

ORIGINAL ARTICLE

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Dermatologic findings in patients with exogenous obesity: A prospective- clinical investigation**Pelin Hizli¹, Ulker Gul², Muzeyyen Gonul², Yavuz Yalcin³, Serdar Guler⁴, Dilek Berker⁵**¹Balikesir University, Faculty of Medicine, Department of Dermatology, Balikesir, Turkey²Health Sciences University Gulhane Faculty of Medicine, Department of Dermatology and Venereology, Ankara, Turkey³Memorial Hospital, Department of Endocrinology, Istanbul, Turkey⁴Liv Hospital, Department of Endocrinology, Ankara, Turkey⁵Ankara Bilkent City Hospital, Department of Endocrinology, Ankara, Turkey

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**Abstract**

Obesity caused by overnutrition without any underlying organic problem is referred to as exogenous (primary) obesity. The aim of this study was to investigate dermatologic findings and their associations with anthropometric parameters in patients with exogenous obesity. From the patients with presenting symptom of obesity, we included 66 with the diagnosis of exogenous obesity. We excluded the patients with following diseases that might cause dermatologic symptoms: Diabetes mellitus, hyperthyroidism, hypothyroidism, polycystic ovarian syndrome, renal diseases, and hepatic diseases. After comprehensive dermatologic examination, we noted all findings for each patient. We performed a statistical analysis to assess the association between dermatological findings and body-mass index, waist circumference, hip circumference and waist/hip ratio. Sixty-four (97%) patients had at least one dermatologic finding. The most common dermatologic findings were plantar hyperkeratosis (63.6%), stria (56.1%), acrochordon (56.1%), and hyperhidrosis (54.5%). Presence of plantar hyperkeratosis, stria, and hyperhidrosis were significantly higher in females compared with males ($p=0.013$, $p=0.004$, $p=0.032$, respectively). The mean body mass index was significantly higher in patients with acanthosis nigricans and keratosis pilaris ($p=0.016$). The mean waist circumference was significantly higher in patients with hirsutism ($p<0.039$) and the mean hip circumference was significantly higher in patients with stria, intertrigo and acanthosis nigricans ($p=0.012$, $p=0.045$). The mean waist/hip ratio was significantly higher in patients with keratosis pilaris ($p=0.024$). Obesity has a significant association with various dermatologic findings as do main anthropometric parameters of obesity.

Keywords: Obesity, hyperkeratosis, acrochordon, hyperhidrosis, body-mass index, stria.**Introduction**

Obesity, the excess of rational or total body fat, can cause many severe health problems [1,2]. Multiple etiologic factors may play a role in the mechanism of obesity [3]. According to the classification based on its causative mechanism, obesity caused by overnutrition without any underlying organic disorder is referred to as exogenous or primary obesity and the one caused by a hormonal or a genetic disorder is referred to as endogenous or secondary obesity [4, 5]. Obesity may lead multiple systemic complications including hypertension, coronary artery disease, cerebrovascular disease, sleep apnea, hiatal hernia, gallbladder stone, hepatic steatosis,

colorectal carcinoma, metabolic dyslipidemia, type 2 diabetes mellitus, hyperuricemia, locomotor osteoarthritis and deep venous thrombosis. In addition to these systemic complications, obesity may have many different effects on the skin [6]. There exist multiple different mechanisms of the effects of the obesity on the skin. It may affect the barrier function, sebaceous glands, production of the sebum, sweat glands, lymphatics, collagenous structures and their functions, wound healing, microcirculation, macrocirculation, and the components of subcutaneous fat tissue. It may also cause many types of dermatosis, affecting the sensitivity of the skin, heat distribution and the structure of the feet [7].

In the prior literature, a limited number of studies focusing the effects of obesity on the skin are available [8, 9]. These prior publications usually focused on obesity together with other conditions such as diabetes mellitus [9, 10]. To the best of our knowledge, no study thus far has investigated the dermatologic findings particularly in the patients with exogenous obesity, in

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the literature of English language. The goal of this prospective -multidisciplinary -clinical study was to investigate dermatologic symptoms occurring in patients with exogenous obesity, and the factors affecting these symptoms.

Materials and Methods

Patients and Study Design

This prospective, clinical study was conducted in line with the dictates of Helsinki Declaration and approved by the local ethical committee of Ankara Numune Training and Research Hospital) (IRB Number: 2011-137). From the patients with the presenting symptom of obesity between April 2011 and June 2011 in our tertiary institution, 66 with the diagnosis of exogenous obesity (age range: 19-69 years) were included in the study. The patients with exogenous obesity were referred us from the endocrinology clinic of our tertiary institution after taking a detailed patient history, a comprehensive physical examination and laboratory analysis, with a record of additional diseases. We excluded the patients with following diseases that might cause dermatologic symptoms: diabetes mellitus, hyperthyroidism, hypothyroidism, polycystic ovarian syndrome (PCOS), renal diseases and hepatic diseases. We noted all skin findings of every single patient after comprehensive dermatologic examination.

We confirmed the diagnosis of obesity calculating the body- mass index (BMI) for all patients using the well- known formula "[BMI = weight (kg) / height (m²)]" [11]. Diagnosed as obesity were the patients with BMI more than 30. We noted the waist circumferences of all patients measuring at the level of belly, parallel to the ground. Additionally, we noted the hip circumferences measuring at the level of pubis anteriorly and at the level of the point at which greater gluteal muscle is most prominent posteriorly.

Of the patients with acrochordons, we noted the number of the lesions. To confirm the presence of any fungal infection, we performed a native fungus scanning for patients with lesions consistent with superficial fungal infections like tinea pedis and onychomycosis clinically.

We assessed the association between the gender and the frequency of dermatological findings. We excluded hirsutism (a female disease) from the comparison of males and females. Additionally, we investigated the association between the anthropometric data of the patients (BMI, waist circumference, hip circumference, waist/hip ratio) and the presence of any dermatologic finding.

Statistical Analysis

We presented the results of continuous variables as mean $\pm$ standard deviation (SD), sequential variables as median (minimum-maximum) and categorical variables as percentage (%). We tested the normality of the distribution of the continuous variables using Shapiro Wilk test. We tested the importance of the differences of mean values among the groups using independent T test and median values using Mann Whitney U test. We tested the association of categorical variables among the groups using Pearson's Chi-square or Fisher's exact test. To assess the correlation between the number of acrochordons and anthropometric measurement results, we used Spearman's correlation test. For the statistical analysis, we used SPSS 11.5 software for Windows (SPSS Inc., Chicago, IL). A P value less than 0.05 was considered statistically significant.

Results

From 66 patients, 16 (24.2%) were male and 50 (75.8%) were female. The mean age of the study population was 41.7 ± 11.7 (19 - 69) years and the mean BMI was 39.7 ± 7.5 (30- 60.9). Of the 66 patients, 25 (37.8%) had no disease coexisting with obesity. However, 42 (63.6%) patients had coexisting diseases as shown in table 1.

Table 1. Coexisting diseases in patients with exogenous obesity

	Frequency (n=42)	
	n	%
Hypertension	12	18.1
Sleep apnea syndrome	7	10.6
Asthma	6	9
Depression	3	4.5
Lumbar hernia	2	3
COPD	2	3
Migraine	2	3
Renal stones	2	3
Aortic insufficiency	1	1.5
Coronary artery disease	1	1.5
Hepatitis B carrier status	1	1.5
Endometrial myoma	1	1.5
Thyroiditis	1	1.5
History of gynecologic surgery	1	1.5

Dermatologic examination revealed that 64 (97%) patients had at least one dermatologic finding whereas 2 (3%) had no dermatologic finding. The most common dermatologic findings were plantar hyperkeratosis (63.6%), stria (56.1%), acrochordon (56.1%) and hyperhidrosis (54.5%) as shown in table 2.

Table 2. Dermatologic findings of the patients

	Frequency (n=66)	
	n	%
Plantar hyperkeratosis	42	63.6
Stria	37	56.1
Acrochordon	37	56.1
Hyperhidrosis	36	54.5
Intertrigo	19	28.8
Tinea pedis	15	22.7
Onychomycosis	13	19.7
Hirsutism	13	19.7
Folliculitis	8	12.1
Acanthosis nigricans	8	12.1
Keratosis pilaris	5	7.6
Psoriasis	3	4.5
Acne	2	3

The frequency of dermatologic findings in males and females were shown in table 3. Presence of plantar hyperkeratosis, stria, and hyperhidrosis were significantly higher in females compared with males ($p=0.013$, $p=0.004$, $p=0.032$, respectively). The mean anthropometric data of the patients with and without every single dermatologic finding was shown in table 4. The mean BMI was significantly higher in patients with acanthosis nigricans and keratosis pilaris compared with the patients without acanthosis

nigricans and keratosis pilaris ($p=0.016$). The mean waist circumference was significantly higher in patients with hirsutism compared with the patients without hirsutism ($p=0.039$). The mean hip circumference was significantly higher in patients with stria, intertrigo and acanthosis nigricans compared with the patients without stria, intertrigo and acanthosis nigricans ($p=0.012$, $p=0.045$). The mean waist/hip ratio was significantly

higher in patients with keratosis pilaris compared to the patients without keratosis pilaris ($p=0.024$), but it was significantly lower in patients with plantar hyperkeratosis compared to the patients without plantar hyperkeratosis ($p=0.008$). The number of acrochordons varied from 1 to 50 among patients and it was not significantly associated with the BMI, waist circumference, hip circumference, and waist/hip ratio of the patients ($p > 0.05$).

Table 3. The frequency of dermatologic findings in males and females

	Females (n=50)	Males (n=16)	P value
Plantar hyperkeratosis	36 (72%)	6 (37.5%)	0.013
Stria	33 (66%)	4 (25%)	0.004
Acrochordon	28 (56%)	9 (56.3%)	0.986
Hyperhidrosis	31 (62%)	5 (31.3%)	0.032
Intertrigo	16 (32%)	3 (18.8%)	0.362
Tinea pedis	11 (22%)	4 (25%)	1.000
Onychomycosis	9 (18%)	4 (25%)	0.719
Folliculitis	4 (8%)	4 (25%)	0.075
Acanthosis nigricans	7 (14%)	1 (6.3%)	0.668
Keratosis pilaris	5 (10%)	0 (0%)	0.325

Table 4. The mean anthropometric data of the patients with and without every single dermatologic finding.

	BMI			Waist Circumference			Hip Circumference			Waist/Hip Ratio		
	-	+	p	-	+	p	-	+	p	-	+	p
Plantar hyperkeratosis	39.3±7.7	39.9±7.5	0.753	114.4±13.3	110.8±13.8	0.312	122.5±11.1	129.0±14.7	0.067	0.92±0.11	0.85±0.10	0.008
Stria	38.0±6.5	41.1±8.0	0.099	111.3±14.0	112.8±13.4	0.658	121.9±12.2	130.3±13.9	0.012	0.90±0.12	0.86±0.10	0.091
Acrochordon	39.1±7.9	40.2±7.2	0.567	109.8±13.1	114.0±13.8	0.214	127.7±16.1	125.8±11.7	0.598	0.85±0.11	0.90±0.10	0.079
Hyperhidrosis	38.0±7.2	41.1±7.6	0.097	110.2±13.5	113.7±13.6	0.290	124.4±12.6	128.5±14.5	0.223	0.88±0.12	0.88±0.10	0.971
Intertrigo	38.7±7.2	42.3±7.9	0.076	111.0±12.6	114.9±15.7	0.295	124.5±12.0	131.9±16.5	0.045	0.88±0.11	0.87±0.10	0.715
Tinea pedis	39.4±7.4	40.9±7.8	0.500	111.8±13.6	113.1±14.0	0.746	125.9±14.5	129.1±10.9	0.440	0.88±0.12	0.86±0.10	0.529
Onychomycosis	39.5±7.6	40.7±7.1	0.593	112.7±13.3	109.9±15.1	0.519	126.5±14.1	127.2±12.5	0.863	0.88±0.11	0.85±0.16	0.312
Hirsutism	39.3±6.2	44.2±9.8	0.117	109.2±11.3	117.4±14.0	0.039	126.3±12.2	134.2±17.5	0.079	0.86±0.10	0.88±0.10	0.508
Folliculitis	39.6±7.5	41.2±7.2	0.574	112.2±13.7	112.6±14.2	0.934	125.9±13.8	133.9±11.1	0.124	0.88±0.11	0.82±0.10	0.120
Acanthosis nigricans	38.9±7.4	45.6±4.9	0.016	111.2±13.6	118.6±12.2	0.150	125.1±13.6	137.9±9.5	0.012	0.88±0.11	0.86±0.10	0.604
Keratosis pilaris	39.1±7.1	47.4±8.3	0.016	111.2±13.4	123.2±11.6	0.057	126.7±13.8	126.0±14.5	0.915	0.87±0.10	0.98±0.16	0.024

- : absence, +: presence

Discussion

Dermatologic findings of the patients with obesity have an implication for physicians to find out the causative mechanisms of these findings and to keep the other associations of the obesity with different organ systems in mind. Despite this implication, prior studies focusing on the frequency and number of dermatologic findings are quite limited as are the studies about the causative mechanism of these findings. In the perspective of conducting a study with select patients of obesity, this is the first study in the literature, conducted only with exogenous obesity patients. In addition, this study investigated the association of dermatologic findings with anthropometric parameters, unlike previous literature.

Hidalgo et al. reported the most common dermatologic findings of the patients with obesity as acrochordons, stria, plantar hyperkeratosis, acanthosis nigricans and keratosis pilaris

respectively [9]. However, Mutairi reported the most common finding as plantar hyperkeratosis, followed by acanthosis nigricans, acrochordons, stria, intertrigo, acne, hirsutism, folliculitis, tinea cruris, and hyperhidrosis [8]. In these studies, reported dermatologic findings were almost similar but we should bear in mind that they included patients with diabetes mellitus and other diseases that might cause dermatologic findings in their study population. Unlike these publications, we excluded the patients with diseases that might cause dermatologic findings like diabetes mellitus, hyperthyroidism, hypothyroidism, PCOS, renal diseases and hepatic diseases. In our study, we found the prevalence of acanthosis nigricans lower than in these studies. Because we excluded the patients with diabetes, this finding suggests that acanthosis nigricans might have an association with diabetes mellitus. Supporting this contention, Hud et al. reported a higher fasting plasma insulin level in patients with obesity and acanthosis nigricans, compared to the patients without acanthosis

nigricans, suggesting the presence of acanthosis nigricans as a marker of hyperinsulinemia [12]. Additionally, the reason for lower prevalence of acanthosis nigricans in our study might be the exclusion of the patients with PCOS.

In consistent with the prior literature, we found plantar hyperkeratosis as the most common dermatologic finding. Hills et al. reported that a higher pressure on the feet of the patients with obesity caused plantar hyperkeratosis and structural differences of musculoskeletal system between males and females might be the cause of higher incidence of plantar hyperkeratosis in females [13]. In consistent with this report, we found the prevalence of plantar hyperkeratosis higher in females than in males.

Kahana et al. reported that any association between the presence of acrochordons and obesity was not present, but presence of acrochordons might be associated with increased risk of diabetes mellitus and carbohydrate metabolism disorder [10]. Despite this report, we found acrochordons in 56% of our study group. Accordingly, presence of acrochordons might be directly associated with obesity as well as glucose intolerance, because we did not evaluate the glucose intolerance of the patients in our study group. Demir et al. supported this contention with their study reporting that presence of acrochordons was associated with glucose intolerance [14].

In consistent with the study of Yosipovitch et al. [15], we found a positive correlation between the presence of keratosis pilaris and BMI. However Barth et al. reported that obesity was not effective on the development of keratosis pilaris alone [16]. Because of different reports from various studies, the association of presence of keratosis pilaris with obesity remains a matter of debate.

We found a higher prevalence of tinea pedis and onychomycosis in our study than in the previous study of Şahin et al. that focus on general population [17]. Thus, we can hypothesize that, dermatophyte infections might be more common in patients with obesity compared to the normal population.

Hirsutism was a common finding in female patients of our study group with a frequency of 26%. Higher incidence of hirsutism despite the exclusion of the patients with PCOS might be associated with ethnic factors. Additionally, in contrast with previous publications [18], we did not found any significant association between BMI and presence of hirsutism, but found that presence of hirsutism was significantly higher in patients with higher waist circumference.

Although focusing on a limited population of obesity to determine absolute association of dermatological findings with obesity, this study has some limitations. The major limitation was the number of patients. The descriptive statistics might have been more meaningful if more patients had been included. The lack of comparison of dermatologic findings with another patient group with different features was another limitation for this study as well as the lack of a control group.

Conclusion

In conclusion, obesity has a significant association with dermatologic findings as do main anthropometric parameters of obesity. The most common dermatologic findings of the patients with exogenous obesity were plantar hyperkeratosis,

stria, acrochordons, and hyperhidrosis, respectively. Plantar hyperkeratosis and hyperhidrosis were more common in females than in males. Presence of acanthosis nigricans and keratosis pilaris were significantly associated with higher BMI. We found a significant association between the presence of hirsutism and waist circumference; presence of stria, intertrigo and acanthosis nigricans with hip circumference; and presence of plantar hyperkeratosis and keratosis pilaris with waist/hip ratio.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

All procedures performed in this study were in accordance with the ethical standards of local ethical committee of Ankara Bilkent City Hospital (formerly: Ankara Numune Training and Research Hospital) (IRB Number: 2011-137)

References

- Hellerstein M, Parks E. Obesity & Overweight. In: Greenspan F, Gardner D (eds). Basic and clinical endocrinology, 7 Edition. New York: The McGraw-Hill Companies, Inc. 2004;794-813.
- Klein S, Romijn J. Obesity. In: Kronenberg H, Melmed S, Polonsky K, Larsen P (eds). Williams textbook of endocrinology, 11 Edition. Philadelphia: Saunders Elsevier. 2008;1563-88.
- Ersoy R, Çakır B. Obezite. Turk Med J. 2007;1:109-11.
- Flier S, Folder D. Eating disorders: obesity, anorexia nervosa, and bulimia nervosa. In: Wilson. Foster D, Kronenberg H, Larsen P (eds). Williams Textbook of Endocrinology, 9 Edition. Philadelphia: W. B. Saunders Company. 1998;1061-95.
- Günöz H. Çocuk ve Adölesanlarda Obezite. Aktüel Tıp Dergisi. 2001;6:58-61.
- Kopelman B. Defining overweight and obesity. In: Kopelman P, Dunizt M (eds). The management of obesity and related disorders. London: Taylor & Francis e-Library, 2003;1-10.
- Scheinfeld NS. Obesity and dermatology. Clin Dermatol. 2004;22:303-9.
- Al-Mutairi N. Associated cutaneous diseases in obese adult patients: a prospective study from a skin referral care center. Med Princ Pract. 2011;20:248-52.
- Garcia-Hidalgo L, Orozco-Topete R, Gonzalez-Barranco J, et al. Dermatoses in 156 obese adults. Obes Res. 1999;7:299-302.
- Kahana M, Grossman E, Feinstein A, et al. Skin tags: a cutaneous marker for diabetes mellitus. Acta Derm Venereol. 1987;67:175-7.
- Garrow JS, Webster J. Quetelet's index (W/H²) as a measure of fatness. Int J Obes. 1985;9:147-53.
- Hud JA, Jr., Cohen JB, Wagner JM, et al. Prevalence and significance of acanthosis nigricans in an adult obese population. Arch Dermatol. 1992;128:941-4.
- Hills AP, Hennig EM, McDonald M, et al. Plantar pressure differences between obese and non-obese adults: a biomechanical analysis. Int J Obes Relat Metab Disord. 2001;25:1674-9.
- Demir S, Demir Y. Acrochordon and impaired carbohydrate metabolism. Acta Diabetol. 2002;39:57-9.
- Yosipovitch G, Mevorah B, Mashiach J et al. High body mass index, dry scaly leg skin and atopic conditions are highly associated with keratosis pilaris. Dermatol. 2000;201:34-6.
- Barth JH, Wojnarowska F, Dawber RP. Is keratosis pilaris another androgen-dependent dermatosis? Clin Exp Dermatol. 1988;13:240-1.
- Sahin I, Oksuz I, Kaya I, et al. Dermatophytes in the rural area of Duzce, Turkey. Mycoses. 2004;47:470-4.
- Ruutiainen K, Erkkola R, Gronroos MA, et al. Influence of body mass index and age on the grade of hair growth in hirsute women of reproductive ages. Fertil Steril. 1988;50:260-5.