=0.009$ and

<0.001,respectively). A statistically significant positive correlation of left hand "atd angle" was observed with BMI.

Conclusion: Dermatoglyphics can potentially be used as a tool for the prediction of obesity.

Recommendations: A large-scale study with a well-defined protocol is required for establishing dermatoglyphics as a screening tool for obesity.

***Key Words**: Obesity, Dermatoglyphics, BMI, anthropometric parameters, axial triradii, digital triradii*

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Introduction

Obesity is derived from a Greek word that means 'overeating' and is defined as abnormal or excessive fat accumulation that may lead to impaired health. Body mass index (BMI) is a simple and widely used parameter for the classification of overweight and obesity. According to

world health organization (WHO), people with bmi≥25 are termed as overweight and those with BMI ≥30 are termed as obese. In 2016, about 39% and 13% of the world's adult (individuals ≥18 years of age) population, which corresponds to 1.9 billion and 650 million adults, were overweight and obese, respectively. The prevalence of obesity has increased three- folds in 2016 when compared with that in 1975.[1] Obesity is considered a major risk factor for the development of various non communicable diseases such as cardiovascular diseases, diabetes mellitus, musculoskeletal disorders, and a certain type of cancers.[1-3] As common hypothesis obesity occurs when caloric intake is greater than the energy expenditure. However, with the developments in our knowledge about obesity, it is now considered to be an inheritable disorder that is caused by a complex interaction of genetic, environmental, and behavioral factors.[4] Previously regarded as an epidemic of the western world, obesity is now a major concern for low-and middle-income countries like India. Presently, identification of individuals at high risk of obesity and related co-morbidities is an important goal for healthcare providers worldwide.

Due to increase awareness about the management of obesity, various researches are being carried out to invent methods for preventing this chronic disease. Dermatoglyphics, a term derived from two Greek words: 'derma' meaning skin and 'glyphic' meaning carving, is the study of epidermal ridges and their arrangement on the volar aspect of the hand, finger, feet, and toe. Abnormal dermatoglyphics pattern arises when any disturbance occurs in the growth of the fetus during early stages of fetal life. Arches, loops, and whorls are the three basic patterns found in hand.[5] Dermatoglyphics has proved to be helpful in the prediction of various genetic disorders and in diagnosing certain congenital malformations. Many studies have indicated the role of dermatoglyphics in the prediction of different diseases like hypertension, diabetes mellitus, asthma, rheumatoid arthritis and schizophrenia. The researchers have proposed that there might be some genetic abnormality involved in the occurrence of these diseases, which can be predicted from the analysis of dermatoglyphic parameters.[6,7-14] For the management of obesity, it would be really helpful to have a handy tool like dermatoglyphics to predict the probability of having obesity later in life. This will help in saving many lives and resources.

Certain studies have reported that evaluation of centralized obesity (measured using anthropometric indices such as waist circumference, hip circumference, waist-to-hip ratio, and waist-to-height ratio) is a method for predicting co-morbidities associated with obesity compared with the evaluation of BMI alone.[16-20] Hence, the objectives of the current study were: 1) To study the prevalence of disordered anthropometric indices in the study population;

2) To explore the correlation, if any, between body fat distribution (or obesity) and the "atd angle", a dermatoglyphic parameter.

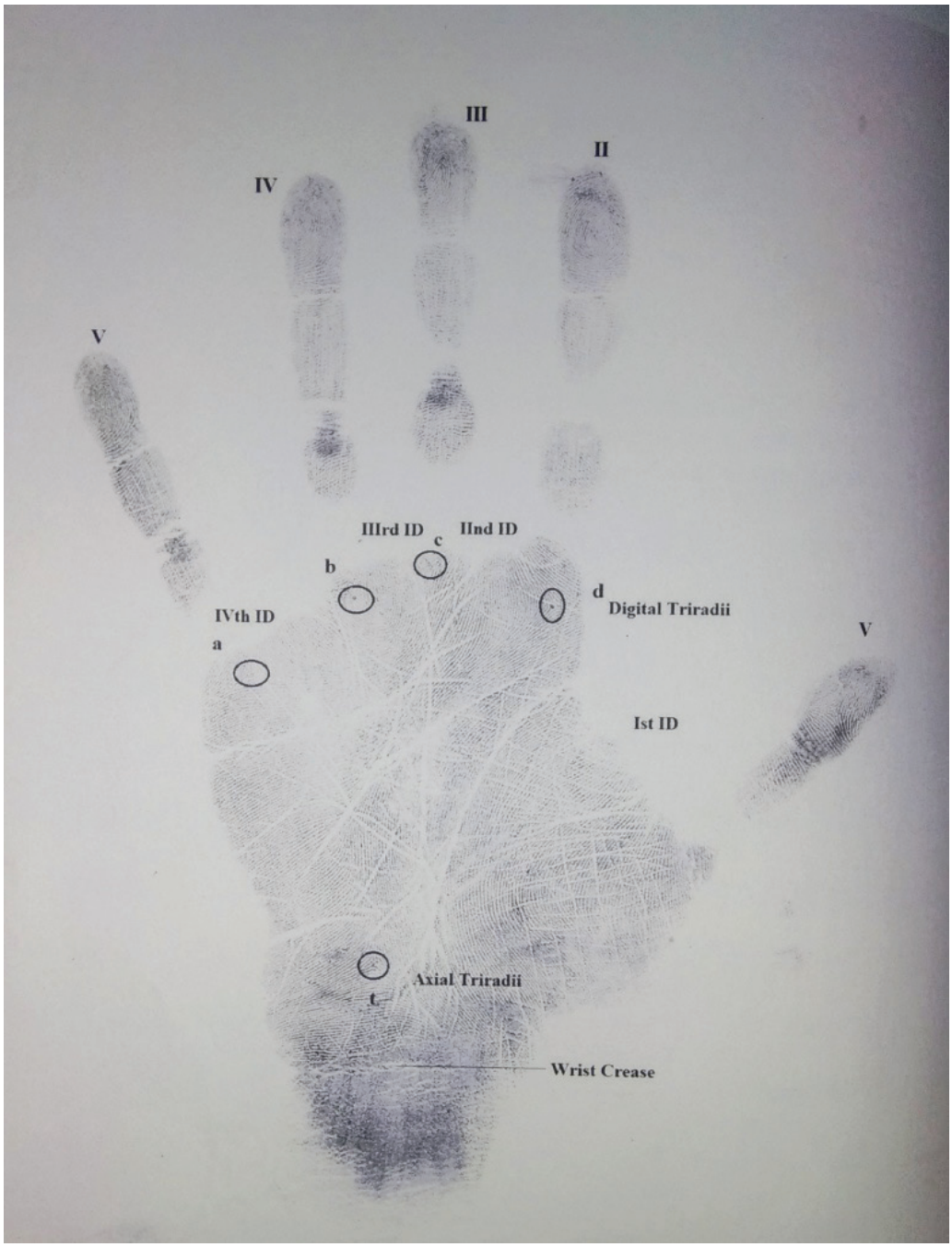
Material and Method

The present cross sectional study was conducted in the Department of Anatomy, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala) after ethical clearance from IEC (Institutional Ethics Committee vide Project No: IEC-1087). The study included 400 participants (200 males and 200 females) from students and employees of the college. Prior informed consent for the study was obtained from all the subjects in both English and vernacular. No personal information was retained or published without the prior consent of the individual. Subjects with age above 18 years and below 40 years were included in the study. Subjects who had a problem in standing erect, with postural defects or those confined to a wheel chair, with skin diseases like eczema, leprosy involving finger/palm, or with any inflammation, trauma, anomalies of hand were excluded. All demographic and anthropometric parameters such as age, gender, body weight, height, waist circumference, hip circumference, and BMI were collected for the study population. For assessing the prevalence of obesity, the study participants were grouped in the following 4 categories based on the BMI values:

Categories	**BMI (kg/m2)**
Underweight	<18.0
Normal	18.0 to 22.9
Overweight	23.0 to 24.9
Obese	≥25

For collecting the dermatoglyphic parameters, the entire palm of all the subjects was covered with ink and hand imprints for both the hands were taken on a pair of white paper-sheet placed on a flat surface with a foam

pad underneath. The subject's wrists were placed on the bottom of the paper and palms were pressed firmly so that the center is printed without any white space. Digits were printed separately and it was reviewed that the entire pattern on each digit is printed. For the purpose of the present study following landmarks of the handprints were considered: a) digital and axial triradii must be present; b) no space present in the center of the palm; c) all the fingertip area must be present and digital wrist creases can be located. The following observations were made in case of palm prints: Axial and digital triradii were observed in the palm. The obtained palm/digit prints were examined with the help of a magnifying glass. By drawing the lines connecting triradii (a, t to d),"atd angle" was measured using a goniometer.[6-21]



Statistical Analysis: For determining statistical significance of difference among various variables qualitative data was analyzed by Pearson's Chi square test and quantitative data by student's independent t-test and one way ANOVA . P-value of < 0.05 was considered significant. All analysis was done using SPSS version-20.

Results

A total of 400 study subjects comprising of 200 males and 200 females were included in the study. The results obtained for the prevalence of obesity among the study participants are shown in Table 1. The obesity was statistically significantly more prevalent among males compared with females (chi-square value = 26.584, p <0.001).

Table 1: Prevalence of Obesity in the Study Population

BMI (Kg/m2)	Males	Females	Total
<18.0 (Underweight)	34 (17%)	42 (21%)	76 (19%)
18.0-22.9 (Normal)	52 (26%)	93 (46.5%)	145 (36.25%)
23-24.9 (Overweight)	50 (25%)	33 (16.5%)	83 (20.75%)
≥25 (Obese)	64 (32%)	32 (16%)	96 (24%)

The results for the "atd angle" measured for both left and right hands for the entire study population are presented in Table 2. The right hand "atd angle" was statistically significantly higher than the left hand "atd angle" for the entire study population (p-value <0.001). Also, males had statistically significantly higher right and left hand "atd angles" compared with females (p = 0.011 and 0.004, respectively).

Table 2: Results for the "atd angle" Across the Study Population

Atd angle	Entire study population (n=400) Mean ± SD	Males (n=200) Mean ± SD	Females(n=200) Mean ± SD	T-value (Male vs Females)	P-value (Male vs Females)
Right atd angle	38.93 ± 2.57	39.26 ± 2.34	38.61 ± 2.75	2.544	0.011
Left atd angle	37.62 ± 3.06	38.07 ± 2.81	37.18 ± 3.24	2.919	0.004

Results of the left hand "atd angle" were statistically significantly different among subjects in different BMI categories for obesity (p <0.001). A statistically significant difference was observed in the values of both right and left hand "atd angle" for the comparison of obese versus non-obese subjects (p = 0.009 and <0.001, respectively) (Table 3 and Table 4). Interestingly, a numerically higher mean value for both the right and left hand "atd angle" was observed in the obese subjects compared with that of normal subjects.

Table 3: Comparison of the "atd angle" in Subjects with Normal and Increased BMI

Atd angle	BMI (kg/m2)				T-value	P-value
	<18.0 (Underweight) (n=76)	18.0-22.9 (Normal) (n=145)	23-24.9 (Overweight) (n=83)	≥25 (Obese) (n=96)		
Right atd angle	38.70 ± 2.68	38.79 ± 2.31	38.72 ± 2.58	39.53 ± 2.79	2.308	0.076
Left atd angle	36.83 ± 3.05	36.88 ± 2.90	37.80 ± 3.13	39.23 ± 2.62	14.893	<0.001

Table 4: Comparison of the "atd angle" in Obese vs Non-obese Subjects

Atd angle	**Non-obese**	**Obese (BMI ≥25 kg/m2) (n=96)**	**T-value**	**P-value**
	(BMI <25 kg/m2) (n=304) Mean ± SD	Mean ± SD		
Right atd angle	38.75 ± 2.47	39.53 ± 2.79	-2.624	0.009
Left atd angle	37.12 ± 3.02	39.23 ± 2.62	-6.167	<0.001

A statistically significant positive correlation of right hand "atd angle" was observed with weight and waist-to-hip ratio, while a statistically significant positive correlation of left hand "atd angle" was observed with weight, BMI, waist circumference, hip circumference, and waist-to- height ratio.

Table 5: Correlation of atd Angle with Various Demographic and Anthropometric Parameters

	Right atd angle		**Left atd angle**	
	Correlation coefficient	**P-value**	**Correlation coefficient**	**P-value**
Weight	0.147	0.003	0.247	<0.001
Height	0.112	0.025	0.069	0.167
BMI	0.112	0.025	0.271	<0.001
Waist circumference	-0.020	0.685	0.149	0.003
Hip circumference	0.110	0.028	0.167	0.001
Waist-to-hip ratio	-0.170	0.001	-0.062	0.218
Waist height ratio	-0.066	0.186	0.130	0.009

Discussion

The current study indicates that a higher value of "atd angle", especially that of the left hand can be predictive of the risk of obesity in north Indian adults. Results obtained in the current study are in-line with those obtained in earlier studies, that is, the dermatoglyphic parameter such as "atd angle" is positively correlated with the occurrence of obesity. In the past, a few studies have been conducted and data have been published for the correlation between dermatoglyphic parameters including the "atd angle" and obesity in different age, geographic, and ethnic groups. Bhardwaj N. Et. Al. conducted a study to explore the association of the dermatoglyphic patterns with obesity in 370 school-going children of both sexes. An increase in the number of arches in thumb, mainly right thumb, was observed in 42% of the obese children. An increased "atd angle", abnormal endings of the main palm lines, additional triradii, and reduced line were observed in 29%, 21%, 17%, and 11% of obese children, respectively.[23] Alberti A et al. conducted a study in 2172 children and adolescents aged 10 to 19 years to explore the relationship between dermatoglyphic parameters and obesity in the center-west region of Brazil. The results suggested that a greater number of lines in the left hand finger two, a higher frequency of the radial and ulnar loop pattern can be considered the predictive marker of obesity in the study population. Dermatoglyphic characteristics are influenced by nutritional status of children and adolescents.[24] Sharmila. D conducted another study to assess the correlation between dermatoglyphic patterns and obesity in 300 children. Results showed that an increased number of arches can be used as a predictive marker for obesity in children.[25] Oladipo et al. conducted a study to assess the link between dermatoglyphic features and obesity in subjects from the Ibibio ethnic group in Nigeria. It was reported that subjects with obesity had a high percentage of arch pattern and a significantly higher value of "atd angle" compared with the normal subjects.[26]

Conclusion

Dermatoglyphics could be proved a vital tool for the prediction of various diseases with a genetic link. Despite the positive correlation observed in the current study it is not yet established whether we can use any of the dermatoglyphic parameters to precisely predict obesity, due to limitations of these studies. Thus, large-scale studies with a well-defined protocol are required to be conducted with the involvement of regulatory bodies for establishing the importance of dermatoglyphics as a screening tool for obesity.

Conflict of Interest: Nil

Source of Funding: Self

Ethical Clearance: Taken from Institutional Ethics Committee (IEC) vide Project No. IEC-1087

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