

Original Research Article

Cutaneous manifestations in obese patients and non-obese controls in a tertiary care centre: a case-control study

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ABSTRACT

Background: Obesity has emerged as one of the most serious public health concerns in the 21st century. It is responsible for varied changes in structure and function of different components of skin. Skin care of obese patients deserves particular attention, not only because of high prevalence of cutaneous alteration but mainly because many of these disorders are preventable and could be treated, improving patient's quality of life.

Methods: Two hundred patients with BMI ≥ 30 kg/m² and two hundred age and sex matched controls (BMI: 18.5-24.9 kg/m²) were included in this study.

Results: Compared to the control group, obese patients were having higher prevalence of various skin conditions of which most common were acanthosis nigricans, acrochordons, striae distensae, frictional hyperpigmentation and infections.

Conclusions: There is increased incidence and severity of cutaneous manifestations like acanthosis nigricans, acrochordons, striae distensae, frictional hyperpigmentation and infections in obese patients than control subjects. These can be used as markers for the early detection of various components of metabolic syndrome.

Keywords: Obesity, Acanthosis nigricans, Acrochordons, Body mass index

INTRODUCTION

Obesity is defined as an unhealthy excess of body fat that leads to an impaired quality of life, or more specifically, as an unhealthy excess of body fat that increases the risk of morbidity and premature mortality.¹ Causes of obesity may be genetic, behavioral, environmental, physiological, social and cultural factors which cause energy imbalance and promote excess fat deposition. In 2016 more than 1.9 billion adults were overweight, of these over 650 million were obese. Thirty nine percent of adults aged 18 years and over were overweight and 13% were obese.²

Although obesity is a global phenomenon, India is unique in that it has to grapple with both over and under nutrition at the same time. Obesity can be seen as the first wave of

a defined cluster of non-communicable diseases called New World Syndrome, one of today's most neglected public health problems, affecting every region of the globe.³

Obesity can result either from increased energy intake, decreased energy expenditure or combination of both⁴. It is associated with a number of effects on skin physiology, which includes effects on skin barrier function, sebaceous gland and sebum production, sweat glands, lymphatics, collagen structure and function, wound healing, micro and macro circulation and subcutaneous fat.⁵

Obese individuals demonstrated increased transepidermal water loss and erythema compared with control subjects.⁵ Androgens, insulin, growth hormone and insulin like

growth factor are frequently elevated in obese patients and have shown to activate sebaceous glands and influence acne severity.⁶⁻⁸ Collagen structure and function are shown to be altered in obese patients disturbing wound healing and wound collagen deposition.⁹

Obesity affects cutaneous sensation, temperature regulation and vasculature. It is associated with a number of dermatoses, including acanthosis nigricans, acrochordons, striae distensae, keratosis pilaris, hyperandrogenism and hirsutism and adiposis dolorosa. Though obesity causes various skin changes, its impact on skin has received minimal attention.

Objectives

The primary objective was to study various cutaneous manifestations in obese patients. The secondary objectives were to analyze these manifestations in relation to their BMI and to compare cutaneous manifestations in obese patients and non-obese controls.

METHODS

Study population

Two hundred patients with BMI ≥ 30 kg/m² and two hundred age and sex matched controls with BMI between 18.50-24.99 kg/m² attending Dermatology OPD, VIMS, Ballari over a period of 16 months (January 2016 to April 2017) were included in the study.

The exclusion criteria for the study were children <15 years, patients exposed to factors known to be responsible for causing obesity, pregnant and lactating mothers, severely ill and immune compromised patients.

Study design

This was an observational, case control, hospital based study

Clinical evaluation

After informed consent, a detailed history was taken and clinical examination including height, weight, BMI, blood pressure were noted. Dermatological examination was done and findings were recorded in a preformed proforma and photographs were recorded. Laboratory investigations included random blood sugar and fasting lipid profile in all the patients and controls. Other relevant investigations were carried out as and when required.

Quetelet Index or BMI devised by Adolph Quetelet was calculated as weight in kilograms divided by the square of height in metres and patients were enrolled into cases and controls based on World Health Organization (WHO) classification of adults (Table 1) according to BMI.¹⁰⁻¹²

Table 1: Classification of obesity according to World Health Organisation.

Classification	B.M.I (kg/m ²)	Risk of co-morbidities
Underweight	<18.50	Low
Normal	18.50-24.99	Average
Overweight	≥ 25.00	
Preobese	25.00-29.99	Increased
Class 1 obesity	30.00-34.99	Moderate
Class 2 obesity	35.00-39.99	Severe
Class 3/ morbid obesity	≥ 40.00	Very severe

Statistical analysis

Statistical analysis was done using IBM Statistical Products of Service Solution (SPSS) 20.0 software. Associations between various variables were assessed using One way ANOVA and Chi square test and $p < 0.05$ was considered as statistically significant.

Ethical approval

The protocol was approved by the Institutional Ethics Committee at the study site. The study was conducted in accordance with the ethical principles originating in the declaration of Helsinki. All the participants provided written and audio visual informed consent to participate in the study.

RESULTS

The final study sample of 400 patients comprised two groups, 200 obese cases and 200 non-obese controls. Of the total 200 cases 124 (62%) were females and 76 (38%) were males, with sex ratio of 0.61:1 (M:F). Of the total patients, 64 (32%) were in 18-30 years age group followed by 48 (24%) each in 41-50 years and 31-40 years. Majority of patients i.e. 100 (50%) were in Class 1 obesity (BMI 30.00-34.99) and least number of patients, 30 (15%) belonged to class 3 obesity (BMI ≥ 40) (Table 2).

Among 200 cases, 16 were having abnormal lipid profile in the form of raised LDL and total cholesterol. Sixty one were having abnormal blood sugar levels and 35 were having high blood pressures. Forty three patients (21.5%) among 200 cases had family history of obesity, majority of them, in their mothers. Urban population, 124 (62%) was affected more with obesity than people from rural areas, 76 (38%).

The most common cutaneous manifestations seen were acanthosis nigricans, acrochordons, striae distensae, plantar hyperkeratosis, frictional hyperpigmentation and keratosis pilaris (Table 3). Acanthosis nigricans was the commonest association seen and its severity showed direct relation with the severity of obesity. Acrochordons

were seen almost in same frequency as acanthosis nigricans. As the severity of obesity increased acrochordons were noticed in more numbers and involved more areas. Frictional hyperpigmentation was seen to affect obese patients more than control subjects and incidence was proportional to the severity of obesity. Striae distensae, plantar hyperkeratosis and keratosis pilaris followed a similar pattern, with increase in incidence and severity as severity of obesity increased (Table 4).



Figure 1: Acanthosis nigricans in a class 2 obese female.



Figure 2: (a) Multiple acrochordons, (b) acanthosis nigricans in a class 2 obese male.

Table 2: Demographic data (n=200).

	Number of patients	Percentage (%)
Gender		
Male	76	38.0
Female	124	62.0
Age (in years)		
≤30	64	32.0
31-40	48	24.0
41-50	49	24.5
>50	39	19.5
Obesity class (in kg/m²)		
Class 1 (30-34.99)	100	50.0
Class 2 (35-39.99)	70	35.0
Class 3 (≥40)	30	15.0

Table 3: Distribution of most common cutaneous manifestations in obese cases and non-obese controls.

	Cases (%)	Controls (%)
Acanthosis nigricans	55.5	4.5
Acrochordons	53.5	8
Keratosis pilaris	11	1
Striae distensae	38.5	6
Plantar hyperkeratosis	28	5
Frictional hyperpigmentation	39	3
Infections	45	20
Acne vulgaris	20	10
Seborrheic dermatitis	20	5
Chronic eczema	17	5
Psoriasis	16	2
Hirsutism	8	2
Androgenetic alopecia	5	1

Other conditions which showed an increased incidence in obese patients with significant p value are seborrheic dermatitis, infections, hirsutism, chronic eczema and psoriasis (Table 3). Conditions like acne vulgaris, varicose veins, androgenetic alopecia, lymphedema are seen in increased numbers among obese patients, but without significant p value (Table 5).

Table 4: Cutaneous manifestations among obese patients in relation to their body mass index

	Class 1 (%)	Class 2 (%)	Class 3 (%)
Acanthosis nigricans	34	71	90
Acrochordons	41	65	66.7
Striae distensae	29	40	66.7
Plantar hyperkeratosis	16	28.6	66.7
Frictional hyperpigmentation	26	43	73
Keratosis pilaris	3	5.7	50



Figure 3: (a) Striae distensae (b) furuncle and (c) vitiligo in genitalia of a class 2 obese female.



Figure 4: Chronic plaque psoriasis in a class 1 obese female.



Figure 5: Tinea corporis in a class 2 obese female.

Table 5: Distribution of less common cutaneous manifestations in obese cases and non-obese controls.

	Cases (numbers)	Controls (numbers)
Hidradenitis suppurativa	3	-
Palpable purpura(legs)	15	10
Varicose veins	25	10
Meralgia paresthetica	4	2
Sebaceous cyst	35	26
Lymphedema	2	-

DISCUSSION

Obesity, once wrongly considered as a sign of prosperity is now being increasingly pointed at, as a risk factor for many conditions in the field of medicine and surgery.

Increased incidence of obesity was seen in the age group of 18-30 years (32%) in this study. A study by Boza et al showed incidence at a higher age group (40-49 years).¹³ Increased incidence of obesity in a lower age group in our study may be due to the changing lifestyle and young people seeking medical help earlier. Sex ratio corresponds with study by Kalra et al.³ According to the National Family Health Survey (NFHS) the percentage of women who are overweight or obese in the age group of 15-49 years increased from 11% in NFHS-2 to 15% in NFHS-3.³ Distribution of patients in different classes of obesity correlated with the study by Al-Mutairi with majority of cases in Class 1 and Class 2 obesity.¹⁴ Association with systemic features like lipid profile abnormality, diabetes, hypertension, in our study were supported by other studies. Studies by Sczygielska et al and Bhatti et al showed elevation in all parameters of lipid profile except serum HDL in obese patients.^{15,16} Khan et al showed in his study that obese patients have more tendency to develop diabetes mellitus.¹⁷ These form a cluster known as metabolic syndrome or syndrome X originally described by Reaven which includes insulin resistance, impaired glucose tolerance, abdominal obesity, reduced HDL-cholesterol levels, elevated triglycerides and hypertension.¹⁸ In a given population, some people are genetically predisposed to develop obesity, but that genotype may be expressed under certain conditions like high fat diet and sedentary lifestyle.⁴ This explains why obese cases had more stronger family history of the same than control population and why urban population was more affected.

The incidence of various cutaneous manifestations like acanthosis nigricans, acrochordons, striae distensae, plantar hyperkeratosis, frictional hyperpigmentation, keratosis pilaris and infections are significantly more in obese patients and their severity correlated with BMI. This finding was supported by various studies. Studies by Hud et al, Katz et al and Burke et al showed significant association of acanthosis nigricans, keratosis pilaris, striae distensae and bacterial infections in obese patients

and also the correlation of their severity with BMI.¹⁹⁻²¹ Study done by Garcia-Hidalgo et al showed severity correlation of acrochordons, plantar hyperkeratosis, keratosis pilaris and frictional hyperpigmentation with severity of obesity.²² Lecerf et al in his study showed increased incidence of dermatophyte infections in obese patients especially in body folds.²³

Shift of binding of insulin to insulin like growth factor receptor, due to hyperinsulinemia, on keratinocytes and fibroblasts occurs in obese patients leading to hyperplasia and occurrence of acanthosis nigricans and acrochordons.⁶ Hyperpigmentation in acanthosis nigricans is due to hyperkeratosis and papillomatosis. Pathogenesis of striae in obesity is unknown, but Arem and Kisher have proposed that striae are a form of dermal scarring in which the dermal collagen ruptures as a result of stretching.²⁴ Plantar hyperkeratosis is a result of abnormal mechanical stress on the skin which stimulates overactivity of the keratinization process. This natural process of symptom free hyperkeratosis helps to protect the skin and soft tissue layers from mechanical injury.²⁵ Garcia-Hidalgo et al have concluded that insulin resistance plays a role in the occurrence of keratosis pilaris.²² Frictional hyperpigmentation in obesity is due to increased skin folds in obese individuals.²² Adiponectin produced from adipose tissue is a potent immunosuppressive cytokine which increases the chances of infection.²⁶ In addition, obese patients have larger skin folds and sweat more profusely thus increasing both frictional and moisture components leading to skin rashes.²⁴ Macerated skin is readily colonized by various micro-organisms like candida albicans, staphylococcus and streptococcus. Increased number of dermatophyte infections in our study may be due to the warm weather combined with poor hygiene in our locality.

The increased incidence and severity of psoriasis seen in obese individuals in this study is supported by studies done by Fleming et al and Ganguly et al.^{27,28} Exact mechanism underlying the epidemiological association between psoriasis and obesity is uncertain. Researchers have theorized that adipocyte elaboration of pro inflammatory cytokines may exacerbate psoriasis.^{29,30} Also obesity may interfere with successful treatment of psoriasis because some of the drugs used in the treatment of psoriasis may be contraindicated in patients with certain obesity related diseases such as non alcoholic liver disease or high blood pressure.³¹ Prospective studies are needed to determine whether weight control reduces psoriasis morbidity. Seborrheic dermatitis showed significantly increased incidence in obese group than in non-obese controls. Increased incidence of seborrheic dermatitis in obesity may be due to similar mechanism as that of psoriasis as both are chronic inflammatory disorders.³²

Increased incidence of hirsutism in obese patients in our study is supported by Al-Mutairi.¹⁴ Increased incidence of acne vulgaris in the obese group is supported in studies by Halvorsen et al and Abulnaja.^{33,34} Hyperandrogenism

in obesity is due to two reasons, one is increased amount of adipose tissue which will synthesize testosterone and, second is hyperinsulinemia which will increase the production of ovarian androgens. These play a key role in the increased incidence of hirsutism, acne vulgaris and androgenetic alopecia in obese patients.³⁵ Recent progress in understanding the nutrient sensitive kinase m-TORC 1 allows a new view of nutrient signaling in acne by both high glycemic load diet and increase insulin, IGF-1 and leucine signaling due to milk protein consumption. Acne should be regarded as an m-TORC driven disease of civilization, such as obesity, type 2 diabetes, and cancer induced by western diet.³⁶

Chronic eczema was found to be increased in obese patients than controls. This finding is supported in a study of Silverberg et al.³⁷ Chronic venous insufficiency is mainly due to increase in intra-abdominal pressure and resulting impairment in venous return. Pigmentation in chronic venous insufficiency is due to hemoglobin from red blood cells inciting an inflammatory reaction manifesting with erythema and warmth.²⁴

CONCLUSION

Most of the obese patients have atleast one of these cutaneous manifestations. Although the cutaneous manifestations mentioned here are seen in non-obese subjects also, their incidence and severity are significantly more in obese individuals. These cutaneous markers of obesity can thus be used as means to diagnose conditions like diabetes, hypertension or dyslipidemia and to treat them before any serious complications associated with these disorders occur.

Limitations

Main limitation was a limited study period of 16 months. The sample should have been population based rather than hospital based so as to extrapolate to general population.

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Conflict of interest: None declared

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