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The relationship between the frequency and severity of postpartum diastasis recti abdominis with the density of striae gravidarum

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ABSTRACT

Aims: This study aims to evaluate how the presence and severity of striae gravidarum (SG) affect the frequency and severity of postpartum diastasis recti abdominis (none/mild/severe).

Methods: This study included 107 patients who underwent caesarean section for various indications and were examined for diastasis recti during postpartum outpatient clinic visits. SG was scored according to the Davey scoring system and interrectal distances were measured by ultrasonography during postpartum outpatient clinic visits and evaluated for diastasis recti at postpartum weeks 3-6.

Results: Patients who scored 0 points according to the Davey score, indicating the absence of striae, were excluded from the study. Patients in the mild and severe groups were then compared in terms of DRG 1 and DRG 2. It was observed that the groups were homogeneously distributed. A significant difference ($p<0.001$) was found in terms of the supra-umblic interrectal distance (DRG 1) between the mild striae group (Davey score 1–2) and the severe striae group (score ≥3). When evaluated in terms of subumbilical interrectal distance (DRG 2), a significant difference was observed between the groups ($p=0.003$). The findings indicate that increasing striae density correlates with greater interrectal distance, placing patients at higher risk of diastasis recti.

Conclusion: The SG score can be utilized as a predictive tool to determine the likelihood of diastasis recti occurring during pregnancy. Furthermore, this study could contribute to understanding the pathogenesis of both SG and diastasis recti by examining collagen and fascia tissue samples in larger patient populations.

Keywords: Striae gravidarum, diastasis recti, postpartum diastasis recti abdominis, postpartum complications, striae gravidarum severity

INTRODUCTION

Striae gravidarum (SG) is a common, misshapen skin change that affects 55% to 90% of women. It may occur during pregnancy, particularly in the anterior abdominal wall and flank areas.[1] The condition is characterized by the thinning of the epidermis, the loss of dermal papillae and rete ridges, as well as a decrease in the levels of collagen, fibronectin and fibrils that form the extracellular matrix. SG initially manifests as flat, pink to red bands, designated as "Striae Rubra" or "Immature Striae." Subsequent to this, it undergoes a process of swelling, elongation, and widening, acquiring a purple-red coloration. Over time, the scars gradually fade and become hypopigmented (striae alba or striae matures). Eventually, these striae appear as wound-like, wrinkled, white, and atrophic scars parallel to skin tension lines.[2,3]

Dysfunctional fibroblasts are unable to provide the necessary support tissue to respond appropriately to mechanical stretch. Fibrillary collagen types I and III are the primary components of the interstitial matrix. These collagens are essential for maintaining tissue stability and functionality. Collagen, a component of the abdominal fascia and aponeurosis, including the linea alba, plays an important structural role in providing support and resistance to the abdominal wall against intra-abdominal pressure.[4]

Although the literature offers various descriptions of diastasis recti abdominis (DRA), it can be defined as the separation of the rectus abdominis muscles along the midline of the abdominal wall, accompanied by gap formation. The diagnosis of DRA is based on the presence of at least a 2.5 cm opening at any level of the linea alba, or the presence of sufficient space for two fingers to enter in one or more regions located just above the umbilicus, 3 and 5 cm above the umbilicus, and 3 cm below the umbilicus. It is a common occurrence for the muscles to separate during pregnancy. A re-examination must therefore be performed after the puerperium period to

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confirm the diagnosis. In light of the quantity and quality of collagen density and the support and resistance functions of fibroblasts in the abdominal wall, it is important to consider that disruptions in this mechanism may play a role in the formation of diastasis recti. In a study, it was observed that both type I and type III collagen were present in lower quantities in women with DRA than in women with a normal abdominal wall.[5,6]

The common mechanism involving dysfunctional fibroblasts may be responsible for the histopathogenesis of both SG and DRA. Based on this scientific reality, the evaluation of how the presence of SG affects the frequency and severity of postpartum DRA, in proportion to its severity (none/mild/severe), constitutes the primary objective for this study.

METHODS

The study was conducted with the permission of the Clinical Researches Ethics Committee of Erzincan Binali Yıldırım University (Date: 22.03.2021, Decision No: 05/20). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study encompasses cases admitted to the gynecology and obstetrics service between March 2021 and March 2022, who underwent a cesarean section for various reasons, and who underwent a diastasis recti examination during postnatal outpatient clinic visits. Pregnancies beyond 34 weeks who were between the ages of 18-35, who gave birth by cesarean section, and who had a cesarean section at most 3 times were included in the study; Women who had a history of non-cesarean abdominopelvic surgery, who had more than four cesarean sections, who had a known muscle or skin disease, who received corticosteroid treatment for any reason, who had multiple pregnancy or polyhydramnios, who had a history of gestational diabetes or who gave birth to a macrosomic baby were excluded from the study. Pregnant women who were hospitalized for delivery were evaluated using the Davey scoring system in terms of pregnancy-related striae density. This evaluation was conducted without any specific sequence, solely by a gynecologist and obstetrician. The Davey scoring system is as follows: The abdomen is divided into four quadrants using the midline and a line drawn horizontally from the umbilicus as a reference. In each quadrant, a score is assigned based on the number of striae present. A score of 0 is given for no striae, 1 for moderate striae (1–3), and 2 for numerous striae (4 or more). The total line score is calculated by summing the scores for all four quadrants. Patients with no stretch marks are classified as belonging to the "no stretch marks" group. Patients with a total striae score of 1 or 2 are classified as belonging to the "mild striae" group, while patients with a score between 3 and 8 are classified as belonging to the "severe striae" group. During abdominal skin examinations, all colors of stripes, including reddish, bright, and silvery stripes, are included. Women who met the specified criteria during pregnancy and whose data were recorded with the Davey scoring system were invited to the hospital to undergo evaluation by a physical medicine and rehabilitation (PMR) specialist at the PMR outpatient clinic between three and six months postpartum. The evaluation process involved a physical examination method to determine the presence and severity of DRA. Among those evaluated, DRA was defined as significant as follows: A minimum of a 2.5 cm gap is present at any level of the linea alba, or one or more cases are observed just above the umbilicus, at 3 and 5 cm above the umbilicus, and at 3 cm below the umbilicus. "There should be sufficient space in the area for two fingers to fit.

The study included patients of various ages, occupations (high physical activity, low physical activity, housewife), smoking status, presence of chronic disease, number of births, weight gained during pregnancy, week of birth, baby birth weight, family history of SG (yes/no), number of deliveries by caesarean section, breastfeeding status, and other relevant information. The status of milk pumping (yes/no), history of abdominal and/or pelvic floor exercises (yes/no), height, weight (at the time of birth and at the postpartum third to sixth month control), and body-mass index (BMI) information were recorded. Finally, among those with DRG, IRD (inter rectal distance) was measured and recorded via ultrasonography within 3 days by a different gynecologist and obstetrician, who was unaware of the study details, to avoid bias.

Statistical Analysis

Normality of the numerical data was examined by the Shapiro-Wilk test. Since quantitative variables did not meet the normality assumption, minimum, maximum, median value and 1st and 3rd quartile values were given in their descriptive statistics. Differences in measurement results between independent groups were analyzed using the Mann-Whitney U test, as normality assumptions were not met. Additionally, Spearman's correlation analysis was used to understand the relationship structure between the measurement results. SPSS (version 26.0, SPSS Inc., Chicago) software was used for statistical analysis of the data. Significance levels were adjusted according to asymptotic 2-sided tests. $p<0.05$ was considered statistically significant.

RESULTS

Upon examination of the data from 107 patients included in the study, it was found that while the age of the patients ranged between 19 and 44 years, the average age was 28.76±5.57 years. Additionally, the BMI of the patients was found to be between 17 kg/m^2 and 41 kg/m^2, with an average of 27.25±4.29. The number of caesarean sections ranged between 1 and 4, with a mean value of 1.83±0.82, and the number of births (parity) ranged between 1 and 7, with a mean value of 2.17±0.99. These findings are consistent with the expected relationship between the number of cesarean sections and age. The gestational age at birth ranged from 35 to 41 weeks, with an average of 38.09±1.27 weeks. The average birth weight was 3040.37±450.56 grams, with a range of 2000 to 4030 grams. It is anticipated that the infant's birth weight will increase with the gestational age. One patient was diagnosed with gestational diabetes mellitus and another with hypothyroidism. Only 4 (3.7%) of the 107 patients were smokers, and their smoking was below 10 cigarettes per day. 10 of the 107 patients (9.25%) reported high physical activity levels, while the remaining 97 (90.65%) patients indicated that their occupations required low physical activity. None of the patients reported a history of exercise for the pelvic floor muscles (Table 1).

Table 1. Demographic and clinical characteristics of the study population (n=107)

Descriptive statistics	Mean	SD
Number of C/S	1.83	0.82
Age	28.76	5.57
Parity	2.17	0.99
Weight	76.94	11.94
Gestational age	38.09	1.27
Birth weight	3040.37	450.56
BMI	27.25	4.29
DRG1	12.69	4.24
DRG2	12.61	5.08
Davey total	4.96	2.29

C/S: Caesarean sections, BMI: Body-mass index, DRG1: Supraumbilical interrectal distance, DRG2: İnfraumbilical interrectal distance, SD: Standard deviation

When Spearman's correlation analysis was performed, there was a strong significant relationship (p<0.001) (rho=0.479) between age and parity. There was a strong correlation (p<0.001) (rho=0.403) between the age of the patients and the increase in the number of cesarean sections, which is an expected situation. There was a strong correlation (p<0.001) (rho=0.733) between the number of births and the increase in the number of cesarean sections, which is a predicted situation in the study. A significant and strong correlation was found between the increase in the number of deliveries and the sub-umbilical interrectal distance (DRG2) (p=0.009) (rho=0.252). A correlation was also found between the mother's weight and the baby's birth weight (p=0.015) (rho=0.236). There was no correlation between the mother's weight and interrectal distances, but a strong significant correlation was found for all four Davey scores and the sum of Davey scores (p=0.002) (rho=0.294). This may be explained by the fact that obesity alone causes striae. The strong correlation (p<0.001) (rho=0.375) between birth week and infant birth weight is a legitimate finding since the birth weight of the baby is expected to increase as the week progresses. The negative correlation (p=0.044) (rho=-0.195) between height and number of cesarean sections may be explained by the decrease in cephalopelvic discordance as height increases. Again, a significant correlation was found between height and Davey 1 score (p=0.039) (rho=0.200). No significant correlation was found between BMI and interrectal distances, but a strong significant correlation was found for Davey scores (p=0.033) (rho=0.211). This may be explained by the relationship between obesity and striae formation.

When the main objective of the study was evaluated in terms of interrectal distances and Davey scores, a strong significant correlation was found for the interrectal distance above the umbilicus and below the umbilicus (p<0.001) (rho=0.518). Similarly, when the relationship between infraumbilical interrectal distance and Davey scores was analyzed, a strong significant relationship was found between all four Davey scores and total Davey scores (p<0.001) (rho=0.349). Similarly, when the relationship between infraumbilical interrectal distance and Davey scores was analyzed, a strong significant relationship was found between all four Davey scores and total Davey scores (p=0.002) (rho=0.301) (Table 2, 3).

When the supra-umbilicus interrectal distance (DRG 1) and sub-umbilicus diastasis recti (DRG 2) distances were analyzed in terms of total score according to the Davey scoring system, the number of patients with DRG 1 measurement was 12 mm and DRG 2 measurement was 9 mm. In patients with Davey score 1 or 2 (mild striae) (n=25), DRG 1 measurements ranged between 6 and 19 mm. DRG 2 measurements ranged between 6 and 24 mm. In patients with a Davey score of 3 or more,

Table 2. Correlation matrix of demographic and clinical variables

Variables		Age	Parity	Weight	BWeek	BW	C/S	Height	PW	BMI
Parity	rho	.479**								
	p	.000								
Weight	rho	-.035	.088							
	p	.721	.367							
BWeek	rho	-.089	-.088	.178						
	p	.361	.366	.067						
BW	rho	.170	.041	.236*	.375**					
	p	.079	.674	.015	.000					
C/S	rho	.403**	.733**	.170	-.156	.016				
	p	.000	.000	.080	.109	.867				
Height	rho	-.162	-.189	.338**	.051	.134	-.195*			
	p	.095	.051	.000	.602	.170	.044			
PW	rho	-.037	.108	.961**	.195*	.226*	.168	.313**		
	p	.703	.266	.000	.044	.019	.084	.001		
BMI	rho	.027	.156	.867**	.185	.167	.190	-.038	.911**	
	p	.784	.115	.000	.061	.093	.055	.700	.000	

BWeek: Birth week, C/S: Number of caesarean sections, BW: Baby weight, PW: Postpartum weight, BMI: Body-mass index, DRG1: Supraumbilical interrectal distance, DRG2: Infraumbilical interrectal distance

Table 3. Correlations between Davey scores and interrectal distances

Variables		Age	Parity	Weight	BWeek	BW	C/S	Height	PW	BMI	DRG1	DRG2	Davey1	Davey2	Davey3	Davey4
DRG1	rho	.079	.131	.075	-.102	-.002	.044	.074	.047	.086						
	P	.418	.177	.441	.297	.987	.652	.447	.628	.389						
DRG2	rho	.037	.252**	.128	-.101	-.099	.122	.130	.076	.096	.518**					
	P	.703	.009	.189	.299	.308	.211	.181	.435	.337	.000					
Davey1	rho	.025	.010	.283**	-.001	.025	.043	.200*	.214*	.211*	.554**	.487**				
	P	.797	.917	.003	.995	.796	.664	.039	.027	.033	.000	.000				
Davey2	rho	.015	-.009	.225*	-.006	-.108	.054	.090	.168	.196*	.451**	.509**	.862**			
	P	.874	.926	.020	.954	.270	.578	.357	.085	.048	.000	.000	.000			
Davey3	rho	-.086	.066	.345**	-.047	.114	.052	.038	.302**	.316**	.331**	.359**	.439**	.470**		
	P	.376	.497	.000	.628	.242	.593	.696	.002	.001	.001	.000	.000	.000		
Davey4	rho	-.067	.102	.310**	-.071	.044	.097	.028	.263**	.288**	.274**	.382**	.415**	.476**	.894**	
	P	.496	.297	.001	.465	.650	.322	.773	.006	.003	.004	.000	.000	.000	.000	
Davey score	rho	-.073	.034	.294**	.035	.055	.116	.083	.228*	.211*	.349**	.301**	.631**	.602**	.685**	.614**
	P	.456	.725	.002	.724	.574	.235	.396	.018	.033	.000	.002	.000	.000	.000	.000

BWeek: Birth week, C/S: Number of caesarean sections, BW: Baby weight, PW: Postpartum weight, BMI: Body-mass index, DRG1: Supraumbilical interrectal distance, DRG2: Infraumbilical interrectal distance

DRG 1 measurements ranged between 6 and 23 mm. When analyed in terms of DRG 2, measurements ranged between 4 and 26 mm (Table 4).

Table 4. Relationship between Davey scores and interrectal distances

	DRG1	DRG2
	Median [Q1–Q3]	**Median [Q1–Q3]**
Davey scores		
Mild	9 [8–11]	9 [7–11]
Severe	14 [10–16]	12 [9–16]
*p	<.001	.003

Q1: Percentile 25, Q2: Percentile 75, Min: Minimum, Max: Maximum, *p shows the results of Mann-Whitney U analysis, DRG1: Supraumbilical interrectal distance, DRG2: Intraumbilical interrectal distance

Patients in the mild and severe groups were then compared in terms of DRG 1 and DRG 2. It was found that the groups did not conform to normal distribution and there was a significant difference ($p< 0.001$) between the mild striae group with Davey score 1-2 and the severe striae group with score 3 and above in terms of supra-umbilicus interrectal distance (DRG 1). When evaluated in terms of sub-umbilicus interrectal distance (DRG2), it was observed that the groups did not comply with the normal distribution and there was a significant difference between them ($p=0.003$). These data suggest that as the striae density increases, the intrarectal distance will also increase and put patients at higher risk of diastasis recti.

DISCUSSION

This study shows that the frequency of SG in pregnant women, whether mild or severe according to the Davey scoring system, can give an idea in predicting diastasis recti. Although the pregnant woman's BMI was effective in the development of striae, the number of previous cesarean sections, gestational week and baby birth weight did not have any significance in terms of striae density and diastasis recti.

A study investigating the relationship between type 1 and type 3 collagen density and the development of abdominal hernias revealed that low collagen levels were associated with an increased risk of hernia development. Furthermore, the incidence of diastasis recti was found to be higher in patients with low collagen levels.[7] Furthermore, studies have demonstrated that type 1 and 3 collagen levels are diminished in obese patients.[8] Although our study did not include histological data on collagen types and amounts, the visual appearance of striae density, which is a result of collagen deficiency, was shown to be associated with diastasis recti. In this study, the higher striae density observed in patients with higher BMIs aligns with the findings of the study conducted by Szczęsny et al.[8] A number of studies have indicated that the development of diastasis recti is more prevalent in patients with low collagen levels, and that these patients are more susceptible to hernia formation.[9-12]

Pregnancy represents one of the most significant factors influencing the development of diastasis recti.[13] In this study, all patients who had given birth were examined for diastasis recti, indicating that all patients had experienced at least one pregnancy. Nevertheless, there was no discernible correlation between the rise in the number of pregnancies and the interrectal distance. In the study conducted by RM Blotta et al.,[7] it was asserted that pregnancy alone does not result in permanent diastasis recti.

In a study conducted by Doğan and colleagues,[14] it was proposed that there is a correlation between the formation of adhesions and SG density in patients with a high density of SG. Fibroblast activity is responsible for collagen production. Since the problems arising in this mechanism may play a role in the formation of striae, they may be related to defects in the anterior abdominal wall such as decreased adhesion development and diastasis recti.[15,16] It has been shown that in the case of normally functioning fibroblasts, both striae formation and peritoneal adhesions will be less.[17] A study by Kapadia et al.[18] demonstrated a correlation between connective tissue collagen and skin elasticity. The study also revealed a potential link between perineal tears and a deficiency in collagen synthesis.

Despite the prevalence of research indicating a correlation between high infant birth weight and increased maternal weight and the formation of SG, findings from Farahnik et al.[19] and Chang et al.[1] challenge this assumption. Their studies revealed no significant relationship between infant birth weight and maternal striae formation. In this study, although there was a relationship between maternal BMI and striae density, there was no relationship between baby birth weight and striae score. The lack of a relationship between infant birth weight and the study may be attributed to the exclusion of macrosomic babies and pregnancies with polyhydramnios. Studies conducted by Wierrani et al.[20] demonstrated that the application of vitamin C, hyaluronic acid, and various vitamins to areas with striae led to an increase in fibroblast activity and collagen production in those areas. The results of this study indicate that it is important to consider the possibility of diastasis recti developing in patients with high SG scores due to defective fibroblast activity and low collagen levels.

Limitations

The use of only the Davey score and ultrasonographic measurements is among the limitations of this research. It is clear that more objective results can be obtained if samples are taken during the operation and histopathologic examinations are performed and added to the study.

CONCLUSION

The SG score can be utilized as a predictor of the likelihood of diastasis recti occurring during pregnancy, with the potential to inform clinical decision-making regarding the need for surgical intervention. Furthermore, this study may contribute to the understanding of the pathogenesis of striae gravidarum and diastasis recti, particularly when supported by future collagen studies conducted in larger patient cohorts and fascia tissue samples.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the Clinical Researches Ethics Committee of Erzincan Binali Yıldırım University (Date: 22.03.2021, Decision No: 05/20).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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