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Macronutrient Intake, Hemoglobin Levels, Stress Levels, and Nutritional Status on the Menstrual Cycle of the Vegetarian Community

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Abstract: Background: The menstrual cycle is the period from the start of menstruation to the beginning of the next menstruation. Disorders in the menstrual cycle include various abnormalities such as excessive or very light bleeding, irregular cycles, or even the absence of menstruation. Objective: This study aims to analyze the relationship between nutritional intake, hemoglobin levels, stress levels, nutritional status, and vegetarian's menstrual cycle. Methods: The research design used is a cross- sectional study. The sample consisted of 62 members of the Indonesia Vegetarian Society (IVS) Jakarta, selected through purposive sampling. Data analysis was conducted using the chi-square test. Results: The results of the bivariate analysis showed a relationship between energy intake (p=0,046), hemoglobin levels (p=0,011), and stress levels (p=0,005) with the menstrual cycle. However, there was no relationship between protein intake (p=0,449), fat intake (p=0,071), carbohydrate intake (p=0,609), iron intake (p=0,318), and nutritional status (p=0,854) with the respondent's menstrual cycle. Conclusion: Vegetarians are advised to monitor their carbohydrate intake, regularly check hemoglobin levels, and apply effective stress management techniques to avoid irregular menstrual cycles.

Keywords: *nutrient intake; hemoglobin levels; stress levels; nutritional status; menstrual cycle*

1. INTRODUCTION

A vegetarian diet is a dietary pattern based on plant-derived foods, with or without the inclusion of milk and eggs, but completely excluding meat and fish (Silvia *et al.*, 2015). Vegetarianism is classified into several types, namely vegan (strict vegetarian), lacto-vegetarian, lacto-ovo vegetarian, and ovo-vegetarian. Vegetarians tend to consume a wide variety of vegetables, fruits, grains, and legumes. Typically, to replace meat, they use ingredients such as tempeh, tofu, or other plant-based products.

Individuals who follow a vegetarian diet may experience deficiencies in certain nutrients. Generally, vegetarians are at risk of vitamin B12 and iron deficiencies, since these nutrients are primarily found in animal-based foods or fortified products. Lacto-ovo vegetarians may obtain vitamin B12 and iron from eggs and dairy products; however, their intake of vitamin B12 may still be insufficient. Research conducted by Fitriani in 2021 showed that 68.2% of respondents had low iron intake, and 63.63% of them suffered from anemia (Fitriani *et al.*, 2021). Iron is an essential nutrient in the formation of hemoglobin;

thus, insufficient iron intake can lead to iron-deficiency anemia (Silvia *et al.*, 2015). This is a major concern, especially for women who menstruate monthly, as they can lose around 30–50 cc of blood, equivalent to a loss of 12–15 mg of iron per month (Kristianti *et al.*, 2014).

The menstrual cycle begins in women at puberty (Ilham *et al.*, 2022). The onset of menstruation is called menarche, and it ends with menopause. The interval between the first day of menstruation and the next menstrual period is known as the menstrual cycle (Prayuni *et al.*, 2019). A normal menstrual cycle typically lasts between 21 and 35 days, with an average of 28 days, and menstruation usually lasts about 3 to 5 days (Masnilawati & Thamrin, 2021).

Food intake affects the regularity of the menstrual cycle. Research conducted by Sitoayu in 2017 showed that macronutrient intake is associated with menstrual cycle regularity. Based on Rachmawati's 2015 study, individuals with moderate to severe energy deficiency were 7.14 times more likely to experience irregular menstrual cycles (Rachmawati & Murbawani, 2015). Inadequate protein intake increases the risk of menstrual cycle disorders by 5.42 times, while individuals with low carbohydrate intake are 3.79 times more likely to experience irregular menstrual cycles (Sitoayu *et al.*, 2017).

Macronutrient intake, especially protein, and micronutrients such as iron, also influence hemoglobin levels. Hemoglobin levels in the body are derived primarily from dietary intake of iron and vitamin B12 (Barus, 2022). Hemoglobin plays a role in delivering oxygen throughout the body, including to the brain. The menstrual cycle is regulated by a hormonal system that works in coordination with the pituitary gland in the brain. If the hypothalamus does not receive enough oxygen, its function may be disrupted.

The menstrual cycle is also directly affected by stress levels (Nathalia, 2019). Stress is a physiological, psychological, and behavioral response used by individuals to adapt to and manage internal and external pressures or tension. Stress stimulates the release of the hormone cortisol in the body. This hormone inhibits the secretion of Luteinizing Hormone (LH), which in turn disrupts the release of estrogen and progesterone, causing delays or irregularities in the menstrual cycle.

Nutritional status refers to the condition of the body as a result of food intake and nutrient utilization (Pebrina, 2015). Several studies have shown that vegetarians generally have a lower Body Mass Index (BMI) compared to non-vegetarians (Santoso *et al.*, 2019). Based on research by Dya in 2019, respondents with normal nutritional status tended to have regular menstrual cycles, while those who were overweight experienced irregular cycles (Dya & Adiningsih, 2019).

The Indonesia Vegetarian Society (IVS) is a vegetarian community with around 160,000 members across Indonesia. Previous research conducted by Wahyuni in 2018 found that 35.71% of adolescent vegetarians in IVS experienced menstrual disorders.

2. METHODS

This study is an analytical observational research conducted using a cross-sectional survey method. The sampling technique used in this study was purposive sampling with the following inclusion criteria:

1. Respondents were registered members of the Indonesia Vegetarian Society (IVS);
2. Respondents were women who had experienced menstruation for at least one year;
3. Respondents had agreed to and signed the informed consent provided.

The sample size was calculated using the two-proportion formula, resulting in a total of 50 samples. To anticipate potential dropouts, an additional 10% was added, yielding a final total of 55 female respondents from the Indonesia Vegetarian Society community in Jakarta.

The study was conducted from December 2023 to June 2024. The research locations included three sites that collaborated with the Indonesia Vegetarian Society (IVS): Alpukat Bistro Restaurant, the Maitreyawira Buddhist Training Center in West Jakarta, and Maitreyawira School Jakarta.

This study received ethical approval from the Research Ethics Committee of Universitas Pembangunan Nasional "Veteran" Jakarta, with approval number 90/III/2024/KEP.

3. RESULTS AND DISCUSSION

Univariate analysis was conducted to determine the distribution of respondent characteristics (type of vegetarian, duration of being a vegetarian, and age), menstrual cycle, nutrient intake, hemoglobin levels, stress levels, and nutritional status among members of the Indonesia Vegetarian Society (IVS) community in Jakarta.

Table 1. Respondent Characteristic

Vegetarian	**N**	**%**
Lacto-ovo vegetarian	47	75,8
Ovo vegetarian	3	4,8
Vegetarian	12	19,4
Duration of being a vegetarian	**N**	**%**
≤10 years	18	29
>10 years	44	71
Age	**N**	**%**
15-18 years	14	22,6
19-29 years	16	25,8
30-49 years	32	51,6

This study involved 62 members of the IVS Jakarta community. The majority of respondents (75.8%) followed a lacto-ovo vegetarian diet, 4.8% were ovo-vegetarians, and 19.4% adhered to a vegan diet. Most respondents had been vegetarians for more than ten years (71%), with many influenced by the teachings of Maitreya Buddhism. In terms of age, 51.6% of respondents were in the late adulthood group (30–49 years), 25.8% were in early adulthood, and 22.6% were adolescents. Menstrual cycle disorders experienced by some respondents may be influenced by age, as the decline in reproductive organ function with age is a normal process, especially approaching menopause.

Dependent Variable

Table 2. Distribution of Respondents Based on Menstrual Cycle

Menstrual Cycle	N	%
Regular	45	72,6
Irregular	17	27,4
Total	62	100

The distribution of respondents based on menstrual cycle regularity was divided into two categories: regular (21–32 days) and irregular (<21 days or >32 days). Table 2 shows that among the 62 vegetarian respondents in IVS Jakarta, 27.4% experienced menstrual cycle disorders, while 72.6% had regular menstrual cycles. These results indicate that the majority of vegetarians in IVS Jakarta have regular menstrual cycles.

Independent Variable

In this study, the 3×24-hour Food Recall method was used to assess the respondents' nutrient intake. The results were classified into two categories: adequate and inadequate. Macronutrient intake was considered adequate if it exceeded 80–110% of the Recommended Dietary Allowance (RDA), and inadequate if it was below 80% of the RDA (Wahyuni & Dewi, 2018). Meanwhile, iron intake was considered adequate if it was ≥77% of the RDA and inadequate if it was <77% (Nurhidayati *et al.*, 2017). The analysis results showed that the majority of respondents had insufficient energy intake (61.3%), with an average of 1,656.529 grams. Most respondents also had low carbohydrate intake (80.6%), which was attributed to irregular eating patterns and small portion sizes of carbohydrate sources. However, 54.8% of respondents had adequate protein intake, mainly from plant-based sources such as tofu, tempeh, and soy milk, as well as from dairy products and eggs among lacto-ovo vegetarians. Fat intake among most respondents (58.1%) was in the adequate category, primarily derived from plant-based sources and dairy products. Iron intake was also sufficient in 62.9% of respondents, with 53.2% of lacto-ovo vegetarians obtaining adequate iron from milk and eggs.

In this study, hemoglobin (Hb) levels were measured using a digital Hb checker (GCHb) with fingertip blood sampling. Hemoglobin levels were categorized into two groups: normal (Hb ≥12 g/dl) and anemic (Hb <12 g/dl). Based on Table 3, 66.1% of respondents had normal hemoglobin levels, while 33.9% were anemic. Most vegetarians in IVS Jakarta had normal hemoglobin levels. The relatively high hemoglobin levels among vegetarians were supported by higher intake of certain nutrients, such as protein and iron. Most respondents had adequate protein and iron intake, as they still consumed eggs, dairy products, and various types of legumes rich in protein and iron. Stress levels in this study were measured using the **Depression Anxiety Stress Scale (DASS-42)** questionnaire, which consists of 42 questions. The respondents were categorized into two groups based on stress level: stressed (including mild, moderate, and severe) and not stressed. Table 7 shows that 59.7% of respondents experienced stress, while 40.3% did not. Among those who experienced stress, 16.1% had severe stress and 43.5% had very severe stress. The occurrence of stress

may be influenced by factors such as family, community, environment, age, household income, family history of mental health disorders, and social support.

Nutritional status in this study was assessed using the **Body Mass Index (BMI)**. Respondents were classified into two categories based on their nutritional status: normal and abnormal. The analysis results showed that 54.8% of respondents had normal nutritional status, while 45.2% had abnormal nutritional status. Respondents with abnormal nutritional status were further divided into two groups: undernutrition and overnutrition. The prevalence of undernutrition and overnutrition among vegetarian respondents was 8.1% and 37.1%, respectively. The higher proportion of overnutrition among vegetarian respondents was likely due to high fat consumption, resulting from frequent intake of fried foods and fast food. This was supported by the findings showing that 41.7% of respondents with overnutrition had adequate fat intake.

Relationship Between Nutrient Intake and Menstrual Cycle

Based on Table 3, the statistical test results showed that energy intake had a significant relationship with the menstrual cycle among members of the IVS Jakarta community (p-value = 0.046). The low energy intake was likely due to respondents skipping meals and preferring low-calorie snacks such as fruit juice or fresh fruit instead of rice. A deficiency in carbohydrate intake reduces overall energy intake, and although fats contribute significantly to energy, the high fat content observed in this study was mainly due to cooking methods.

Low energy intake decreases estrogen levels, a hormone that regulates the menstrual cycle; thus, menstrual cycle disorders and reduced reproductive function may occur. This finding is consistent with the study by Rachmawati and Murbawani (2015), which showed a significant relationship between energy intake and menstrual cycle disorders (p-value = 0.000). According to that study, individuals with moderate to severe energy deficits were 7.14 times more likely to experience irregular menstrual cycles (Rachmawati & Murbawani, 2015).

Table 3. Relationship Between Nutrient Intake and Menstrual Cycle

Nutrient Intake	Menstrual Cycle				Total		*P-Value*
	Regular		Irregular				
	n	%	n	%	n	%	
Energy							
Adequate	14	58,3	10	41,7	24	100	
Inadequate	31	81,6	7	18,4	38	100	0,046
Total	45	72,6	17	27,4	62	100	
Protein							
Adequate	26	76,5	8	23,5	34	100	
Inadequate	19	67,9	9	32,1	28	100	0,449
Total	45	72,6	17	27,4	62	100	
Fat							
Adequate	23	63,9	14	36,1	36	100	
Inadequate	22	84,6	4	15,4	26	100	0,071
Total	45	72,6	17	27,4	62	100	
Carbohydrate							
Adequate	8	66,7	4	33,3	12	100	
Inadequate	37	74	13	26	50	100	0,609
Total	45	72,6	17	27,4	62	100	
Iron							
Adequate	30	76,9	9	23,1	39	100	
Inadequate	15	65,2	8	34,8	23	100	0,318
Total	45	72,6	17	27,4	62	100	

Based on Table 3, the statistical test results showed that protein intake did not have a significant relationship with the menstrual cycle among members of the IVS Jakarta community (p-value = 0.978). However, the majority of respondents with adequate protein intake—particularly lacto-ovo vegetarians—had regular menstrual cycles (76.5%). Most respondents consumed protein from eggs, dairy products, legumes, and their processed forms. Conversely, respondents with low protein intake tended to have irregular menstrual cycles (32.1%). Low protein intake, especially when derived solely from plant-based sources, can reduce the frequency of LH (Luteinizing Hormone) peaks, shorten the follicular phase, and increase the risk of infertility due to anovulation (Hidayah *et al.*, 2016; Premaiswari *et al.*, 2021), because FSH (Follicle-Stimulating Hormone) and estrogen fail to reach the levels required to trigger ovulation and follicle development (Arisanti *et al.*, 2023).

Based on Table 3, the statistical test results also showed that fat intake did not have a significant relationship with the menstrual cycle among IVS Jakarta members (p-value = 0.071). Although there was no significant association between fat intake and the menstrual cycle, most respondents (36.1%) with adequate fat intake had irregular menstrual cycles. The high fat intake among respondents was due to frequent consumption of fried and sautéed foods, as well as high-fat fast foods, especially among adolescents and young adults. Lacto-ovo vegetarians also consumed eggs and dairy products, which contain high levels of fat. The trans fat content in fried foods can affect the menstrual cycle, while consuming less trans fat and more unsaturated fats is associated with fewer menstrual irregularities and a

lower risk of infertility (Sitoayu *et al.*, 2017).

Based on Table 3, the statistical test results indicated that carbohydrate intake did not have a significant relationship with the menstrual cycle among IVS Jakarta members (p-value = 0.609). This finding is consistent with the study by Noviyanti (2018), which also found no relationship between carbohydrate intake and menstrual cycles (p-value = 0.141). The low carbohydrate intake may be due to small portions of staple carbohydrate foods or the complete omission of these foods by respondents. Many respondents skipped carbohydrate sources in the morning, replacing them with beverages such as tea or coffee. In addition, most respondents reduced their intake of sugar and sweet foods or drinks, which are major contributors to carbohydrate intake.

Table 3 also shows that among respondents with adequate iron intake, 30 respondents (76.9%) had regular menstrual cycles, while among those with inadequate iron intake, 8 respondents (34.8%) had irregular cycles. Statistical test results showed that iron intake did not have a significant relationship with the menstrual cycle among IVS members (p-value = 0.898). Respondents' iron intake tended to be high, which was consistent with their good protein intake. Iron is a key component in the formation of hemoglobin, making the amount of iron in the body very important in determining hemoglobin levels in the blood. Iron deficiency can cause anemia, characterized by reduced red blood cell production and lower hemoglobin concentration (Hidayati *et al.*, 2022). Iron, which helps form hemoglobin to deliver oxygen to the brain, plays an important role in the menstrual cycle. The brain, which is highly dependent on oxygen, regulates estrogen production. If the brain's oxygen supply is disrupted, hormone production may also be impaired, since the hormonal control center is located in the brain (Chandra *et al.*, 2016).

Table 4. Relationship Between Hemoglobin Levels and the Menstrual Cycle

Hemoglobin Levels	Menstrual Cycle				Total		*P-Value*
	Regular		Irregular				
	n	%	n	%	n	%	
Normal	34	75,6	7	17,1	41	100	
Anemia	11	52,4	10	47,6	21	100	0,011
Total	45	72,6	17	27,4	62	100	

Relationship Between Hemoglobin Levels and Menstrual Cycle

Based on Table 4, 75.6% of respondents with normal hemoglobin levels had regular menstrual cycles, while 47.6% of respondents with low hemoglobin levels (anemia) experienced irregular menstrual cycles. Statistical testing showed a significant relationship between hemoglobin levels and menstrual cycles among members of the IVS Jakarta community (p-value = 0.011). Anemia, which results from low hemoglobin levels due to insufficient iron intake, can affect women's menstrual cycles (Febriani, 2021). Adequate hemoglobin levels help maintain a regular menstrual cycle, whereas low hemoglobin levels—often caused by iron deficiency—can lead to menstrual irregularities (Kristianti *et al.*, 2014). This occurs because the hypothalamus receives insufficient oxygen due to low hemoglobin levels, which can inhibit the release of hormones essential for the development of reproductive glands and sex hormones. As a result, the menstrual cycle tends to become

longer and irregular (Khikmawati & ER, 2012).

Table 5. Relationship Between Stress Levels and the Menstrual Cycle

Stress Levels	Menstrual Cycle				Total		*P-Value*
	Regular		Irregular				
	n	%	n	%	n	%	
Normal	23	92	2	8	25	100	
Stress	22	59,5	15	40,5	37	100	0,005
Total	45	72,6	17	27,4	62	100	

Relationship Between Stress Levels and Menstrual Cycle

Based on Table 5, the statistical test results showed that stress levels had a significant relationship with the menstrual cycle among members of the IVS Jakarta community (p-value = 0.005). Vegetarians generally consume more grains, vegetables, nuts, and legumes, which make their diets rich in nutrients such as antioxidants, folate, phytochemicals, and fiber. Folate, in particular, is associated with brain function. Meta-analysis studies have shown that individuals with depression tend to have lower folate intake. Folate metabolism produces S-adenosylmethionine, a compound that influences neurotransmitters related to depression (Jin *et al.*, 2021).

A previous study from the German National Health Interview and Examination Survey (GHS) reported that the prevalence of depressive disorders was higher among vegetarians—almost 15% higher than in non-vegetarians. Furthermore, vegetarians also exhibited higher rates of anxiety disorders, with the prevalence of anxiety being more than twice as high in vegetarians compared to non-vegetarians (Michalak *et al.*, 2012).

Stress is the body's and mind's reaction to demands that can cause tension and disrupt daily routines (Sitoayu *et al.*, 2017). Stress triggers the hypothalamus to release Corticotropic Releasing Hormone (CRH), which then stimulates the anterior pituitary gland to release Adrenocorticotropic Hormone (ACTH). This process is known as the hypothalamic-pituitary-adrenal (HPA) axis. The adrenal cortex is then stimulated by ACTH to release cortisol. Subsequently, the release of cortisol inhibits the secretion of Gonadotropin-Releasing Hormone (GnRH) in the hypothalamus, which in turn reduces the release of Luteinizing Hormone (LH), affects the synthesis of progesterone and estrogen, and ultimately alters the menstrual cycle (Ilham *et al.*, 2022).

Table 6. Relationship Between Nutritional Status and the Menstrual Cycle

Nutritional Status	Menstrual Cycle				Total		*P-Value*
	Regular		Irregular				
	n	%	n	%	n	%	
Normal	25	73,5	9	26,5	34	100	
Abnormal	20	71,4	8	28,6	28	100	0,854
Total	45	72,6	17	27,4	62	100	

The Relationship Between Nutritional Status and Menstrual Cycle

Based on Table 6, as many as 28.6% of respondents with underweight or overweight nutritional status had irregular menstrual cycles. Although the statistical test results showed that nutritional status did not have a significant relationship with the menstrual cycle among members of the Indonesian Vegetarian Society (IVS) Jakarta (p-value = 0.0879), the majority of respondents with normal nutritional status (73.5%) had regular menstrual cycles.

This study also found that the percentage of vegetarian respondents with overweight nutritional status (37.1%) was higher than those with underweight status (8.1%). The production of follicle-stimulating hormone (FSH) by the anterior hypothalamus in women can be inhibited by both undernutrition and overnutrition. Approximately three to thirty ovarian follicles are stimulated to grow by FSH. Afterward, only one follicle continues to develop further, while the others regress. Menstruation occurs as a result of ovulation, or the development of an egg cell, which is triggered by luteinizing hormone (LH). Disruptions in the production of FSH and LH can lead to menstrual cycle irregularities (Astuti & Noranita, 2016).

4. CONCLUSION

Based on the research conducted on members of the Indonesian Vegetarian Society (IVS) Jakarta), it can be concluded that:

1. There is a relationship between energy intake and menstrual cycle, but no relationship between protein, fat, carbohydrate, and iron intake with the menstrual cycle.
2. There is a relationship between hemoglobin levels and menstrual cycle.
3. There is a relationship between stress levels and menstrual cycle.
4. There is no relationship between nutritional status and menstrual cycle.

Therefore, respondents are advised to pay attention to inadequate nutrient intake, particularly carbohydrate intake, to regularly check their hemoglobin levels, and to practice effective stress management techniques to prevent disturbances in the menstrual cycle.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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