



## Body fat percentage, mid-upper arm circumference, and menstrual cycle in female students at X high school

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### ABSTRAK

**Latar Belakang:** Siklus menstruasi yang tidak teratur pada remaja putri merupakan suatu tanda adanya gangguan pada sistem reproduksi. Salah satu faktor terjadinya gangguan siklus menstruasi yaitu masalah status gizi. Status gizi dapat dilihat menggunakan beberapa indikator antropometri berupa persentase lemak tubuh dan lingkaran lengan atas (LILA).

**Tujuan:** Menganalisis hubungan antara persentase lemak tubuh dan LILA dengan siklus menstruasi pada siswi SMK X Sidoarjo.

**Metode:** Jenis penelitian yang digunakan adalah cross-sectional. Sampel yang digunakan sebesar 66 siswi berdasarkan teknik stratified random sampling. Pengambilan data terkait persentase lemak tubuh menggunakan alat Mi Body Composition Scale 2, terkait lingkaran lengan atas (LILA) menggunakan pita LILA dan terkait siklus menstruasi menggunakan kuesioner siklus menstruasi 3 bulan terakhir. Analisis data yang digunakan yaitu uji korelasi Rank Spearman.

**Hasil:** Hasil menunjukkan bahwa responden memiliki rata-rata persentase lemak tubuh sebesar 26,6%, LILA sebesar 23,6 cm dan siklus menstruasi selama 34 hari. Berdasarkan uji hubungan antara persentase lemak tubuh dengan siklus menstruasi didapatkan p-value 0,000 dan r-value -0,865, serta antara LILA dengan siklus menstruasi didapatkan p-value 0,000 dan r-value -0,916. Semakin tinggi persentase lemak tubuh, maka semakin pendek siklus menstruasi. Semakin kecil LILA, maka semakin panjang siklus menstruasi.

**Kesimpulan:** Terdapat hubungan yang signifikan antara persentase lemak tubuh dan LILA dengan siklus menstruasi pada siswi SMK X Sidoarjo. Remaja putri diharapkan untuk menjaga status gizinya agar tetap normal guna mempertahankan keteraturan siklus menstruasinya, sehingga dapat meminimalisir risiko infertilitas di masa yang akan datang.

**KATA KUNCI:** Lingkaran lengan atas (LILA); persentase lemak tubuh; remaja putri; siklus menstruasi;



## ABSTRACT

**Background:** Irregular menstrual cycle in adolescent girls is an indicator of reproductive organ disorders. One of the risk factor for menstrual cycle disorders is nutritional status problem. Nutritional status can be measured using several anthropometric indicators such as body fat percentage and mid-upper arm circumference (MUAC).

**Objectives:** This study aimed to analyze the correlation between body fat percentage and MUAC with the menstrual cycle in girls of X High School Sidoarjo.

**Methods:** The type of this research was cross-sectional. The sample used 66 students with stratified random sampling technique. Body fat percentage was obtained by using the Mi Body Composition Scale 2, mid-upper arm circumference (MUAC) was measured by using midline, and the menstrual cycle was obtained by using a menstrual cycle questionnaire for the last 3 months. Data were analyzed with Rank Spearman test.

**Results:** The results showed that average of body fat percentage was 26.8%, MUAC was 23.8 cm, and menstrual cycle was 35 days. Based on the test of the relationship between body fat percentage and the menstrual cycle, p-value 0.000 (r-value -0.875) were obtained, while MUAC and the menstrual cycle showed p-value 0.000 (r-value -0.916). The higher the body fat percentage, the shorter the menstrual cycle. The smaller the MUAC, the longer the menstrual cycle.

**Conclusions:** There was a significant relationship between body fat percentage and MUAC with the menstrual cycle within girls in X High School Sidoarjo. Adolescent girls are expected to maintain normal nutritional status in order to maintain the regularity of their menstrual cycle, so as to minimize the risk of infertility in the future.

**KEYWORD:** body fat percentage; girl adolescent; Mid-upper arm circumference (MUAC); menstrual cycle;

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## INTRODUCTION

According to Riset Kesehatan Dasar (Riskesdas) 2010, the prevalence of menstrual cycle disorders at the national level was 13.7%, while East Java was 13.3%. The health effect that can arise due to irregular menstrual cycles is anovulation. Anovulation is the absence of ovum release from the ovarium, causing a person to be infertile in the future (1). Women with irregular menstrual cycles have a low chance of getting pregnant because the ovulation period is irregular, causing the failure of ovum production. Menstrual cycle disorders are one of the clinical manifestations of polycystic ovary syndrome (PCOS). A preliminary study which conducted at X high school in Sidoarjo showed that 15 female students (67%) had menstrual cycle disorders. There are several factors related to the menstrual cycle abnormalities, including nutritional status, food intake, stress levels, consumption of hormonal drugs, hormonal disorders and

endocrine disorders (1). Previous research conducted by Dya and Adiningsih (2019) stated that there was a relationship between nutritional status and the menstrual cycle in female students of MAN 1 Lamongan.

According to the Indonesian Ministry of Health (2017), anthropometric indicators that can be used to detect nutritional status was mid-upper arm circumference (MUAC). MUAC measurement can be used to determine the risk of chronic energy deficiency or malnutrition in individu, especially in women (2). Malnutrition condition in women may alter the function of her reproductive organ thus will affect her menstrual cycle. Another anthropometric indicator that can be measured as a parameter of nutritional status was the percentage of body fat. Based on the previous study, the higher percentage of body fat, the more likely women to experience menstrual cycle disorders (3). Estrogen hormone is a hormone that

play a role in the menstrual cycle produced by adipose tissue, so that young women who had higher body fat levels may affect the production of the hormone estrogen to increase as well (1,4). The purpose of this study was to analyze the relationship between body fat percentage and mid-upper arm circumference (MUAC) with the menstrual cycle in female students of X high school Sidoarjo.

## MATERIALS AND METHODS

This research was an observational analytic study with a cross-sectional design. Participants enrolled in this study were 66 female students in X high school Sidoarjo using Lemeshow stratified sampling formula. The sampling method was stratified random sampling. The inclusion criteria in this study were 14-19 years old, had menstruated, physically and mentally healthy (no injuries to the arms and legs), did not smoke and consumed alcohol, were also willing to participate in the study. Female students who were taking hormonal drugs such as regimens, norethynodrel and contraception pills, had reproductive or hormonal diseases such as PCOS were excluded from this study. The study instrument for percentage of body fat was Mi Body Composition Scale 2 with 0,1% accuracy level and mid-upper arm circumference (MUAC) was measured with midline. Menstrual cycle was documented using a menstrual cycle adopted from Sari regarding the

history of the menstrual cycle in the last 3 months (5). The participants who involved in this study were asked to record their menstrual cycle three months before the data collection process.

In this study, body fat percentage was categorized into 4 categories, namely underfat (<21%), normal (21-32%), overfat (33-39%) and obese (>39%). MUAC was classified into risk of chronic energy deficiency risk (<23.5 cm) and not risk (> 23.5 cm) (safe). The menstrual cycle was categorized into normal (21-35 days), polymenorrhea (<21 days), oligomenorrhea (>35 days) and amenorrhea (>3 months). The correlation test performed in this study was Spearman Rank test using the SPSS for Windows 20.0 program with a 95% confidence level ( $\alpha = 0.05$ ) based on the data normality test. This research has received ethical approval by the Health Research Ethics Committee Universitas Nahdlatul Ulama Surabaya with issued number 282/EC/KEPK/UNUSA/2021. All participants who participate in this study had submitted informed consent before the study conducted.

## RESULTS AND DISCUSSIONS

**Table 1** showed that almost half participants were 17 years old (41.1%). Over half of the participants (67.1%) had normal nutritional status (BMI/A) and 79.5% of the participants had age of menarche in the normal category (12-15 years).

**Table 1. Characteristic of participants**

Variable	n	%
Age (years old)		
15	7	10.6
16	25	37.9
17	25	37.9
18	8	12.1
19	1	1.5
Nutritional Status (BMI/A)		
Underweight (< 5 <sup>th</sup> percentile)	12	18.2
Normal (5 <sup>th</sup> - ≤85 <sup>th</sup> percentile)	42	63.6
Overweight (85 <sup>th</sup> - ≤95 <sup>th</sup> percentile)	9	13.6
Obesity (>95 <sup>th</sup> percentile)	3	4.5
Menarche		
Normal (12-15 years old)	51	77.3
Early (<12 years old)	15	22.7

The mean of percentage body fat in this study was  $26.79 \pm 8.74$  (normal body fat). Based on the participants' body fat percentage data, 28.8%

participants had under fat, 43.9% had normal fat, and 27.3% had overfat-obesity category (**Table 2**). Half of participants were at risk of chronic energy

deficiency that indicated by MUAC <23.5 cm (50%). **Table 2** also described that 75.8% participants had normal menstrual cycles, while

24.2% experienced irregular menstrual cycle, include polymenorrhea, oligomenorrhea, and amenorrhea.

**Table 1. Body Fat Percentage, Mid-Upper Arm Circumference and Menstrual Cycle of Participants**

Category	n	(%)	Mean ± SD	95% CI
Body Fat Percentage				
Underfat	19	(28.8)		
Normal	29	43.9	26.8 ± 8.7	24.7-28.9
Overfat	13	19.7		
Obesity	5	7.6		
Mid-Upper Arm Circumference				
At risk of chronic energy deficiency	33	50	23.8 ± 3.2	23.0-24.5
No risk of chronic energy deficiency	33	50		
Menstrual Cycle				
Normal	50	75.8		
Polymenorrhea	5	7.6	34.6 ± 18.4	30.6-39.3
Oligomenorrhea	6	9.1		
Amenorrhea	5	7.6		

Based on **Table 3**, it could be seen that participants who experienced polymenorrhea had obese body fat percentage. It also showed that oligomenorrhea and amenorrhea occurred in participants with underfat percentage. Spearman Rank test showed that there was a significant correlation between the percentage of body fat and the menstrual cycle with p-value 0.000 and r-value -0.865. r-value indicated that higher percentage of body fat affect shorter menstrual cycle.

From **Table 4**, it described that participants who experienced polymenorrhea were not at risk of developing chronic energy deficiency, while participants with oligomenorrhea and amenorrhea were at risk of developing chronic energy deficiency. Based on data analysis using the Spearman Rank test, p-value 0.000 (<0.05) with r-value -0.916 indicated that there was correlation between upper arm circumference and menstrual cycle in female students significantly.

**Table 3. Correlation between Body Fat Percentage with Menstrual Cycle**

Body Fat Percentage	Menstrual Cycle								Total	
	Normal		Polymenorrhea		Oligomenorrhea		Amenorrhea		n	%
	n	%	n	%	n	%	N	%		
Underfat	10	52.6	0	0	5	26.3	4	21.1	19	100
Normal	26	89.8	1	3.4	1	3.4	1	3.4	29	100
Overfat	12	92.3	1	7.7	0	0	0	0	13	100
Obesitas	2	40	3	60	0	0	0	0	5	100

*p-value= 0.000\* r-value = -0.875*

\*Spearman-Rank correlation test with significant at p-value <0.05

The r-value explained that the greater MUAC, the shorter the menstrual cycle.

The prevalence of abnormal body fat percentage in this study was related to calorie intake and physical activity. Participants with underfat category seem to skip meals, especially at night due to laziness. That habit may affect the fulfillment of their daily nutritional needs. This study also found excessive body fat

percentage in the participants. It can be caused by frequently consume high-calorie and high-fat food, such as fast food and fried foods. In addition, the excess body fat can also be determined by physically inactive. This study results similar with Arraniri's et al (2017) which stated that there was a significant relationship between calorie intake and body fat percentage (6). Excessive food intake will be stored in the

body and yield in elevating the amount of fat in the body. The percentage of body fat was also influenced by physical activity. Amelia and Syauby (2014) explained that the lower physical activity in a person, the percentage of body fat more likely to be higher, and vice versa (7). In

addition to calorie intake and physical activity, body fat is also influenced by gender. Adolescent girls are more likely to experience excess nutrition because girls reserve more excess energy as fat, while boys tend to use excess energy to synthesize protein (8).

**Table 4. Correlation between Mid-Upper Arm Circumference with Menstrual Cycle**

Mid-Upper Arm Circumference	Menstrual Cycle									
	Normal		Polymenorrhea		Oligomenorrhea		Amenorrhea		Total	
	n	%	n	%	n	%	N	%	n	%
At risk	22	66.7	0	0	6	18.2	5	15.1	33	100
No risk	28	84.8	5	15.2	0	0	0	0	33	100
p-value = 0.000* r-value = -0.916										

\*Spearman-Rank correlation test with significant at p-value <0,05

Most of the students who had chronic energy deficiency risk also had negative body image. They concerned about their body shape and appearance (negative body image). Adolescent who likely to think that ideal body shape is slim or thin body dispose to try various weight loss diet, like calorie deficit diet (9). Chronic calorie deficit may cause nutrition problem, like chronic energy deficiency. Chronic energy deficiency is a nutrition problem that can be screened through mid-upper arm circumference (MUAC) measurement. MUAC <23.5 cm describe the occurrence of muscle mass depletion. Muscle mass depletion occurs due to the conversion of protein in the liver and muscles into energy as a result of decreasing of fat reserves when energy intake is insufficient (10)(11). According to Wahyuni (2018), there was a significant relationship between carbohydrate and protein intake and MUAC in female students. Excessive or insufficient food intake may cause changes in body composition, mainly muscle mass. MUAC is an indicator of the main muscle mass location in the body (12).

Previous study explained that food intake, physical activity, and nutritional status mainly influenced menstrual cycle in girls. In this study, most of the participants often consume high-calorie and high-fat food. This dietary habit can impact the fulfillment of nutrients and nutritional status. Abnormal nutritional status can induce irregular menstrual cycle. In line with the research of Nahdah et al. (2022), insufficient or excessive fat intake could cause disruption of reproductive hormones secretion (13). Anggoro (2022) stated

that there was relationship between nutritional status and menstrual cycle significantly (p-value 0.011) (14). Undernutrition or overnutrition can affect the secretion of gonadotrophin-releasing hormone (GnRH), so it can affect luteinizing hormone (LH) and follicle stimulating hormone (FSH). Decreasing of the production of these two hormones may interfere secretion of the estrogen hormone. Low estrogen secretion will affect in disruption of the menstrual cycle (15).

Body fat has a role in menstrual cycle regulation. The estrogen hormone is produced by fat tissue. Adolescent who consumes high calorie, high fat, high sodium, and low fiber food lead to high body fat percentage. On the other hand, low-fulfillment of nutritional needs can lead to poor nutritional status (16). People with poor nutritional status tend to have low percentage of body fat. The results of this study similar with Triany et al. (2018), that there was significant relationship between the percentage of body fat and the menstrual cycle of adolescent girls Pekalongan City (17). Deborah et al. (2017) also stated that female students with excess body fat had 4x higher risk of menstrual cycle irregularities than students with normal body fat (18). Women with a body fat percentage of <21% or >33% have 3.521 times greater risk of experiencing menstrual cycle disorders than women with a normal body fat percentage (19). Optimal body fat percentage required by women to maintain normal menstrual cycle was 22% (20).

MUAC is an indicator of the risk of chronic energy deficiency or malnutrition in women.

Participants with the risk of chronic energy deficiency had irregular eating habits. Some participants with MUAC <23.5 cm had low fulfillment of nutritional requirement. If this situation occurs continuously, fat reserves in body can be depleted. Low levels of fat in the body may affect secretion of the estrogen hormone. Decreasing levels of estrogen can cause menstrual cycle disorders. The results of this study were in line with Elinda (2018), there was a relationship between MUAC and the menstrual cycle in female students in Medan. Malnourished adolescent girls had risk to experience menstrual cycle irregularities (21). Malnutrition can reduce the physiology of hypothalamus in producing GnRH. Low GnRH production can affect the stimulation of the anterior pituitary, causing depletion in LH and FSH secretion. Depletion of FSH and LH impact on decreasing levels of estrogen hormone. That mechanism yield in inhibition of releasing ovum process that can influence on irregularity of menstrual cycle (1)(16). This study, even with small number of participants, found that body fat percentage and MUAC had strong relationship with menstrual cycle in adolescent. The limitations in this study was causal effect between those variables could not explained due to cross sectional design. This study also did not observe hormonal imbalance among the participants that may related to their menstrual cycle, thus we suggest future research to analyze those hormon-level related to menstrual cycle.

#### CONCLUSIONS AND RECOMMENDATIONS

There was significant correlation between the percentage of body fat and MUAC with menstrual cycle in female students of X high school in Sidoarjo. Dietary and reproduction education for adolescent are required to improve their dietary pattern-nutritional status and reproductive health (indicated by menstrual cycle).

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