

The Relationship between Body Mass Index and Menstrual Cycle of Female Students in SMK Negeri 2 Gorontalo

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ABSTRACT

Introduction: The menstrual cycle is a regularly coordinated hormonal process in a woman's body which can be an indicator to describe a woman's reproductive health. Riskesdas (2018) shows that 11.7% of Indonesian youth experience menstrual cycle disorders. Body Mass Index (BMI) can be a factor that can interfere with the menstrual cycle, so the purpose of this study was to analyze the relationship between Body Mass Index (BMI) and the menstrual cycle in female students at SMK Negeri 2 Gorontalo.

Method: This study used a *cross-sectional* design. The sample was selected using a *probability sampling* technique utilizing simple random sampling with a total sample of 173 people, the instruments used were scales and meters for body mass index data and menstrual cycle questionnaires. The study was conducted in November 2022. The relationship between BMI and the menstrual cycle was tested using the *Spearman correlation* test.

Results: Out of 173 respondents whose data were analyzed, 128 respondents (74%) had a normal BMI, 19 respondents (11%) were underweight, and 26 respondents (15%) were overweight. Among the total respondents, 117 (67.6%) had a normal menstrual cycle, while 56 (32.4%) had an abnormal cycle. There were 14 respondents (10.9%) with normal BMI, 18 respondents (94.7%) with underweight BMI, and 24 respondents (92.3%) with overweight BMI who had an abnormal menstrual cycle. There was a significant correlation between BMI and menstrual cycle among female students of SMK Negeri Gorontalo, with a p-value of 0.019.

Conclusion: significant association exists between BMI and menstrual cycle among SMK Negeri 2 Gorontalo female students. This study can serve as a recommendation for the school to provide information regarding reproductive health, particularly menstrual cycles.

Key words: Body mass index, female student, menstrual cycle



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Introduction

Adolescence begins at 10-19 years, marking the transition from childhood to adulthood, and is characterized by the onset of menstruation. Furthermore, the menstrual cycle is one relevant indicator that can depict women's reproductive health.¹ Menstruation is the cyclic and regular shedding of the uterine wall in response to interactions of hormones produced by the hypothalamus, pituitary gland, and ovaries.¹ One of the factors that can disrupt the menstrual cycle is the Body Mass Index. Although various hormones play a role in influencing the menstrual cycle, research has indicated that a high Body Mass Index can lead to amenorrhea, irregular menstrual cycles, heavy or prolonged menstruation, and menstrual pain.²

Based on the data from the 2018 Riskesdas (National Basic Health Research) cited in Arum et al. (2019), approximately 11.7% of Indonesian adolescents aged 15-19 years experience menstrual cycle disorders.³ The Body Mass Index can be calculated as body weight divided by height, where body weight is in kilograms and height is in meters. The percentage of body fat can be predicted using the Body Mass Index. Fat is one of the compounds in the body that plays a crucial role in forming reproductive hormones, such as androgen and estrogen. When estrogen levels increase, it indirectly leads to an increase in androgen levels, causing disruptions in follicle development. Limited body fat can decrease aromatized androgen hormone levels into estrogen, leading to irregular menstrual cycles.⁴

Women with low body fat levels have significantly lower estrogen levels. Therefore, weight loss can restore regular menstrual function by reducing the aromatization of androgen into estrogen in adipose tissue.² Obesity is linked to excessive estrogen levels. Estrogen is a primary reproductive hormone that can influence the menstrual cycle. Obesity can also increase the risk of gynecological conditions, including infertility, polycystic ovary syndrome, and irregular menstrual cycles, although various hormones also play a role.²

The Riskesdas in 2010 reported that 13.7% of women aged 10-59 in Indonesia experienced irregular menstrual cycles in the past year. The highest percentage of irregular menstruation was found in the Gorontalo region (23.3%), while the lowest was in Southeast Sulawesi (8.7%), with Lampung at 11.3%. Several factors that can influence the menstrual cycle include disruptions in hormone function, systemic abnormalities, thyroid disorders, and excessive prolactin hormone.⁵ According to Riskesdas data from 2010 and 2013, Gorontalo was among the 15 provinces with a high prevalence of obesity.⁶

Vocational high school (SMK) students have different activities compared to students in junior and senior high school, as they engage in practical training outside regular school

hours. They enter the workforce directly, so they need to be aware that their activities can affect their Body Mass Index (BMI), which can influence their menstrual cycles. Regular menstrual cycles are essential for proper reproductive organ function and to avoid disruptions in the students' activities.

Methods

Observational analytic study with a cross-sectional approach held on month November 2022 and take place in SMK Negeri 2 Gorontalo. Study This uses primary data in the form of questionnaire cycle menstruation, index data mass body obtained with weight to respondent's height.

Population and Sample

Sampling used a probability sampling technique using simple random sampling, namely as many as 173 respondents. The inclusion criteria for this study were female students aged 15-18 years who were already menstruating and willing to participate. The exclusion criteria for this study were female students with menstrual cycle disorders caused by gynaecological diseases and female students who were not willing to be the research sample.

Data Collection Procedures

The source of data in this research is primary data. This study used scales and measuring tape to obtain Body Mass Index data by collecting data on body weight three times for more accurate results and a questionnaire to obtain data on the menstrual cycle, age, age at menarche, and family history.

Method of Data Analysis

Data processing and analysis in this study used the statistical package for social science (SPSS) version 16.0 program (IBM, USA), which is presented in tabular form to view data on respondent characteristics in the form of age, menarche age, weight, height as well as a table of the relationship between body mass index and menstrual cycle. After that, the researcher will perform univariate analysis to see the frequency and distribution of data and bivariate analysis using the Spearman correlation test, and it is said that the research results are significant if the results are $p < 0.05$.

Results

Respondents of this study consisted of 173 people who met predetermined criteria. Respondents were then analyzed based on the primary information provided. The analysis shows that most respondents were 16 years old, namely 78 people (45.1%), while the minor

age group is 17, totalling 13 people (7.5%). The majority of respondents got their first menstruation (menarche) aged > 13 years, namely 94 people (54.3%).

Table 1. Characteristics of Study Participants

Characteristics	Frequency (n)	Percentage (%)
Age		
15 Years old	41	23.7
16 Years old	78	45.1
17 Years old	13	7.5
18 Years old	41	23.7
Menarche Age		
<11 Years old	17	9.8
11-13 Years old	62	35.8
>13 Years old	94	54.3
Weight		
40-50 kg	110	63.6
51-60 kg	35	20.2
61-70 kg	28	16.2
Height		
140-150 cm	71	41
151-160 cm	69	39.9
161-170 cm	33	19.1

Table 2 reveals the distribution of BMI for SMK Negeri 2 Gorontalo female students. The majority of respondents have a normal BMI comprising 128 people (74%), and the underweight BMI category is the least, with only 19 people (11%).

Table 2. Distribution of Frequency and Percentage of Body Mass Index for Study Participants

Body Mass Index	Frequency (n)	Percentage (%)
Very underweight	0	0
Underweight	19	11
Normal	128	74
Overweight	26	15
Obesity	0	0

Table 3 shows the distribution of menstrual cycle abnormality of SMK Negeri 2 Gorontalo female students. The respondents had a normal menstrual cycle, comprising 117 individuals (67.6%). Out of 56 respondents with abnormal menstrual cycles, 11 individuals (6.4%) experienced Polymenorrhea, 15 individuals (8.7%) had Oligomenorrhea, one individual (0.6%) had Hypermenorrhea, one individual (0.6%) had Hypomenorrhea, eight individuals (4.6%) had Brachymenorrhea, four individuals (2.3%) had Menorrhagia. The majority experienced Dysmenorrhea, totalling 16 individuals (9.2%).

Table 3. Distribution of Frequency and Percentage Menstrual Cycle Abnormality of SMK Negeri 2 Gorontalo Female Students

Menstrual Cycle Type	Frequency (n)	Percentage(%)
Normal	117	67.6
Polymenorrhea	11	6.4
Oligomenorrhea	15	8.7
Hypermenorrhea	1	0.6
Hypomenorrhea	1	0.6
Brachymenorrhea	8	4.6
Menorrhagia	4	2.3
Dysmenorrhea	16	9.2

Table 4 indicate the association between BMI and menstrual cycles in SMK Negeri 2 Gorontalo female students. Most female students have a normal menstrual cycle, comprising 117 respondents (67.6%), while 56 students (32.4%) have an abnormal menstrual cycle. Out of 19 students in the underweight BMI category, the majority experienced Dysmenorrhea, totalling eight individuals (4.6%). Among the overweight BMI category, out of 26 students, most experienced Oligomenorrhea, totalling 12 individuals (6.9%). In the normal BMI category, out of 128 students, 14 individuals (8.1%) had an abnormal menstrual cycle. The research results indicate that the analysis of the association between BMI and menstrual cycle in female students of SMK Negeri 2 Gorontalo using the Spearman rank test yielded a p-value of 0.019. This value is smaller than $\alpha=0.05$, which means there is a significant association between Body Mass Index and menstrual cycle in female students of SMK Negeri 2 Gorontalo.

Table 4. The Association between Body Mass Index and Menstrual Cycles in SMK Negeri 2 Gorontalo Female Students

Menstrual Cycles	Body Mass Index						Total	p-value
	Normal		Underweight		Overweight			
	n	(%)	n	(%)	n	(%)		
Normal	114	65.9	1	0.6	2	1.2	117	67.6
Polymenorrhea	3	1.7	2	1.2	6	3.5	11	6.4
Oligomenorrhea	2	1.2	1	0.6	12	6.9	15	8.7
Hypermenorrhea	1	0.6	0	0	0	0	1	0.6
Hypomenorrhea	0	0	1	0.6	0	0	1	0.6
Brachymenorrhea	3	1.7	5	2.9	0	0	8	4.6
Menorrhagia	2	1.2	1	0.6	1	0.6	4	2.3
Dysmenorrhea	3	1.7	8	4.6	5	2.9	16	9.2
Total	128	74	19	11	26	15	173	100

Discussion

The research data shows that most respondents had a normal body mass index, namely 128 people (74%). This is appropriate with Arisman's statement that economic and technological developments have led to improvements in nutrition compared to previous decades.⁷ Adolescent diet is very influential on adolescent health, including nutritional status. Nutritional status should be in adequate conditions to ensure further growth and development. Being overweight in adolescents can occur due to lack of activity or lifestyle, such as smoking, lack of sleep, and eating fast food can exacerbate this condition. Doing physical activity is one of the efforts to prevent unhealthy body conditions. Healthy activities like walking and small exercise are less attractive to teenagers, and most prefer walking in malls. This can be a fun physical activity.⁸ Based on the results of research conducted by Oktaviani et al. (2012) concerning the relationship between fast food consumption habits, physical activity, consumption patterns, and characteristics of adolescents and parents with body mass index (BMI) showed the results of statistical tests showed a relationship between food consumption patterns and BMI.⁹

Nutritional status in adolescents will affect BMI, where BMI is one of the factors that can affect the menstrual cycle. The menstrual cycle is said to be normal if it lasts for 21-35 days, with menstrual periods ranging from 3-7 days. During menstruation, the amount of blood is no more than 80 ml per day, with a frequency of changing pads 2-6 times per day.¹⁰

The research data shows that most 173 respondents had normal menstrual cycles. The results of research conducted by Gilbert et al. (2022) concerning the relationship between BMI and menstrual cycles also showed that the majority of the 113 respondents had normal menstrual cycles, as many as 85 people (75.2%).¹¹ Shortening the follicular period causes shorter menstrual cycles (polymenorrhea), which is associated with decreased fertility and miscarriage. Meanwhile, prolongation of the menstrual cycle (oligomenorrhea) is related to the incidence of anovulation, infertility, and miscarriage.¹²

One of the factors that can interfere with the menstrual cycle is BMI. Although various hormones play a role in influencing the menstrual cycle, research has suggested that a high BMI can cause amenorrhea, irregular menstrual cycles, heavy or long periods, and painful menstruation.² It has known that BMI affects the menstrual cycle through the role of the hormone estrogen. The hormone is produced in the placenta, ovaries, adrenal glands, and adipose tissue. Low body fat lowers estrogen levels. This is related to infertility. High estrogen in the body can cause prolonged menstrual cycles.⁴

The study's results were from 128 respondents with a normal body mass index. 117

respondents (67.6%) had normal menstrual cycles, while 14 (8.1%) had abnormal menstrual cycles. Respondents in this study have different characteristics. Some have a normal BMI but have an abnormal menstrual cycle. Some have an abnormal BMI but have normal menstrual cycles. Here it should be noted that in the female reproductive system, good nutrition and psychological factors influence. Even though the nutrition is good, if a woman experiences psychological disorders, it will disrupt her reproductive system. This research is in line with the study conducted by Sitepu in 2018 entitled "Relationship of Body Mass Index and Menstrual Cycles in Young Girls at SMA Negeri 1 Tigapanah Kab. Karo in 2018." The test used in this study was the Spearman Rank test, with the results showing a significant correlation between body mass index and the menstrual cycle.¹³

The menstrual cycle in women with high body fat levels is due to increased production of androstenedione, an androgen that acts as a precursor for reproductive hormones. Androgens are converted to estrogens through the aromatization process of granulosa cells and adipose tissue assisted by the aromatase enzyme. Increased estrogen levels can cause negative feedback of GnRH secretion in the hypothalamus. This also results in FSH levels not reaching their peak, and follicular development will stop so that ovulation does not occur. This situation can cause amenorrhea or oligomenorrhea. Fat levels in the body are related to the hormone leptin, which regulates appetite, energy consumption, and the sympathetic nervous system. People who are overweight will experience leptin resistance, so leptin fails to control fat in the body. Uncontrolled fat levels can cause an increase in estrogen levels.¹⁴

The results showed that of the 26 obese respondents, 12 (6.9%) had oligomenorrhea. Fat is one of the compounds in the body that has an essential role in forming reproductive hormones, namely androgen and estrogen hormones. When estrogen levels increase, androgen levels indirectly increase, causing disturbances in follicular development. Limited fat in the body can cause androgen hormone levels which aromatize to become hormones, to decrease so that the menstrual cycle is irregular.¹⁴

Women who are overweight have excess fat, so estrogen synthesis in the body will increase, causing negative feedback in the hypothalamus and inhibiting follicular development, resulting in no menstruation (amenorrhea) and elongation of the follicular period (oligomenorrhea). Obese women can also experience dysmenorrhea. The research data showed that of the 26 respondents (15%) with a high body mass index, 5 (2.9%) experienced dysmenorrhea. This is because excess fat tissue can cause pressure on blood vessels or vascular hyperplasia by fatty tissue in the female reproductive organs so that blood that

should flow during menstruation is disrupted and causes pain.¹⁰

Women with thin bodies found low levels of FSH and estrogen and changes in the ratio of FSH to LH. Sometimes high prolactin levels are found.¹⁴ The results showed that out of 19 respondents (11%) with a low body mass index, eight (4.6%) had dysmenorrhea. This is due to the lack of hormone synthesis and small fat reserves in women, which can cause menstrual cycle irregularities because the lack of body fat levels can cause a decrease in androgen levels which are aromatizing with estrogen. Being underweight can result in decreased production of androgen hormones for the secretion of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), which can harm the menstrual cycle. It can also result in a shortening of the luteal phase.⁴ Women with low BMI are at risk of experiencing dysmenorrhea, and this is due to a weak body condition that causes resistance to pain.

The limitation of the research is that this study only analyzes the relationship between BMI and the menstrual cycle in female students at SMK Negeri 2 Gorontalo. However, research on the factors that affect the menstrual cycle cannot be carried out.

Conclusion

Based on the research results that have been done, it is concluded that there showed high acceptance and satisfaction of the digital illustrator in practical skills. The learners expressed high perceived usefulness, ease of use, and intention to use the digital illustrator in learning practical histology skills. The learners also found the materials relevant, effective, enjoyable, and exciting and would recommend them to their fellow students for use. The expressed high acceptance of and satisfaction with the video-based instructional materials was, to a large extent, also uniform among the respondents of the three study centers. Thus, irrespective of location, the learners generally appeared optimistic about their experiences using the digital illustrator to learn histology practicals in medical faculty.

Conflicts of Interest

Nothing to declare

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