Our Dermatology Online

Original Article

A clinical study of striae emphasizing co-morbidities

Priyanka Agarwal, Priya K Sundar, Umashankar Nagaraju, Belliappa P Raju

Department of Dermatology, Rajarajeswari Medical College and Hospital, Bengaluru, Karnataka, India

Corresponding author: Priyanka Agarwal, MD, E-mail: priyankka.agarwal@gmail.com

ABSTRACT

Background: Striae are a disfiguring cutaneous condition characterized by linear smooth bands of atrophic-appearing skin that occur in areas of dermal damage produced by stretching. They occur about twice as frequently in women as in men. They commonly occur during pregnancy, puberty, and obesity. **Aims of the Study:** The aim was to study the clinical profile and co-morbidities associated with striae and to study the correlation between striae and obesity with grading of obesity based on BMI. **Methods:** A complete evaluation of 107 patients with striae attending the Department of Dermatology of Rajarajeswari Medical College and Hospital was done over a period of one year. The data was collected by history taking and clinical examination. **Results:** This study comprised 107 patients, with a female preponderance. The majority of the patients (38.3%) belonged to the age group of 20–29 years. Striae alba was present in 66.4% of the patients. Striae because of pregnancy was present in 31.8%, followed by 22.4% who gave a history of steroid use. In adult female patients, the sites commonly involved were the abdomen (42.1%), thigh (30.8%), and breast (12.1%), whereas the thigh (50%) and buttocks (22.7%) were sites more commonly involved in adolescent female patients. In adult male patients, the sites commonly involved were the thigh (12.1%) and abdomen (8.4%), whereas in adolescent male patients, the sites most involved were the lower back (31.8%), thigh (9.1%), knee (9.1%), and buttocks (9.1%). Obesity was the major co-morbidity associated with striae, present in 39 (36.4.%) patients. Most of these obese patients belonged to obesity class I. **Conclusion:** Pregnancy is the most common cause of striae in females. Steroid abuse is the most common cause of developing striae in males in the present era, which is a multi-faceted problem that needs multi-dimensional interventions. Obesity is the major comorbidity associated with striae, followed by diabetes mellitus. In obese individuals, it is most often seen in obesity class I. Hence, a modification of lifestyle is the key to preventing obesity, which may, to a certain extent, prevent the development of striae.

Key words: Striae, Obesity, BMI, Co-morbidities

INTRODUCTION

Striae are a disfiguring cutaneous condition characterized by smooth, linear bands of atrophic-appearing skin that occur in areas of dermal damage produced by stretching [1].

Striae usually develop between 5 and 50 years of age. They occur about twice as frequently in women as in men [2]. They may have differing etiologies yet commonly occur during pregnancy, puberty, and obesity [3-5]. They occur in numerous other conditions such as connective tissue disorders, Cushing's syndrome, Marfan syndrome, hypercortisolism, diabetes, and long-term systemic or topical steroid use or exposure [6]. Although frequently encountered, the prevalence of striae distensae cited in the literature varies tremendously, ranging from 11% to 88% [7]. Anatomical sites affected vary widely, with the commonly affected areas being the abdomen, breast, thighs, and buttocks [3,4].

They rarely cause significant medical concern. However, they pose a psychological burden for the patients. Striae poses a considerable challenge to clinicians in terms of evaluation and treatment. A proper understanding of striae is essential for a rational approach. Hence, this study was undertaken to study the clinical profile and co-morbidities associated with striae and to study the correlation between striae and obesity with grading of obesity based on BMI.

How to cite this article: Agarwal P, Sundar PK, Nagaraju U, Raju BP. A clinical study of striae emphasizing co-morbidities. Our Dermatol Online. 2025;16(1):1-6.

Submission: 19.06.2024; **Acceptance:** 07.08.2024

DOI: 10.7241/ourd.20251.1

METHODS

Ethical clearance was taken from the institutional ethical committee. In the present study, we included 107 patients with striae, attending as outpatients and admitted as inpatients at the Department of Dermatology, Rajarajeswari Medical College and Hospital, over a period of one year. Patients of both sexes and all age groups with striae were included in the study. Pregnant female patients were excluded. Post-pregnancy patients were included after 6 months post-partum.

Consent was taken from the patient or from the parent or guardian (in case of a minor patient). A detailed history, including information on the patient's demographics, clinical presentation, along with a history of associated medical and surgical condition were obtained. We classified the patients based on the number of sites involved as localized and multiple site involvement.

Localized: patients who had a single site involved bilaterally.

Multiple: when two or more sites were involved bilaterally.

A diagnosis of striae was made based on clinical presentation, histopathology, and exclusion of other diseases that may have a similar presentation. BMI was calculated for every patient taking the patient's weight and height into consideration. Every patient was categorized based on the international classification of adult underweight, overweight, and obesity according to BMI (Adapted from WHO 1995, WHO 2000, and WHO 2004) (Table 1).

Investigations such as complete hemogram, fasting and post-prandial blood sugar levels, lipid profile, liver function test, renal function test, thyroid profile, ultrasonogram, serum cortisol, serum adrenocorticotropic hormone, luteinizing hormone, follicle-stimulating hormone, total and free testosterone, prolactin, dehydroepiandrosterone sulfate, chest X-ray, magnetic resonance imaging, electrocardiogram, and echocardiogram were done where required to exclude other comorbidities. Skin biopsy for histopathology was done if required. The results of the investigations were documented.

Statistical Analysis

A descriptive study of the patients with striae was performed. The collected data was analyzed with IBM SPSS Statistics, version 23.0. To describe the data, descriptive statistics, frequency analysis, and percentage analysis were used and depicted in the form of graphs and pie charts wherever necessary.

Table 1: Classification of obesity

Classification	BMI (kg/m²)	
	Principal cut-off points	Additional cut-off points
Underweight	< 18.50	< 18.50
Severe thinness	< 16.00	< 16.00
Moderate thinness	16.00–16.99	16.00–16.99
Mild thinness	17.00–18.49	17.00–18.49
Normal range	18.50–24.99	18.50–22.99
		23.00–24.99
Overweight	>= 25.00	>= 25.00
Pre-obese	25.00–29.99	25.00–27.49
		27.50–29.99
Obese	>= 30.00	>= 30.00
Obese class I	30.00–34.99	30.00–32.49
		32.50–34.99
Obese class II	35.00–39.99	35.00–37.49
		37.50–39.99
Obese class III	>= 40.00	>= 40.00

RESULTS

A total of 107 patients were examined during the period of the study. There were 71 female and 36 male patients. The female-to-male ratio was 2:1. The peak period of age at presentation was between 20 and 29 years, constituting 38.3% of all patients. In our study, 20.6% of the patients belonged to the adolescent age group (10–19 years), among which 15 were female, and the remaining were male, with a female-to-male ratio of 2.1:1. The average age of the adolescent females in our study was 14.7 years, whereas in the adolescent males, it was 15.8 years.

In our study, the majority of the patients presented with striae alba (66.4%), 27.1% with striae rubra, and 4.7% with hyperpigmented striae. One patient had both striae alba and striae rubra, and one patient had purple striae (Fig. 1). Among the adolescent patients, the majority (68.2%) presented with striae alba.

Post-pregnancy striae were seen in 31.8%, 22.4% developed it following steroid abuse, 19.6% because of weight gain, 11.2% due to exercise, 5.6% due to pubertal growth spurt, 4.7% due to both exercise and steroids, and 4.7% because of weight loss. Striae following pregnancy was the most common cause among female patients present in 47.9 % whereas steroid abuse was the main cause of developing striae in male patients present in 41.7% (Fig. 2). Among patients with striae

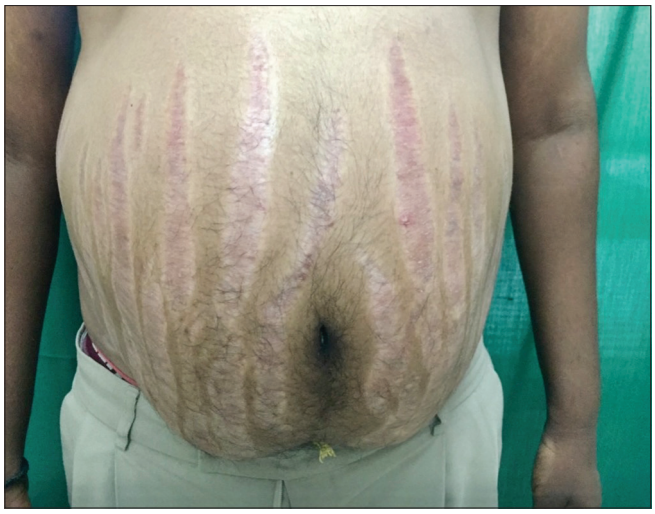

Figure 1: Purple striae involving the abdomen in iatrogenic Cushing syndrome.

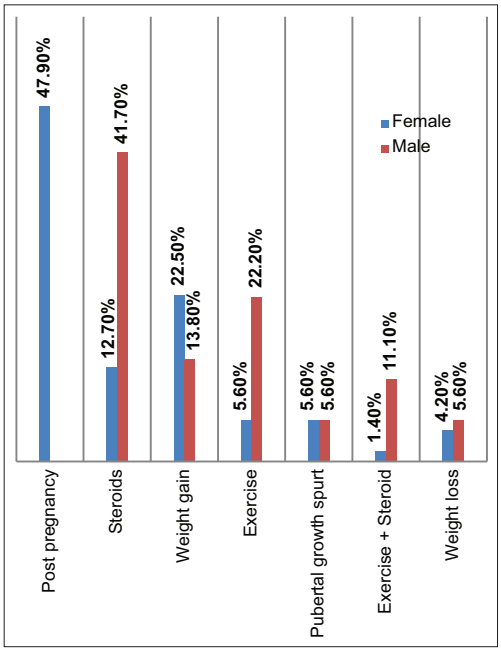

Figure 2: Sex distribution of striae vs. their etiology.

due to steroid abuse, topical steroid was abused by 18.7% of all patients for a duration of three months to two years. The causes for topical steroid abuse were fungal infections, intertrigo, and pruritus. Among these patients, the most common site of development of striae was the medial aspect of the thigh, followed by the axilla (Figs. 3a and 3b).

Localized striae were seen in 36.4% of the patients, among which 13.1% was due to topical steroid abuse (Table 2), whereas multiple sites were involved in 63.6% of the patients (Fig. 4). The thigh (50%) and buttocks (22.7%) were sites more commonly involved

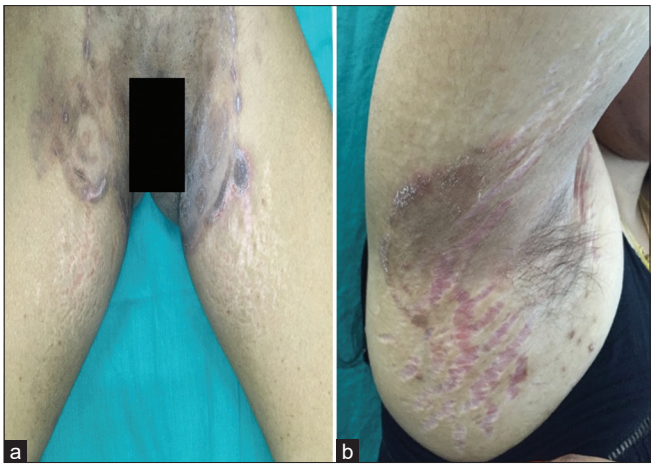

Figure 3: (a and b) Medial aspect of the thigh and axilla, sites commonly involved following topical steroid abuse.

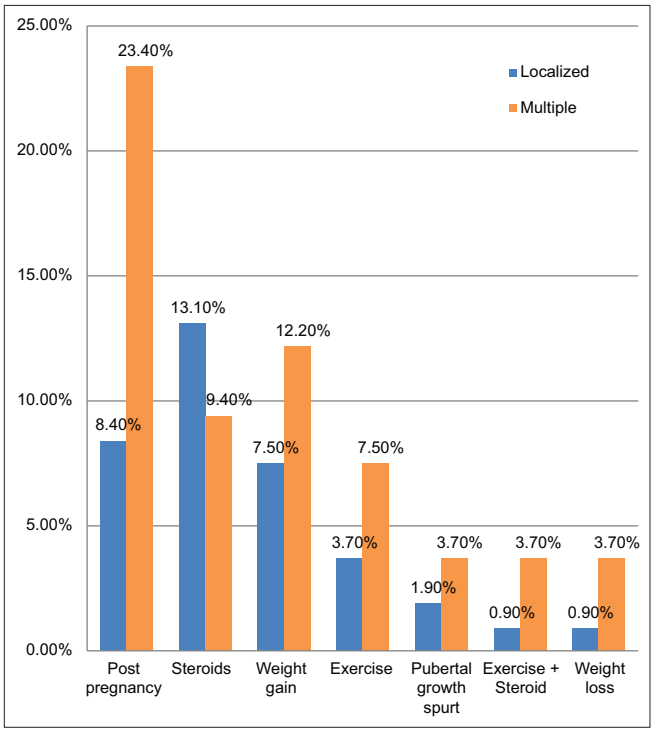

Figure 4: Distribution of the number of sites involved vs. etiology.

Table 2: Distribution of the number of sites involved based on the formulation of the steroid

Etiology (Steroid)	Number of sites	
	Localized	Multiple (2/>2)
Topical steroid	14 (13.1%)	6 (5.6%)
Systemic steroid	0 (0.0%)	4 (3.7%)
Total	14 (13.1%)	10 (9.3%)

in adolescent female patients. In adolescent male patients, the sites most often involved were the lower back (31.8%), thigh (9.1%), knee (9.1%), and buttocks (9.1%). Sites commonly involved in adult female patients were the abdomen (42.1%), followed by the

thigh (30.8%) and breast (12.1%), whereas in adult male patients, sites more commonly involved were the thigh (12.1%) and abdomen (8.4%). The abdomen was the most common site, involved in 33 (97.1%) patients who developed post-pregnancy striae, followed by the thigh (52.9%) and breast (35.3%).

In our study, obesity was the main comorbidity associated with striae, present in 39 (36.4%) patients (Fig. 5), among which 13 obese patients belonged to the age group 30–39 years. Most of these obese individuals belonged to obesity class I, accounting for 20.6% of the patients (Fig. 6). Other co-morbidities associated with striae were diabetes mellitus (8.4%), hypertension (5.6%), polycystic ovarian syndrome (5.6%), both diabetes mellitus and hypertension (1.9%), iatrogenic Cushing syndrome (0.9%), and pituitary microadenoma (0.9%).

Other comorbidities present in patients with obesity were diabetes mellitus, present in six obese patients, followed by PCOS, present in five obese patients (Fig. 7).

DISCUSSION

Striae is a connective tissue disorder due to cutaneous atrophy affecting a good proportion of the global population. Although it is not usually an impairing medical problem, it causes psychological distress, hence affects the quality of life. Most of the patients in our study were female, with a female-to-male ratio of 2:1. Among adolescent patients (10–19 years), the female-to-male ratio was 2.1:1. This was in accordance with a study by Sisson [4], who found that, in adolescent children, striae occur in girls about 2.5 times more frequently than in boys. The average age of the adolescent females was 14.7 years, whereas in the adolescent males, it was 15.8 years. This was in concordance with Al-Himdani et al. [7], who stated that the average age of the adolescent females developing striae was 13–14 years whereas that of adolescent males was 14 years. Striae alba was present in 68.2% of adolescent patients. This was similar to a study by Cho et al. [3], in which, out of 131 adolescent subjects with striae, 69.5% had striae that were white in color.

Pregnancy was the cause attributed by 31.8% of the patients who developed striae. Steroid abuse by 22.4% of the patients was the second major cause for developing striae, and in male patients, it was seen in

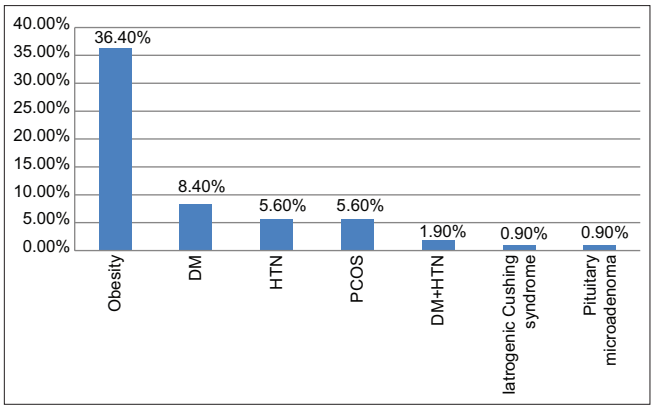

Figure 5: Comorbidities associated with striae.

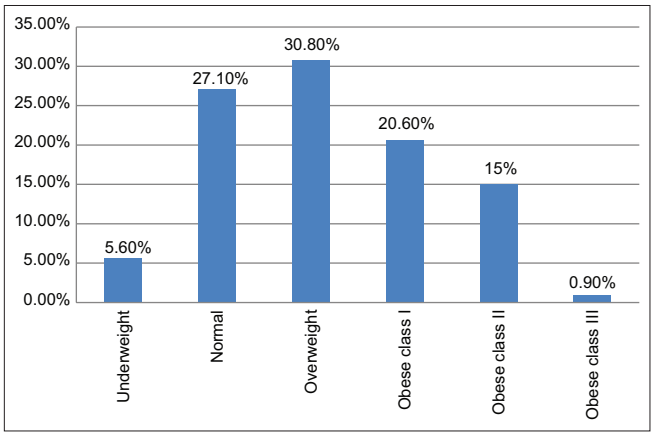

Figure 6: Distribution of striae vs. BMI.

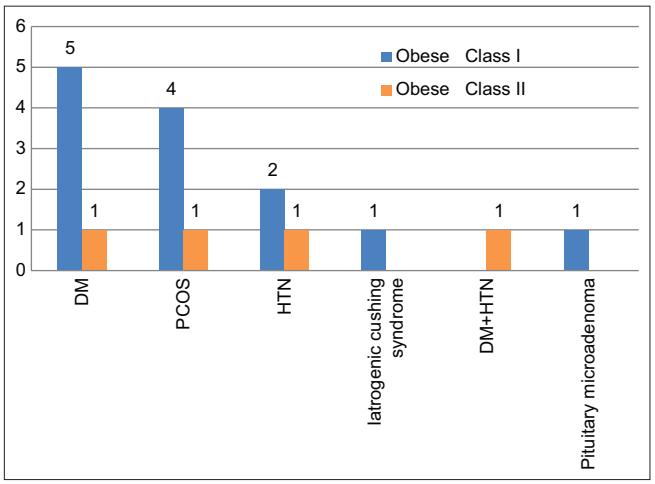

Figure 7: Comorbidities associated with obesity.

41.7%. Twenty patients gave a history of using topical steroids for a duration varying between three months to two years. Pavithran [8] showed the development of pinkish atrophic striae at the sites of prolonged application of topical corticosteroid in two male and one female patient. The duration of application in the three cases was 4, 22, and 18 months, which was

concordant with our study. A study by Nnoruka and Okoye [9] on topical steroid abuse as a depigmenting agent showed the presence of striae in 28.3% of cases because of steroid abuse. The median duration of use was nine years. Gupta [10] reported a case where a patient with vitiligo developed striae following the application of topical steroids for just 25 days. The main cause for steroid abuse may be attributed to their lack of information and severe withdrawal dermatitis that results from the withdrawal of the offending steroid, which makes discontinuation difficult for the patient.

The thigh (50%) and buttocks (22.7%) were the most common sites of striae development in adolescent female patients, whereas the lower back was the most common site involved, in 31.8% of the adolescent male patients, followed by the thigh, buttocks, and knee. In a study by Cho et al. [3], in adolescents of both sexes, the buttock was the most prevalent area of striae development, followed by the lower back and knee in boys and by the thigh and calf in girls. Striae were significantly more common on the thigh of girls and on the knee of boys. Al-Himdani et al. [7] stated that thighs, buttocks, and breasts are sites involved in adolescent females, whereas the thighs, buttocks, calves, and back are sites most often involved in adolescent males. These studies were concordant with our study. In our study, the sites most often involved in adult female patients were the abdomen (42.1%), thigh (30.8%), and breast (12.1%), whereas the thigh (12.1%), abdomen (8.4%), and axilla (7.5%) were the sites most often involved in adult male patients. The breast and thigh are sites commonly involved in adult females, whereas the buttocks is the site mostly involved in adult males, as stated by Al-Himdani et al. [7]. The difference in site involvement in adolescents and adults in either sex may be explained based on the difference in etiology. Striae during adolescence mainly occur because of rapid deposition of adipose tissue or muscular hypertrophy beneath the dermal layer [11], whereas as stated by Al Himdani et al. [7], striae in adult women occur mainly post-pregnancy and, in adult males, is a result of sudden weight gain/loss and muscular exercise.

The abdomen was the most common site involved (97.1%) in patients who attributed the development of striae to past pregnancy assessed not earlier than six months postpartum. This was followed by the thigh in 52.9% and the breast in 35.3%, which was in concordance with most previous studies [5,12]. Mechanical distention and rapidly developing obesity are associated mostly with striae formation during pregnancy. It is suggested that relaxin and estrogen, perhaps in combination with the raised cortisol levels of pregnancy, may cause the accumulation of mucopolysaccharides, increase the water absorption of connective tissue [13] and prime it for cleavage in the presence of mechanical stress [14]. The axilla and the medial aspect of the thigh were the most common sites involved following topical steroid abuse, which was similar to most previous studies [8,10,15]. The involvement of the axilla and groin may be explained by the fact that increased warmth, maceration, inflammation, and close approximation of the skin of the groin enhance penetration of corticosteroids because the physiological state of the skin at these sites is similar to that which results from occlusive therapy [8]. This, in turn, leads to systemic absorption of enough medication to produce a state of hyperadrenalism with subsequent striae formation as a sequela [15].

In the present study, obesity was the main co-morbidity associated with striae present in 39 (36.4%) patients. Among these, 13 obese patients belonged to the age group of 30–39 years at the time of presentation. Among all our patients, 20.6% had class I obesity (30–34.99). This contrasts with previous studies. A study by Divyashree et al. [16] in Karnataka on 100 patients with obesity showed a higher prevalence of striae among class II obesity patients (30.4%) with most of the obese patients with striae belonging to the age group 21–30 years. In another comparative study, done by Boza et al. [17], which included 76 cases (obese patients) and 73 controls, striae were the most prevalent dermatosis in obese patients (68.4%). The presence of striae was positively correlated with the increase in the degree of obesity. Most (83.3%) of grade III obesity patients had striae followed by grade II (70.4%) and grade I (52%). Other major comorbidities associated with striae that we came across in our study were diabetes mellitus present in nine (8.4%) patients, hypertension present in six (5.6%) patients, and both present in two (1.9%) patients.

Co-morbidities associated with obesity were diabetes mellitus present in six obese patients, hypertension present in three obese patients, and both diabetes mellitus and hypertension in one patient. Five patients had PCOS. Iatrogenic Cushing syndrome and pituitary microadenoma were present in one patient, each. This was consistent with a study by Divyashree et al. [16], in which associated diseases present in obese patients with striae were diabetes mellitus and hypertension.

To the best of our knowledge, there is a paucity of large-scales studies on patients with striae.

CONCLUSION

Pregnancy as a cause of striae is inevitable. However, the rising number of cases following steroid abuse is alarming. Steroid abuse is a multi-faceted problem and because of its easy over-the-counter availability and the immediate short-term relief for various dermatological conditions, it is more often abused than used. Hence, a multi-dimensional approach is required. Obesity is the major comorbidity associated with striae, followed by diabetes mellitus. Both, most often, point toward an unhealthy lifestyle, and a modification of the same may be a useful tool in avoidance of the development of striae.

Statement of Human and Animal Rights

All the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the 2008 revision of the Declaration of Helsinki of 1975.

Statement of Informed Consent

Informed consent for participation in this study was obtained from all patients.

REFERENCES

1. Burrows NP, Lovell CR. Disorder of Connective Tissue. In: Burns T, Breathnach S, Cox N, Griffiths C, editors. Rook's Textbook of Dermatology. 8th ed. Oxford: Wiley-Blackwell; 2010. p.45.1-45.70.
2. Maari C, Graham-Brown RA. Anetoderma and other atrophic disorders of the skin. In: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, editors. Fitzpatrick's Dermatology in general medicine. 7th edn. New York: McGraw-Hill; 2008. p. 559-60.
3. Cho S, Park ES, Lee DH, Chung JH. Clinical features and risk factors for striae distensae in Korean adolescents. J Eur Acad Dermatol Venereol. 2006;20:1108-13.
4. Sisson WR. Colored striae in adolescent children. J Pediatr. 1954;45:520-30.
5. Osman H, Rubeiz N, Tamim H, Nassar AH. Risk factors for the development of striae gravidarum. Am J Obstet Gynecol. 2007;196:62.1-5.
6. Yang YJ, Lee GY. Treatment of striae distensae with nonablative fractional laser versus ablative CO2 fractional laser: A randomized controlled trial. Ann Dermatol. 2011;23:481-9.
7. Al-Himdani S, Ud-Din S, Gilmore S, Bayat A. Striae distensae: A comprehensive review and evidence-based evaluation of prophylaxis and treatment. Br J Dermatol. 2014;170:527-47.
8. Pavithran K. Topical corticosteroid induced atrophic striae and tinea incognito. Ind J Dermatol Venereol Leprol. 1986;52:351-4.
9. Nnoruka E, Okoye O. Topical steroid abuse: Its use as a depigmenting agent. J Natl Med Assoc. 2006;98:934-9.
10. Gupta R. Striae atrophicans due to topical fluocinolone acetonide. Indian J Dermatol Venereol Leprol. 1992;58:283-4.
11. Ammar NM, Rao B, Schwartz RA, Janniger CK. Adolescent striae. Cutis. 2000;65:69-70.
12. Picard D, Sellier S, Houivet E, Marpeau L, Fournet P, Thobois B, et al. Incidence and risk factors for striae gravidarum. J Am Acad Dermatol. 2015;73:699-700.
13. Brennan M, Young G, Devane D. Topical preparations for preventing stretch marks in pregnancy. Cochrane Database Syst Rev. 2012;11:CD000066.
14. Liu DT. Letter: Striae gravidarum. Lancet. 1974;1:625.
15. Sorensen GW, Odom RB. Axillary and inguinal striae induced by systemic absorption of a topical corticosteroid. Cutis. 1976;17:355-7.
16. Divyashree RA, Naveen KN, Pai VV, Athanikar SB, Gupta G. Cutaneous manifestations of obesity among dermatology patients in a tertiary care center. Ind J Dermatol Venereol Lepro. 2014;80:278.
17. Boza JC, Trindade EN, Peruzzo J, Sachett L, Rech L, Cestari TF. Skin manifestations of obesity: A comparative study. J Eur Acad Dermatol Venereol. 2012;26:1220-3.

Source of Support: This article has no funding source.

Conflict of Interest: The authors have no conflict of interest to declare.