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Relationship between hemoglobin level and incidence of primary dysmenorrhea among high school students

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ABSTRACT

Background: Adolescence is a transitional phase from childhood to adulthood, characterized by significant physical and psychological changes. In women, this phase is characterized by menstruation that occurs regularly. Menstruation is often accompanied by lower abdominal pain known as dysmenorrhea. One of the factors that contribute to the occurrence of dysmenorrhea is the hemoglobin (Hb) level in the blood. Lack of oxygen can affect the pain threshold mechanism, thus increasing the intensity of pain felt during menstruation. This study aimed to identify the relationship between hemoglobin levels and the incidence of primary dysmenorrhea in female students at Public Senior High School 1 Semarapura, Klungkung, Bali.

Methods: The research method used a cross-sectional study conducted in the Klungkung area in May 2024. The sample of this study was taken by purposive sampling as many as 103 people, consisting of second-year of senior high school female students aged 16-18 years. The study samples were female adolescents who met certain inclusion and exclusion criteria, including 16-18 years old, already having menstruation, active as a student at Public Senior High School 1 Semarapura, willing to be a research subject and signed informed consent, having moderate to heavy physical activity levels, normal, mild, or moderate stress levels, menarche age ≥ 11 years, menstrual duration not more than 7 days. Exclusion criteria included students with BMI in the underweight or obese category and who were menstruating at the time of the study. Hemoglobin levels were measured using a digital Hb meter, while the incidence of primary dysmenorrhea was measured using the WaLIDD Score.

Results: Data analysis using Spearman's rho hypothesis test showed a very strong correlation between hemoglobin levels and the incidence of primary dysmenorrhea with a correlation coefficient (r) of -0.752 and a value of $p = 0.000$ ($p < 0.05$). This unidirectional relationship indicates that the lower the hemoglobin level, the higher the intensity of dysmenorrhea pain felt.

Conclusion: This study concludes that there is a significant relationship between hemoglobin levels and the incidence of primary dysmenorrhea in female students of a public high school in Bali.

Keywords: adolescent, girls, hemoglobin levels, primary dysmenorrhea.
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INTRODUCTION

Adolescence is a transitional phase from childhood to adulthood, characterized by both physical and psychological transformations. In women, menstruation is characterized by physiological changes in the female body that occur periodically due to the influence of hormonal levels in the body. This process releases the endometrial layer from the uterus which takes place starting from adolescence until reaching menopause.[2] During the menstrual period, women generally often complain of the appearance of painful sensations or cramps in the lower abdominal area that can radiate to the back and inner thigh area. This condition is known as dysmenorrhea.[2]

Dysmenorrhea comes from the Greek "Dys" meaning difficult, painful or abnormal; "meno" means month; "rhea" means flow. So dysmenorrhea means pain in the lower abdomen and can radiate to the back and inner thigh surface during menstruation.[3] Dysmenorrhea is divided into two types, namely primary dysmenorrhea and secondary dysmenorrhea. Primary dysmenorrhea is a painful condition during menstruation that starts from menarche without any abnormalities in the genital organs.[4] The intensity of cramps or pain experienced can range from mild to severe.[5] Dysmenorrhea is often followed by various other symptoms that include general weakness, gastrointestinal and neurological disorders, including headache, nausea, vomiting, constipation or diarrhea, and increased frequency of urination.[6]

The highest prevalence of dysmenorrhea is often found in adolescent women, which is estimated to be between 20-90%.[7] The incidence of dysmenorrhea in the world is quite high. The world's highest prevalence of dysmenorrhea in adolescents is 89.5%. In the United States

in 2012, the incidence of dysmenorrhea was 72.9%.[3] While in Indonesia, the incidence of dysmenorrhea in adolescent girls in 2010 was 64.25%, consisting of 54.89% primary dysmenorrhea and 9.36% secondary dysmenorrhea.[8] Women of reproductive age in Indonesia, 55% experience pain during menstruation.[9]

Women who suffer from dysmenorrhea can experience disruptions to their health and productivity. Their dysmenorrhea often hinders their ability to perform normal daily activities and sometimes requires pharmacological intervention. This situation can result in a decrease in women's quality of life, as in the case of schoolgirls experiencing primary dysmenorrhea who are unable to focus on learning and experience decreased motivation to learn due to the pain felt. This situation can worsen if followed by an unstable psychiatric condition, including stress, depression, intense anxiety, and emotional fluctuations such as extreme sadness or happiness.[7] It is reported that 30%-60% of adolescent girls who experience Dysmenorrhea, and 7%-15% do not go to school.[10]

Factors that influence dysmenorrhea include first menstruation at a very early age, never having given birth to children, long menstrual periods, nutritional status, exercise habits, stress, family history and nutritional intake.[3] The length of the menstrual period plays a role in determining hemoglobin levels.[10] Decreased hemoglobin levels in the blood correlate with an increased likelihood of adolescent dysmenorrhea.[11] This condition makes hemoglobin levels one of the factors affecting primary dysmenorrhea in women.[9]

The normal hemoglobin level for women is between 12 and 16 g/dL. Hemoglobin levels below 12 g/dL are indicated as anemia. Haemoglobin, which is found in erythrocytes, has an essential function in binding oxygen (O2). Hemoglobin is responsible for providing oxygen to all parts of the body. If the level decreases, it can potentially cause ischemia which leads to hypoxic conditions. In addition, during the menstrual phase, decreased levels of estrogen and progesterone trigger the release of prostaglandins. Painful conditions during menstruation can result from increased levels of prostaglandins in the blood circulation. Women who experience dysmenorrhea are known to have prostaglandin production that is 10 times higher than women who do not experience the condition.[5]

The increase in prostaglandin during menstruation, which causes pain, will be exacerbated by a reduction in blood supply to the myometrium leading to an intensification of uterine contractions and dysrhythmias. Decreased blood supply to the uterus will reduce hemoglobin levels leading to hypoxia or oxygen deprivation. This condition results in a decrease in the threshold of pain sensitivity in the afferent nerves of the nervus pelvicus. This means that the lower the hemoglobin level in adolescent girls, the more susceptible they are to experiencing dysmenorrhea.[9]

This condition is by a study conducted by Endang Wahyuningsih and Linda Puspita Sari in 2014, which found that most participants with low hemoglobin levels reported having dysmenorrhea, with a total of 11 participants or 27.5%, while only 1 participant or 2.5% of this group did not experience dysmenorrhea. In the group with higher hemoglobin levels, there were 4 participants or 10.0% who experienced dysmenorrhea and 2 participants or 5.0% who did not experience the condition. Another study conducted by Sofia Mawaddah and Ida Misrayani Pratiwi in 2018 revealed that out of 56 adolescent girls with Hb levels ≥ 12 grams per deciliter, 48 of them experienced moderate dysmenorrhea and 8 others experienced severe dysmenorrhea. Furthermore, among 34 respondents whose Hb levels were ≤ 12 grams per deciliter, all of them experienced severe dysmenorrhea.

Based on the background that has been described, the researcher became interested in further examining the relationship between hemoglobin level and the incidence of dysmenorrhea among adolescent girls. This study is considered vital because the incidence of dysmenorrhea can have a significant impact on the quality of life of adolescent girls in carrying out daily activities. In addition, it is hoped that this study can contribute as an additional source of information for the health sector, especially in the field of physiotherapy, as well as for the general public including the elderly.

METHODS

This study used a correlational analytic descriptive design with a cross-sectional approach, where data were collected at one specific time. This study aims to identify the relationship between hemoglobin levels and the incidence of primary dysmenorrhea in female students at Public Senior High School 1 Semarapura, Klungkung, which was conducted from April to June 2024. The target population of the study was all female students at Public Senior High School 1 Semarapura, while the target population was class XI students. The study sample was female adolescents who met certain inclusion and exclusion criteria, including 16-18 years old, already having menstruation, active as a student at Public Senior High School 1 Semarapura, willing to be a research subject and signed informed consent, having moderate to heavy physical activity levels, normal, mild, or moderate stress levels, menarche age ≥ 11 years, menstrual duration of no more than 7 days, and not consuming alcohol and not smoking. Exclusion criteria included students with BMI in the underweight or obese category and who were menstruating at the time of the study.

The sample size was calculated using Lemeshow's formula for a cross-sectional study, resulting in a total sample of 89 people to anticipate dropouts. The sampling technique used probability sampling with the purposive sampling method, where the sample was selected based on certain criteria by the research topic. The variables studied included independent variables (hemoglobin level), dependent variables (incidence of primary dysmenorrhea), and control variables (physical activity, stress level, age at menarche, duration of menstruation, and cigarette and alcohol consumption). The instruments used in the study included informed consent forms, personal identity sheets, WaLIDD score questionnaires, IPAQ questionnaires, DASS 21 questionnaires, digital Hb meters, alcohol swabs, lancets, Hb strips, scales, microtoise, laptops, and stationery. The research procedure began with the

preparation of a proposal, observation at the research location, submission of permits, preparation of informed consent, and preparation of research instruments. Furthermore, sample selection was carried out using Google Forms, followed by filling out informed consent by the sample, measuring BMI, hemoglobin levels, and primary dysmenorrhea. Data were analyzed using SPSS IBM 26 with descriptive analysis to provide a detailed description of each variable and bivariate analysis using the Spearman rho correlation test to determine the relationship between hemoglobin levels and the incidence of primary dysmenorrhea.

The research flow involved several stages, starting from population identification (grade XI female students at Public Senior High School 1 Semarapura), selection of research criteria, random sampling, filling informed consent, measurement of BMI, hemoglobin levels, and primary dysmenorrhea, to data analysis and reporting of research results. The ethics commission of Udayana University has reviewed and approved the ethical feasibility of this research with number 136/UN14.2.2.VII.14/LT/2024.

RESULTS

Based on the results of the study, the majority of samples had hemoglobin levels in the normal range, as many as 54 people (52.4%). Most of the samples experienced primary dysmenorrhea with moderate severity, as many as 46 people (44.7%). The results of the analysis with Spearman's Rho correlation test showed that there was a very strong relationship between hemoglobin levels and the incidence of primary dysmenorrhea, with a correlation value (r) of -0.752 and a significant value (Sig.) less than 0.05. This means that the higher the hemoglobin level, the lower the incidence of primary dysmenorrhea in female students.

Based on Table 1, the frequency distribution on the characteristics of the research sample provides information on the frequency and percentage in each category. When based on age, it can be seen that the entire sample is aged 16-18 years because it is the inclusion of this study. It can be seen that 17 years of age dominates the frequency of research samples as many as 66 students (64.1%), while 16 years of age is 32 students (31.1%) and 18 years of age is 5 students (4.9%). In the table, based on the age of menarche, it can be seen that all samples started menstruating from the age of 11-15 years. The majority of the study samples had a menarche age of 12 years as many as 48 students (46.9%), followed by a menarche age of 13 years as many as 38 students (36.9%), 14 years as many as 10 students (9.7%), 11 years as many as 4 students (3.9%), and 15 years as many as 3 students (2.9%).

Based on the table, it was found that the length of menstruation can be seen that all samples menstruate for 3-7 days. The majority of the study samples had a menstrual period of 5 days as many as 39 students (37.9%), followed by a menstrual period of 7 days as many as 35 students (34.0%), 6 days as many as 15 students (14.6%), 4 days as many as 12 students (11.7%), and 3 days as many as 2 students (1.9%). Cigarette and alcohol consumption can be seen that all samples do not consume cigarettes and alcohol because they are the inclusion of this study as many as 103 students (100.0%). Meanwhile, based on the table, the levels of physical activity seen throughout the sample have moderate and heavy physical activity levels because they are included in this study. Samples with moderate physical activity were 55 students (53.4%) and heavy physical activity was 48 students (46.6%). Stress levels can be seen that all samples have stress levels in the normal, mild stress, and moderate stress categories because they are included in this study. Samples with stress levels in the normal category were 61 students (59.2%), mild stress was 19 students (18.4%), and moderate stress was 23 students (22.3%). IMT can be seen that all samples have IMT in the normal and overweight categories because they are the inclusion of this study. Samples with BMI in the normal category were 70 students (68.0%) and overweight were 33 students (32.0%).

Based on table, hemoglobin levels can be seen that the majority have normal hemoglobin levels as many as 54 students (52.4%), while samples with mild anemia were 19 students (18.4%), moderate anemia were 27 students (26.2%), and severe anemia were 3 students (2.9%). Primary dysmenorrhea can be seen that the majority have moderate primary dysmenorrhea levels in as many as 46 students (44.7%), followed by mild dysmenorrhea in as many as 35 students (34.0%), severe dysmenorrhea in as many as 18 students (17.5%), and no dysmenorrhea as many as 4 students (3.9%).

Table 2 shows the results of the Spearman rho correlation test between the variable hemoglobin levels and the incidence of primary dysmenorrhea in high school adolescent girls that there is a significant relationship with the Sig value. (2-tailed) of 0.000 which is smaller than 0.05. The correlation coefficient value (r) obtained is -0.752 which means that the correlation is very strong because the value is between 0.700 - 0.890. While the negative value in the correlation coefficient indicates that there is an unidirectional relationship. A unidirectional relationship means the higher the hemoglobin level, the lower the incidence of primary dysmenorrhea in female students in Bali.

DISCUSSION

This study shows that age is one of the factors that play a role in the relationship between hemoglobin levels and the incidence of primary dysmenorrhea among female students in Bali. The characteristics of the research sample conducted on female students in Bali based on age showed that the entire sample was between 16 to 18 years old, according to the inclusion criteria of this study. Of the total 103 participating students, the majority were 17 years old (66 students or 64.1%), followed by 16 years old (32 students or 31.1%), and the rest were 18 years old (5 students or 4.9%).

Adolescence is characterized by significant physical and hormonal changes, including a more regular and stable menstrual cycle. Adolescent girls at this age tend to experience more regular menstruation compared to younger girls, who are often still adjusting to the menstrual cycle.[12] This condition can affect hemoglobin levels in the blood due to more regular menstrual bleeding and the volume of blood lost during menstruation.[13] Lower hemoglobin levels in adolescent girls can trigger more severe

Table 1. Frequency Distribution of Research Sample Characteristics Based on Age

Characteristics	Category	Frequency	Percentages (%)
Age (years)	16	32	31.1
	17	66	64.1
	18	5	4.9
	Total	103	100
Menarche age (years)	11	4	3.9
	12	48	46.6
	13	38	36.9
	14	10	9.7
	15	3	2.9
	Total	103	100
Duration of menstruation (days)	3	2	1.9
	4	12	11.7
	5	39	37.9
	6	15	14.6
	7	35	34
	Total	103	100
Cigarette and alcohol consumption	No	103	100
	Yes	0	0
	Total	103	100
Physical activity level (IPAQ)	Moderate	55	53.4
	Severe	48	46.6
	Total	103	100
Stress levels (DASS-21)	Normal	61	59.2
	Mild Stress	19	18.4
	Moderate Stress	23	22.4
	Total	103	100
BMI	Normal	70	68
	Overweight	33	32
	Total	103	100
Hemoglobin Levels	Normal	54	52.4
	Mild anaemia	19	18.4
	Moderate anaemia	27	26.2
	Severe anaemia	3	2.9
	Total	103	100
Primary dysmenorrhea	No dysmenorrhea	4	3.9
	Mild	35	34
	Moderate	46	44.7
	Severe	18	17.5
	Total	103	100

Table 2. Spearman Rho Correlation Test Results between the Relationship between Hemoglobin Levels and the Incidence of Primary Dysmenorrhea in Female Students in Bali

Relationship between sleep quality and dynamic balance	
Correlation Coefficient	-0.752
Sig. (2-tailed)	0.000
N	103

primary dysmenorrhea, caused by hypoxia in the uterine tissue that increases the production of prostaglandins, chemicals that cause strong and painful contractions of the uterine muscles.[14]

This study supports the finding that adolescents with low hemoglobin levels are more prone to primary dysmenorrhea.[15] In addition, adolescents who experience menarche at a younger age are at higher risk of primary dysmenorrhea due to longer exposure to prostaglandins during the ovulatory cycle.[16] Age influences the relationship between hemoglobin levels and the incidence of primary dysmenorrhea through hormonal and physiological mechanisms that affect the menstrual cycle and the volume of blood lost during menstruation. This study emphasizes the importance of health monitoring and good nutrition in adolescent girls to prevent anemia and reduce the risk of primary dysmenorrhea.

Physical activity has a significant

influence on the relationship between hemoglobin levels and the incidence of primary dysmenorrhea in female students in Bali. In addition, the physical activity level of the sample was divided into moderate (55 female students or 53.4%) and vigorous (48 female students or 46.6%) physical activity. Research shows that regular exercise can increase hemoglobin levels, which in turn can reduce the risk and severity of dysmenorrhea. Physical activity helps improve blood and oxygen circulation to body tissues, including the uterus, thus reducing menstrual pain.[17] However, too intense physical activity can also cause hemolysis, which is the destruction of red blood cells, which can reduce hemoglobin levels. Therefore, a balance in the intensity of physical activity is needed to obtain maximum benefits without negative effects on hemoglobin levels.

This study used the International Physical Activity Questionnaire (IPAQ) to measure respondents' physical activity levels. The analysis showed that respondents with moderate and vigorous physical activity levels had a lower incidence of dysmenorrhea compared to those with light or sedentary physical activity levels. This suggests that adequate physical activity can be one of the strategies to reduce the incidence of primary dysmenorrhea in adolescent girls. This study emphasizes the importance of balanced physical activity in maintaining healthy hemoglobin levels and reducing the incidence of primary dysmenorrhea. Education on the importance of physical activity and good nutrition for adolescent girls is essential to improve their quality of life during menstruation. Based on stress levels measured using the DASS-21 scale, the majority of the sample had normal stress levels (61 female students or 59.2%), followed by mild stress (19 female students or 18.4%) and moderate stress (23 female students or 22.4%).

This study found that stress has a significant influence on the incidence of primary dysmenorrhea in female students in Bali. Stress can affect hemoglobin levels and exacerbate dysmenorrhea symptoms. High stress conditions can lead to increased production of the hormone cortisol, which can negatively affect the body's hormonal regulation and affect the menstrual cycle.[18] Stress can also affect diet and sleep patterns, which in turn can affect hemoglobin levels in the blood.

Chronic stress is known to lower hemoglobin levels through complex mechanisms, including changes in diet that lead to deficiencies in essential nutrients such as iron, which is necessary for hemoglobin production. Stress can also lead to chronic sleep disturbances, which can further exacerbate anemia conditions. In the context of dysmenorrhea, stress can increase prostaglandin production, which contributes to more intense uterine contractions and more severe menstrual pain. The study also indicated that adolescents with higher stress levels tend to experience dysmenorrhea with greater intensity compared to those with lower stress levels. Therefore, stress management through relaxation techniques, exercise, and psychological counseling can be an important part of the reduction of dysmenorrhea symptoms in adolescent girls. Interventions that focus on stress reduction can help improve their quality of life and reduce the negative impact of primary dysmenorrhea.

The age distribution of menarche in the sample showed that most of them started menstruating at the age of 12 (48 female students or 46.6%), followed by the age of 13 (38 female students or 36.9%), and the rest started menstruating at the age of 11, 14, and 15 with 4 (3.9%), 10 (9.7%), and 3 female students (2.9%) respectively.

Menarche age plays an important role in the relationship between hemoglobin levels and the incidence of primary dysmenorrhea. Adolescent girls who experience early menarche, which is less than 11 years old, have a higher risk of experiencing primary dysmenorrhea because their bodies are exposed to prostaglandins for a longer period.[19] Prostaglandins stimulate contraction of the uterine muscles and cause pain during menstruation. Anemia caused by low hemoglobin levels can worsen menstrual pain because it causes hypoxia in the uterine tissue, which increases uterine muscle contractions and pain intensity. This study found that low hemoglobin levels were negatively correlated with the incidence of primary dysmenorrhea in schoolgirls in Bali, especially in those with early menarche.

The importance of monitoring menarche age and hemoglobin levels is clear in the prevention and management of primary dysmenorrhea. Health education to adolescent girls on the importance of maintaining hemoglobin levels through good nutrition and a balanced diet is necessary to reduce the risk of dysmenorrhea. Medical interventions, such as the use of iron supplements to prevent anemia, can be considered as a measure to reduce the incidence of primary dysmenorrhea. Regular monitoring of hemoglobin levels and evaluation of menarche age can help identify adolescents at high risk and provide timely interventions. Thus, a better understanding of the role of age in menarche and hemoglobin levels may help in reducing the burden of dysmenorrhea in adolescent girls.

The length of menstruation experienced by the research sample ranged from 3 to 7 days. The majority of the samples had a length of menstruation for 5 days (39 students or 37.9%), followed by menstruation for 7 days (35 students or 34.0%), 6 days (15 students or 14.6%), 4 days (12 students or 11.7%), and 3 days (2 students or 1.9%).

Duration of menstruation is a factor that influences the relationship between hemoglobin levels and the incidence of primary dysmenorrhea. In general, the duration of the menstrual cycle ranges from 22 to 35 days with a normal menstrual period lasting 3 to 7 days.[20] When a woman experiences a menstrual period longer than 7 days, this condition is known as menorrhagia or hypermenorrhea. Hypermenorrhea can lead to more frequent uterine contractions and increased prostaglandin production, which can cause additional pain and block the blood supply to the uterus, exacerbating dysmenorrhea symptoms.[21]

This study suggests that menstrual periods longer than 7 days may exacerbate primary dysmenorrhea symptoms due to stronger and more frequent uterine contractions, accompanied by an increase in prostaglandins that cause additional pain. In addition, decreased hemoglobin levels during a long menstrual period can

reduce blood supply to uterine tissues, causing ischemia and increasing pain. The amount of blood lost in one menstrual period is around 20-25 cc and is considered abnormal if the menstrual blood loss is more than 80 ml. The amount of 20-25 cc implies an iron loss of 12.5-15 mg/month or approximately equal to 0.4-0.5 mg a day. Menstruation is normally accompanied by a decrease in Hb levels of 0.25-0.5 gr/dl. The longer menstruation lasts, the more it is excreted from the body. Menstruation causes women to lose iron up to 2 times the amount of loss from men.[22]

Thus, maintaining hemoglobin levels within the normal range is very important to reduce the risk and severity of primary dysmenorrhea, especially for adolescent girls who experience menstruation longer than 7 days. Health education on the importance of good nutrition and interventions such as iron supplementation can help prevent anemic conditions that can aggravate dysmenorrhea.

In this study, alcohol and cigarette consumption were controlled as part of the inclusion and exclusion criteria. Girls who were included in the study were those who did not consume alcohol and did not smoke. This was done to avoid the negative influence of alcohol and smoking on hemoglobin levels and the incidence of primary dysmenorrhea.

In general, alcohol consumption and smoking can affect women's reproductive health, including the incidence of dysmenorrhea.[23] Alcohol is known to increase estrogen levels in the body, which then triggers the production of prostaglandins.[14] Prostaglandins are chemicals that can cause stronger uterine muscle contractions and increase pain sensitivity, thus exacerbating dysmenorrhea symptoms.

Cigarettes, on the other hand, contain various toxic substances such as nicotine and carbon monoxide. Nicotine can interfere with the metabolism of estrogen, a hormone that is important in regulating the menstrual cycle. This disruption can cause menstrual cycle irregularities and increase the intensity of pain during menstruation. Carbon monoxide in cigarettes can bind to hemoglobin more strongly than oxygen, thus reducing the efficiency of oxygen absorption by the body and increasing carboxyhemoglobin levels.[23] In response, the body tries to raise hemoglobin levels to compensate for the lack of oxygen, which can ultimately affect the overall health condition. Thus, controlling for alcohol and cigarette consumption in this study was important to ensure that the relationship between hemoglobin levels and the incidence of primary dysmenorrhea could be observed without the influence of these external factors. The results suggest that keeping hemoglobin levels within the normal range can help reduce the risk and severity of primary dysmenorrhea, and this can be achieved by avoiding smoking and alcohol consumption.

This study found a significant association between hemoglobin levels and the incidence of primary dysmenorrhea in female students in Bali. The Spearman rho correlation test showed a correlation coefficient (r) of -0.752 with a significance value (p-value) of 0.000, which indicates a very strong and statistically significant correlation. This negative correlation coefficient indicates that the higher the hemoglobin level, the lower the incidence of primary dysmenorrhea in female students.

Previous research also showed a significant relationship between hemoglobin levels and the incidence of dysmenorrhea. Research at SMA Negeri 1 Way Bungur found that students with low hemoglobin levels had a higher risk of experiencing dysmenorrhea, with a significant p-value (0.011 <0.05). This study states that female students whose hemoglobin levels are anemic experience dysmenorrhea due to ischemia, which is a state of temporary and reversible oxygen deficiency in tissues. Decreased oxygen levels occur due to reduced hemoglobin levels and decreased blood flow, resulting in a decrease in the pain threshold of the hemoglobin nerve and decreased blood flow, resulting in a decrease in the pain threshold of the afferent nerve of the pelvic nerve. In severe dysmenorrhea conditions, excessive amounts of prostaglandins are released into the bloodstream, so in addition to dysmenorrhea, other effects such as diarrhea, nausea, vomiting and flushing are also found.[25]

Research at SMA Negeri 4 Palangka Raya also found a similar relationship, where the results of the chi-square test showed a p-value of 0.00 (≤0.05), indicating a significant relationship between hemoglobin levels and the incidence of dysmenorrhea in adolescent girls. The amount of blood lost in one menstrual period is around 20-25 cc. When menstruation occurs normally accompanied by a decrease in Hb levels by 0.25-0.5 gr/dl. This shows the condition of menstruation with a long duration and large volume will cause a lot of blood loss to reduce hemoglobin levels also in the blood which leads to conditions of oxygen deficiency in the tissue.[22]

In addition, research by Adhana and Hastuti in 2018 on 119 first-year midwifery students in Magelang concluded that the relationship between anemia and the incidence of dysmenorrhea was in the moderate category at 0.527 with a positive relationship direction. Symptoms of anemia shown by feeling tired cause excessive lactate production. This fatigue will reduce a person's ability to cope with pain so it can increase pain perception.[11]

Decreased hemoglobin levels in the blood are often associated with anemia, which can cause hypoxia or lack of oxygen in body tissues including the uterus.[26] Hypoxia in uterine tissues can trigger strong and irregular muscle contractions, which is one of the main causes of menstrual pain or dysmenorrhea. Decreased hemoglobin levels can also increase the production of prostaglandins, chemicals that cause stronger uterine muscle contractions and increase pain sensitivity.[13]

This study also showed that low hemoglobin levels can cause stimulation of the myometrium and decreased blood circulation, which increases uterine contractions and dysrhythmias.[27] Decreased blood and oxygen supply (hypoxia) to the uterus leads to the accumulation of anaerobic metabolites which then stimulate pain receptors. Prostaglandin F2a, which is also involved, lowers the threshold of pain perception by sensitizing nerve receptors.[28] Peak menstrual pain is often associated with the highest prostaglandin levels, which lowers the pain threshold in the afferent nerves of the nervous pelvis due to low oxygen

supply from decreased hemoglobin levels. Hypoxia that occurs due to low hemoglobin levels leads to stronger uterine contractions and more intense pain during menstruation. In addition, the increased production of prostaglandins in low hemoglobin conditions aggravates menstrual pain, as prostaglandins cause strong and irregular contractions of the uterine muscles.[26] Therefore, maintaining good hemoglobin levels is essential to reduce the severity of menstrual pain.

Other studies supporting these results show that individuals with below-normal hemoglobin levels (anemia) experience various complications such as fatigue, stress on organs, decreased immunity, and decreased learning concentration, all of which can worsen the condition of dysmenorrhea. Haemoglobin, as an essential protein in erythrocytes that binds oxygen, is essential in providing oxygen to the entire body.[29] Decreased hemoglobin levels can lead to ischemia and hypoxia, triggering more intense pain during menstruation.

Thus, this study confirms the importance of maintaining hemoglobin levels within the normal range to reduce the risk and severity of primary dysmenorrhea in adolescent girls. Education on adequate nutritional intake, especially iron, as well as the implementation of a healthy lifestyle with regular exercise, is highly recommended. The results of this study are expected to be a guide for health workers in providing appropriate education and interventions related to primary dysmenorrhea in adolescent girls.

However, this study also has some limitations that need to be considered. This study was not able to control for all factors that affect hemoglobin levels, such as iron intake through diet and a history of taking blood supplement tablets. In addition, this study used a cross-sectional design, so it can only show a correlation relationship without being able to confirm a cause-and-effect relationship. Nevertheless, the results of this study are expected to serve as a guide in efforts to prevent and treat primary dysmenorrhea in adolescent girls as well as a basis for further research with more comprehensive methods.

CONCLUSION

The conclusion of this study showed a significant relationship between hemoglobin levels and the incidence of primary dysmenorrhea in female students in Bali. The results of data analysis using the Spearman rho correlation test showed a correlation coefficient of -0.752 with a significance value of 0.000, which indicates a very strong and statistically significant relationship. The relationship found was negative, which means that the higher the hemoglobin level, the lower the incidence of primary dysmenorrhea. Conversely, the lower the hemoglobin level, the higher the incidence of primary dysmenorrhea.

ETHICAL CLEARANCE

The Research Ethics Commission of the Faculty of Medicine, Udayana University, stated that this research was ethically feasible with number 136/UN14.2.2.VII.14/LT/2024.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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AUTHOR CONTRIBUTIONS

GRJ developed the research design, collected and processed data, and wrote the manuscript. NKAJA and NW directed data collection and revised the manuscript.

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