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ORIGINAL ARTICLE

The relationship between fat mass and visceral fat on the menstrual cycle and dysmenorrhea among female students

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ABSTRACT

Menstruation is a natural and periodic uterine bleeding process influenced by sex hormones, primarily estrogen and progesterone, which are partly synthesized from body fat. In healthy, nonpregnant, premenopausal women, adipose tissue plays a significant role in regulating the menstrual cycle. According to the World Health Organization (2018), more than 75% of women experience menstrual disorders, with dysmenorrhea, premenstrual syndrome (PMS), and irregular menstruation being the most common. Irregular menstrual cycles include heavier or lighter bleeding lasting 7–9 days, cycles shorter or longer than 21–35 days, intermenstrual spotting or bleeding, postcoital bleeding, and the absence of menstruation for 3–6 months.This study aimed to analyze the relationship between fat mass and visceral fat with the menstrual cycle and dysmenorrhea among female medical students at the Faculty of Medicine, Maranatha Christian University, in 2024. This analytical observational study used a cross-sectional design and included 66 participants whose body composition was measured using Bioelectrical Impedance Analysis (BIA). Data on menstrual cycles and dysmenorrhea were collected using a questionnaire and a Visual Analog Scale (VAS) ranging from 1 to 10. Statistical analysis was performed using SPSS version 27, employing Spearman's correlation and the Mann–Whitney test. The results showed p-values of 0.267 and 0.315 for the relationship between fat mass and visceral fat with the menstrual cycle, and p-values of 0.043 and 0.034 for their relationship with dysmenorrhea. These findings indicate that fat mass and visceral fat are significantly associated with dysmenorrhea but not with the menstrual cycle.

Keywords: fat mass, visceral fat, menstrual cycle, dysmenorrhea

INTRODUCTION

Menstruation is described as a normal physiological process occurring in women of reproductive age, including healthy adolescents, premenopausal women, and non-pregnant individuals, regulated by the hormones estrogen and progesterone.[1] The menstrual cycle typically lasts 21–35 days, with the bleeding phase lasting 2–7 days and an average blood loss of approximately 20–80 mL. Studies have reported that 14–25% of women experience irregular menstrual cycles.[2] A cycle is categorized as irregular when menstrual bleeding is heavier or lighter than usual and lasts 7–9 days, when the cycle length is shorter than 21 days or longer than 35 days, when intermenstrual spotting or bleeding occurs, when bleeding follows sexual intercourse, or when menstruation is absent for 3–6 months. Irregular menstruation may result from instability in progesterone and estrogen levels that disrupt normal hormonal patterns.[2]

Dysmenorrhea, referring to menstrual pain, affects approximately 50% to 90% of adolescent girls and women of reproductive age.[3] A meta-analysis conducted across several countries involving more than 21,000 participants reported a total prevalence of dysmenorrhea of 71.1%. From 19 studies including 11,226 women, 20.1% were unable to attend school or college due to dysmenorrhea. Overall, 40.9% of adolescent girls reported a negative impact on their academic performance and concentration.[4] Diet and nutritional intake influence organ function and sex hormone levels, which in turn affect BMI and body fat percentage. These factors are directly associated with ovulatory disorders, menstrual pain, and irregular menstrual cycles. Consequently, these conditions significantly affect women's quality of life as well as their physical and

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mental well-being, as irregular menstrual cycles are among the most common gynecological problems that can cause significant anxiety among students.[5]

A study by Kafaei-Atrian demonstrated that weight gain and increased body fat can influence the stability of steroid hormones such as androgens, estrogens, and sex hormone-binding globulin (SHBG). Several mechanisms explain the effect of adipose tissue on ovulation and the menstrual cycle: (1) adipose tissue plays a crucial role in converting androgens to estrogens; (2) women who are underweight, have inadequate energy intake, or are overweight may exhibit altered estrogen metabolism; and (3) obese women tend to have a reduced ability to bind estrogen to sex hormone-binding globulin, rendering estrogen inactive and leading to increased free estradiol levels in serum.[5] Progesterone, one of the major steroid hormones, is synthesized from cholesterol through a biochemical pathway starting with the formation of pregnenolone.[6] Progesterone deficiency can affect endometrial thickness and may cause a luteal phase defect, thereby influencing the menstrual cycle. Progesterone also affects prostaglandin production, which contributes to the sensation of menstrual pain.[7,8]

Because adipose tissue is closely associated with estrogen, assessing body composition parameters such as fat mass and visceral fat is clinically more meaningful. BMI has certain limitations, particularly when evaluating individuals with excess body fat. Previous research has shown that BMI provides limited information about fat distribution and varies across ethnic groups as well as between women and men.[9]

This study is relevant because visceral fat serves as a reliable indicator of hormonal imbalance. Visceral fat functions as endocrine tissue that contributes to hormone secretion and regulatory processes, including those involved in the menstrual cycle. Therefore, this updated research focuses on evaluating visceral fat, which can also be inferred from fat mass, as changes in fat mass are linearly associated with changes in visceral fat.[10] This study also provides important insights into maintaining optimal body composition to support a healthy and regular menstrual cycle.

METHOD

This study is an observational analytic cross-sectional study using a correlational analysis design for the research variables. The research was conducted at the Faculty of Medicine, Universitas Kristen Maranatha, from January 2024 until the thesis defense period. Menstrual disorders were assessed using a self-administered questionnaire evaluated based on the following criteria: (1) menstrual cycle length, where a normal cycle lasts 26–32 days, and cycles shorter than 26 days or longer than 32 days are classified as irregular; (2) duration of menstruation, where a normal duration is 3–7 days, and durations shorter than 3 days or longer than 7 days are categorized as irregular; and (3) volume of menstrual blood loss, represented by the number of sanitary pads changed per day, which is normally between 2 and 5 per day during menstruation.

Dysmenorrhea was evaluated by asking participants about the presence of severe menstrual pain and scored using the Visual Analog Scale (VAS) ranging from 1 to 10, where scores of 1–3 indicate mild pain, 4–7 indicate moderate pain, and 8–10 indicate severe pain. The menstrual cycle was subsequently classified as regular or irregular. Fat mass and visceral fat were categorized as normal or abnormal. Fat mass was measured using Bioelectrical Impedance Analysis (BIA) and expressed as a percentage. The normal range of fat mass in women is 18–28%. Normal visceral fat levels in women are 5–8% of total fat mass. Numeric variables were tested for normality. Based on the results of the normality test, correlations were analyzed using the Spearman correlation test for dysmenorrhea and the nonparametric Mann-Whitney test for menstrual cycle. All statistical analyses were performed using IBM SPSS version 27.

RESULTS

This study included 66 female medical students from the Faculty of Medicine, Maranatha Christian University. The distribution of body mass index (BMI) showed that nearly half of the respondents were categorized as obese (47%), while 42% had a normal BMI, 9% were overweight, and 2% were underweight. This pattern indicates that a substantial proportion of respondents had an above-normal body weight. Most participants reported a normal menstrual duration of three to seven days (92%) and a normal menstrual cycle length of 21–35 days (78%), suggesting that the majority experienced regular menstrual patterns. In addition, almost all participants changed their sanitary pads two to five times per day, reflecting adequate menstrual hygiene practices (see Table 1).

The Kolmogorov–Smirnov normality test indicated that the data were not normally distributed ($p > 0.05$), so the Mann–Whitney test was used for comparative analysis. No significant differences were found in median fat mass or visceral fat between participants with normal and abnormal menstrual cycles ($p > 0.05$).

This finding suggests that variations in body composition, as measured by fat mass percentage and visceral fat level, may not strongly influence menstrual cycle regularity in this sample population. It implies that other physiological, hormonal, or lifestyle factors could have a more dominant role in regulating menstrual cycle consistency among young women with varied body mass compositions (see Table 2).

Since the data were not normally distributed ($p > 0.05$), Spearman correlation analysis was performed. The results demonstrated statistically significant but weak positive correlations between fat mass and dysmenorrhea ($p = 0.043$, $r = 0.213$) and between visceral fat and dysmenorrhea ($p = 0.034$, $r = 0.228$).

These findings indicate that higher fat mass and visceral fat levels are modestly associated with increased dysmenorrhea severity, as measured by the Visual Analogue Scale (VAS). Although the correlation strength is weak, the significant rela tionship suggests that adiposity could play a role in the pathophysiology of dysmenorrhea, potentially through inflammatory or hormonal mechanisms. Elevated adipose tissue, especially visceral fat, is known to contribute to increased prostaglandin production and systemic inflammation, both of which may exacerbate menstrual pain (see Table 3). In summary, the results suggest that while fat mass and visceral fat are not significantly associated with menstrual cycle regularity, they show a weak but significant relationship with dysmenorrhea intensity. These findings emphasize that excess body fat, particularly visceral fat, may influence menstrual pain more than cycle regularity.

Table 1. Participant's demographic characteristics

Characteristic	n (%)
BMI	
Underweight	1 (2%)
Normal	28 (42%)
Overweight	6 (9%)
Obese	31 (47%)
Sanitary pad change frequency per day	
< 2 times	1 (1%)
2–5 times	65 (99%)
Menstrual duration (days)	
< 3	0 (0%)
3–7	61 (92%)
> 7	5 (8%)
Menstrual cycle (days)	
< 21	4 (6%)
21–35	52 (78%)
> 35	10 (16%)
Age at menarche (years)	
< 12	9 (14%)
12–13	49 (74%)
> 13	8 (12%)

Table 2. Distribution of median fat mass and visceral fat in relation to the menstrual cycle

Variable	Menstrual cycle	Median	Minimum	Maximum	p-value
Fat mass (%)	Normal	39.8	25.3	54.1	0.267
	Abnormal	39.6	25.2	49.0	
Visceral fat level	Normal	11.0	4	20	0.315
	Abnormal	10.5	4	20	

Note: Mann–Whitney U test

Table 3. Relationship between fat mass and visceral fat with dysmenorrhea

Independent variable	Median	Minimum	Maximum	r-value	p-value
Fat mass (%)	39.8	25.2	54.1	0.213	0.043
Visceral fat level	11.0	4	20	0.228	0.034
Dysmenorrhea (VAS score)	6	1	10	–	–

Note: Spearman correlation test. The r-value indicates a weak positive correlation.

DISCUSSION

In this study, no statistically significant relationship was found between fat mass and the menstrual cycle, nor between visceral fat and the menstrual cycle. This result is consistent with the findings of Trisina et al.[11], who studied female medical students at the Faculty of Medicine, Udayana University, and found no significant association between body fat percentage and the menstrual cycle. In the present study, body fat distribution was relatively balanced between normal and abnormal categories. However, other factors that could influence menstrual cycles were not considered.

Previous studies have also suggested that visceral fat may represent an alternative indicator of abnormal fat distribution.[12,13] However, research exploring the relationship between visceral fat and the menstrual cycle remains scarce. Therefore, this study has certain limitations due to the limited number of available references. A significant correlation was observed between fat mass and dysmenorrhea, as well as between visceral fat and dysmenorrhea. This finding aligns with the study conducted by Putri & Lubis[14], who reported that women with either high or low fat mass were more likely to experience dysmenorrhea than those with normal fat mass. Similarly, Syafriani[15] found that women with abnormal nutritional status had an 8.5 times higher risk of developing dysmenorrhea.

Trisina[11] also reported that there was no significant association between body fat percentage and the menstrual cycle among female medical students at Universitas Udayana. Consistent with this, the present

study found a lower prevalence of students with abnormal menstrual cycles compared to those with normal cycles. This unequal distribution may have contributed to the findings. In the study by Prathiha[16], an uneven distribution was also observed between non-overweight and overweight subjects, which resulted in the absence of a significant relationship between the menstrual cycle and body fat percentage. Similarly, this study found that the number of subjects with abnormal fat mass and visceral fat levels was greater, which may have reduced the representation of each body weight category. The menstrual cycle is influenced by factors such as physical activity, stress level, and age at menarche, yet these factors were not assessed in this study, potentially affecting the resulting data.[17]

Nutritional intake, which is metabolized into body fat, plays an important role in the menstrual cycle. Estrogen synthesized through fat metabolism serves as one of the main factors influencing both the menstrual cycle and dysmenorrhea. Body fat also affects gonadotropin function, which regulates follicle-stimulating hormone (FSH) and luteinizing hormone (LH). Such dysfunction may disrupt hormonal balance, particularly involving estrogen and progesterone.[18] Progesterone additionally affects prostaglandin release, which is believed to be a major contributing factor to dysmenorrhea.[19] During prolonged menstrual cycles, continuous uterine contractions stimulate prostaglandin and lead to vascular hyperplasia, which can obstruct uterine blood flow and cause dysmenorrhea.[20] Prostaglandins are synthesized from lipids produced by adipocytes throughout the body; therefore, both excessive and insufficient fat levels may contribute to dysmenorrhea.[21] Other factors such as stress, physical activity, family history, age at menarche, and hemoglobin concentration can also influence menstrual cycles and dysmenorrhea in women.[22]

Although fat mass and visceral fat have established roles in reproductive hormone regulation, this study did not find a significant relationship between body fat percentage and menstrual cycle characteristics. Several factors may explain these results. Limited sample variability and relatively homogeneous fat mass distribution among participants could reduce the statistical power to identify true associations. Moreover, unmeasured confounding variables, including stress levels, dietary habits, physical activity, thyroid function, and medication use, may affect menstrual patterns. Measurement limitations, such as the use of self-reported menstrual cycle data and the assessment of body composition at a single time point, may also contribute.

Another possibility is that the effect of fat mass on the menstrual cycle becomes evident only at very low or very high fat levels, producing minimal variation within the normal range. Additionally, individual differences in hormonal sensitivity may lead to variable responses to estrogen produced by adipose tissue, further complicating the detection of associations in this study's sample.

CONCLUSION

This study found no significant association between fat mass or visceral fat and menstrual cycle regularity among female medical students. These findings suggest that variations in body composition alone may not substantially affect menstrual patterns in young women who generally exhibit normal menstrual characteristics. However, a weak yet statistically significant positive correlation was identified between both fat mass and visceral fat and the severity of dysmenorrhea. This suggests that increased adiposity, particularly visceral fat, may modestly contribute to menstrual pain, possibly through inflammatory or hormonal mechanisms. Overall, the results indicate that adiposity may exert a greater influence on the severity of menstrual pain than on cycle regularity. Further research with larger and more diverse populations is warranted to clarify these associations and to examine additional factors such as stress, physical activity, diet, and hormonal profiles. Longitudinal studies incorporating biochemical markers of inflammation and hormone levels would provide a more comprehensive understanding of the mechanisms linking body fat distribution and menstrual health.

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