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The relationship between stress levels, training intensity, micronutrient intake, and primary dysmenorrhea in athletes

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Abstract

Primary dysmenorrhea is commonly experienced by adolescent and adult women, including female athletes. The pain is associated with various factors, such as sociodemographic, psychosocial, lifestyle or health-related factors, and reproductive factors. This study aims to analyze the relationship between stress levels, training intensity, and micronutrient intake with primary dysmenorrhea among female student athletes at SMAN X Bandung and to analyze the most dominant variable associated with primary dysmenorrhea. This research method used a cross-sectional design. The sample consisted of 63 female student athletes at SMAN X Bandung, selected through proportionate stratified random sampling. The Spearman rho correlation test showed that training intensity ($p = 0,000$; $r = 0,507$), iron intake ($p = 0,000$; $r = -0,620$), vitamin B6 intake ($p = 0,000$; $r = -0,503$), and magnesium intake ($p = 0,000$; $r = -0,430$) were associated with primary dysmenorrhea in female student athletes. In contrast, stress level and calcium intake ($p = > 0,05$) were not associated with primary dysmenorrhea in female student athletes. High training intensity was found to increase the risk of primary dysmenorrhea by 13,091 times compared to low training intensity, while iron intake was found to be a protective factor ($OR < 1$). Monitoring and providing education on stress management, proper training programs, and adequate micronutrient intake are necessary to improve athletes' health and performance.

Keywords: Micronutrient Intake; Stress Levels; Training Intensity; Primary Dysmenorrhea

INTRODUCTION

Dysmenorrhea is one of the most common gynecological problems experienced by women of reproductive age (Itani *et al*., 2022). It is defined as pain in the lower abdomen that occurs before or during menstruation (Putra *et al*., 2024). Based on its pathophysiology, dysmenorrhea is classified into two types: primary and secondary. The key difference is that secondary dysmenorrhea involves pelvic pathology (Itani *et al*., 2022). Primary dysmenorrhea is frequently experienced by both adolescent and adult women and is often accompanied by symptoms such as dizziness, fatigue, diarrhea, and sweating (Sharghi *et al*., 2019).

According to World Health Organization (WHO) data from 2017, approximately 90% of women experience dysmenorrhea, with 10–16% reporting severe pain (Maufiroh *et al*., 2023). Based on research data from the Center for Information and Counseling on Adolescent Reproductive Health in Indonesia (2009), the incidence of primary dysmenorrhea among women of productive age reached 72.84%. In West Java, the prevalence of primary dysmenorrhea was also relatively high, reaching 54.9% (Andriyani *et al*., 2017).

It is common for adolescent girls to participate in sports, and athletes frequently undergo high-intensity training, especially before competitions. This can lead to increased stress, which in turn affects reproductive hormones (Vannuccini *et al*., 2020). A study by Momma *et al*. (2022) on Japanese female athletes and non-athletes found that 85.6% of female athletes experienced dysmenorrhea, with 52.9% experiencing severe pain. Achieving optimal performance in athletes requires not only structured training but also adequate macro- and micronutrient intake (Beck *et al*., 2021). However, athletes often fail to meet their micronutrient needs due to poor dietary habits (Ghazzawi *et al*., 2023), which may be linked to dysmenorrhea prevalence (Naz *et al*., 2020).

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Dysmenorrhea is also part of the physiological changes seen in menstrual dysfunction, which is one of the three components of the Female Athlete Triad (FAT). FAT is a metabolic condition observed in physically active women and is characterized by low energy availability (LEA), with or without eating disorders, low bone mineral density (BMD), and menstrual dysfunction (MD) (Amoruso *et al*., 2024). Preventing such conditions is essential to maintain an athlete's health and performance, especially during training and competition (Armour *et al*., 2020).

The causes of primary dysmenorrhea are associated with sociodemographic, psychosocial, lifestyle or health-related, and reproductive factors (Uden *et al*., 2024). Stress has been identified as a psychosocial factor that contributes to dysmenorrhea by increasing cortisol secretion (Triwahyuningsih *et al*., 2024). Lifestyle-related and reproductive factors, especially in athlettes, such as long training durations, early menarche, and irregular menstrual cycles are also significant contributors (Momma *et al*., 2022). High-intensity training may increase prostaglandin synthesis, exacerbating menstrual pain. Furthermore, insufficient intake of micronutrients such as vitamin E, vitamin B6, magnesium, calcium, and iron has been shown to intensify dysmenorrhea symptoms (Fitrianingsih *et al*., 2023; Muawanah *et al*., 2025). Despite this, research focusing on the relationship between micronutrient intake and primary dysmenorrhea in athletes remains limited and warrants further investigation.

A preliminary study was conducted involving six female athletes at SMAN X Bandung to explore their experiences with primary dysmenorrhea through direct interviews. The findings revealed that one participant experienced severe pain rated 8 out of 10, while three others reported moderate pain rated 6. The athletes also reported eating three meals per day, engaging in high-intensity training (rated 5), and occasionally experiencing restlessness and difficulty resting. Several incidents of dysmenorrhea have been observed to negatively affect both the health and performance of female athletes. Therefore, this study aims to examine the relationship between stress levels, training intensity, and micronutrient intake with primary dysmenorrhea in female athletes at SMAN X Bandung.

METHOD

This analytic research method used cross sectional design. The research was conducted from February to April 2025 at SMAN X in Bandung City. The sample was selected using a random sampling technique, specifically proportionate stratified random sampling. The study involved 63 female student athletes from grades X to XII at SMAN X Bandung. The total population consisted of 127 female student athletes, from which the 63 samples were drawn.

The inclusion criteria for this study were: (1) female adolescent athletes enrolled in the class of athletes at SMAN X Bandung, (2) currently experiencing or having experienced menstruation, and (3) willing to participate as respondents. The exclusion criteria were: (1) diagnosed with reproductive disorders or diseases such as endometriosis, adenomyosis, myoma, infections, or ovarian cysts, and (2) absence during the data collection period.

The dependent variable in this study was primary dysmenorrhea, while the independent variables included stress levels, training intensity, and micronutrient intake (iron, vitamin B6, calcium, and magnesium). The data collection process involved several steps: (1) the researcher visited the research site, (2) provided and explained the information sheet to participants prior to data collection, (3) distributed informed consent forms for participants to sign before the study began, and (4) conducted data collection through face-to-face interviews. During the interviews, participants completed the Numeric Rating Scale (NRS) to assess the severity of primary dysmenorrhea, the Depression Anxiety Stress Scales-42 (DASS-42) to assess stress levels, the Rating of Perceived Exertion (RPE) to assess training intensity, and a 2×24 hour food recall to assess micronutrient intake.

Bivariate analysis was conducted using the Spearman's rho test, while multivariate analysis was performed using multiple logistic regression. This study was approved by the Research Ethics Committee of Respati University Indonesia, with approval number 68/SK.KEPK/UNR/1/2025.

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RESULTS AND DISCUSSION

Result

Table 1 presents the characteristics of female athletes at SMAN X Bandung based on age, type of sport, training duration, training frequency, stress level, training intensity, micronutrient intake, and the degree of primary dysmenorrhea.

Table 1. Characteristics of Female Student Athletes at SMAN X Bandung

Characteristics	Frequency (N = 63)	Percentage (%)
Age		
X ± SD	16,54 ± 1,09	
Min-max	15-19	
Type of Sports		
Fencing	6	9,5
Weightlifting	1	1,6
Athletics	2	3,2
Badminton	1	1,6
Wrestling	1	1,6
Karate	7	11,1
Diving	2	3,2
Archery	3	4,8
Pencak Silat	5	7,9
Water Polo	4	6,3
Artistic Swimming	1	1,6
Rowing	1	1,6
Free Diving	1	1,6
Gymnastic	5	7,9
Dance art	1	1,6
Football	1	1,6
Squash	2	3,2
Taekwondo	2	3,2
Tarung Derajat	2	3,2
Volley	15	23,8
Training Duration		
Short	4	6,3
Long	59	93,7
Training Frequency		
Rarely	3	4,8
Sometimes	9	14,3
Often	51	81
Stress Levels		
Mild	45	71,4
Severe	18	28,6
Training Intensity		
Low	31	49,2
High	32	50,8
Iron Intake		
Less	41	65,1
Enough	22	34,9
Vitamin E Intake		
Less	63	100
Enough	0	0
Vitamin B6 Intake		
Less	37	58,7
Enough	26	41,3

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Characteristics	Frequency (N = 63)	Percentage (%)
Vitamin D Intake		
Less	63	100
Enough	0	0
Calcium Intake		
Less	59	93,7
Enough	4	6,3
Magnesium Intake		
Less	46	73
Enough	17	27
Primary Dysmenorrhea		
Mild	23	36,5
Severe	40	63,5

Based on Table 1, the majority of the 63 female athletes were 17 years old, totaling 21 students (33,3%). Additionally, most female athletes participated in team sports and martial arts, specifically volleyball and karate, with 15 students (23,8%) and 7 students (11,1%), respectively. The majority engaged in long training durations, with 59 students (93.7%), and frequent training sessions, with 51 students (81%).

The degree of primary dysmenorrhea experienced by the athletes indicated that most suffered from severe pain, with 40 students (63,5%). Regarding psychosocial factors, stress levels were predominantly mild among 45 athletes (71,4%). Concerning training intensity, the majority were categorized as heavy, comprising 32 athletes (50,8%).

Micronutrient intake assessments revealed that the requirements for vitamin E and vitamin D were inadequately met by all athletes (100%). Furthermore, deficiencies were observed in iron intake (41 students, 65,1%), vitamin B6 (37 students, 58,7%), calcium (59 students, 93,7%), and magnesium (46 students, 73%).

The results of the bivariate analysis using Spearman's rho correlation test to analyze the relationship between stress levels, training intensity, and micronutrient intake with primary dysmenorrhea among female athletes at SMAN X Bandung are presented in Table 2.

Table 2. Analysis of the Relationship between Stress Level, Training Intensity, and Micronutrient Intake with Primary Dysmenorrhea

Independent Variable	Primary Dysmenorrhea						*P value*	r
	Mild		Severe		n	%		
	n	%	n	%				
Stress Levels								
Mild	19	42,2	26	57,8	45	100	0,141	0,188
Severe	4	22,2	14	77,8	18	100		
Training Intensity								
Low	19	61,3	12	38,7	31	100	**0,000****	0,507
High	4	12,5	28	87,5	32	100		
Iron Intake								
Less	6	14,6	35	84,5	41	100	**0,000****	-0,620
Enough	17	77,3	5	22,7	22	100		
Vitamin B6 Intake								
Less	6	16,2	31	83,8	37	100	**0,000****	-0,503
Enough	17	65,4	9	34,6	26	100		
Calcium Intake								
Less	22	37,3	37	62,7	59	100	0,628	0,062
Enough	1	25	3	75	4	100		
Magnesium Intake								
Less	11	23,9	35	76,1	46	100	**0,000****	-0,430
Enough	12	70,6	5	29,4	17	100		

**p value < 0,05; **p value < 0,01*

Based on Table 2, training intensity had a *p-value* of 0,000 (p < 0,05), indicating a statistically significant result and leading to the rejection of the null hypothesis (Ho). The correlation coefficient was 0.507, indicating a strong positive correlation. For iron intake, the *p-value* was also 0,000 (p < 0,05), resulting in the rejection of Ho. The correlation coefficient was –0.620, indicating a strong negative correlation. Similarly, vitamin B6 intake had a *p-value* of 0,000 (p < 0,05), with a correlation coefficient of –0.503, suggesting a moderate negative correlation. Magnesium intake also showed a *p-value* of 0,000 (p < 0,05), with a correlation coefficient of –0.430, indicating a moderate negative correlation. In contrast, both stress level and calcium intake had *p-values* greater than 0,05, so the null hypothesis (Ho) was not rejected, indicating no statistically significant relationship.

Five variables met the inclusion criteria for the multivariate analysis (*p-value* < 0,25): stress level, training intensity, iron intake, vitamin B6 intake, and magnesium intake. These variables were considered to have potential associations with the dependent variable and were therefore included in the multivariate logistic regression model. Multiple logistic regression was performed to identify significant independent predictors and to calculate the magnitude of their influence using odds ratios. The results of this analysis are presented in Table 3.

Table 3. Full Model The Relationship between Stress Levels, Training Intensity, Micronutrient Intake with Primary Dysmenorrhea

Independent Variable	**Primary Dysmenorrhea**						***P value***	**OR**	**95% CI**
	Mild		**Severe**		**n**	**%**			
	n	**%**	**n**	**%**					
Stress Levels									
Mild	4	22,2	14	77,8	18	100	0,493	1,965	0,285-13,553
Severe	19	42,2	26	57,8	45	100	*Baseline*		
Training Intensity									
Low	4	12,5	28	87,5	32	100	0,004	13,091	2,248-76,234
High	19	61,3	12	38,7	31	100	*Baseline*		
Iron Intake									
Less	6	14,6	35	84,5	41	100	0,019	0,066	0,007-0,637
Enough	17	77,3	5	22,7	22	100	*Baseline*		
Independent Variable	**Primary Dysmenorrhea**						***P value***	**OR**	**95% CI**
	Mild		**Severe**		**n**	**%**			
	n	**%**	**n**	**%**					
Vitamin B6 Intake									
Less	6	16,2	31	83,8	37	100	0,159	0,260	0,040-1,696
Enough	17	65,4	9	34,6	26	100	*Baseline*		
Magnesium Intake									
Less	11	23,9	35	76,1	46	100	0,749	1,498	0,126-17,781
Enough	12	70,6	5	29,4	17	100	*Baseline*		

Based on Table 3, it was found that primary dysmenorrhea among female athletes is influenced by training intensity and iron intake, which is controlled by stress level, vitamin B6 intake, and magnesium intake. Athletes with high training intensity had a 13.091 times greater risk of experiencing primary dysmenorrhea compared to those with low training intensity. In contrast, iron intake showed a protective effect, as indicated by an odds ratio (OR) < 1, meaning that adequate iron intake may reduce the risk of primary dysmenorrhea.

The *p-values* in Table 3 show that training intensity and iron intake have *p-values* < 0,05, indicating statistically significant associations, and thus no further assessment for confounding was required for these two variables. For the other three variables—magnesium intake, stress level, and vitamin B6 intake—a confounding assessment was conducted by sequentially removing the variable with the highest *p-value*. The removal of each variable led to a change in the OR greater than 10%, confirming their role as confounding variables. Therefore, all three were re-included in the final model.

Subsequently, an interaction test was conducted between iron intake and training intensity, with the results presented in Table 4.

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Table 4. Interaction Test Results

Interaction	***P value***
Iron Intake*Training Intensity	0,746

The results presented in Table 4 indicate that the *p-value* for the interaction test between the two variables is greater than 0,05. This suggests that there is no statistically significant interaction between iron intake and training intensity. Therefore, the final model is based on the results prior to the interaction test, as shown in Table 3.

Discussion

The Relationship between Training Intensity and Primary Dismenorrhea in Female Student Athletes

Based on the results of this study, a significant relationship was found between training intensity and primary dysmenorrhea in female athletes. The higher the training intensity, the greater the severity of primary dysmenorrhea experienced. These findings align with the research of Czajkowska *et al*. (2015), who reported that high-intensity training can exacerbate premenstrual syndrome (PMS) symptoms in athletes. Previous studies by Kitamura (2012) also demonstrated a correlation between PMS severity and primary dysmenorrhea (Momma *et al*., 2022).

Using the Rating of Perceived Exertion (RPE) scale, it was found that the majority of female athletes reported a training intensity level of 5, which corresponds to "heavy" exertion. This level indicates that athletes feel tired and find training difficult, but still able to continue without excessive strain. As the RPE is a self-reported measure, it is inherently subjective, capturing the athletes' perception of fatigue during training without input from coaches. Interviews revealed that student athletes followed different training programs depending on their sport, typically consisting of two sessions per day. Training sessions generally included material delivery, physical conditioning, technical skills, and strength training. Most athletes engaged in high intensity training during the second session in the afternoon.

Sustained high intensity training can increase levels of inflammatory cytokines and prostaglandin synthesis. As menstruation approaches, the body responds by decreasing progesterone and increasing production of metalloproteinases (MMPs) and inflammatory cytokines such as IL-8, IL-1, IL-6, and TNF-α. These processes lead to inflammation characterized by edema, redness, and leukocyte infiltration. Additionally, elevated prostaglandin levels induce strong myometrial contractions, which contribute to dysmenorrhea pain (Barcikowska *et al*., 2020).

Conversely, low intensity training can help alleviate dysmenorrhea pain by reducing cortisol levels, which are involved in stimulating prostaglandin production (Momma *et al*., 2022). Moreover, combining light and heavy training intensities in a program tailored to the athlete's condition can minimize the risk of overreaching and overtraining (Liu *et al*., 2023). One practical approach for athletes experiencing primary dysmenorrhea is High Intensity Interval Training (HIIT), which alternates periods of intense exercise with recovery or low intensity phases. Examples include sprints, strength exercises such as squats, jumping jacks, or burpees, followed by recovery intervals (Atashak & Rashidi, 2018).

The Relationship between Iron Intake and Primary Dismenorrhea in Female Student Athletes

Based on the results of this study, a significant relationship was identified between iron intake and primary dysmenorrhea in female athletes. Higher iron intake was associated with a lower severity of primary dysmenorrhea. These findings are consistent with the studies conducted by Syafila *et al*. (2024) and Purwaningtyas *et al*. (2023), which also reported a significant correlation between iron intake and primary dysmenorrhea among female students.

The 2x24-hour dietary recall revealed that the majority of female athletes had inadequate iron intake. This deficiency may be attributed to poor food choices lacking sufficient iron sources. Additionally, during data collection, it was observed that athletes frequently consumed snacks and iced tea during breaks. Tea contains tannins and polyphenols, compounds known to inhibit iron absorption

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in the gastrointestinal tract by binding dietary iron, thereby reducing its bioavailability and potentially leading to anemia over time (Fauzia *et al*., 2024; Royani *et al*., 2019).

Iron plays a crucial role in the synthesis of hemoglobin (Hb), which is responsible for the transport, storage, and utilization of oxygen throughout the body. Iron recycled from the breakdown of red blood cells is reused for hemoglobin formation. Insufficient hemoglobin levels can impair oxygen delivery to tissues, including the uterus, resulting in vasoconstriction and ischemia. These conditions stimulate the synthesis of compounds such as arachidonic acid, prostaglandins, phospholipids, and vasopressin. Elevated levels of prostaglandins and vasopressin exacerbate vasoconstriction and ischemia, thereby increasing prostaglandin production further and intensifying menstrual pain (Muawanah *et al*., 2025).

It is recommended that student athletes increase their intake of foods rich in heme iron sources (e.g., meat, fish, poultry, and seafood) as well as non-heme iron sources (e.g., vegetables, nuts, and seeds). Heme iron is particularly advised because it is more readily absorbed, which can help reduce the severity of primary dysmenorrhea pain (Beck *et al*., 2021).

The Relationship between Vitamin B6 Intake and Primary Dismenorrhea in Female Student Athletes

Based on the results of this study, a significant relationship was found between vitamin B6 intake and primary dysmenorrhea in female athletes. Higher vitamin B6 intake was associated with a lower severity of primary dysmenorrhea. These findings are consistent with the research of Fitrianingsih *et al*. (2023) on taekwondo athletes, which also reported a correlation between vitamin B6 intake and primary dysmenorrhea.

The 2x24-hour dietary recall revealed that the majority of female athletes had insufficient vitamin B6 intake. This deficiency may be attributed to limited quantity and poor selection of vitamin B6-rich foods (Polak *et al*., 2021). Only about half of the athletes regularly consumed vitamin B6-rich foods such as milk and meat, which likely affects the body’s response to primary dysmenorrhea symptoms. It is recommended that student athletes pay attention to their intake of vitamin B6-rich foods, including liver, chicken, beef, milk, fish, kidneys, cereals, soybeans, and peanuts (Batubara *et al*., 2018).

One proposed mechanism of vitamin B6 during menstruation is its role in stimulating cell membranes to facilitate magnesium transport into cells, which helps relax smooth muscles—including uterine muscles that may contract excessively due to elevated prostaglandin levels (PGF2α and PGE2). Elevated prostaglandins can cause strong, irregular uterine contractions, ischemia, and menstrual pain. Additionally, low vitamin B6 levels can impair the liver’s ability to conjugate estrogen, leading to increased estrogen levels that contribute to menstrual pain (Bunga *et al*., 2018).

Vitamin B6 also regulates membrane ion transport that affects hormone function by binding to steroid hormones. Furthermore, it plays a role in the production of neurotransmitters such as serotonin and GABA, which regulate pain perception, stress, and anxiety. Therefore, vitamin B6 deficiency during menstruation can worsen dysmenorrhea symptoms by increasing muscle tension, hormonal imbalances, and disruptions in neurochemical regulation (Putri & Sutiari, 2024).

The Relationship between Magnesium Intake and Primary Dismenorrhea in Female Student Athletes

Based on the results of this study, a significant relationship was found between magnesium intake and primary dysmenorrhea in female athletes. Higher magnesium intake was associated with a lower severity of primary dysmenorrhea. These findings are consistent with studies by Nahra *et al*. (2017) and Yaralizadeh *et al*. (2024), which reported that magnesium intake, particularly around 300 mg per day, is effective in reducing the symptoms of primary dysmenorrhea in female students.

The 2x24-hour dietary recall indicated that the majority of female athletes had insufficient magnesium intake. This insufficiency is likely due to limited quantity and poor selection of magnesium-rich foods both at school and at home. Student athletes rarely consumed vegetables, especially green leafy vegetables, which were mostly obtained from mixed fried rice. Additionally, less than a quarter of the athletes consumed papaya, a fruit rich in vitamin B6. It is recommended that student athletes increase

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their consumption of magnesium-rich foods such as chicken, beef, fish, eggs, green vegetables, bananas, and papaya (Lestari, 2019).

Magnesium deficiency can lead to various disorders, including fatigue and increased dysmenorrhea pain. Low magnesium levels disrupt the contractility and relaxation processes of smooth muscles in the uterus (Yaralizadeh *et al*., 2024). Furthermore, magnesium's role in inhibiting prostaglandin synthesis—specifically PGF2α, which is involved in menstrual pain—is also impaired (Goss, 2023). Consequently, individuals with magnesium deficiency tend to experience more severe dysmenorrhea due to increased uterine contractions and vasoconstriction (Ferries-Rowe *et al*., 2020).

The Relationship between Stress Levels and Primary Dismenorrhea in Female Student Athletes

Based on the results of this study, no significant relationship was found between stress levels and primary dysmenorrhea in female athletes. These findings align with the research of Nurharta *et al*. (2024), which also reported no association between stress levels and primary dysmenorrhea. Conversely, these results contradict those of Mizgier *et al*. (2025), who found a significant relationship between stress and primary dysmenorrhea.

The discrepancy between studies may be attributed to differences in how stress was measured. Mizgier *et al*. (2025) directly measured cortisol levels, the main stress hormone, whereas this study relied on self-reported questionnaires administered via Google Forms, which may introduce subjective bias. Increased cortisol levels have been linked to heightened primary dysmenorrhea pain through stimulation of prostaglandin synthesis, leading to excessive uterine contractions, ischemia, and hypoxia (Hussien *et al*., 2022).

In this study, stress levels were assessed using the DASS-42 questionnaire. Item number 11, which relates to individuals feeling easily upset, showed higher stress levels, reflecting emotions commonly experienced when athletes make mistakes or fail to achieve set targets (Rap'i *et al*., 2024). However, the overall stress level based on the total score was categorized as mild. This may be due to the fact that most athletes had limited competition activity early in the year, coinciding with the timing of data collection.

The absence of a relationship between stress and primary dysmenorrhea in this study may also be influenced by individual differences in stress management. Factors such as personality traits, adaptability, and coping strategies affect how the body responds to stress. Thus, although stress can biologically trigger dysmenorrhea, its impact varies depending on individual stress management (Rita & Sari, 2019).

Primary dysmenorrhea is a multifactorial condition, with stress being one possible contributing factor. High stress levels activate the production of Adrenocorticotrophic Hormone (ACTH) by the hypothalamus, stimulating the adrenal glands to produce cortisol. Cortisol increases prostaglandin production, compounds responsible for excessive myometrial contractions, which cause menstrual pain or dysmenorrhea. Prolonged unmanaged stress can also raise adrenaline and estrogen levels, further increasing uterine muscle tension and exacerbating dysmenorrhea symptoms (Azizah *et al*., 2023; Kho & Shields, 2020).

Stress management is a crucial skill that enables athletes to cope effectively with pressure. Beyond its impact on performance, effective stress management can help minimize the severity of dysmenorrhea. Various approaches—encompassing physical, technical, and mental training—need to be explored in greater depth. Mental training includes relaxation techniques such as progressive muscle relaxation and autogenic training, which gradually reduce physical and mental tension. Additionally, techniques such as hypnosis, self-talk, imagery training, and mindfulness meditation can reinforce positive suggestion in athletes (Fadilah *et al*., 2024).

The Relationship between Calcium Intake and Primary Dismenorrhea in Female Student Athletes

Based on the results of this study, no significant relationship was found between calcium intake and primary dysmenorrhea in female athletes. These findings are consistent with the study by Wildayani *et al*. (2023), which also reported no association between calcium intake and primary dysmenorrhea among adolescent students. However, these results contradict the findings of Charandabi *et al*. (2017), who found a significant relationship between calcium intake and the severity of primary dysmenorrhea.

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The discrepancy in findings may be due to differences in research methods. Charandabi *et al*. (2017) conducted an intervention study that directly measured calcium levels following supplementation, whereas this study relied on self-reported calcium intake using a 2x24-hour dietary recall interview. The latter approach is more prone to subjective bias, as participants may not accurately or thoroughly report their dietary intake.

The lack of association observed in this study may also be due to overall low calcium consumption among the participants and the absence of controlled calcium supplementation. More than half of the athletes had inadequate calcium intake, likely due to dietary habits that did not include calcium-rich foods. Higher calcium intake was more commonly found in athletes who regularly consumed milk or dairy products during training days and weekdays.

Calcium plays a crucial role in muscle function, especially in modulating responses to nerve stimuli. It acts as a stabilizer of muscle activity. When calcium levels are insufficient, smooth muscles, including those in the uterus, may become more prone to contraction, thereby worsening menstrual cramps and increasing dysmenorrhea pain (Matsas *et al*., 2023; Zarei *et al*., 2016).

Student athletes are encouraged to consume more calcium-rich foods, including milk and dairy products (such as yogurt and cheese), fortified milk, broccoli, kale, legumes, almonds, and sesame seeds (Beck *et al*., 2021). However, it should be noted that plant-based calcium sources often contain absorption inhibitors—such as oxalate in spinach—which reduce calcium bioavailability. In contrast, animal-based sources typically have higher bioavailability and are more efficiently absorbed (Wildayani *et al*., 2023).

CONCLUSION

Based on the research that there is a relationship between training intensity, iron, vitamin B6, and magnesium intake with primary dysmenorrhea in female athletes at SMAN X Bandung. Training intensity and iron intake have a strong correlation with the direction of the relationship being positive and negative respectively. Meanwhile, vitamin B6 and magnesium intake had a moderate correlation with a negative relationship direction. There was no relationship between stress level and calcium intake with primary dysmenorrhea in female athletes at SMAN X Bandung. Primary dysmenorrhea in female athletes is influenced by training intensity and iron which is controlled by stress level, vitamin B6, and magnesium intake. High training intensity has a risk of causing primary dysmenorrhea 13,091 times higher than light training intensity. Iron intake is protective, so iron sufficiency can reduce the risk of primary dysmenorrhea. There is no interaction between the variable of iron intake and training intensity.

The limitation of this study is that the research design was conducted cross-sectionally at one time, not repeatedly in the long term. In addition, limited funds affect the assessment of each variable and instrument used. Assessment of stress levels, training intensity, and micronutrient intake is only based on subjective answers of female athletes through questionnaires and does not conduct laboratory examinations to determine the level of micronutrient intake. Assessment of the degree of primary dysmenorrhea is also based on self-report and does not directly analyze variations in the CYP1A1, BDNF, and OPRM1 genes that affect dysmenorrhea pain. Future researchers are expected to add variables to strengthen the results of the study, such as age of menarche, genetics, and directly analyze nutrients and related hormones through laboratory tests.

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