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Relationships between Body Mass Index, Nutritional Intakes, and Living Arrangement with Menstrual Cycle among Students

Aliza Umar Indriani[1)], Jimmy Yanuar Annas[2)], Lilik Herawati[3)]

[1)]Midwifery Program Study, Faculty of Medicine, Universitas Airlangga, Surabaya
[2)]Department of Obstetrics and Ginecology, Faculty of Medicine,
Universitas Airlangga/ Dr. Soetomo Hospital, Surabaya
[3)]Department of Physiology and Biochemistry,
Faculty of Medicine, Universitas Airlangga, Surabaya

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ABSTRACT

Background: Disorders of the menstrual cycle are common in women aged 18-26 years. Indonesian Basic Health Research year 2013 data shows that as many as 13.7% of women of reproductive age experience problems with irregular menstrual cycles. Disturbances in the menstrual cycle can cause infertility and decrease the quality of life of students. The purpose of this study was to determine the relationship between body mass index (BMI), nutritional intake patterns, and living arrangements with the menstrual cycle of female students.
Subjects and Method: A cross-sectional study was conducted at the Faculty of Medicine, Airlangga University, from July to September 2022. A total of 176 female students from the Faculty of Medicine, Airlangga University, class of 2018-2021 were selected using a purposive sampling technique. The dependent variable is the menstrual cycle. The independent variables are body mass index (BMI), patterns of nutritional intake, and living arrangements. The instrument used in this research is a questionnaire. Research data were analyzed using binary logistic regression.
Results: Overweight BMI (OR= 49.32; 95%CI= 9.57 to 254.35; p<0.001) and patterns of excess nutrition (OR= 28.69 95%CI= 4.97 to 165.94; p<0.001) have a relationship with female students' menstrual cycles Faculty of Medicine, Airlangga University
Conclusion: Overweight BMI and nutritional intake patterns together have a relationship to the menstrual cycle of female students at the Faculty of Medicine, Airlangga University.

Keywords: body mass index, pattern of nutritional intake, living arrangement, menstrual cycle

Correspondence:
Aliza Umar Indriani, Faculty of Medicine, Universitas Airlangga. Jl. Mayjen Prof. Dr. Moestopo No. 47, Tambaksari, Surabaya 60132, East Java. Email: aliza.umar.indriani-2019@fk.unair.ac.id. Mobile: +6281252337795.

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BACKGROUND

The menstrual cycle is a physiological process that results from the coordination of events that occur in the hypothalamus, anterior pituitary, and female reproductive organs (Gil et al., 2009). Irregular menstru-

al cycles are the main symptom of anovulation which is a phenomenon accompanied by decreased ovarian steroid secretion and production (Mumford et al., 2012). A woman's normal menstrual cycle ranges from 24-38 days (Munro et al., 2018). Factors that can cause an abnormal menstrual cycle include stress, smoking, consumption of hormonal drugs and endocrine disorders, nutritional status, nutritional intake patterns, and the environment (Kusmiran, 2016).

Disorders of the menstrual cycle are common in women aged 18-26 years (Mumford et al., 2012). The 2013 Basic Health Research data shows that as many as 68% of women in Indonesia aged 10-59 years reported having regular menstrual cycles and 13.7% of women had problems with irregular menstrual cycles.

The occurrence of disturbances in the menstrual cycle can lead to the development of various chronic diseases including infertility, risk of heart disease, and risk of type II diabetes mellitus (Cirillo et al., 2016; Norheim et al., 2015). In addition to students, menstrual cycle disorders can cause a decrease in the quality of life of students and can affect their daily activities, academic performance, and can also have an impact on social life (Bajalan et al., 2019).

Student living arrangements affect their state of health and lifestyle. This is because students who live alone have more freedom and independence in choosing health-related behaviors and lifestyles (Benz et al., 2017).

Changes in living arrangements patterns affect student lifestyles, one of which is nutritional intake patterns (El Ansari et al., 2012). Patterns of poor nutritional intake determine a person's body mass index (BMI) which has an impact on a person's reproductive function. Reproductive function depends on the balance of hormones, one of which depends on the type of food and eating habits. Menstrual disorders are a common feature of a variety of eating disorders and result from a complex interaction of many factors including weight loss, decreased body fat, hypoleptinemia, eating attitudes, and abnormal psychological behavior (Amgain and Neupane, 2019).

Research conducted by Dya and Adiningsih (2019) shows that as many (63.3%) subjects with normal BMI have normal menstrual cycles (62.7%). Meanwhile, subjects with abnormal BMI had abnormal menstrual cycles (71.4%).

In addition, research conducted by Sitoayu et al. (2017) showed that nutritional intake patterns affect women's menstrual cycles. As many as 53% of women with bad protein intake experienced disturbances in their menstrual cycles and 56.6% of women with bad fat intake experienced disturbances in their menstrual cycles.

Research related to the living arrangement of the menstrual cycle is still limited. In addition, it is necessary to know and prove whether there is a relationship between BMI, nutritional intake patterns and the menstrual cycle. Therefore, it is necessary to conduct research on the relationship between BMI, nutritional intake patterns, and living arrangements with the menstrual cycle in female students of the Faculty of Medicine, Airlangga University

SUBJECTS AND METHOD

1. Study Design

This research was conducted using an observational analytic study with a cross sectional approach. The location of this research is at the Faculty of Medicine, Airlangga University, held from July to September 2022.

2. Population and Sample

The population in this study were female students of the Faculty of Medicine, Airlangga University, class of 2018 – 2021. The

sample used was 176 subjects who met the inclusion criteria. The sampling technique is purposive sampling.

3. Study Variables

The dependent variable is the menstrual cycle. The independent variables are BMI, nutritional intake patterns, and living arrangements.

4. Operational Definition of Variables

Body mass index

This is a mathematical formula for body weight (kg) divided by height squared (m) to determine a person's nutritional status. Body mass index data are categorized based on the WHO Pacific Region with underweight categories for BMI <18.5, normal 18.5 – 22.9, and overweight >22.9.

Nutrition Intake Patterns

This is any individual food intake that contains nutrients for the body. The pattern of nutritional intake is categorized based on the 2019 nutritional adequacy rate. It is said that nutritional intake is lacking if it is <80% RDA, normally 80-120% RDA, more than 120% RDA.

Living Arrangements

This is the pattern of residence, structure and composition of a person's household including the number of households members and their relationship to one another. Living arrangement data was obtained based on demographic data (subject's place of residence).

Menstrual Cycle

This is about the time interval from menstruation to the next menstruation. Categorized based on FIGO 2018, namely regular if the menstrual cycle is between 24 – 38 days, and irregular if <24 days or >38 days.

5. Study Instruments

This study uses a questionnaire method that is distributed online to the subject. For menstrual cycle data using a menstrual cycle questionnaire. Body Mass Index (BMI) data was obtained from collecting data on the subject's weight and height and then categorized based on the BMI threshold table by the WHO Pacific Region 2000. In addition, data on nutritional intake patterns were obtained using a 24-hour Food Recall questionnaire to obtain calculation data from dietary intake. nutrients which are then processed with nutrisurvey software. For living arrangement data obtained from a demographic questionnaire in the form of questions (Does the subject live alone (boarding house, campus dormitory), or live with parents/family/relatives.

6. Data analysis

Data analysis in this research was carried out through quantitative tests using univariate analysis, bivariate analysis, and multivariate analysis with SPSS. Bivariate analysis in this study used the Chi-Square test to find out the relationship between 2 variables. Meanwhile, multivariate analysis uses binary logistic regression to determine the relationship of all independent variables simultaneously with the dependent variable.

7. Research Ethics

This research was conducted with the consent of the research subject, anonymous, confidential, and ethical approval from the ethics committee of FK Unair which was declared ethically feasible based on decision no. 120/EC/KEPK/FKUA/2022

RESULTS

1. Sample Characteristics

Subjects participating in this study were female students of the Faculty of Medicine, Airlangga University, both from the midwifery and medical study programs, from the 2018-2021 class. Data was collected to obtain a total of 176 subjects. Table 1 shows that the highest age distribution of subjects is 20 years old, namely 60 (34.1%) and the least is 23 years old, namely 10 (5.7%).

2. Bivariate Analysis

Table 3 shows the results of bivariate ana-

lysis that there is a significant relationship between body mass index (p < 0.001) and nutritional intake patterns (p < 0.001) and the menstrual cycle. However, no significant relationship was found between living arrangements and the menstrual cycle of female students at the Faculty of Medicine, Airlangga University (p = 0.125).

3. Univariate Analysis

Table 2 shows that most of the subjects 85 (51.7%) had a normal body mass index, as many as 44 (25.0%) subjects with less body mass index. In addition, the majority of 81 (46.0%) subjects had adequate nutritional intake patterns and at least 27 (15.3%) subjects had excessive nutritional intake. The living arrangement data showed that the majority of subjects 83 (47.1%) lived alone, namely in boarding houses or dormitories for more than 3 months. For menstrual cycle data, 50% of the subjects had regular and irregular menstrual cycles.

Table 1. Sample characteristics based on age

Sample Characteristics (year)	Frequency (n)	Percentage (%)
19	28	15.9
20	60	34.1
21	48	27.3
22	30	17.0
23	10	5.7

Table 2. Univariate Analysis

Variables	Frequency (n)	Percentage (%)
BMI		
< 18.5 (Underweight)	44	25.0
18.5 – 22.9 (Normal)	85	48.3
>22.9 (Overweight)	47	26.7
Nutrition Intake Patterns		
<80% (Lacking)	68	38.6
80% - 120% (Adequate)	81	46.0
>80% (Over)	27	15.3
Living Arrangement		
With parents	54	30.7
Boarding / Dormitory 3 Months	39	22.2
Boarding/Dormitory > 3 Months	83	47.1
Menstrual Cycle		
24 – 38 days (in order)	88	50.0
<24 or >38 (not in order)	88	50.0

4. Bivariate Analysis

Table 3 shows the results of bivariate analysis that there is a significant relationship between body mass index (p < 0.001) and nutritional intake patterns (p < 0.001) and the menstrual cycle. However, no significant relationship was found between living arrangements and the menstrual cycle of female students at the Faculty of Medicine, Airlangga University (p = 0.125).

5. Multivariate Analysis

Table 4 shows that the overweight BMI and the pattern of excess nutritional intake together have a relationship to the menstrual cycle of female students at the Faculty of Medicine, Airlangga University. Female students with overweight BMI were at risk for having irregular menstrual cycles 49.33 times compared to female students with normal BMI, and these results were statisti-

cally significant (OR= 49.32; 95% CI= 9.57 to 254.35; p<0.001). Female students with a pattern of nutritional intake were more at risk of experiencing irregular menstrual cycles 28.69 times compared to female students with an adequate nutritional intake pattern, and these results were statistically significant (OR= 28.69 95% CI= 4.97 to 165.94; p<0.001).

Table 3. Bivariate analysis between bmi, nutrition intake patterns, and living arrangement with menstrual cycle

Independent Variable	Menstrual Cycle				p
	Not In Order		In Order		
	n	%	n	%	
BMI					
<18.5 (Underweight)	43	97.8	1	2.2	<0.001
18.5 – 22.9 (Normal)	5	5.9	80	94.1	
>22.9 (Overweight)	40	85.1	7	14.9	
Nutrition Intake Patterns					
<80% (Lacking)	57	83.8	11	16.2	<0.001
80 – 120% (Adequate)	7	8.6	74	91.4	
>120% (Over)	24	88.9	3	11.1	
Living Arrangement					
With parents	28	51.9	26	48.1	0.125
Boarding / Dormitory 3 Months	14	35.9	25	64.1	
Boarding/ Dormitory > 3 Months	46	55.4	37	44.6	

Table 4. Results of multivariate analysis between BMI and nutritional intake patterns with menstrual cycles in female students of the Faculty of Medicine, Airlangga University

Independent Variables	OR	95% CI		p
		Lower limit	Upper limit	
Body Mass Index	49.33	9.57	254.34	<0.001
Nutrition Intake Patterns	28.69	4.96	165.94	<0.001
N observation= 176				
-2 log likelihood= 59.97				
Nagelkerke R^2= 86.5%				

DISCUSSION

1. The relationship between BMI and the menstrual cycle of female students

This study is in line with Dya and Adiningsih (2019), that there is a relationship between body mass index and the menstrual cycle (p= 0.036). In that study, women with poor body mass index tended to experience irregular menstrual cycles. The same thing was also found in a study conducted by Dars et al. (2014) that there is a significant relationship between BMI and the menstrual cycle (p <0.001).

Body mass index is a representation of fat in the body which is related to hormonal balance and menstruation. A good body mass index affects the work of the hypothalamus to reduce reproductive hormones so that the menstrual cycle becomes normal or good (Prathita et al., 2017). The results of this study are also supported by a similar study conducted by Ali Abdella et al. (2016) Egypt that found a significant relationship between body mass index and the menstrual cycle (p= 0.0001). Body mass in-

dex has an important role in the regularity of the menstrual cycle in women.

Women with BMI are more likely to have excessive amounts of fat as well resulting in increased levels of estrogen in the blood. Through protein secretion, the high levels of estrogen provide negative feedback to GnRH (Gonadotropin Releasing Hormone) so that the work of the anterior pituitary in producing FSH is inhibited. These obstacles result in disruption of follicular maturation resulting in lengthening of the menstrual cycle. On the other hand, high levels of estrogen provide positive feedback to the LH hormone which causes these hormones to have high levels in the body. High levels of the LH hormone cause the follicles to grow continuously which does not reach the process of maturation and ovulation, causing disturbances in the menstrual cycle (Baziad, 2008; Marmi, 2013).

Irregular menstrual cycles in women with a low body mass index indicate a low percentage of fat in their body. This can cause low estrogen levels which result in menstrual cycle irregularities (Simbolon et al., 2018). A low body mass index can cause a decrease in the GnRh hormone resulting in disturbances in the secretion of the LH and FSH hormones which cause a decrease in estrogen levels. So that it results in ovulation disorders which are a factor in the occurrence of disturbances in the menstrual cycle (Sitoayu et al., 2017).

2. The relationship between nutritional intake patterns and the menstrual cycle of female students

This research is in line with research conducted by Rachmawati and Murbawani (2015) that found a significant relationship between nutrient intake and the menstrual cycle ($p < 0.001$). From the results of the 24-hour food recall, it was found that there was poor intake due to irregular eating patterns, namely often missing meals and fond of eating fast food.

A good nutritional intake pattern is a representation of adequate energy results according to needs. Energy is one source of increased caloric intake in the luteal phase. In this phase, there is an increase in energy intake so that the shortening of the luteal phase will not occur if the intake of carbohydrates, fats and proteins is met properly (Dewantari, 2013; Hanapi, 2021). Inadequate nutritional intake can lead to insufficient energy levels. Lack of energy can cause the concentration of blood sugar to be less too resulting in the hormone adrenaline being produced by the body. The hormone adrenaline will inhibit the effectiveness of progesterone in suppressing estrogen activity resulting in disruption of the menstrual cycle (Devi, 2009).

A normal menstrual cycle is inseparable from the presentation of good carbohydrates, proteins and fats. A good presentation of carbohydrates, protein and total fat simultaneously can increase the concentration of testosterone and progesterone levels which can reduce the risk of disturbances in the menstrual cycle (Mumford et al., 2016). Calorie intake plays a role in regulating GnRh secretion which stimulates the pituitary to release FSH and LH. Excess nutrition will result in disruption of GnRh to produce FSH and LH resulting in irregular menstrual cycles (Pérez-Pérez et al., 2015).

Women with less calorie intake will have an impact on the disruption of steroid hormone production. Sex hormones come from steroid hormones that are converted from cholesterol molecules. As a steroid precursor, cholesterol is stored in theca cells in large quantities. The process of follicular maturation which results in an increase in steroid biosynthesis in the follicle is influenced by GnRh. LH stimulation causes peripheral tissues to convert steroids into androgenically active compounds so

that testosterone levels increase and the excretion of 17-keto steroids decreases. As a result, the ovulation cycle changes and has an impact on disrupting the menstrual cycle (Rakhmawati and Dieny, 2013).

3. The relationship between living arrangement and the menstrual cycle

In this study, the results of bivariate analysis were obtained (p = 0.125), which means that there is no relationship between the living arrangement and the menstrual cycle. This is in contrast to the study by Benz et al. (2017) and Small et al. (2013) which states that living arrangements are related to behavior and habits (lifestyle) that are directly related to health. College students who live alone generally have an unhealthy lifestyle, including poor diet, engaging in less physical activity, exercising less, etc. This is because students who live alone tend to have more freedom and independence in terms of health-related behavior and lifestyle choices without parental rules. In addition, a study linked that students who live with their parents have more healthy habits and their emotional needs are fulfilled because there is direct support from both parents (Lupi et al., 2015).

Living arrangements that are directly related to lifestyle are associated with influences on the regularity of the menstrual cycle in women. Based on a study conducted by Hosokawa et al. (2012) which states that lifestyle factors have a direct and indirect determining role in the trajectory of the development of the menstrual cycle.

However, no direct relationship was found between the living arrangement and the menstrual cycle, which could be due to the high level of knowledge and good practice of women regarding the menstrual cycle and matters that can cause disruption of the menstrual cycle so that healthy lifestyle behaviors that are concerned with health status emerge reproduction (Ahmad et al., 2021).

4. The relationship between BMI and nutritional intake patterns with menstrual cycles.

In this study, body mass index was the dominant factor in menstrual cycle disturbances (OR= 49.33; 95% CI= 9.57 to 254.34; p<0.001). The pattern of nutritional intake is the result of calculating the number of calories that enter a person's body. The pattern of nutritional intake will affect a person's body mass index. A good calorie diet influences good anthropometric development which can prevent various diseases (Sazali et al., 2021). An abnormal body mass index can cause disturbances in the GnRh hormone in producing FSH and LH which results in disruption of the menstrual cycle. Therefore, women are advised to pay attention to a healthy and balanced diet in order to fulfill the body's nutrition for the continuation of reproductive health (Devi, 2009). In addition, paying attention to nutritional intake can help prevent infertility in women. A low-calorie diet can stabilize body weight and body mass index which has an impact on reproductive health (Aryani et al., 2020).

AUTHOR CONTRIBUTION

In this study, Aliza Umar Indriani and Jimmy Yanuar Annas collaborated to develop a conceptual framework and research methodology. Aliza Umar Indriani, Jimmy Yanuar Annas, and Lilik Herawati collaborated to analyze the data.

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The study was self-funded.

CONFLICT OF INTERESTS

There is no conflict of interest in this study.

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