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Original Article DERMATOLOGY

Comparison of cutaneous manifestations in diabetic and nondiabetic obese patients: A prospective, controlled study

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ABSTRACT

OBJECTIVE: Obesity is known to be a risk factor for many diseases including dermatological problems. Here, we aimed to determine the cutaneous manifestations in obese patients and the frequency of the accompanying dermatoses and to investigate the effect of diabetes mellitus in obese patients on cutaneous manifestations compared with the control group.

METHODS: Our study included a total of 600 adults: 450 obese volunteers and 150 healthy volunteers. The number of diabetic obese patients was 138 (30%), whereas that of nondiabetic obese patients was 312 (70%). A detailed dermatological examination was performed for each case, and accompanying dermatoses were compared.

RESULTS: The mean body mass index (BMI) in the obese patients and control group was 37.22 kg/m^2 and 22.23 kg/m^2, respectively. The most common dermatoses in the obese patients were, according to their frequency: striae distensae (291 patients, 64.7%), acrochordon (236 patients, 52.4%), acanthosis nigricans (213 patients, 47.3%), plantar hyperkeratosis (209 patients, 46.4%), and venous insufficiency (202 patients, 44.9%). Although hirsutism was more frequently observed in the nondiabetic obese group than in the diabetic obese group, stasis dermatitis was less frequently observed ($p<0.05$).

CONCLUSION: We found that many dermatoses are more frequently observed in the obese patients than in the controls. We observed that the effect of obesity on skin is different from that of diabetes mellitus and that cutaneous manifestations of obesity occur more frequently. More extensive, comprehensive, and advanced studies on this subject are required.

Keywords: Diabetes mellitus; obesity; skin findings.

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Obesity is defined as having a body mass index (BMI) of ≥30 kg/m^2, and it has become one of the major health problems in the world. The prevalence of obesity is increasing all over the world. In the United States of America (USA), its prevalence is estimated as 33.8% [1]. In a study by Gultekin et al. [2], the prevalence of obesity in Turkey was reported to be 20% in men and 34.19% in women.

Obesity leads to an increase in not only comorbidities such as cardiovascular diseases, cancer, diabetes mellitus (DM), and orthopedic problems but also the overall mortality rate by 20% [3]. Obesity is also known to affect the barrier function of the skin, sebum production, sweat glands, lymphatics, collagen structure and function, wound healing, and microcirculation and is closely associated with many skin lesions and skin diseases [1, 4].

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The incidence of DM has been rapidly increasing throughout the world, and in 2010, its incidence was reported to be 8.3% in the USA [5]. The complications of diabetes are known to affect all organs, including the skin, and skin lesions have been reported in about one-third of patients with DM [5]. Skin lesions may even be the first sign of DM in some cases and may be a guiding tool for physicians before the initiation of diagnostic tests for DM [5].

To date, many studies evaluating skin lesions in obese patients have been conducted; however, studies investigating the effect of DM on skin lesions in obese patients are limited. Therefore, we aimed to evaluate skin lesions and concomitant dermatoses in obese patients and to investigate the effect of DM on skin lesions in these patients .

MATERIALS AND METHODS

This prospective study was conducted in accordance with the principles of the Declaration of Helsinki, and it followed the protocol approved by the institutional ethical review board of Istanbul Medeniyet University. Patients were recruited in the study after they gave informed consent. This prospective-controlled study included 600 adults, including 450 obese patients who were admitted to the endocrinology outpatient clinic and 150 healthy volunteers. A BMI of ≥30 kg/m^2 was considered as a diagnostic criterion for obesity [1]. The obese patients were divided into two groups: diabetic (n=138) and nondiabetic (n=312). A hemoglobin A1c (HbA1c) value of ≥6.5% or a fasting blood glucose level of ≥126 mg/dL, a 2-h postprandial glucose of ≥200 mg/dL, or a random glucose value of ≥200 mg/dL in patients with classical symptoms of DM was considered as the main diagnostic criterion of DM [6].

The sociodemographic characteristics and BMI values of all the participants were recorded. The blood count and detailed biochemical and hormonal analysis of all participants were obtained from the medical records. The waist circumference and blood pressure values were measured. Detailed dermatological examinations were performed by the same dermatologist, and concomitant dermatoses were separately compared between the obese and control groups and between the diabetic and nondiabetic obese patients. Patients aged <18 years, pregnant women, long-term corticosteroid users, patients with acromegaly and Cushing's disease, cigarette smokers, and those who consumed alcohol were excluded.

Statistical analyses were performed using the SPSS software version 16. The variables were investigated using Kolmogorov–Smirnov test to determine whether or not they were normally distributed. Non-normally distributed variables were expressed as median with interquartile range and normally distributed variables as mean±SD, as appropriate. Between-group comparisons were assessed for nominal variables with the Student's t test and for non-normal variables with the Mann–Whitney U test. P<0.05 was considered as statistically significant.

RESULTS

Of the 450 obese patients, 370 were females and 80 were males. Of the 150 healthy controls, 114 were females and 36 were males. The mean ages of the obese patients and controls were 37.25±11.37 and 35.67±11.24 years, respectively. No statistically significant difference was found in the age and sex distribution between the patients and healthy controls (p>0.05). The mean waist circumferences of the obese patients and healthy controls were 119.72±12.98 and 82.37±9.21 cm, respectively. The BMI values of the obese patients and healthy controls were 37.22±6.07 and 22.23±2.19 kg/m^2, respectively (p<0.05) (Table 1).

The prevalence of acanthosis nigricans, acrochordon, keratosis pilaris, hirsutism, striae distensae, lymphedema, venous insufficiency, stasis dermatitis, plantar hyperkeratosis, hyperhidrosis, pretibial myxedema, cellulitis, varicose vein, atopic dermatitis, erythema intertrigo, tinea pedis, onychomycosis, tinea cruris, and candidal infections was higher in the obese patients than in the healthy controls (p<0.05), although there were no statistically significant difference in the other skin lesions between the groups (p>0.05) (Table 2).

TABLE 1. Demographics data and body measurements of obese patients and controls

	Study group	Control Group	P value
Participants (n)	450	150	
Age (years±SD)	37.25±11.37	35.67±11.24	0.141
Gender (F/M)	370/80	114/36	0.085
Waist circumference	119.72±12.98	82.37±9.21	<0.001
BMI	37.22±6.07	22.23±2.19	<0.001

BMI: Body mass index, F: Female, M: Male, SD: Standard deviation

Table 2. Evaluation of skin findings in obese patients and controls

	Study Group n (%)	Control Group n (%)	P value
Acanthosis nigricans	213 (47.3)	5 (3.3)	<0.001
Acrochordon	236 (52.4)	5 (3.3)	<0.001
Keratosis pilaris	78 (17.3)	2 (1.3)	<0.001
Gouty tophi	1 (0.2)	0	0.564
Hirsutismus	131 (29.1)	2 (1.3)	<0.001
Striae distensae	291 (64.7)	5 (3.3)	<0.001
Adiposis dolorosa	2 (0.4)	0	0.414
Lymphedema	26 (5.8)	0	0.003
Venous insufficiency	202 (44.9)	5 (3.3)	<0.001
Plantar hyperkeratosis	209 (46.4)	5 (3.3)	<0.001
Hyperhidrosis	81 (18.0)	1 (0.7)	<0.001
Intertrigo	62 (13.8)	0	<0.001
Pretibial myxedema	12 (2.7)	0	0.044
Cellulitis	135 (30)	0	<0.001
Viral infections	11 (2.4)	1 (0.7)	0.054
Varicous vein	185 (41.1)	6 (4)	<0.001
Hidradenitis suppurativa	4 (0.9)	0	0.247
Psoriasis	11 (2.4)	3 (2.0)	0.755
Atopic dermatitis	65 (14.4)	3 (2.0)	<0.001
Skin cancer	1 (0.2)	0	0.564
Contact dermatitis	18 (4)	10 (6.7)	0.180
Seborrheic dermatitis	44 (9.8)	7 (4.7)	0.052
Stasis dermatitis	14 (3.1)	0	0.029
Dishydrotic eczema	5 (1.1)	4 (2.7)	0.175
Tinea pedis	90 (20)	12 (8.0)	0.001
Onychomycosis	66 (14.7)	7 (4.7)	0.001
Tinea cruris	13 (2.9)	0	0.035
Tinea versicolor	4 (0.9)	4 (2.7)	0.100
Candidal infections	43 (9.6)	1 (0.7)	<0.001
Folliculitis	24 (5.3)	5 (3.3)	0.328
Furuncle	12 (2.7)	2 (1.3)	0.354
Carbuncle	2 (0.4)	0	0.414
Impetigo	1 (0.2)	0	0.564
Acute paronychia	0	1 (0.7)	0.083

The most common dermatoses in obese patients were striae distensae in 291 (64.7%) patients, acrochordon in 236 (52.4%), acanthosis nigricans in 213 (47.3%), plantar hyperkeratosis in 209 (46.4%), and venous insufficiency in 202 (44.9%). Although the prevalence of hirsutism in the nondiabetic obese group was found to be higher, the prevalence of stasis dermatitis was found to be lower than that in the diabetic obese group ($p<0.05$). However, there were no statistically significant difference regarding other skin lesions and dermatoses between the diabetic and nondiabetic obese groups ($p>0.05$) (Table 3).

DISCUSSION

In the present study, many skin lesions were found to be more common in obese patients than in healthy controls. However, there were no statistically significant differences in the frequency of skin lesions, except for hirsutism and stasis dermatitis, between the diabetic and nondiabetic obese groups. According to these results, the effect of obesity on the prevalence of skin lesions was more prominent than that of DM, and the occurrence of concomitant DM in obese patients did not significantly

TABLE 3. Evaluation of skin findings in diabetic and nondiabetic obese patients

	Diabetic Obese n=138 (%)	Non-Diabetic Obese n=312 (%)	P value
Acanthosis nigricans	66 (47.8)	146 (46.9)	0.937
Acrochordon	75 (54.3)	160 (51.4)	0.639
Keratosis pilaris	17 (12.3)	61 (19.6)	0.060
Gouty tophi	1 (0.7)	0	0.133
Hirsutismus	27 (19.6)	103 (33.1)	0.004
Striae distensae	86 (62.3)	204 (65.6)	0.438
Adiposis dolorosa	0	2 (0.6)	0.346
Lymphedema	9 (6.5)	16 (5.1)	0.558
Venous insufficiency	60(43.5)	141 (45.3)	0.715
Plantar hyperkeratosis	63 (45.7)	145 (46.6)	0.849
Hyperhidrosis	23 (16.7)	58 (18.6)	0.615
Intertrigo	19 (13.8)	42 (13.5)	0.940
Pretibial myxedema	1 (0.7)	11 (3.5)	0.089
Cellulitis	37 (26.8)	98 (31.5)	0.317
Viral infections	3 (2.2)	8 (2.6)	0.801
Varicous vein	57 (41.3)	127 (40.8)	0.926
Hidradenitis suppurativa	1 (0.7)	3 (1.0)	0.803
Psoriasis	1 (0.7)	10 (3.2)	0.116
Atopic dermatitis	15 (10.9)	49 (15.8)	0.172
Skin cancer	0	1 (0.3)	0.505
Contact dermatitis	5 (3.6)	13 (4.2)	0.782
Seborrheic dermatitis	14 (10.1)	30 (9.6)	0.870
Stasis dermatitis	8 (5.8)	6 (1.9)	0.030
Dishydrotic eczema	1 (0.7)	4 (1.3)	0.601
Tinea pedis	29 (21.0)	61 (19.6)	0.733
Onychomycosis	19 (13.8)	47 (15.1)	0.711
Tinea cruris	3 (2.2)	10 (3.2)	0.544
Tinea versicolor	0	4 (1.3)	0.181
Candidal infections	9 (6.5)	34 (10.9)	0.143
Folliculitis	8 (5.8)	16 (5.1)	0.783
Furuncle	5 (3.6)	7 (2.3)	0.406
Carbuncle	0	2 (0.6)	0.346
Impetigo	0	1 (0.3)	0.505

affect the prevalence of skin disorders.

Many adipokines secreted from adipose tissues are known to have autocrine, paracrine, and endocrine effects. Adipose tissues act as endocrine organs and play an important role in the regulation of insulin resistance and inflammation through the secretion of proinflammatory cytokines. Obesity, which is characterized by a massive increase in the body fat, is known to be associated with many dermatoses due to mechanical effects [7]. Also, it is a predisposing factor for many bacterial and fungal infections [1, 8].

Striae distensae are often characterized by linear atrophic plaques seen on the breast, hips, abdomen, and legs. In a previous study by Nazik et al. [7], striae distensae (62%) were found to be the most common skin lesion in obese patients. Boza et al. [9] reported that the most common skin lesion in obese patients was striae distensae (68.4%) and that there was a positive correlation between BMI and the prevalence of striae distensae. In our study, striae distensae (64.7%) were also the most common dermatosis in obese patients, which was consistent with the studies conducted by Nazik et al. [7] and Boza et al. [9]. The frequent occurrence of striae distensae in obese patients may be due to excessive tension in the skin caused by overweight [10]. However, we found no significant dif-

ference in the prevalence of striae distensae between the diabetic and nondiabetic patients in our study ($p>0.05$).

Acrochordons are asymptomatic, pedunculated, polypoid structures commonly seen in the intertriginous areas [11]. They are known to be strongly associated with DM and insulin resistance [12]. Rasi et al. [12] demonstrated a positive correlation between the number of acrochordons and DM and impaired glucose tolerance. Erdogan et al. [4] reported that acrochordons (53.3%) were the most common skin lesions in adult obese patients. In addition, Garcia et al. [13] showed that there was a positive correlation between the prevalence of acrochordons and BMI. Conversely, the prevalence of acrochordons was found to be 52.4% in the obese group in our study and was significantly higher than that in the control group ($p<0.05$). In addition, the prevalence of acrochordons was reported to be higher in diabetic obese patients than in nondiabetic obese patients, although this difference did not reach statistical significance ($p>0.05$).

Acanthosis nigricans is a dermatosis characterized by symmetrical, velvety, hyperpigmented plaques in the intertriginous areas. The most common etiological factors include hyperinsulinemia and obesity [14]. Hud et al. [15] reported that the prevalence of AN was 74% in obese patients. In a previous study by Dassanayake et al. [16], the prevalence of AN in the normal population aged 35–64 years was reported to be 17.4%. In our study, AN was reported to be the third most common dermatosis, with a prevalence of 47.3%. There was no significant difference in the prevalence of AN between diabetic and nondiabetic obese patients ($p>0.05$).

Obesity is a risk factor for the development of chronic venous insufficiency. Increased intra-abdominal pressure in obese patients is known to counteract venous blood return from the lower extremities, leading to the development of varicose veins [1]. Nazik et al. [7] found that varicose veins were more common in obese patients than in controls. In our study, varicose veins and stasis dermatitis were found to be more common in obese patients than in controls ($p<0.05$). Furthermore, stasis dermatitis was found to be more common in diabetic obese patients than in nondiabetic obese patients ($p<0.05$), indicating an important role of the DM pathogenesis in the development of stasis dermatitis.

Obesity is a risk factor for the development of hyperandrogenism and hirsutism [1]. Nazik et al. [7] demonstrated that hirsutism was more common in obese patients than in controls. Codner et al. [17] reported that DM increased the androgen level and that drugs used in the treatment of DM decreased the androgen levels. Consistent with the study of Nazik et al. [7], our study also demonstrated that the incidence of hirsutism was higher in obese patients than in controls ($p<0.05$). In our study, however, the fact that the incidence of hirsutism was found to be lower in the diabetic obese group than in the nondiabetic obese group may be associated with the lowering of androgen levels by the drugs used by diabetic obese patients for the treatment of DM.

In conclusion, skin manifestations are known to occur in obese patients. These skin lesions can sometimes be indicative of another systemic disease and adversely affect the quality of life of patients. However, the coexistence of DM in obese patients seems to have no significant effect on the prevalence of skin lesions, although further large-scale studies are required to establish a definite conclusion.

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