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CORRELATION BETWEEN VARIOUS ANTHROPOMETRIC AND MUSCULOSKELETAL MEASUREMENTS AND HEMORRHOIDS IN PREGNANCY

ORIGINAL ARTICLE

ABSTRACT

Purpose: The aim of this study was to determine the presence of hemorrhoids in pregnancy and symptoms related to hemorrhoids and to evaluate the relationship between hemorrhoids in pregnancy and various anthropometric and musculoskeletal parameters.

Methods: The retrospective cross-sectional study included pregnant women in 3 different trimesters (1st, 11-15 weeks; 2nd, 16-23 weeks; 3rd, 24-40 weeks) without any anorectal problems before pregnancy. The presence of hemorrhoids and other anorectal symptoms during pregnancy was evaluated with yes/no questions on self-reported scales.

Results: Evaluation was made of 268 pregnant women (92, 1st Trimester; 107, 2nd Trimester; 69, 3rd trimester). In the whole study sample, waist circumference measurement (p = 0.042; OR = 1.13; 95% CI 1.07–1.92), bi-iliac width (p = 0.036; OR = 1.17; 95% CI 1.09–1.38), rectus abdominis muscle strength (p = 0.006; OR = 0.45; 95% CI 0.04–0.58), Diastasis-recti-abdominis grade measured from umbilicus level (p = 0.023; OR = 1.38; 95% CI 1.14–1.83), hypermobility score (p = 0.006; OR = 3.34; 95% CI 1.98–7.94) and parity (p = 0.032; OR = 2.47; 95% CI 1.85–7.19) were found to be important risk factors for the presence of hemorrhoids in pregnancy.

Conclusion: This is the first study to have evaluated hemorrhoids and hemorrhoid-related symptoms and to examine the associated risk factors comprehensively. It was also demonstrated for the first time that waist circumference measurement, bi-iliac width, increased grade of Diastasis-recti-abdominis measured at umbilicus level, hypermobility score, and decreased rectus abdominis muscle strength were risk factors for hemorrhoids in pregnancy.

Keywords: Anthropometric Measurements, Hemorrhoids, Pregnancy.

GEBELİKTE GÖRÜLEN HEMOROİD İLE ANTROPOMETRİK ÖLÇÜMLER VE KAS-İSKELET SİSTEMİ ÖLÇÜMLERİ ARASINDAKİ İLİŞKİNİN İNCELENMESİ

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Bu çalışmanın amacı, gebelikte hemoroid varlığı ve hemoroid ile ilgili semptomları incelemek ve gebelikte hemoroid varlığı ile çeşitli antropometrik ve muskuloskeletal parametreler arasındaki ilişkiyi araştırmaktı.

Metod: Bu retrospektif kesitsel çalışmaya gebelik öncesi herhangi bir anorektal problemi olmayan, 3 farklı trimesterdaki (1. Trimester, 11-15 hafta, 2. Trimester, 16-23 hafta, 3. Trimester, 24-40 hafta) gebeler dahil edildi. Gebelikte hemoroid ve diğer anorektal semptomların varlığı self-reported olarak var/yok şeklinde değerlendirildi.

Bulgular: Çalışmaya 268 gebe (92, 1. trimester; 107, 2. trimester; 69, 3. trimester). Tüm çalışma örnekleminde bel çevre ölçümü (p= 0,042; OR = 1,13; % 95 CI 1,07–1,92), bi-iliak genişlik (p= 0,036; OR = 1,17; % 95 CI 1,09–1,38), rectus abdominis kas kuvveti (p= 0,006; OR = 0,45; % 95 CI 0,04–0,58), umbilikus seviyesinden ölçülen diastazis rekti abdominis (DRA) miktarı (p= 0,023; OR = 1,38; % 95 CI 1,14–1,83), hipermobilite skoru (p= 0,006; OR = 3,34; % 95 CI 1.98–7,94) ve doğum sayısı (p= 0,032; OR = 2,47; % 95 CI 1,85–7,19) hemoroid gelişiminde önemli risk faktörleri olarak bulundu.

Sonuç: Bu çalışma, hemoroid ve hemoroid ile ilişkili semptomları değerlendiren ve hemoroid ile ilişkili risk faktörlerini uygun örneklem genişliği ile kapsamlı olarak değerlendiren tek çalışmadır. Aynı zamanda gebelikte, bel çevre ölçümünün, bi-iliak genişliğin, umblikus seviyesinden ölçülen DRA miktarının ve hipermobilite skorunun artmasının ve rektus abdominis kas kuvvetinin azalmasının hemoroid açısından risk faktörü olduğu ilk kez bu çalışma ile ortaya konulmuştur.

Anahtar Kelimeler: Antropometrik Ölçümler, Gebelik, Hemoroid

INTRODUCTION

Hemorrhoids which develops with the prolapse of the distal rectum contains rectal mucosa, smooth muscle, connective tissue, and blood vessels are common anal canal problem with high recurrence rates and accompanied by acute attacks and chronic symptoms. The incidence of hemorrhoids increases during the reproductive years, especially in pregnancy (1). The incidence has been reported at approximately 85%, especially in the 2nd and 3rd trimesters of pregnancy (2).

Hemorrhoids are classified into three categories: internal (above the dentate line), external (below the dentate line), and mixed. Pregnancy increases the formation of venous veins, the incidence of venous problems, and the incidence of symptomatic hemorrhoids (3). The factors that cause this condition are explained mechanically (expanding uterus, with increasing fetus weight causes venous obstruction in the internal sphincter and enlargement and sagging of the hemorrhoidal plexus) and hormonally (decrease in the level of estradiol and progesterone and decreased gastrointestinal motility) (1).

While pregnancy itself is mentioned as a risk factor for hemorrhoids formation, there are many factors that increase the risk of hemorrhoids during pregnancy (4). In previous studies, it has been stated that obesity, high depression levels, low quality of life, eating disorders, and high doses of iron supplements also increase the risk of hemorrhoids (5). Although there is no research on the topic examining the connection between hemorrhoids and hypermobility in pregnancy, it was stated in a study of Ehlers-Danlos Syndrome that hypermobility associated with connective tissue problems was associated with hemorrhoids. However, that and similar studies in the literature were not conducted on pregnant women (6). Although there are studies in the literature which have investigated the risk factors affecting the formation of hemorrhoids in pregnancy, there are no studies which have examined the relationship between the presence of hemorrhoids and various anthropometric and musculoskeletal parameters. Therefore, this study was planned to investigate the presence of hemorrhoids in pregnancy and symptoms related to hemorrhoids and to evaluate the relationship between hemorrhoids in pregnancy and various anthropometric and musculoskeletal parameters.

MATERIAL AND METHODS

2.1. Study design and participants

This retrospective cross-sectional study was carried out between January 2016 and May 2018 at Hacettepe University, Faculty of Medicine, Department of Obstetrics and Gynecology. The study included pregnant women aged >18 years, who were literate and had no anorectal problems before pregnancy and were in 3 different trimesters (1st Trimester, 11-15 weeks, 2nd Trimester, 16-23 weeks, 3rd Trimester, 24-40 weeks). High-risk pregnant women with gastrointestinal disease, a history of pelvic or anal surgery, hypertension, and/or diabetes mellitus were excluded from the study. All pregnant women were informed about the study on the basis of the Helsinki Declaration and informed consent was obtained for participation in the study. Approval for the study was granted by the Local Ethics Committee of the university (decision no: GO 16/101-30).

2.2. Evaluations

Sociodemographic and Clinical Evaluation

The socio-demographic information, physical characteristics, and detailed obstetric anamnesis (gravida, parity, abortion, curettage) of the pregnant women included in the study were recorded.

Pregnant women participating in the study were evaluated as present/absent according to the presence of hemorrhoids. A valid and reliable classification system was used to define the severity of hemorrhoids: Stage 1 = internal hemorrhoids that do not prolapse, Stage 2 = internal hemorrhoids that prolapse during defecation but decrease spontaneously, Stage 3 = internal hemorrhoids that prolapse and require manual repulsion during defecation, Stage 4 = internal hemorrhoids that prolapse and cannot be manually pushed (7). The presence of constipation, perianal discomfort and pain, protrusion, bleeding, mucous discharge, pruritus, and burning were evaluated as present/absent. Fecal type was determined according to the Bristol Gai-

ta Scale (BGS) (Type 1-2 hard, Type 3-4-5 normal, Type 6-7 diarrhea) (intra and inter-observer ICC values of 0.88 and 0.89, respectively) (8). The colorectoanal problems of the pregnant women and the degree of complaints were evaluated according to the subscales of the Pelvic Floor Distress Inventory-20 Scale of the Pelvic Floor Distress Inventory-20 (KRADE-8), as described by Barber et al. (9) and 2010 Toprak et al (2010) (10), the Turkish version of which have been reported as valid ($p < 0.001$) and reliable (Cronbach's alpha, 0.79, ICC, 0.96-0.98). The scale consists of eight items with a total score ranging from 0 to 100. More severe symptoms are indicated by a higher score.

Anthropometric Measurements

- Circumference measurements: Waist circumference, umbilicus circumference, and hip circumference were evaluated. With the arms out to the side, the narrowest part of the waist between the iliac crests and the subcostal region was measured. The hip circumference was measured from the most prominent portion of the gluteal region at the back while holding the tape measure parallel to the hip (11).

- Diameter measurements: The bi-iliac width (pelvis width) was measured by placing the caliper at an angle of 45° downward on the iliac crests. Bi-trochanteric width was measured from the widest distance between the trochanter bones (12).

Measurement of Abdominal Muscle Strength

Lovett's manual muscle test method (intra and inter-observer ICC values of 0.8 and 0.96, respectively) was used to measure the strength of the rectus abdominis and external oblique muscles (right and left) with a grading system between 0-5. In the muscle test, level 3 was taken as a reference and individuals were grouped as ≤3 and below and >3 according to their muscle strength (13).

Musculoskeletal Measurements

-Lumbal lordosis: Each pregnant woman was asked to stand in a comfortable posture with their feet shoulder-width apart and their arms held loosely next to the trunk. A bubble inclinometer (Model 10602, Fabrication Enterprise Inc.,USA), which has been shown to be a valid and reliable device for lumbal lordosis evaluation (intra and inter-observer ICC values 0.85 and 0.9, respectively) (14) was used at the level of T12-L1 and S1-S2. The inclinometer was placed at the marked points as described by Kolber and Salamh and 3 measurements were taken from each point and the average of the recorded angle values was recorded (15).

-Diastasis recti abdominis (DRA): DRA was evaluated with the method of finger and width (intra and inter-observer ICC values of 0.7 and 0.5, respectively) while the pregnant women were in the supine and hook position. The measurement was performed in three places, from the level of the umbilicus, and at 4.5 cm above and below the umbilicus (16).

-Joint hypermobility: The joint hypermobility of the cases was evaluated using the Beighton scoring method (intra and inter-observer ICC values of 0.4 and 0.8, respectively). Touching the floor with the palmar face of the hand when the knees are in full extension (1 point), hyperextension of ≥10° of the elbow (2 points), knee hyperextension of ≥10° (2 points), passive positioning parallel to the forearm flexor face of the thumb (2 points) and 5th metacarpal joint ≥90° passive extension (2 points). A score of ≥4 points was considered hypermobility (17).

Sample Size Calculation

A binary logistic regression analysis model was used to calculate the risk factor effects. There were a total of 11 risk factors in the model. It has been suggested in the literature that at least 20 people should be included for each risk factor in the regression model (18). Therefore, when 11 risk factors were calculated, it was deemed necessary to include at least a total of 220 people should be present.

2.3. Data Analysis

Data obtained in the study were analyzed statistically using SPSS 23 software (Statistical Package for Social Sciences for Mac version 20.0- Chicago, USA). Descriptive statistics of the data were calculated. In comparing anthropometric parameters according to the presence of hemorrhoids, the Chi-square test was applied to categorical variables, the Student's t-test for normally distributed numerical variables, and the Mann-Whitney U-test for

numerical data that do not show normal distribution. A value of p<0.05 was considered statistically significant. According to the univariate analysis, variables with p<0.20 were considered significant and were included in the binary logistic regression model. Abdominal muscle strength measurement results were categorized into two categories so that multi-category ordinal variables could be included in the model. A value of p<0.05 was considered statistically significant.

RESULTS

A total of 297 pregnant women were initially screened of which 29 were excluded for various reasons; history of the anorectal disease (n=11), perianal surgery (n=3), hypertension (n=6), multiple pregnancy (n=4), gestational diabetes (n=5). Consequently, evaluation was made of 268 pregnant (1st trimester=92, 2nd trimester=107, and 3rd trimester=69). The sociodemographic and clinical characteristics, and detailed obstetric histories

Table 1. Sociodemographic, Clinical and Obstetric Characteristics and Medical Characteristics of the Pregnant Women Between Study Groups

		All Pregnancy (n:268)	Hemorrhoid (No) (n:184)	Hemorrhoid (Yes) (n:84)
Age (year)		31.19±3.95	31.25±4.12	31.05±4.13
Height (cm)		162.48±4.85	162.37±4.85	162.71±4.86
Current body weight (kg)		69.51±10.03	70.08±10.74	68.23±8.18
BMI (kg/m^2)		26.28±3.69	26.54±3.90	25.72±3.12
Body weight before pregnancy (kg)		63.16±10.45	63.82±10.83	61.72±9.49
BMI before pregnancy (kg/m^2)		23.93±3.93	24.21±4.09	23.31±3.47
Fetus weight (kg)		964.86±814.18	876.29±688.48	1202.90±1059.21
Gravida		3.20 (1.00-15.00)	3.37 (1.00-15.00)	2.83 (1.00-8.00)
Parity		0.70 (0-4.00)	0.71 (0-4.00)	0.66 (0.00-3.0)
Nullipar (%)		130 (48.50)	94 (51.08)	36 (42.85)
Primipar (%)		102 (38.05)	61 (33.15)	41 (48.80)
Multipar (%)		36 (13.43)	29 (15.76)	7 (8.33)
Abortion-Curettage		1.00 (0-10.00)	1.00 (0-10.00)	1.00 (0-5.00)
The severity of hemorrhoids (%)	**Stage 1**	39 (46.42)	-	39 (46.42)
	Stage 2	36 (42.85)	-	36 (42.85)
	Stage 3	7 (8.33)	-	7 (8.33)
	Stage 4	2 (2.38)	-	2 (2.38)
Ano-rectal symptoms in pregnancy(%)	**Perianal discomfort**	23 (8.58)	9 (4.89)	14 (16.66)
	Mucous discharge	57 (21.26)	19 (10.32)	38 (45.23)
	Pruritus	28 (10.44)	13 (7.06)	15 (17.85)
	Burning	19 (7.08)	9 (4.89)	10 (11.90)
	Perianal pain	30 (11.19)	8 (4.34)	22 (26.19)
	Protrusion	26 (9.70)	2 (1.08)	24 (28.57)
	bleeding	18 (6.71)	3 (1.63)	15 (17.85)
	Constipation	57 (21.26)	23 (12.50)	34 (40.47)
KRADE-8		9.47±13.00	8.94±12.63	10.61±13.78
Fecal type	**Hard**	33 (12.31)	23 (12.50)	10 (11.90)
	Normal	164 (61.19)	116 (63.04)	48 (57.14)
	Diarrhea	71 (26.49)	45 (24.45)	26 (30.95)

*Data are presented as mean ± standard deviation, median (minimum-maximum), or frequency (%), BMI: Body Mass Index

Table 2. Anthropometric and Musculoskeletal Characteristics of the Pregnant Women Between Study Grpups

		All Pregnancy (n:268)	Hemorrhoid (No) (n:184)	Hemorrhoid (Yes) (n:84)	p
Lumbal lordosis (°)		91.58±14.10	90.89±13.47	93.08±15.38	0.963
Waist circumference (cm)		83.00±9.36	83.76±9.85	81.35±8.00	**0.043**
Umbilicus circumference (cm)		96.44±10.52	96.71±11.12	95.86±9.12	0.127
Hip circumference (cm)		102.26±7.65	102.70±8.23	101.29±6.13	0.241
Strength of the rectus abdominis		4.30±0.89	4.37±0.87	4.15±0.92	**0.013**
Strength of the right external oblique		4.17±0.91	4.27±0.89	3.95±0.91	**0.024**
Strength of the left external oblique		4.17±0.90	4.27±0.89	3.96±0.91	**0.030**
Bi-iliac width (cm)		29.10±5.91	29.45±6.29	28.28±4.88	0.167
Bi-trochanteric width (cm)		32.09±6.47	32.26±6.96	31.70±5.18	0.173
Diastasis recti abdominis (finger)	Umbilicus	1.77 (0-4.00)	1.69 (0-4.00)	1.94 (0-4.00)	**0.003**
	4.5 cm above	1.08 (0-3.00)	1.03 (0-3.0)0	1.19 (0-3.00)	**0.027**
	4.5 cm below	0.54 (0-3.00)	0.59 (0-3.00)	0.52 (0-3.00)	0.132
Joint hypermobility Yes (%)		66 (24.62)	43 (23.36)	23 (27.38)	0.480
Joint hypermobility score		4.72±0.89	4.51±0.75	5.13±1.01	0.167

Data are presented as mean ± standard deviation, median (minimum-maximum), or frequency (%).

such as gravida, parity, abortus, and curettage for all the subjects are given in Table 1.

The presence of hemorrhoids during pregnancy was determined at the rate of 31.34% (grade 1, 46.42%; grade 2, 42.85%; grade 3, 8.33%, and grade 4, 2.38%) in the whole study sample. The incidence of all anorectal problems, KRADE-8 scores were higher than in those without hemorrhoids. According to the BGS, of the whole sample of pregnant women, 61.19% had normal type faeces, 26.49% had diarrhea, 12.31% had hard type faeces, and 21.26% had constipation in all pregnant women. The rate of constipation was 40.47% in pregnant women with hemorrhoids and 12.50% in pregnant women without hemorrhoids. Detailed medical informations of all the pregnant women are given in Table 1.

When the anthropometric and musculoskeletal measurement results of the pregnant women participating in the study were examined, it was seen that the lumbal lordosis values of the whole study sample were 91.50 ± 14.10 and there was no difference according to the presence of hemorrhoids (p>0.05). A significant difference was determined between the groups in respect of waist circumference measurements (p= 0.043), and there was no difference between the groups in respect of umbilicus and hip circumference measurements (p>0.05). There was a difference between the groups in respect of the strength values of the rectus abdominis (p=0.013) and external oblique muscles (right: p=0.024, left: p=0.030). When the bi-trochanteric and bi-iliac diameter measurement results were examined, there was no difference between the groups (p> 0.05). The DRA grades measured at the umbilicus level and at 4.5 cm above and below were 1.77 (0-4.00), 1.08 (0-3.00), and 0.54 (0-3.00), respectively. According to the presence of hemorrhoids, there was a difference in the DRA grades measured at the umbilicus and at 4.5 cm above the umbilicus (p = 0.003, 0.027), and no difference between the groups in the DRA grade measured at 4.5 cm below the umbilicus (p> 0.05). The Beighton hypermobility score of the whole study sample was 4.72 ± 0.89, and benign joint hypermobility was observed in 24.62% of the pregnant women. There was no significant difference determined between the groups (p> 0.05). The anthropometric and musculoskeletal measurements of all the women are presented in Table 2.

Risk factors associated with anthropometric and

Table 3. Analysis of Potential Risk Factors for Hemorrhoids During Pregnancy CI: Confidence Interval, p<0.05.

	All Pregnancy		
	Odds ratio	**95% CI**	**p**
Waist circumference	1.13	1.07-1.92	**0.042**
Bi-iliac width	1.17	1.09-1.38	**0.036**
Bi-trochanteric width	1.09	0.95-1.25	0.215
Strength of the rectus abdominis	0.45	0.04-0.58	**0.006**
Diastasis recti abdominis -Umblicus	1.38	1.14-1.83	**0.023**
Joint hypermobility score	3.34	1.98-7.94	**0.006**
Parity	2.47	1.85-7.19	**0.032**

musculoskeletal measurements in hemorrhoids

As a result of anthropometric and musculoskeletal measurements and obstetric evaluations among the groups separated according to the presence of hemorrhoids during pregnancy; variables with a p value <0.20 (waist circumference, rectus abdominis muscle strength, bi-iliac and bi-trochanteric width, DRA grade of umbilicus level and hypermobility score) were added to the binary logistic regression analysis. The risk model including these parameters and corrected effects is shown in Table 3.

Associated factors were not included in the regression model. Thus, only one of the circumference, muscle strength, and DRA measurement results were added to the model.

The binary logistic regression analysis, it was determined that 6 risk factors were significantly associated with the development of hemorrhoids in pregnant women: waist circumference, bi-iliac width, rectus abdominis muscle strength (≤3), DRA measured from umbilicus level, and parity. The increase in hemorrhoid incidence was determined as 1.13-fold (OR) with increased waist circumference (p=0.042; 95% CI 1.07–1.92), 1.17-fold with large bi-iliac width, (p=0.036; 95% CI 1.09–1.38), 0.45-fold with rectus abdominis muscle weakness (p=0.006; 95% CI 0.04–0.58), 1.38-fold with increased DRA measured from the umbilicus level (p=0.023; 95% CI 1.14–1.83), 3.34-fold with increased hypermobility score (p=0.006; 95% CI 1.98–7.94), and 2.47-fold with high parity (p=0.032; 95% CI 1.85–7.19). The parameter of lordosis was not determined as a risk factor affecting the development of hemorrhoids.

DISCUSSION

The aim of this study was to determine the incidence of hemorrhoids and symptoms related to hemorrhoids in pregnancy, and to evaluate the relationship between various anthropometric and musculoskeletal parameters in pregnancy. Evaluation was made of a total of 268 pregnant women from all 3 trimesters, separated into two groups according to the presence of hemorrhoids. To determine the anthropometric and musculoskeletal parameters associated with hemorrhoids, evaluations were made of lordosis, waist, umblicus and hip circumference, rectus, right and left external oblique abdominal muscle strenght, bi-iliac and bi-trochanteric width, DRA grade measured at umbilicus level and 4.5 cm above and below, and hypermobility. Previous studies of hemorrhoids during pregnancy have mostly been conducted during the third trimester and postpartum (4), immediately after birth (19) or 6 weeks after birth (20). To the best of our knowledge, there is no information in literature of the relationship between hemorrhoids and anthropometric and musculoskeletal parameters. Therefore, the results of this study can be considered important in filling this gap in literature with the determination of symptoms related to hemorrhoids and the relationship between hemorrhoids and various anthropometric and musculoskeletal parameters in pregnant women.

It was determined from the study results that waist circumference measurement and bi-iliac width, decreased rectus abdominis muscle strength, DRA grade measured at the umbilicus level, and the hypermobility score were high risk factors for the development of hemorrhoids during pregnancy.

Although the incidence of hemorrhoids is very common during pregnancy, especially in the 2nd and 3rd trimesters, the primary cause is not fully known (1). With the growth of the uterus in the third trimester of pregnancy in particular, the incidence of hemorrhoids and anorectal symptoms increases with compression of the intestinal tract and lower part of the rectum (21). In few published clinical studies, the frequency of symptomatic hemorrhoids in pregnancy has been reported to vary between 7.9% and 38% (1, 4). In the results of the current study, hemorrhoids were seen to develop during pregnancy at the rate of 31.34% in women who had not had any perianal problems before pregnancy.

The clinical symptoms and signs of hemorrhoids during pregnancy include anal bleeding, anal itching, pain, and impaired bowel function, which worsen with increased intra-abdominal pressure such as sneezing and coughing (1). Abramowitz et al. reported that 9.1% of pregnant women experienced peri-anal discomfort (4). Poskus et al. stated the incidence of hemorrhoids-related anorectal disorders during pregnancy to be 1.6% in the 1st trimester and 61% in the 3rd trimester (22). In the current study, it was determined that the women with hemorrhoids during pregnancy had more anorectal problems than those without hemorrhoids, with higher KRADE-8 scores indicating worse symptoms associated with hemorrhoids.

Functional constipation during pregnancy has been reported to be a risk factor for hemorrhoid development with incidence of approximately 38% (4, 21). Abramowitz et al. reported that constipation is an important factor for hemorrhoids especially in the 3rd trimester (4). Other studies have stated that constipation should be treated and stool stiffness should be reduced to prevent hemorrhoids from occurring during pregnancy (21). In the current study, according to the BGS evaluation, most of the pregnant women (61.19%) had normal fecal type and 21.26% had constipation, which was seen at a higher rate in the group with hemorrhoids. According to these results, constipation was not found to be an important risk factor for hemorrhoids, which could be attributed to the general analysis rather than according to trimester.

In recent literature, the importance of adequate thoracic, abdominal and perineal muscle strength for pelvic floor rehabilitation and the continence mechanism have been frequently mentioned. Studies have demonstrated that a bad sacral and thoracic posture may be a cause of pelvic floor dyssynergia and the evaluation of lumbal lordosis is a reliable evaluation method of sacral and thoracic posture (23). It has also been shown that in individuals with lumbal hyperlordosis, the sacrum at an angle close to horizontal can change the position of the coccyx, the anorectal angle and the puborectalis muscle tone, which affect defecation (24). Although there is evidence in the literature that lumbal lordosis is significantly higher in individuals with constipation and urinary incontinence (23), there are no data of direct evaluation of the relationship between hemorrhoids and lumbal lordosis. In the current study, no difference was determined between the groups according to the presence of hemorrhoids in terms of lordosis value and it was therefore concluded that the change in lordosis during pregnancy was not a risk factor for the development of hemorrhoids.

In literature, although the relationship between waist, umblicus and hip circumference results and hemorrhoids has not been determined, abdominal obesity has been evaluated with waist circumference measured during normal expiration and increased circumference has been determined as a risk factor for hemorrhoids (5). The current study results showed that the increase in waist circumference measured in pregnant women is an important risk factor for hemorrhoids. This may be because an increase in body weight during pregnancy causes stress on the pelvic floor muscles.

To the best of our knowledge, no study in literature has examined the relationship between abdominal muscle strength and hemorrhoids. The current study results showed a significant difference in rectus abdominis, right and left external oblique muscle strength measurement results between the groups determined according to the presence of hemorrhoids, and all the muscle strength values were lower in the group with hemorrhoids. In addition, low rectus abdominis muscle strength was determined as a risk factor for hemorrhoids. This may be due to poor synergistic activity between the pelvic floor and the abdominal muscles, as a

result of a weak anterior ring of the abdominal muscle and pelvic floor muscle stability roller. No clear interpretation can be made of these results in the current study as there was no evaluation of the pelvic floor muscle strength. Further studies are needed on this subject.

In the literature, it has been reported that individuals with pelvic floor dysfunction have larger bi-iliac and bi-trochanteric pelvis widths (25). Sze et al., reported that pelvic transverse width was greater in those with pelvic organ prolapse compared to those with healthy pelvic organs (26). To the best of our knowledge, there is no study in the literature that has directly evaluated the relationship between bi-iliac and bi-trochanteric width and hemorrhoids. The current study results showed no difference in bi-iliac and bi-trochanteric widths between the groups determined according to the presence of hemorrhoids. However, an increased bi-iliac diameter was determine to be a risk factor for the development of hemorrhoids. This result can be considered important as this is the first study in literature to have examined the relationship between bi-iliac and bi-trochanteric diameter and hemorrhoid development in pregnancy.

In the study results, the highest grade of DRA was seen at the level of the umbilicus and this result supports the findings of Noble (27), and Akbayrak et al (28). There are opinions in the literature that DRA may be caused by dysfunction occurring in the abdominal muscles due to the loss of linea albane integrity (29). This dysfunction has been explained in literature by the relationship between pelvic floor muscle strength and endurance and abdominal muscle strength (28). Spitznagle et al. (29) stated that due to the synergistic relationship between the pelvic floor and the abdominal muscles, DRA may affect the pelvic floor system and therefore pelvic problems may occur. In the current study, an increase in DRA measured at the umbilicus level was seen to be an important risk factor for hemorrhoids. This can be considered important as this is the first study to have examined the effect of DRA on hemorrhoids in pregnancy.

Joint laxity is expected to increase as a result of hormonal changes during pregnancy (30). Studies in the literature evaluating the collagen-protein ratio have reported that a decrease in the number of collagen fibers may cause an increase in joint laxity and may constitute a risk factor for hemorrhoid formation (6). At the same time, epidemiological studies in the literature have indicated that the decrease in connective tissue stability is associated with the frequency of hemorrhoids (31). The results of the current study demonstrated that increased benign joint hypermobility is a risk factor for hemorrhoids. This can be considered important as this is the first study to have examined the effect of joint hypermobility on hemorrhoids during pregnancy.

Gravida was not found to be a risk factor associated with hemorrhoids in the current study, which confirmed the findings of Riss et al. (32) and Peery et al. (33). In previous study, risk factors associated with hemorrhoids have included high body mass index and high parity (21). In the current study, high parity was found to be a risk factor in all pregnant women, but there was no relationship between BMI and hemorrhoids.

In literature, the average fetus weight determined as a risk factor for hemorrhoids has beeen reported as 2800 g (21). The average fetus weight measured by ultrasound examination in the current study was 964.86 g. Although fetus weight has been reported as a risk factor for hemorrhoids in literature, it was not found to be significant in the current study, which could be attributed to the lower number of subjects in the 3rd trimester than in the 1st and 2nd trimesters and therefore the average fetal weight was lower than the previous findings in literature.

The strengths of this study are that it was prospective in design, and the evaluations and data analyses were performed by physiotherapists and doctors who are experts in their field. Limitations of the study could be said to be that the nutritional level of the participants during pregnancy was not evaluated and ano-rectal symptoms were determined by subjective evaluation. However, as the pregnant women included in the study were from different provinces of Turkey, objective assessments would have required additional time as there are no objective methods specific to pregnant women for hemorrhoid evaluation.

Conclusions

Hemorrhoids are seen at a high rate in the general population and are know to increase during the reproductive years and especially in pregnancy. This is the first study to have evaluated hemorrhoids and hemorrhoid-related symptoms during pregnancy and to have comprehensively evaluated the anthropometric and musculoskeletal risk factors associated with hemorrhoids with an appropriate sample size. The study results showed that parity is a risk factor for hemorrhoids, which was in accordance with previous findings in literature. In addition, for the first time it was demonstrated that waist circumference and bi-iliac width, rectus abdominis muscle weakness, the grade of DRA measured at the umbilicus level, and hypermobility were risk factors for hemorrhoids during pregnancy. In the treatment of hemorrhoids during pregnancy, the results of this study are important in terms of considering the risk factors associated with hemorrhoids, determining non-pharmacological treatment methods more clearly and providing appropriate treatments to prevent hemorrhoid development before pregnancy. In addition, based on the results of this study, pregnant women can be advised to increase their physical activity levels from the first trimester of pregnancy, pay attention to their fluid intake and diet, avoid constipation, and increase total body muscle strength, especially abdominal muscles.

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