

## Original Research Article

# Cutaneous markers of obesity

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### ABSTRACT

**Background:** The prevalence of obesity is increasing rapidly all over the world. Obesity is accompanied by increasing mortality and morbidity due to conditions such as diabetes, cardiovascular diseases and other metabolic complications. Obesity has multiple psychological impacts as well due to discrimination and bias. Cutaneous manifestations of obesity are common due to factors such as mechanical stresses, hormonal imbalances and insulin resistance. Understanding the epidemiology of cutaneous manifestations among obese individuals will aid in better patient management.

**Methods:** A cross sectional descriptive observational study was conducted over a period of 2 years from August 2010 to August 2012 in the Dermatology outpatient Department of a tertiary care hospital. Information on socio-demographic variables such as age, gender was collected along with anthropometry and biochemical parameters. Individuals were classified based on their type of obesity and health risk assessed using waist-hip ratio. Cutaneous manifestations of obesity were assessed using appropriate methods wherever applicable.

**Results:** The study population consisted predominantly of individuals 20 to 40 years of age. The proportion of females were twice than males. Co-existing illnesses such as diabetes, hypertension and polycystic ovarian disease were present. Only 21% of the individuals reported exercising regularly. Most individuals had mild obesity and elevated waist-hip ratio. Acanthosis nigricans was the most common cutaneous manifestation present among 95% individuals. The other common cutaneous manifestations were striae distense, acrochordons, intertrigo, dermatophytosis and folliculitis.

**Conclusions:** The cutaneous manifestations of obesity are due to multiple factors such as mechanical stresses and hormonal imbalances. This study indicates a high prevalence of cutaneous manifestations among obese individuals. Understanding the etiopathogenesis will facilitate in screening the high-risk individuals who present with cutaneous manifestations for other underlying illnesses. In addition, management of cutaneous manifestations will prevent the cosmetic side effects among obese individuals thus limiting the psychological effects.

**Keywords:** Acanthosis-nigricans, Metabolic-syndrome, Obesity

### INTRODUCTION

Obesity is one of the rapidly rising pandemics in this world. Within two decades from 1980 to 2015 the proportion of obese individuals has risen drastically. According to the estimates from the Global Burden of Disease, in 2015 alone, approximately 107.7 million children and 603.7 million adults were estimated to be

obese.<sup>1</sup> The prevalence of obesity has increased by more than twice in 70 countries. Among other countries, it is steadily in the rise. In addition, obesity also contributes to increased mortality. 4.0 million deaths worldwide are due to elevated BMI. Among the causes of mortality, cardiovascular events accounted for more than two-thirds of the obesity related deaths. This necessitates the increasing need to identify and screen people who have

increased BMI, for earlier initiation of treatment and to consequently reduce mortality.<sup>1</sup>

There are non-medical consequences to obesity as well. According to the WHO report on obesity (2004), obese individuals face more social bias, discrimination and prejudice. This in turn, contributes to increasing reluctance of obese individuals thus leading to delay in seeking health care.<sup>2</sup>

One of the most important organs to be affected by obesity is the skin. On the molecular level, these changes are due to multiple interactions of hormonal factors, adipocytokines and mechanical factors. Most of the skin findings are correlated to the pathology of obesity. However, some conditions are non-obesity related causes. These skin conditions have a positive association with conditions such as diabetes and insulin-resistance.<sup>3,4</sup>

The skin changes in obesity are commonly caused due to 3 reasons:

- Increased body weight, in turn leading to mechanical changes.
- Hormonal imbalances such as hyperandrogenism causing obesity and
- Insulin resistance thus causing hyperinsulinemia.

The chief abnormalities are more apparent in the barrier function of the skin, sweat production, sebaceous glands, lymphatic system, collagen cross linked structure and function, wound healing, the skin microvasculature and subcutaneous adipose tissue. This in turn would manifest as various skin lesions with different underlying etiologies.<sup>5,6</sup>

Various studies have been conducted to assess the cutaneous manifestations of obesity. According to Boza JC et al, striae, plantar hyperkeratosis, acrochordons, intertrigo, pseudoacanthosis nigricans, keratosis pilaris, lymphedema and bacterial infections have been found to be associated with obesity.<sup>7</sup> Among these conditions, striae, pseudoacanthosis nigricans and microbial infections were also correlated with the grades of obesity.

According to Yosipovitch G et al, and Garcia et al, striae distense, adiposis dolorosa, chronic venous insufficiency, intertrigo, candidal infections, seborrheic dermatitis, xanthoma and xanthelasma are additional conditions that are associated with obesity.<sup>8,9</sup> These are due to metabolic abnormalities, inflammatory skin conditions or mechanical causes.

Most of the studies on cutaneous manifestations of obesity have been conducted in western countries. There are very few studies in developing nations like India where the prevalence of obesity is on the rise. This study seeks to observe the cutaneous markers of obesity along with the factors associated with it. This would enable better

identification of high-risk groups, thus in turn helping in better surveillance of patients and management.

## METHODS

The study was conducted at Dermatology outpatient department of Rajah Muthiah Medical College and hospital, Annamalai University and the study period was August 2010 to August 2012.

### Inclusion criteria

All obese patients, across age groups and genders attending the dermatology OPD in the given study period.

### Exclusion criteria

Pregnant women and patients on systemic corticosteroids were excluded from the study.

All patients were questioned in detail regarding their occupation, and life style habits (including their exercise habits, sleep habits, dietary habits, etc.). the onset, duration, and mode of progression of their symptoms was also noted. Specifically, a detailed menstrual history was also elicited from female patients.

### Examinations

All subjects underwent a detailed physical examination which included recording of vitals (pulse rate % blood pressure); anthropometry measurements-height (in meters), weight (in kgs), waist circumference in cms (at level of umbilicus) and hip circumference in cms (at the level of widest part of buttocks) and examination of cutaneous findings and their sites of involvement. All the findings were recorded using a specially designed proforma.

**Table 1: Obesity level classification based on body mass index.**

BMI (Quetlet index)	Grade of obesity
30 - 34.9	Mild, Grade I
35 - 39.9	Moderate, Grade II
40 and above	Morbid, Grade III

**Table 2: Health risk was calculated based on the waist hip ratio.**

Gender	WHR	Health risk
Male	Upto 0.95	Low
	0.96 to 1.0	Moderate
	1.01 and above	High
Female	Upto 0.80	Low
	0.81 to 0.85	Moderate
	0.86 and above	High

From these data, Body Mass Index (BMI, in kilograms per square meter) and waist hip ratio (WHR= waist circumference in cms/ hip circumference in cms) were calculated and patients were classified into various grades of obesity, and health risk as follows.

### Laboratory methods

Apart from the routine blood and urine examinations, specific investigations like fasting blood sugar levels, thyroid profile, fasting lipid profile and radiological investigations like ultrasonography were conducted. Supportive laboratory investigations like scraping for fungus, gram staining and Wood's lamp examination were also carried out to wherever mandatory.

### Radiology examination (USG)

Diagnosis of polycystic ovarian disease was based on ultra-sonographic findings.

### Statistical analysis

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables.

## RESULTS

A total of 100 subjects were included in the final analysis. Among the study population, 1 (1%) participants were aged up to 9 years, 21 (21%) were aged between 10 to 19 years, 29 (29%) participants were aged between 20 to 29 years, 25 (25%) participants were age between 30 to 39 years, 16 (16%) participants were aged between 40 to 49 years, 7 (7%) participants were age between 50 to 51 years and only 1 (1%) participant was 60 years and above.

**Table 3: Summary of baseline characteristics (N=100).**

Parameters	Frequency	Percentage
<b>Age groups</b>		
Up to 9 years	1	1%
10 to 19 years	21	21%
20 to 29 years	29	29%
30 to 39 years	25	25%
40 to 49 years	16	16%
50 to 59 years	7	7%
60 years and above	1	1%
<b>Gender</b>		
Male	34	34%
Female	66	66%
<b>Obesity</b>		
Mild	62	62%
Moderate	24	24%
Morbid	14	14%

Among the study population male participants were 34 (34%) remaining 66 (66%) were female. Among the study population, 62% participants had mild obesity, 24% participants had moderate obesity and 14% participants had morbid obesity (Table 3).

Among the WHR health risk classification, 24% had low, 12% had moderate and 51% had high. The proportion of diabetes, hypertension, PCOD was 22%, 5% and 7% respectively. Among the study population, 21% participants had regular exercise and 32% participants were irregular exercise (Table 4).

**Table 4: Summary of comorbidities.**

Comorbidities	Frequency	Percentage
<b>WHR health risk classification</b>		
Low	24	24%
Moderate	12	12%
High	51	51%
<b>Diabetes</b>		
Yes	22	22%
No	78	78%
<b>Hypertension</b>		
Yes	15	15%
No	85	85%
<b>PCOD</b>		
Yes	7	10.61%
No	59	89.39%
<b>Personal history of exercise</b>		
Regular	21	21%
Irregular	32	32%
Nil	47	47%

The majority of 51% participants were apple shaped. The proportion of avocado and pear shaped was 25% and 24% respectively. Among the study population, 60% participants had mild BMI, 25.26% participants had moderate BMI and 14.74% participants had morbid BMI (Table 5).

**Table 5: Descriptive analysis of fat distribution.**

	Frequency	Percentage
<b>Fat distribution</b>		
Apple	51	51%
Avacado	25	25%
Pear	24	24%
<b>BMI</b>		
Mild	57	60%
Moderate	24	25.26%
Morbid	14	14.74%

The majority of 95% participants had acanthosis nigricans. The followed by striae distansae, acrochordons, intertrigo, dermatophytosis and folliculitis was 72%, 59%, 54%, 16% and 13% respectively (Table 6).

**Table 6: Descriptive analysis of cutaneous changes of obesity.**

Cutaneous changes of obesity	Frequency	Percentage
Acanthosis nigricans	95	95%
Striae distansae	72	72%
Acrochordons	59	59%
Intertrigo	54	54%
Dermatophytosis	16	16%
Folliculitis	13	13%
Hirsutism	7	7%
Planter hyperkeratosis	7	7%
Psoriasis	7	7%
Candidal intertrigo	6	6%
Keratosis pilaris	3	3%
Chronic venous insufficiency	3	3%
Lymphedema	1	1%
Necrotizing cellulitis/fasciitis	1	15%

Among the people with acanthosis nigricans, majority of 95% participants were affected in neck. The followed by Axillae, antecubital fossa and knuckles was 68.42%, 27.37% and 13.68% respectively. Among the people with striae distansae, majority of 51.39% participants were affected in thighs, 27.78% participants were affected in shoulders and 22.22% participants were affected in breast.

**Table 7: Summary of site for cutaneous changes of obesity.**

Site	Frequency	Percentage
<b>Acanthosis nigricans</b>		
Neck	95	90.53%
Axillae	64	68.42%
Antecubital fossa	26	27.37%
Knuckles	12	13.68%
Genitals	8	8.24%
Face	3	3.16%
Popliteal fossa	2	2.11%
Umbilicus	0	0%
<b>Striae distansae</b>		
Thighs	37	51.39%
Shoulders	20	27.78%
Breast	16	22.22%
Abdomen	10	1.39%
<b>Acrochordons</b>		
Neck	44	74.58%
Axillae	15	25.42%
Face	10	16.95%
Trunk	1	1.69%
<b>Intertrigo</b>		
Genitals	53	98.15%
Inframammary	10	18.52%

Among the people with acrochordons, 74.58% participants were affected in neck, 25.42% participants were affected in axillae and 16.95% participants were affected in face. Among the people with intertrigo, 98.15% participants had genitals and 18.52% participants had inframammary (Table 7).

## DISCUSSION

Among the study population, most were between 20 and 29 years of age. (29%). After that, one-fourth (25%) were between 30 and 39 years of age. Adolescents 10 to 19 years of age had a 21% prevalence of obesity. Obesity was relatively less common in the extremes of age at less than 9 years and among more than 60 years. In contrast, in the study by Divyashree RA et al, 41-50 years age group had 30% prevalence of obesity.<sup>4</sup>

With regards to gender, the prevalence of obesity was almost twice among women (66%) compared to men (34%). In the study by Divyashree RA et al, 74% were females and 26% were males. Hence this study has a lesser proportion of females compared to males.<sup>4</sup>

Almost 62% of the study participants were classified as having mild obesity (62%). This is slightly lesser than the study by Divyashree RA et al, were 68% had mild obesity. Almost one-fourth (24%) were having moderate obesity and only 14% were morbidly obese.<sup>4</sup>

With respect to co-morbidities, almost half of the study participants (51%) had a waist-hip ratio that classifies them as high risk. 24% had a waist hip ratio of low health risk category. Only 12% had a waist hip ratio that classified as having moderate health risk. With respect to co-morbidities, almost one-fifth (22%) had diabetes and 15% were hypertensives. With respect to metabolic impairments, 10.61% had polycystic ovarian syndrome. Only 21% reported having regular physical activity. 47% did not have any form of physical activity and 32% reported having irregular physical activity.

With respect to obesity, more than half (51%) had apple pattern of obesity. The prevalence of avocado and pear patterns of obesity were 25% and 24% respectively. 14.74% had BMI in the morbid range.

The most common cutaneous manifestation observed among the obese individuals was acanthosis nigricans. (95%). Neck, axilla and antecubital fossa were the common sites of manifestations of acanthosis nigricans. This is similar to the study by Hahler et al, which report that acanthosis nigricans is the most common cutaneous manifestation of obesity followed by skin tags, striae distense, intertrigo and plantar hyperkeratosis.<sup>10</sup> The study by Divyashree RA et al, report that among 21 to 30 year old, acanthosis nigricans was the most common cutaneous manifestations.<sup>4</sup> Since this study contained most population in that age group, it would account for the increased prevalence of acanthosis nigricans. In the study

by Garcia HL et al, stria dense, stasis pigmentation, bacterial and fungal infections were reported to be common findings.<sup>9</sup>

Stria distense was the second most common dermatologic manifestation observed among 72% of the study participants. Thighs were the most common site followed by breast and shoulders. The pattern of cutaneous manifestations is similar to the pattern described by Yosipovitch G et al.<sup>8</sup> Most disorders are due to mechanical factors and insulin resistance associated changes. This is in contrast to the study by Boza et al, where striae and plantar hyperkeratosis are the common manifestations of obesity in skin.<sup>7</sup>

Among the study population, 59% had acrochordons where neck was the most common site involved, followed by axilla. Acrochordons have been found to be associated with diabetes, hypertension and cardiovascular diseases.<sup>11</sup> 54% had intertrigo, commonly affecting the genitals. 16% had dermatophytosis and 13% folliculitis. The other less common skin manifestations include hirsutism, plantar hyperkeratosis, psoriasis, intertrigo, chronic venous insufficiency, lymphedema and necrotizing fasciitis.

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