International Journal Of Health, Engineering And Technology (IJHET) *E-ISSN 2829 - 8683*
Volume 5, Number 2, July 2026, *Page. 2769 - 2780*
Email : editorijhess@gmail.com

The Association Between Physical Activity And Menstrual Cycle Regularity In Female Students

Anggun Novia Ramadhani[1)*], Satwika Arya Pratama[2)], Fitriana Nugraheni[3)], Nur Anindya Syamsudi[4)]
[1,2,3)] Nutrition Study Program, Faculty of Sports Science and Health, Universitas Negeri Surabaya, East Java, Indonesia
[4)] Midwife Study Program, Faculty of Medicine, Universitas Negeri Surabaya, East Java, Indonesia

*Corresponding Author
E-mail: anggunnovia.22051@mhs.unesa.ac.id

Abstract

Menstrual cycle irregularity remains a common reproductive health problem among adolescent girls and women of reproductive age, and it may be influenced by factors such as body image, physical activity, and nutritional intake. This study aimed to analyze the relationship between body image, physical activity, and nutritional intake and menstrual cycle regularity among undergraduate Nutrition students at the Faculty of Sports Science and Health, Universitas Negeri Surabaya. This study used an analytical observational design with a cross-sectional approach. A total of 78 female students were selected using a quota sampling technique. Body image data were collected using the BSQ-34, physical activity using the IPAQ-SF, and nutritional intake using the 24-hour food recall method. Data were analyzed using the Chi-Square test and Fisher's Exact Test ($p<0.05$). The results showed that 77% of respondents had regular menstrual cycles, 83.3% had a positive body image, and 48.7% had moderate physical activity. No significant relationship was found between body image ($p=0.483$) or energy intake ($p=0.457$), carbohydrate intake ($p=0.070$), protein intake ($p=0.483$), fat intake ($p=0.982$), and iron intake ($p=0.367$) and the menstrual cycle. However, there was a significant relationship between physical activity and the menstrual cycle ($p=0.030$). It can therefore be concluded that in this study only physical activity was related to menstrual cycle regularity, whereas the other variables did not show a significant relationship.

Keywords: Body Image, Female Students, Menstrual Cycle, Nutritional Intake, Physical Activity

INTRODUCTION

Menstrual cycle irregularity remains one of the reproductive health problems most frequently found among adolescent girls and women of reproductive age. Based on data from the Basic Health Research (*Riskesdas*) of 2018, as many as 13.7% of women aged 10–59 years experienced irregular menstruation. In metropolitan areas, this prevalence reached 14.9% and could increase up to 15.8% (Ningsih dkk., 2023). Menstrual cycle irregularity can serve as an indicator of a disturbance in reproductive function or in the hormonal balance of the body that plays a role in the menstrual process. Menstrual cycle irregularity may also be one of the signs of impaired female reproductive function (Karina et al., 2017). A normal menstrual cycle occurs every 21–35 days with a menstrual duration of 3–7 days (Islamy & Farida, 2019).

The problem of menstrual cycle irregularity was also found among female students of the Undergraduate Nutrition Study Program, Universitas Negeri Surabaya. Based on a preliminary study conducted on 24 female students of the 2024 cohort, as many as 37.5% of respondents experienced menstrual cycle irregularity, consisting of 29.2% with *polymenorrhea* (menstrual cycle <21 days) and 8.3% with *oligomenorrhea* (menstrual cycle >35 days). These results indicate that more than one third of the respondents experienced menstrual cycle disturbances, so that further study is required regarding the factors related to menstrual cycle regularity among female students. The regularity of the menstrual cycle is influenced by a hormonal balance involving the hypothalamic–pituitary–ovarian axis, and disturbances in that hormonal balance can be affected by various factors, including psychological factors, physical activity, and nutritional intake, which play a role in female reproductive function (Allaway et al., 2016).

One of the factors suspected to be related to menstrual cycle regularity is body image. During adolescence and early adulthood, attention to body shape and body weight tends to increase, so that

quite a number of women feel dissatisfied with their physical appearance. Dissatisfaction with body shape can influence daily behavior, including eating patterns and dieting habits (Nuriannisa & Faradiba, 2023). Based on a preliminary study using the BSQ-34 questionnaire on 18 female students of the Undergraduate Nutrition Study Program, Faculty of Sports Science and Health, Universitas Negeri Surabaya, as many as 55.6% of respondents experienced mild body image disturbance and 27.8% experienced moderate body image disturbance. These results show that body image problems are still quite commonly found among female students, so their relationship with menstrual cycle regularity needs to be examined. Individuals with a positive body image tend to have a higher level of self-confidence and are better able to accept their bodily condition (Jeronimo et al., 2022).

In addition to body image, physical activity is also one of the factors that may be related to menstrual cycle regularity. Students generally have varied activity patterns, ranging from low activity because much of their time is spent attending lectures, completing assignments, and using digital devices, to high activity because they participate in sports or organizational activities (Fristanti, 2021). These differences in the level of physical activity can affect bodily health conditions, including reproductive health. Regular physical activity can help maintain hormonal balance and improve overall health (Bull et al., 2020). Moderate-intensity physical activity performed regularly has been associated with better reproductive function compared with physical activity that is either too low or too high (Mena et al., 2019).

Another factor that may be related to the menstrual cycle is nutritional intake. The demands of academic life often cause students to have irregular eating patterns, such as skipping meals, restricting the consumption of certain foods, or choosing foods that are less varied (Veronika et al., 2021). Such conditions can cause energy and nutrient intake to be inconsistent with the body's requirements. Continuous menstrual cycle disturbances can increase the risk of infertility and anemia due to excessive bleeding, as well as lower women's quality of life. Irregular menstrual cycles are also an important sign indicating the presence of a disturbance in the reproductive system related to the risk of reproductive diseases such as uterine cancer and infertility (Yolandiani et al., 2020). Therefore, identifying the factors related to the menstrual cycle becomes important as an effort to prevent reproductive health disorders in adolescent girls and women of reproductive age.

Research on the relationship between physical activity and nutritional intake and the menstrual cycle has been widely conducted. However, the results of previous studies still show varied findings. Several studies have reported that macronutrient adequacy plays a role in the phases of the menstrual cycle (Sitoayu et al., 2017), while other studies did not find such a relationship (Purnasari & Illiyya, 2023). In addition, research analyzing the relationship between body image and the menstrual cycle among female students of the Undergraduate Nutrition Study Program, Universitas Negeri Surabaya is still limited. Based on the above description, body image, physical activity, and nutritional intake are factors suspected to be related to menstrual cycle regularity through various physiological and behavioral mechanisms. Therefore, this study was conducted to provide a more comprehensive picture of the factors related to menstrual cycle regularity among female students of the Undergraduate Nutrition Study Program, Faculty of Sports Science and Health, Universitas Negeri Surabaya.

RESEARCH METHODS

Study Design, Subjects, and Instruments

This study was quantitative research using an analytical observational design with a *cross-sectional* approach, in which all variables were measured at the same time within the range of the last three months. The research was carried out from 9 to 13 February 2026 in the Undergraduate Nutrition Study Program, Faculty of Sports Science and Health, Universitas Negeri Surabaya, Lidah Wetan Campus, Surabaya, East Java. The population comprised 237 female students of the 2024 cohort of the Undergraduate Nutrition Study Program. The sample size was calculated using the Slovin formula with a degree of precision of 0.1, yielding 70.3 respondents, which was then increased by 10% to

anticipate *drop out*, so that the total sample fulfilled was 78 respondents. Sampling was conducted using *non probability sampling*, namely *quota sampling* with proportional allocation to each class based on a proportion formula. The inclusion criteria were female students of the 2024 cohort aged 17–20 years who were willing to become respondents, while the exclusion criterion was having a reproductive disease such as uterine myoma, cervical polyp, or tumor. The independent variables were body image perception, physical activity, and nutritional intake, whereas the dependent variable was the menstrual cycle. Menstrual cycle data were obtained through a *self-report* menstrual cycle questionnaire covering the last three months and were categorized as regular (21–35 days) and irregular, consisting of *polymenorrhea* (<21 days) and *oligomenorrhea* (>35 days) (Sitepu et al., 2020). Body image was measured using the Body Shape Questionnaire (BSQ-34) in which each item was scored from 1 ("never") to 6 ("always"), giving a total score range of 34–204 that was categorized as a positive body image (total score ≤110) and a negative body image (total score >110). Physical activity was measured using the International Physical Activity Questionnaire-Short Form (IPAQ-SF), calculated as MET-minutes/week and categorized as light (<600 MET-minutes/week), moderate (≥600–<3000 MET-minutes/week and ≥5 days/week), and vigorous (≥3000 MET and ≥7 days/week) (Dharmansyah & Budiana, 2021).

Procedures and Data Analysis

Data collection began with the provision of an explanatory sheet before consent and an *informed consent* form as a statement of the respondents' willingness to follow the research procedures. Respondents then completed the menstrual cycle questionnaire and the IPAQ-SF physical activity questionnaire directly, accompanied by the researcher, after an explanation of each instrument had been given, and the completed questionnaires were returned to the researcher. Nutritional intake data were collected through direct interviews using the *multiple 24-hour food recall* method on two measurement days, namely a *weekday* and a *weekend* that were not consecutive, covering the types of food, food ingredients, methods of preparation, and portion sizes, which were then converted into grams using the Food Exchange List (DPBM) and/or Household Measures (URT). Intake data were subsequently analyzed using the Nutri Survey nutritional analysis software to obtain the values of energy, macronutrients (carbohydrate, protein, and fat), and iron intake, and the results were expressed as average daily intake, which was then compared with the respondents' daily nutritional requirements calculated using the *Harris-Benedict* formula and categorized as deficit (intake ≤89% of requirement), normal (90–119%), and excess (≥120%). Data analysis was performed univariately to describe the distribution and percentage of each variable, and bivariately to determine the relationship between the independent and dependent variables using the *Chi-Square* test. When the assumptions of the *Chi-Square* test were not met, that is, when more than 20% of the cells had an *expected count* of less than 5, an alternative test was used in the form of *Fisher's Exact Test* for 2x2 tables and the *Likelihood Ratio* for tables larger than 2x2, with a relationship declared significant when the *p-value* was <0.05.

RESULTS AND DISCUSSION

Study Selection

A comprehensive database search across PubMed, the Cochrane Library, and ScienceDirect yielded a total of 599 articles, consisting of 194, 43, and 362 records from each source, respectively. Following removal of two duplicates, 597 unique studies underwent title and abstract screening. Of these, 588 were excluded for reasons such as non-relevance to Parkinson's disease, inappropriate intervention class, animal or in-vitro design, and lack of measurable motor outcomessaddsasad

Respondent Characteristics

Table 1. Frequency Distribution of Respondents' Age

Age	Frequency (n)	Percentage (%)
18 years	3	3.8
19 years	30	38.5
20 years	45	57.7
Total	**78**	**100.0**

Table 1 presents the characteristics of the 78 respondents based on age. The results show that the majority of respondents were 20 years old, namely 45 respondents (57.7%), followed by respondents aged 19 years, namely 30 respondents (38.5%), while the smallest proportion was respondents aged 18 years, namely 3 respondents (3.8%). This age distribution indicates that all respondents were within the late adolescent to early adult age range, which is a period of reproductive age in which menstrual cycle patterns have generally become established after *menarche*. This characteristic is relevant to the objective of the study because at this age the reproductive hormonal function regulated by the hypothalamic–pituitary–ovarian axis has entered a relatively stable phase, so that any menstrual cycle irregularity found is more likely to be related to lifestyle factors such as physical activity and nutritional intake, as well as psychological factors such as body image, rather than to the physiological immaturity of the reproductive axis that commonly occurs in the first years after *menarche*.

Univariate Analysis

Table 2. Frequency Distribution of Body Image

Body Image	Frequency (n)	Percentage (%)
Negative	13	16.7
Positive	65	83.3
Total	**78**	**100.0**

Table 2 shows the results of the study on 78 respondents based on the body image of female Nutrition students at Universitas Negeri Surabaya, which indicate that most respondents had a positive body image, namely 65 respondents (83.3%), while 13 respondents (16.7%) had a negative body image. It can therefore be concluded that the body image of female Nutrition students at Universitas Negeri Surabaya was predominantly positive. This finding is in line with the study conducted by Sitepu et al. (2020), which showed that most female students had a positive body image. Nevertheless, there were still respondents with a negative body image who have the potential to experience dissatisfaction with their bodies, which may have an impact on eating behavior and mental health (Sitepu et al., 2020). Body image is an individual's perception of the size, shape, and appearance of the body, which is influenced by both internal and external factors such as the social environment, the media, and personal experience, and individuals with a positive body image tend to have a higher level of self-confidence and to be better able to accept their bodily condition (Jeronimo et al., 2022).

Table 3. Frequency Distribution of Physical Activity

Physical Activity	Frequency (n)	Percentage (%)
Light	35	44.9
Moderate	38	48.7
Vigorous	5	6.4
Total	**78**	**100.0**

Table 3 shows the results of the study on 78 respondents based on the physical activity of female Nutrition students at Universitas Negeri Surabaya, which indicate that most respondents had a moderate level of physical activity, namely 38 respondents (48.7%), followed by light physical activity in 35 respondents (44.9%), while only 5 respondents (6.4%) had vigorous physical activity. Physical activity is any bodily movement produced by skeletal muscles that requires energy, and an adequate level of physical activity is very important for maintaining bodily health, including reproductive

health, because regular physical activity can help maintain hormonal balance and improve overall health (Bull et al., 2020). The distribution of physical activity dominated by the moderate category shows that respondents had performed sufficient activity; however, there were still respondents with low physical activity who need attention because this may have an impact on health, including the menstrual cycle.

Table 4. Frequency Distribution of Energy, Macronutrient, and Iron Intake

Category	Frequency (n)	Percentage (%)
Energy		
Deficit	66	84.6
Normal	12	15.4
Total	**78**	**100.0**
Carbohydrate		
Deficit	73	93.6
Normal	5	6.4
Total	**78**	**100.0**
Protein		
Deficit	65	83.3
Normal	13	16.7
Total	**78**	**100.0**
Fat		
Deficit	42	53.8
Normal	23	29.5
Excess	13	16.7
Total	**78**	**100.0**
Iron		
Deficit	62	79.4
Normal	10	12.9
Excess	6	7.7
Total	**78**	**100.0**

Based on Table 4, the results of interviews with 78 respondents using the *multiple 24-hour recall* method show that most respondents had energy, macronutrient, and iron intake in the deficit category. Energy intake was in deficit in 66 respondents (84.6%) and normal in 12 respondents (15.4%); carbohydrate intake was in deficit in 73 respondents (93.6%) and normal in 5 respondents (6.4%); protein intake was in deficit in 65 respondents (83.3%) and normal in 13 respondents (16.7%); fat intake was in deficit in 42 respondents (53.8%), normal in 23 respondents (29.5%), and excessive in 13 respondents (16.7%); while iron intake was in deficit in 62 respondents (79.4%), normal in 10 respondents (12.9%), and excessive in 6 respondents (7.7%). This shows that the majority of respondents had not met the recommended daily energy and nutrient requirements in accordance with their needs. Based on the results of the *multiple 24-hour recall* interviews, this condition was caused by irregular eating patterns, the habit of skipping meals, and the demands of academic activities, so that respondents more frequently consumed practical foods with a less balanced nutrient composition. This finding is in line with the study conducted by Fajarwati et al. (2023), which showed that most adolescent girls had carbohydrate adequacy levels in the insufficient category, and explained that irregular eating patterns and dieting habits are among the factors causing low carbohydrate intake in adolescent girls. An imbalance between the consumption of macronutrients and the body's requirements over the long term can lead to nutritional problems (Rorimpandei et al., 2020), while women of reproductive age are at high risk of iron deficiency due to blood loss during menstruation, and low iron intake can increase the risk of iron deficiency anemia (Sari et al., 2019).

Table 5. Frequency Distribution of the Menstrual Cycle

Menstrual Cycle	Frequency (n)	Percentage (%)
Irregular		
Polymenorrhea	12	15.3
Oligomenorrhea	6	7.7
Subtotal	**18**	**23.0**
Regular	60	77.0
Total	**78**	**100.0**

Table 5 shows the results of the study on 78 respondents based on the menstrual cycle of female Nutrition students at Universitas Negeri Surabaya, which indicate that most respondents had a regular menstrual cycle, namely 60 respondents (77%), while 18 respondents (23%) had an irregular menstrual cycle, consisting of *polymenorrhea* in 12 respondents (15.3%) and *oligomenorrhea* in 6 respondents (7.7%). A regular menstrual cycle falls within the range of 21–35 days, whereas menstrual disturbances include *polymenorrhea* (menstrual cycle <21 days) and *oligomenorrhea* (menstrual cycle >35 days). The factors that can cause differences in the menstrual cycle include nutrient intake, nutritional status, age, physical activity, reproductive disease, smoking, and stress (Sitoayu et al., 2017). The impact that arises if menstrual cycle irregularity is not promptly addressed is the possibility of fertility disorders, and an irregular menstrual cycle is also an important sign indicating the presence of a disturbance in the reproductive system related to the risk of reproductive diseases such as uterine cancer and infertility (Yolandiani et al., 2020).

Bivariate Analysis

Table 6. Relationship Between Body Image and the Menstrual Cycle

Body Image	Menstrual Cycle						*p-value*
	Irregular		Regular		Total		
	n	%	n	%	n	%	
Negative	4	5.1	9	11.5	13	16.7	0.483
Positive	14	18.0	51	65.4	65	83.3	
Total	**18**	**23.1**	**60**	**76.9**	**78**	**100**	

Table 6 presents the results of the analysis of 78 respondents using *Fisher's Exact Test* between body image and the menstrual cycle among female Nutrition students at Universitas Negeri Surabaya, which show that there was no significant relationship between body image and the menstrual cycle ($p = 0.483$; $p>0.05$). Although no statistically significant relationship was found, the results of the cross-tabulation show that respondents with a positive body image tended to have a higher proportion of regular menstrual cycles than respondents with a negative body image, in which 51 of 65 respondents (78.5%) with a positive body image experienced a regular menstrual cycle. This finding indicates that a positive body image tends to be associated with a better psychological condition and more positive health behavior, because individuals with a positive body image have a better level of self-acceptance, healthier eating behavior, and a lower risk of psychological stress than individuals with a negative body image (Jeronimo et al., 2022). Such a condition can help maintain the energy balance and reproductive hormonal function that play a role in menstrual cycle regularity (Nuriannisa & Faradiba, 2023).

Table 7. Relationship Between Physical Activity and the Menstrual Cycle

Physical Activity	Menstrual Cycle						*p-value*
	Irregular		Regular		Total		
	n	%	n	%	n	%	
Light	12	15.4	23	29.5	35	44.9	0.030
Moderate	4	5.1	34	43.6	38	48.4	
Vigorous	2	2.6	3	3.8	5	6.7	
Total	**18**	**23.1**	**60**	**76.9**	**78**	**100**	

Table 7 presents the results of the analysis of 78 respondents based on the *Likelihood Ratio* value between physical activity and the menstrual cycle among female Nutrition students at Universitas Negeri Surabaya, which show that there was a significant relationship between physical activity and the menstrual cycle with a value of p = 0.030 (p<0.05). Based on the results of the cross-tabulation, most respondents with moderate physical activity had a regular menstrual cycle compared with respondents with light or vigorous physical activity, in which 34 of 38 respondents (43.6%) with moderate-intensity physical activity experienced a regular menstrual cycle. This finding indicates that moderate physical activity is the level of activity that is most optimal in supporting women's reproductive health, because moderate physical activity can help maintain the body's energy balance without giving rise to excessive physiological stress. A good energy balance plays a role in maintaining the function of the hypothalamic–pituitary–ovarian axis so that the secretion of reproductive hormones such as GnRH, FSH, and LH can proceed normally, and this optimal hormonal function plays an important role in the process of ovulation and menstrual cycle regularity (Bull et al., 2020).

Table 8. Relationship Between Energy, Macronutrient, and Iron Intake and the Menstrual Cycle

Intake Category	Menstrual Cycle						*p-value*
	Irregular		Regular		Total		
	n	%	n	%	n	%	
Energy							
Deficit	14	17.9	52	66.7	66	84.6	0.457
Normal	4	5.1	8	10.3	12	15.4	
Total	**18**	**23.0**	**60**	**76.9**	**78**	**100**	
Carbohydrate							
Deficit	15	19.2	58	74.3	73	93.4	0.070
Normal	3	3.8	2	2.6	5	6.6	
Total	**18**	**23.0**	**60**	**76.9**	**78**	**100**	
Protein							
Deficit	14	17.9	51	65.4	65	83.3	0.483
Normal	4	5.1	9	11.5	13	16.7	
Total	**18**	**23.0**	**60**	**76.9**	**78**	**100**	
Fat							
Deficit	10	12.8	32	41.1	42	53.8	0.982
Normal	5	6.4	18	23.0	23	29.5	
Excess	3	3.8	10	12.8	13	16.7	
Total	**18**	**23.0**	**60**	**76.9**	**78**	**100**	
Iron							
Deficit	13	16.7	49	62.8	62	79.5	0.367
Normal	4	5.1	6	7.7	10	12.8	
Excess	1	1.3	5	6.4	6	7.7	
Total	**18**	**23.1**	**60**	**76.9**	**78**	**100**	

Based on Table 8, the results of the study on 78 respondents using *Fisher's Exact Test* for energy, carbohydrate, protein, and iron intake and the *Chi-Square* test for fat intake in relation to the menstrual cycle of female students show that there was no significant relationship between these variables and the menstrual cycle (p>0.05). Energy intake obtained a value of p = 0.457, carbohydrate intake p = 0.070, protein intake p = 0.483, fat intake p = 0.982, and iron intake p = 0.367. The results of the cross-tabulation show that in every intake category the majority of respondents still had a regular menstrual cycle, in which 52 of 66 respondents (66.7%) with an energy deficit, 58 of 73 respondents (74.3%) with a carbohydrate deficit, 51 of 65 respondents (65.4%) with a protein deficit, 32 of 42 respondents

(41.1%) with a fat deficit, and 49 of 62 respondents (62.8%) with an iron deficit experienced a regular menstrual cycle. This pattern indicates that a deficit in nutrient intake in this study was not directly followed by menstrual cycle irregularity, so that energy and nutrient intake was not the main factor influencing menstrual cycle regularity in this population (Purnasari & Illiyya, 2023).

Discussion

The Relationship Between Body Image and the Menstrual Cycle

Based on the results of the data analysis using *Fisher's Exact Test*, a value of p = 0.483 (p>0.05) was obtained, which means that there was no significant relationship between body image and the menstrual cycle among female Nutrition students at Universitas Negeri Surabaya. This result is not in line with several previous studies which stated that body image has a relationship with the menstrual cycle. The difference between the results of this study and previous studies was caused by the different characteristics of the respondents. In this study, most respondents had a positive body image and the majority still had a regular menstrual cycle, so that the variation in data between groups became less apparent. In addition, the respondents of this study were Nutrition students who had better knowledge related to health and eating patterns than the general population, so that even though there was dissatisfaction with body shape, respondents were still able to maintain their lifestyle and reproductive health status.

The relationship between body image and eating behavior can also be seen in the BSQ-34 instrument, particularly items 17 and 21, which assess worry about weight gain and the tendency to undertake dieting as a result of dissatisfaction with body shape. This condition shows that the perception of the body can influence consumption patterns and nutrient intake, which subsequently has the potential to affect reproductive health. Individuals with a positive body image have a better level of self-acceptance, healthier eating behavior, and a lower risk of psychological stress than individuals with a negative body image (Jeronimo et al., 2022), and such a condition can help maintain the energy balance and reproductive hormonal function that play a role in menstrual cycle regularity (Nuriannisa & Faradiba, 2023).

Conceptually, body image is a psychological construct that encompasses an individual's perception, evaluation, and attitude toward the shape and size of the body, and it is influenced by internal factors such as self-confidence and personal experience as well as external factors such as the media and social pressure (Jeronimo et al., 2022). Thus, the absence of a significant relationship in this study can be explained by the fact that body image does not play a direct role in the hormonal regulation that governs the menstrual cycle. The influence of body image on the menstrual cycle is likely to be indirect, for example through psychological stress or disturbances in eating behavior.

The Relationship Between Physical Activity and the Menstrual Cycle

Based on the results of the data analysis using the *Likelihood Ratio* test, a value of p = 0.030 (p<0.05) was obtained, which means that H1 was accepted and H0 was rejected, so that it can be interpreted that there was a significant relationship between physical activity and the menstrual cycle among female Nutrition students at Universitas Negeri Surabaya. This study is in line with the research conducted by Winengsih et al. (2023), which showed that there was a significant relationship between physical activity and the menstrual cycle among midwifery students at Universitas Bhakti Kencana Bandung with a value of p = 0.046 (p<0.05). Based on the cross-tabulation results in that study, most respondents with moderate physical activity had a regular menstrual cycle compared with respondents with light or vigorous physical activity.

Moderate physical activity can help maintain the body's energy balance without giving rise to excessive physiological stress, so that the function of the hypothalamic–pituitary–ovarian axis continues to operate optimally and supports the secretion of reproductive hormones that play an important role in the process of ovulation and menstrual cycle regularity (Bull et al., 2020). In addition, moderate physical activity also contributes to maintaining insulin sensitivity, reducing inflammation, improving blood circulation, and helping to maintain a healthy body composition, and such conditions

can support the balance of the estrogen and progesterone hormones that play a role in regulating the menstrual cycle (Mena et al., 2019).

Physical activity that is too vigorous can affect reproductive hormones and thereby cause menstrual cycle irregularity. Vigorous physical activity that is not balanced by adequate energy intake can lead to *low energy availability* (LEA), a condition in which the available energy is insufficient to support the body's physiological functions optimally. This condition can disturb the function of the hypothalamic–pituitary–ovarian axis and thereby reduce the secretion of the GnRH, FSH, and LH hormones that play a role in the process of ovulation, so that the menstrual cycle can become irregular and the risk of amenorrhea and anovulation increases (Salmawati, 2022). Conversely, physical activity that is too light or a *sedentary lifestyle* can also have an impact on reproductive health, because a lack of physical activity can cause more energy to be stored as body fat (Purwati & Muslikhah, 2021), and such an accumulation of body fat can affect the balance of reproductive hormones because adipose tissue plays a role in the metabolism of estrogen in the body.

The Relationship Between Energy and Carbohydrate Intake and the Menstrual Cycle

Based on the results of the data analysis using the *Pearson Chi-Square* test, the p value obtained did not meet the assumptions of the *Pearson Chi-Square* test because more than 20% of the cells had an *expected count* of less than 5. Therefore, the analysis was continued using *Fisher's Exact Test*, which yielded a value of p = 0.457 (p>0.05) for energy intake, meaning that H1 was rejected and H0 was accepted, so that it can be interpreted that there was no significant relationship between energy intake and the menstrual cycle among female Nutrition students at Universitas Negeri Surabaya. This result is in line with the previous study conducted by Palupi et al. (2022), in which energy intake had no relationship with the menstrual cycle (p = 0.390), and it is also supported by the study conducted by Noviyanti et al. (2018), which stated that there was no relationship between energy intake and the menstrual cycle.

Energy intake has an important role in maintaining the function of the reproductive system, because a long-term energy deficiency can cause disturbances in the hypothalamic–pituitary–ovarian axis that plays a role in the regulation of reproductive hormones and can thereby disturb the menstrual cycle, whereas an excess of energy can also trigger a hormonal imbalance that has an impact on menstrual disturbances (Elliott, 2021). The non-significance of the results of this study may be caused by the variation in energy intake between respondents that was not very large, so that it was not strong enough to demonstrate a significant difference, and other factors such as physical activity, stress, and nutritional status may also play a role in influencing the menstrual cycle (Elliott, 2021).

For carbohydrate intake, the *Pearson Chi-Square* test obtained a value of p = 0.043; however, that test result did not meet the assumptions of the *Pearson Chi-Square* test, so that the analysis was continued using *Fisher's Exact Test*, which yielded a value of p = 0.070 (p>0.05), so it can be concluded that there was no significant relationship between carbohydrate intake and the menstrual cycle. This result contradicts the findings and theory of the previous study by Sitoayu et al. (2017), which stated that within the reproductive system carbohydrate intake plays a role in the luteal phase of the menstrual cycle. Physiologically, a deficit in carbohydrate intake can cause a decrease in the body's energy reserves, and a continuous condition of energy deficiency can affect the work of the hypothalamus in regulating the release of GnRH, which in turn can disturb the secretion of the FSH and LH hormones that play a role in the process of ovulation and the menstrual cycle. This study is nevertheless in line with the research conducted by Fajarwati et al. (2023), which showed that there was no relationship between the level of carbohydrate adequacy and the menstrual cycle, indicating that the menstrual cycle is influenced by various factors so that carbohydrate intake is not the main factor affecting menstrual cycle regularity (Fajarwati et al., 2023).

The Relationship Between Protein, Fat, and Iron Intake and the Menstrual Cycle

Based on the results of the data analysis using *Fisher's Exact Test*, a value of p = 0.483 (p>0.05) was obtained for protein intake, which means that H1 was rejected and H0 was accepted, so that it can be interpreted that there was no significant relationship between protein intake and the menstrual cycle

among female Nutrition students at Universitas Negeri Surabaya. This study is in line with the research conducted by Purnasari and Illiyya (2023), which showed that there was no significant relationship between protein intake and the menstrual cycle (p>0.05), in which most respondents had insufficient protein intake but the majority still had a regular menstrual cycle (Purnasari & Illiyya, 2023). The menstrual cycle is influenced by various factors such as nutritional status, physical activity, stress, energy balance, and the individual hormonal condition, so that even though protein has an important role in the formation of hormones and in the body's metabolism, an insufficient protein intake does not always directly cause a disturbance of the menstrual cycle (Wahyuni et al., 2020).

For fat intake, the analysis using the *Chi-Square* test obtained a *p-value* of 0.982 (p>0.05), which means that H1 was rejected and H0 was accepted, so that it can be interpreted that there was no significant relationship between fat intake and the menstrual cycle. This result is not in line with the previous study by Rahmi et al. (2024), which stated that fat intake is related to reproductive hormones during the menstrual cycle because fat acts as a material for the formation of sex hormones in the body through the role of cholesterol, and an increased fat level in the body stimulates the secretion of leptin by adipose tissue into the blood, where leptin acts as a signal to the hypothalamus to secrete GnRH (Galiano et al., 2014). The results of the *multiple 24-hour recall* in this study showed that the eating patterns of respondents at the time of data collection were irregular and some respondents were on a diet, so that main mealtimes were missed and respondents chose to consume certain menu items in the morning rather than a complete meal. A similar finding was also reported by Sitoayu et al. (2017), namely that respondents' eating patterns were irregular because they often skipped main mealtimes and undertook dieting.

For iron intake, the *Pearson Chi-Square* test did not meet its assumptions, so that the results of the analysis were read from the *Likelihood Ratio* value, and it can be concluded that there was no significant relationship between iron intake and the menstrual cycle among female Nutrition students at Universitas Negeri Surabaya. This study is in line with the research conducted by Nurhalisa and Soekatri (2022), which showed that there was no significant relationship between iron intake and the menstrual cycle, in which most respondents had insufficient iron intake but still had a regular menstrual cycle, and menstrual cycle disturbances are influenced not only by iron intake but also by other factors such as physical activity, hemoglobin status, stress, nutritional status, and the individual hormonal balance (Nurhalisa & Soekatri, 2022). The absence of a relationship in this study may also be because most respondents were still able to carry out physiological compensation for their low iron intake, so that a disturbance of reproductive function had not yet arisen. In addition, the absence of a significant relationship for all intake variables may be influenced by the intake measurement method using the *multiple 24-hour recall*, which depends on the respondents' memory and allows *underreporting* or *overreporting* to occur, so that the intake results obtained do not necessarily describe actual consumption (Purnasari & Illiyya, 2023).

Research Limitations

This study has several limitations, namely that it has not yet measured other factors that have the potential to influence the menstrual cycle, such as stress levels, sleep quality, and nutritional status. The process of collecting intake data was carried out through interviews with a number of respondents within a limited time, so that the researcher had limited opportunity to carry out repeated confirmation and a more thorough exploration of information for each respondent. Menstrual cycle data were obtained based on the respondents' *self report* for the last three months, which allows inaccuracy of reporting to occur.

CONCLUSION

Based on the results of the study on the relationship between body image, physical activity, and nutritional intake and menstrual cycle regularity among female students of the Undergraduate Nutrition Study Program, Faculty of Sports Science and Health, Universitas Negeri Surabaya, it can be concluded that most respondents had a regular menstrual cycle (77%), a positive body image (83.3%), and physical activity in the moderate category (48.7%), while most of their nutrient intake was in the deficit category; there was no significant relationship between body image and the menstrual cycle (p=0.483), between energy intake and the menstrual cycle (p=0.457), between carbohydrate intake and the menstrual cycle (p=0.070), between protein intake and the menstrual cycle (p=0.483), between fat intake and the menstrual cycle (p=0.982), or between iron intake and the menstrual cycle (p=0.367), whereas there was a significant relationship between physical activity and the menstrual cycle (p=0.030), in which respondents with a moderate level of physical activity tended to have a regular menstrual cycle rather than an irregular one (43.6%), so that in this study only physical activity was related to menstrual cycle regularity while the other variables did not show a significant relationship, and it is therefore important for female students to maintain physical activity at a moderate intensity and to increase awareness of the importance of fulfilling balanced nutrition in order to support reproductive health and menstrual cycle regularity.

REFERENCES

Allaway, H. C. M., Southmayd, E. A., & Souza, M. J. D. (2016). The physiology of functional hypothalamic amenorrhea associated with energy deficiency in exercising women and in women with anorexia nervosa. *Hormone Molecular Biology and Clinical Investigation*, 25(2), 91–119. https://doi.org/10.1515/hmbci-2015-0053

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., ... & Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, 54(24), 1451–1462.

Dharmansyah, D., & Budiana, D. (2021). Indonesian adaption of the International Physical Activity Questionnaire (IPAQ): Psychometric properties. *Jurnal Pendidikan Keperawatan Indonesia*, 7(2), 159–163.

Elliott, S. K. J. (2021). Methodological considerations for studies in sport and exercise science with women as participants: A working guide for standards of practice for research on women. *Sports Medicine*, 51, 843–861.

Fajarwati, S. H., Sholichah, F., & Sugiyanti, D. (2023). Hubungan tingkat kecukupan zat gizi makro dengan siklus menstruasi pada remaja putri. *Jurnal Gizi dan Kesehatan*, 15(2), 112–120.

Fristanti, Y. M. (2021). Relationship of the intensity of smartphone use to physical activity and food consumption level in UNESA Nutrition students in the era of the COVID-19 pandemic. *Jurnal Gizi Universitas Negeri Surabaya*, 1(2), 72–94.

Galiano, D. G., Allen, S. J., & Elias, C. F. (2014). *Role of the adipocyte-derived hormone leptin in reproductive control*. National Library of Medicine.

Islamy, A., & Farida. (2019). Faktor-faktor yang mempengaruhi siklus menstruasi pada remaja putri tingkat III. *Jurnal Keperawatan Jiwa*, 7(1), 13–18.

Jeronimo, F., Carraca, E. V., & Rodrigues, B. (2022). Body image and self-acceptance in young women: A cross-sectional analysis. *Journal of Health Psychology Research*, 10(1), 45–58.

Karina, E. S., Nuryanto, & Kusumastuti, A. C. (2017). Hubungan obesitas sentral dengan siklus menstruasi dan dismenorea primer pada remaja. *Journal of Nursing College*, 6(4), 319–325.

Mena, G. P., Mielke, G. I., & Brown, W. J. (2019). The effect of physical activity on reproductive health outcomes in young women: A systematic review and meta-analysis. *Human Reproduction Update*, 25(5), 541–563. https://doi.org/10.1093/humupd/dmz013

Ningsih, S. R., Andriani, R., & Lestari, W. (2023). Analisis faktor ketidakteraturan siklus menstruasi pada wanita usia reproduktif. *Jurnal Kesehatan Reproduksi*, 14(1), 25–34.

Noviyanti, D., Sulistyowati, E., & Handayani, S. (2018). Hubungan asupan zat gizi makro dengan siklus menstruasi pada remaja putri. *Jurnal Gizi dan Pangan*, 13(2), 89–96.

Nurhalisa, I., & Soekatri, M. Y. (2022). The relationship between intakes of iron, folic acid, vitamin C, age at menarche, hemoglobin status and physical activity with menstrual cycles in female students at SMAIT Al-Ichwan Cikarang Utara-Indonesia. *Journal of Biomedical Research & Environmental Sciences*, 3(6), 631–637. https://doi.org/10.37871/jbres1508

Nuriannisa, F., & Faradiba, N. R. (2023). Body image, waist hip ratio, and menstrual cycle in adolescent girls at X High School Sidoarjo. *Amerta Nutrition*, 7(4), 534–539.

Palupi, M., Wardani, R., & Susanti, D. (2022). Hubungan tingkat kecukupan energi dan status gizi dengan siklus menstruasi pada mahasiswi. *Jurnal Ilmiah Gizi Kesehatan*, 3(2), 76–81.

Purnasari, G., & Illiyya, L. (2023). Hubungan antara status gizi, asupan protein dan zat besi terhadap siklus menstruasi remaja putri di SMAN 1 Jatiroto. *Muhammadiyah Journal of Nutrition and Food Science*, 4(1), 56–64. https://doi.org/10.24853/mjnf.4.1.56-64

Purwati, Y., & Muslikhah, A. (2021). Gangguan siklus menstruasi akibat aktivitas fisik dan kecemasan. *Jurnal Kebidanan dan Keperawatan Aisyiyah*, 6(2), 217–228.

Rahmi, N., Iskandar, & Mauliza. (2024). Hubungan pola makan dan status gizi dengan keteraturan menstruasi pada mahasiswi Prodi Kedokteran Fakultas Kedokteran Universitas Malikussaleh. *GALENICAL: Jurnal Kedokteran dan Kesehatan Mahasiswa Malikussaleh*, 3(1), 1–9.

Rorimpandei, C., Kapantow, N., & Malonda, N. (2020). Hubungan antara asupan zat gizi makro dengan status gizi pada remaja putri di Desa Kayuuwi dan Kayuuwi Satu Kecamatan Kawangkoan Barat. *Jurnal KESMAS*, 9(4), 1–8.

Salmawati. (2022). Siklus menstruasi pada mahasiswi keperawatan semester VII Universitas Nasional Jakarta. *Jurnal Penelitian Keperawatan Kontemporer*, 2(1), 107–115.

Sari, P., Rahmad, A. H. A., & Dewi, R. (2019). Pengaruh asupan protein dan zat besi (Fe) terhadap kadar hemoglobin pada wanita usia reproduksi. *Jurnal Kesehatan*, 8(3), 145–152. https://doi.org/10.26630/jk.v8i3.509

Sitepu, F. H., Effendy, E., & Amin, M. M. (2020). Validity and reliability of instruments Body Shape Questionnaire-34 (BSQ-34) based on Indonesia version. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(6), 1545–1555.

Sitoayu, L., Pertiwi, D. A., & Mulyani, Y. (2017). Kecukupan zat gizi makro, status gizi, stres, dan siklus menstruasi pada remaja. *Jurnal Gizi Klinik Indonesia*, 13(3), 121–128.

Veronika, Puspitawati, & Fitriani. (2021). Associations between nutrition knowledge, protein-energy intake and nutritional status of adolescents. *Journal of Public Health Research*, 10(2), 2239.

Wahyuni, Y., Hanifah, S., Permata, S. I., Rosya, E., Nurhayati, E., & Sari, W. (2020). Analisis perbedaan asupan zat gizi berdasarkan status gizi dan siklus menstruasi pada remaja putri di SMP Gatra Desa Kohod Kabupaten Tangerang. *Jurnal Kesehatan*, 13(2), 98–106. https://doi.org/10.23917/jk.v13i2.12647

Winengsih, E., Fitriani, D. A., Stelata, A. G., & Sugiharti, I. (2023). Hubungan aktivitas fisik dengan siklus menstruasi pada mahasiswa kebidanan Universitas Bhakti Kencana Bandung. *JNPH: Journal of Nursing and Public Health*, 11(2), 201–208.

Yolandiani, R. P., Fajria, L., & Putri, Z. M. (2020). Faktor-faktor yang mempengaruhi ketidakteraturan siklus menstruasi pada remaja. *Jurnal Ilmiah Kesehatan*, 68, 1–11.