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Nutrition factors related to menstrual cycle among girls: a study in a high school in Sidoarjo, Indonesia

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ABSTRACT

Introduction: Irregular menstrual cycle is one indicator of reproductive health disorders. Nutritional status and behaviour are risk factors for menstrual cycle irregularities. This study aimed to analyse the correlation between nutritional status and behaviour with the menstrual cycle in adolescent girls.

Methods: This research was a cross sectional study with 73 students from High School Sidoarjo, Indonesia as respondents. Nutritional status of respondents was obtained from anthropometric measurements, food intake with three times 24 hours food records, body image with MBSRQ-AS questionnaire, and physical activity was collected from the IPAQ questionnaire. Data were analysed using Spearman's test on SPSS 26.0.

Results: The most common menstrual cycle problem experienced by respondents was oligomenorrhea (8.2%). The majority of respondents had good nutritional status based on BMI/A (67.1%) while 50.7% of respondents had a risk of chronic energy deficiency. The majority of respondents had intake less than needed. As much as 82.2% of respondents had moderate physical activity, while the body image score of respondents showed that 72.6% of respondents had a positive body image. The p-value in the correlation test was <0.05 in each variable. Menstrual cycles had the strongest correlation with nutritional status.

Conclusion: Nutritional status and behaviour factors are related to the menstrual cycle in adolescent girls. Health promotion regarding reproductive health and nutrition in adolescent girls can be further improved, considering that the menstrual cycles may have an impact on fertility in the future.

Keywords: girl adolescent, menstrual cycle, nutrition.
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INTRODUCTION

Adolescent girls have a potential tendency to experience irregular menstrual cycles. Health effects that can arise due to irregular menstrual cycles continuously are anovulation and infertility.[1] Menstrual cycle disorders are one of the clinical manifestations of Polycystic Ovary Syndrome (PCOS). People with PCOS have an 8.572 times greater risk of experiencing infertility than those without PCOS.[2] Women with PCOS also have a risk of ovarian cancer, problems with pregnancy or childbirth, and metabolic disorders (obesity, diabetes mellitus, dyslipidaemia, hypertension, and cardiovascular disorders).[3]

Irregular menstrual cycle can be caused by several factors, including nutritional factors. The nutritional factors that can affect the menstrual cycle are nutritional status and nutritional behaviour (consumption patterns, physical activity, and body image). Low or high nutritional status equally has the potential to cause menstrual disorders in adolescent girls. Anthropometric indicators that can be used as parameters of nutritional status include Body Mass Index (BMI), upper arm circumference, body fat percentage, and waist-to-hip ratio (WHR). In women who have poor nutritional status, the levels of gonadatropin-releasing hormone (GnRH) secreted by follicle stimulating hormone (FSH) and luteinizing hormone (LH) will decrease and cause estrogen levels to also decrease which affects ovulation and the menstrual cycle.[4] Nutritional status in women also has an impact on the number of body fat cells, where body fat cells can affect the production of the hormone estrogen and have an impact on menstrual cycle irregularities.[5]

Besides nutritional status, another nutritional factor related to the menstrual cycle is food intake. The amount of food intake is correlated with nutritional status, so it can affect the menstrual cycle as well.[6] In addition to food intake, physical activity also correlated with the menstrual cycle. Physical activity is related to the body's adipose tissue that affects reproductive hormones such as follicle stimulating hormone (FSH) and luteinizing hormone (LH) which can cause menstrual cycle irregularities.[4] Another nutritional behavioural factor that is also related to the menstrual cycle is body image or the perception of a person's body image. Adolescent girls with a negative body image tend to experience stress which will affect the reproductive organs, causing the menstrual cycle to be disrupted. Stress affects the production of the hormone prolactin which is associated with increased levels of the hormone cortisol and decreased levels of luteinizing hormone (LH) which causes the menstrual

cycle to be disrupted.[4,7]

Several previous studies have analysed these factors. However, research that discusses all nutritional factors that can be related to the menstrual cycle is still limited, especially in Indonesia. Based on the above background, the purpose of this study was to analyse nutritional status and nutritional behaviour (food intake, physical activity, and body image) as factors that influence the menstrual cycle in adolescent girls. The results of this study are expected to be additional information as well as material for planning or evaluating nutrition programs from the government for young women. The aim of this study is to analyze the correlation between nutritional status and behaviour with the menstrual cycle in adolescent girls.

METHODS

Study Design and Sampling

This study was an observational analytic with cross sectional design study. The population used in this study was all students in a high school as many as 180 students. The sample size was calculated by WHO Sample Size Software using the stratified sampling formula from Lemeshow et al. The minimum sample size was 66 respondents, then to anticipate dropouts, 10% of 66 respondents were added, so that a total of 73 respondents were needed. The inclusion criteria in this study were female students aged 14-18 years, had menstruation, healthy, did not smoke and consume alcohol, and was agreed to be this study's respondents. Students who took drugs or hormonal supplementation and had reproductive or hormonal disorders such as Polycystic Ovary Syndrome (PCOS) were excluded.

Ethics

This research has been reviewed and approved by the Health Research Ethics Committee (registration number: 282/KEPK/UNUSA/2021). All students who met the inclusion criteria were explained about the study methods. Besides, written information (information for consent) was also provided to parents or guardians. We also collected informed consent of all the respondents.

Data Collection

The instruments used for anthropometric measurements in this study include a stature meter to measure height, Mi Body Composition Scale 2 to measure body weight and body fat percentage, and midline to measure upper arm circumference and body circumference. All anthropometric measurements were repeated twice, and the measurement results were written in the respondent's anthropometric form. Energy and macronutrients (carbohydrates, protein, fat) intakes of respondents were obtained using a 3x24 hours food record and were analysed with Nutrisurvey software. The respondents' intake was compared with the nutritional needs of each respondent. The contentment of nutritional needs was expressed in percent (%). The respondent's body image data was obtained from self-administered of Multidimensional Body Self Relation Questionnaire Appearance Scales (MBSRQ-AS) questionnaire, while the physical activity data for a week was collected from self-reported of International Physical Activity Questionnaire. In addition, interviews were conducted regarding the history of the menstrual cycle for the last three months on the respondents.

Data Analysis

All research data were then analysed using IBM SPSS 26.0 (IBM Corp., Armonk, New York, USA). Univariate analysis aimed to determine the characteristics of respondents, while bivariate analysis aimed to determine the correlation between study variables. Bivariate data analysis was carried out using the correlation test Spearman because the data were not normally distributed.

RESULTS

The data on the characteristics of the respondents in this study were listed in Table 1. From Table 1, it could be seen that the majority of respondents' menstrual cycles were normal (78.1%), while the most common menstrual cycle problems experienced by respondents were oligomenorrhea (8.2%). Based on nutritional status using the z-score of BMI/A, it showed that the majority of respondents had good nutritional status (67.1%) and underweight (16.4%). These results were also seen from the body fat percentage data for the majority of respondents, which was normal (49.3%) and under fat (26%). The presence of poor nutritional status in respondents was also reported by the results of the measurement of upper arm circumference, which 50.7% of respondents had a risk of chronic energy deficiency. The waist-to-hip ratio owned by 89% of respondents was classified as safe. Data on the nutritional intake of respondents showed that the majority of respondents had deficit intakes, mainly for carbohydrates. The results of the self-administered IPAQ showed that the respondents had moderate and high physical activity (respectively 82.2% and 17.8%), while the body image scores of the respondents showed that the majority of respondents (72.6%) had a good body perception (satisfied with their body or own appearance).

The results of the analysis in Table 2 were explained that respondents with normal menstrual cycles tended to had normal or optimal BMI/A, body fat percentage, upper arm circumference, waist circumference, waist-to-hip ratio, and body image. Respondents with polymenorrhea (menstrual cycle < 21 days) had body mass index, body fat percentage, upper arm circumference, waist circumference, waist-to-hip ratio, fulfilment of energy, protein, fat, and carbohydrate intake which led to obesity or the highest than others. Table 2 also explained that oligomenorrhea (menstrual cycle > 35 days) and amenorrhea (no menstruation for the last three months) occurred in respondents who had the lowest body mass index, body fat percentage, upper arm circumference or risk of chronic energy deficiency. Respondents with low intakes of energy, protein, fat, and carbohydrates were also found in respondents with amenorrhea. In addition, respondents with high physical activity also had amenorrhea.

Table 3 showed the results of the Spearman test that had been carried out, where all variables, both nutritional status and nutritional behaviour, had a significant correlation with the menstrual cycle ($p < 0.05$). Nutritional status had a very strong correlation strength, mainly body mass

Table 1. Characteristics of Respondents

Variable	n	%	Median (Q1-Q3)
Age (years)			17.0 (16.0-17.0)
Body weight (kg)			48.4 (43.3-55.9)
Height (cm)			156.5 (152.6-159.0)
Body Mass Index/Age (BMI/A) (z-score)			
Underweight (< 5th percentile)	12	16.4	20.1 (17.9-23.5)
Normal (5th - 85th percentile)	49	67.1	
Overweight (85th - 95th percentile)	9	12.3	
Obesity (>95th percentile)	3	4.1	
Age of menarche (year)			12.0 (12.0-13.0)
Body fat percentage (%)			
Underfat (< 21%)	19	26.0	25.4 (20.2-32.7)
Normal (21-32%)	36	49.3	
Overfat (33-39%)	13	17.8	
Obesity (> 39%)	5	6.8	
Upper arm circumference (cm)			
Risk of chronic energy deficiency (< 23.5 cm)	37	50.7	23.0 (21.4-25.5)
No risk (> 23.5 cm)	36	49.3	
Waist circumference (cm)			67.0 (63.0-74.5)
Hip circumference (cm)			91.5 (87.5-97.1)
Waist to Hip Ratio			
Safe (< 0.80)	65	89.0	0.8 (0.7-0.8)
Risk (> 0.80)	8	11.0	
Body image score			
Positive (> 75)	53	72.6	80.0 (74.5-84.5)
Negative (< 75)	20	27.4	
Physical activity score (MET)			
Medium (600-2999)	60	82.2	1850.0 (9781.0-2912.0)
Height (> 3000)	13	17.8	
% Intake Fulfilment			
Energy (%)			63.7 (50.0-78.2)
Proteins (%)			76.1 (60.5-99.7)
Fat (%)			77.1 (60.2-100.9)
Carbohydrates (%)			50.1 (39.2-65.1)
Menstrual Cycle (days)			
Polymenorrhea (< 21 days)	5	6.8	30.0 (27.8-33.5)
Normal (21-35 days)	57	78.1	
Oligomenorrhea (> 35 days)	6	8.2	
Amenorrhea (> 3 months)	5	6.8	

index/age, upper arm circumference, and hip circumference. Table 3 also showed that the fulfilment of nutritional intake was significantly correlated with the menstrual cycle ($p < 0.05$). Intake of energy, protein, fat, and carbohydrates had a positive correlation direction. Similarly, the score of physical activity, while the body image score was significantly correlated with negative correlation (r -0. 252). It means that the smaller the body image levels (negative body image), the longer her menstrual cycle (oligomenorrhea).

DISCUSSION

The menstrual cycle is one of the indicators related to reproductive health in women. Normal menstruation occurs around 21-35 days. Longer menstrual cycles (> 35 days) can be a predictor of an ovulation in adolescents.[8] Adolescent girls with irregular menstrual cycles showed the possibility of hormonal imbalances and disorders in follicular development, which could increase the risk of developing polycystic ovarian syndrome (PCOS).[9] PCOS is the most common endocrine or hormonal problem in women and its prevalence continues to increase every year. Some of the risk factors for PCOS are nutritional status and lifestyle, such as eating habits, stress, and physical activity.[10]

The results of this study indicated a significant correlation between nutritional status and the menstrual cycle. All indicators of nutritional status, including body mass index/age, body fat percentage, upper arm circumference, waist circumference, and waist-to-hip ratio had negative r ((-0.49)-(-0.93)) (Table 3) which means the greater the nutritional status, the shorter the menstrual cycle (polymenorrhea). The results of this study

Table 2. Menstrual Cycle and Nutritional Behaviour-Status

	Menstrual Cycle (Median (Q1-Q3))				*p-value*
	Polymenorrhea (n=5)	Normal (n=57)	*Oligomenorrhea* (n=6)	*Amenorrhea* (n=5)	
Body mass index/age (z-score)	23.7 (16.1-26.6)	20.8 (18.5-23.1)	18.3 (17.5-25.1)	17.9 (16.6-19.6)	0.322
Body fat percentage (%)	40.1 (33.7-43.4)	26.5 (22.3-32.7)	18.2 (13.7-20.7)	14.7 (13.5-19.8)	<0.001*
Upper arm circumference (cm)	30.0 (26.3-32.1)	23.5 (22.3-25.5)	19.9 (19.0-23.0)	20.0 (18.6-20.4)	<0.001*
Waist circumference (cm)	83.0 (80.9-89.5)	69.5 (64.9-74.5)	60.3 (59.7-61.1)	61.5 (59.0-62.0)	<0.001*
Waist hip ratio	0.8 (0.8-0.9)	0.8 (0.7-0.8)	0.7 (0.7-0.7)	0.70 (0.70-0.80)	<0.001*
% energy intake	103.1 (91.8-110.7)	58.4 (50.2-72.0)	88.5 (80.9-95.4)	32.2 (25.0-47.7)	<0.001*
% protein intake	128.2 (109.3-138.9)	74.0 (58.8-93.4)	91.9 (81.7-123.6)	38.7 (32.0-70.5)	<0.001*
% fat intake	99.1 (77.4-112.3)	72.4 (60.2-99.4)	101.6 (74.6-1221.4)	40.0 (25.3-79.5)	0.025*
% carbohydrate intake	97.1 (90.1-109.3)	49.0 (39.0-62.0)	79.5 (75.9-83.9)	25.8 (20.6-28.5)	<0.001*
Body image score	79.0 (75.5-86.0)	81.0 (75.5-84.0)	74.5 (70.3-88.0)	76.0 (71.5-85.5)	0.493
Physical activity score	1850.0 (1381.5-4216.0)	1850.0 (974.5-2801.0)	1259.5 (953.5-3472.5)	2671.0 (2079.5-3315.5)	0.493

Note: Kruskal Wallis Test
*= significant (<0.05)

Table 3. Correlation of Nutritional Status-Behaviour and Menstrual Cycle

	Menstrual Cycle	
	r	p
Body mass index/age (z-score)	-0.9	<0.001*
Body fat percentage (%)	-0.9	<0.001*
Upper arm circumference (cm)	-0.9	<0.001*
Waist circumference (cm)	-0.9	<0.001*
Waist hip ratio	-0.5	<0.001*
% energy intake	0.5	<0.001*
% protein intake	0.5	<0.001*
% fat intake	0.4	<0.001*
% carbohydrate intake	0.4	<0.001*
Body image score	-0.3	0.032*
Physical activity score	0.3	0.024*

Note: Spearman Test
*= significant (<0.05)

also showed a significant correlation between intake adequacy and the respondent's menstrual cycle. Rüttgers et al explained that long-term intake affects the amount of body fat (adipose) tissue.[11] The more food consumed, especially Western diet, the more adipose tissue was accumulated in the body.[12] Insufficient intake in the long term was also associated with the risk of decreased muscle mass. Muscle mass depletion occurs when body adipose decreases, especially when energy intake is not met the nutrition needs. Body adipose plays a role in the process of formation, conversion, and storage of reproductive hormones, especially estrogen, hence if the amount of body adipose is not optimal, the hormone estrogen cannot be secreted optimally.[13,14] In addition, poor nutritional status will cause a decrease in production of GnRH via decreased hypothalamic function. Decreased GnRH has an impact on lower secretion of FSH and LH, thus the hormone estrogen also decreases. This decrease can inhibit the ovulation process, so that the menstrual cycle becomes long (oligomenorrhea or amenorrhea).[15] The result of this study was similar with Dumesic et al which explained that the distribution of body fat increases the risk of PCOS, where PCOS respondents had more body fat than control respondents.[16]

This research showed that body image negatively related to the menstrual cycle. Body image associated with psychological stress or stress. Stress conditions may cause increasing levels of the hormone cortisol which then has an impact on decreasing LH.[4] Body image can also affect food intake. In a previous study, adolescents with negative body image will try to lose weight, thus it has an impact on decreasing food intake. Decreased food intake will cause a decrease in nutritional status and cause disturbances in the menstrual cycle in the long time. Besides body image, another factor in this study related to the menstrual cycle was physical activity with *r* 0.264. The results of this study were in line with previous research which explained that high physical activity was associated with menstrual dysfunction and subfertility in female athletes.[17] High physical activity could cause oligomenorrhea and amenorrhea through hypothalamic dysfunction mechanisms. The presence of disturbances in the hypothalamus caused a decrease in the secretion of GnRH, FSH, and LH.

This research was conducted in only a location, so the sample size involved was very limited. In addition, the food intake studied was only related to the fulfilment of macronutrient intake quantitatively. Future research is expected to involve more respondents, so that the research results can be more generalized. Further research is also expected to include qualitative

intake variables (food choice) as one of the factors related to the menstrual cycle in adolescent girls.

CONCLUSION

Nutritional status, food intake, body image, and physical activity are related to the menstrual cycle in adolescent girls. Reproductive health and nutrition education for adolescent girls can be further improved, considering that the menstrual cycle may have an impact on fertility in the future. Further studies are needed to evaluate more deeply various factors that affect the correlation between nutritional status and behaviour with the menstrual cycle in adolescent girls.

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DISCLOSURES

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Author Contribution

All authors similarly contribute to the think about from the investigate concepts, information acquisitions, information investigation, factual investigations, changing the paper, until detailing the consider comes about through publication.

Ethical Consideration

This research has been reviewed and approved by the Health Research Ethics Committee (registration number: 282/KEPK/UNUSA/2021).

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