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Original Research Article

Relationship of Physical Activity with the Incidence of Anemia in Junior High School Adolescent Girls in Kupang City

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Abstract: ***Introduction*:** Adolescent girls are at risk of anemia. Anemia is a condition where hemoglobin levels in the blood are below normal. Based on data from the Kupang City Health Office as of March 2023, 38% (371) of 965 junior high school girls screened had anemia. One of the factors that influence the occurrence of anemia is physical activity. ***Aims*:** Analyzing the relationship between physical activity and the incidence of anemia among junior high school girls in Kupang City. ***Methods*:** The analytic observational study with cross-sectional design. The research instrument used was the IPAQ-Short Form questionnaire to measure physical activity and blood sampling using EasyTouch GcHb to measure hemoglobin levels. The sampling technique used was probability sampling technique, namely proportionate stratified random sampling and got 100 respondents. Data analysis used was univariate and bivariate analysis using the Chi-Square test. ***Results*:** Based on physical activity, out of 100 respondents, 20% were in the heavy category, 44% in the moderate category, and 36% in the light category. Based on the incidence of anemia, out of 100 respondents, 33% were anemic and 67% were not anemic. The results of bivariate analysis of the relationship between physical activity and the incidence of anemia showed a p value = 0.684 (p>0.05). ***Conclusion*:** There was no significant relationship between physical activity and the incidence of anemia among junior high school girls in Kupang City.

Keywords: Physical activity, Anemia, Adolescent Girls, Kupang City.

INTRODUCTION

Adolescence is a transitional period from childhood to adulthood. According to WHO, adolescents are the population in the age range of 10-19 years. This stage is a unique and essential stage of human development because adolescents experience rapid physical, cognitive, and psychosocial growth, so it needs to be balanced with adequate nutrition (WHO, 2023). Adolescent girls are a group at risk of anemia because every month, they experience menstruation, so their nutritional needs increase (Sari *et al*., 2018).

Anemia is one of the most common health problems in the world, especially in developing countries such as Indonesia (Lutfiasari & Yanuaringsih, 2020). According to the World Health Organization, WHO (2013), an estimated 30% of the world's population suffers from anemia, especially in developing countries (Kurniasih *et al*., 2021). Fifty percent of the incidence of anemia is due to iron deficiency (Asyari *et al*., 2022). Anemia is when blood hemoglobin (Hb) levels are below average at a certain age and gender. According to WHO, anemia occurs when the Hb in a woman's blood is <12 grams/dL and in a man's blood is <14 grams/dL (Wio *et al*., 2022). Anemia can cause adolescents to experience fatigue, reduced concentration in learning, low academic ability, inhibited physical growth, and decreased work efficiency. It can also cause a decrease in the body's immune system, making an anemic adolescent more susceptible to infectious diseases (Annisa *et al*., 2018; Wio *et al*., 2022).

The 2018 Riskesdas data shows that the prevalence of anemia in adolescents is 32%, meaning that 3-4 out of 10 adolescents suffer from anemia (Indonesian Ministry of Health, 2018b). This is affected by suboptimal nutritional intake and lack of physical activity. Important factors that influence the occurrence of iron deficiency anemia in adolescents are iron deficiency, low socioeconomic status, obesity, physical

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activity intensity, iron diet, and menstrual history that causes blood loss >80mL/month (Kurniasih *et al*., 2021).

The lack of hemoglobin in the blood is caused by physical activity. Lack of physical activity causes the body's cell metabolism to decrease, causing iron metabolism in the body to fall. (Yulita *et al*., 2022). Iron is a component of hemoglobin. If iron production decreases, it will affect hemoglobin formation, reducing oxygen transport throughout the body (Yulita *et al*., 2022). The WHO definition of physical activity is any body movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement during leisure time, transportation to and from a place, or as part of one's job (WHO, 2023).

The research results by Yulita *et al*., (2022) show a significant relationship between physical activity and the incidence of anemia in adolescent girls at Pondok Pesantren Assalam Naga Beralih. This was also stated by Irmawati *et al*., (2022) namely that there is a relationship between physical activity and the incidence of anemia in adolescent girls at SMKN 1 Batumandi in 2020. However, research conducted by Kurniasih *et al*., (2021) shows no relationship between physical activity patterns and hemoglobin levels in adolescent girls at SMAN 1 Luragung District Luragung Kuningan Regency. Chibriyah and Anita (2018), also demonstrated the same research results, who found no relationship between physical activity and hemoglobin levels of female santri of Al-Munawwir Krapyak Islamic Boarding School.

Based on preliminary data obtained by researchers from the Kupang City Health Office regarding the results of anemia screening of adolescent girls as of March 2023, of the 11 health centers in Kupang City, five health centers have sent data on the incidence of anemia in teenage girls to the Kupang City Health Office. Of these five health centers, 965 7th-grade junior high school girls were screened, and 38% had anemia, which is 371 people.

Previous research conducted by Yulita *et al*., (2022), Irmawati *et al*., (2022), Kurniasih *et al*., (2021), and Chibriyah and Anita (2018) on physical activity and the incidence of anemia was conducted on high school students. According to the 2013 Riskesdas data, 26.4% of children aged 5-14 years experienced anemia, and 18.4% of anemia occurred at 15-24 years old (Indonesian Ministry of Health, 2013). This shows that anemia is mainly experienced by junior high school students aged 12-15 years.

Based on the above background, researchers are interested in researching the relationship between physical activity and the incidence of anemia in junior high school girls in Kupang City.

METHODS

This is an analytic observational study with a cross-sectional design, which studies the relationship between the independent variable and the dependent variable without intervening in the sample, and the study was conducted once simultaneously. The study was conducted from August 19 to October 19, 2023, in thirteen junior high schools from six districts in Kupang City.

Data was collected by filling out the International Physical Activity Questionnaire (IPAQ) Short Form questionnaire to measure physical activity and blood sampling using EasyTouch GcHb to measure hemoglobin levels. Sampling in this study used a probability sampling technique, namely a proportionate stratified random sample, and obtained 100 respondents who were willing and signed informed consent before the study was conducted. The independent variable in this study is physical activity, and the dependent variable is the incidence of anemia. Data analysis was used as univariate and bivariate analysis using the Chi-Square test. Physical activity was divided into three categories, namely heavy physical activity, moderate physical activity, and light physical activity. The incidence of anemia consisted of anemia (Hb level <12gr/dl) and not anemia (Hb level ≥12gr/dl).

This study has obtained ethhicaal approval from the Health Research Ethics Commission of the Faculty of Medicine and Veterinary Medicine, Universitas Nusa Cendana, with letter number 56/UN15.16/KEPK/2023.

RESULTS

Characteristics of Respondents

The study took 100 junior high school adolescent girls from 13 schools from six sub-districts in Kupang City as respondents. The characteristics of respondents in this study include school origin and age. The characteristics of the respondents can be seen in Table 1 below.

Table 1: Characteristics of Respondents

Characteristics	***n***	%
Age		
12 year	17	17%
13 year	67	67%
14 year	16	16%
Total	**100**	**100**%

Junior High Schools		
SMPK Adisucipto	17	17%
SMPN 11 Kupang	10	10%
SMPN 16 Kupang	2	2%
SMPK St. Yoseph	26	26%
SMPN 9 Kupang	3	3%
SMPN 20 Kupang	7	7%
SMPN 1 Kupang	3	3%
SMP Plus Attin	5	5%
SMP Kristen 1	5	5%
SMPN 6 Kupang	8	8%
SMPK Giovani	6	6%
SMP Kupang Montessori School	4	4%
SMP Surya Mandala	4	4%
Total	**100**	**100%**

Univariate Analysis

The results showed that most junior high school adolescent girls tended to have moderate physical activity levels, with 44% of the total sample falling into this category. In addition, as many as 36% of adolescent girls have a level of physical activity that is classified as light, and the remaining 20% have a level of heavy physical activity. Based on the incidence of anemia, 33% of respondents had anemia, and 67% did not have anemia.

Table 2: Univariate Analysis

Characteristics	***n***	%
Physical Activity		
Heavy	20	20%
Moderate	44	44%
Light	36	36%
Incidence of Anemia		
Anemia	33	33%
Not Anemia	67	67%

Bivariate Analysis

Table 3: Relationship between Physical Activity and Incidence of Anemia

Physical Activity	**Incidence of Anemia**		**Total**	***p-Value***
	Anemia	**Not Anemia**		
Heavy	5	15	20	0,684*
Moderate	15	29	44	
Light	13	23	36	

*Chi-Square test

The study's results in Table 4.4 show that out of 100 respondents, five respondents (5%) with heavy physical activity experienced anemia, and 15 respondents (15%) with heavy physical activity did not experience anemia. Fifteen respondents (15%) with moderate physical activity experienced anemia, and 29 respondents (29%) with moderate physical activity did not experience anemia. At the level of light physical activity, 13 respondents (13%) experienced anemia, and 23 respondents (23%) did not experience anemia. Based on the results of the Pearson Chi-Square test, the value of 0.684> 0.05, it can be concluded that there is no relationship between physical activity and the incidence of anemia in junior high school girls in Kupang City.

DISCUSSION

Physical activity is any movement of the body due to skeletal muscle activity and requires energy. Physical activity data from this study found that 20 respondents had heavy physical activity, 44 respondents had moderate physical activity, and 36 respondents had light physical activity.

Heavy physical activity is a physical activity carried out with heavy intensity for 3 days or more or physical activity that produces 1500 MET minutes/week and can also be a combination of all physical activity intensities for 7 days or more with a minimum of 3000 MET minutes/week. Physical activity is carried out by junior high school adolescent girls who are included in the heavy category, for example, fast cycling and aerobic

exercise. Moderate physical activity levels are carried out with heavy intensity physical activity of at least 20 minutes for 3 days / more or at least 5 days or by walking for at least 30 minutes every day or a combination of heavy, moderate, and walking physical activity intensity for at least 5 days with a total of at least 600 MET minutes/week. Activities included in moderate physical activity are leisurely cycling, light lifting, and doing housework.

Light physical activity is the lowest level of physical activity and is not included in the other two categories of physical activity (Dharmansyah & Budiana, 2021). Examples of activities included in light physical activity are all walking activities either at school, at home, and walking to travel from one place to another.

Most of the respondents in this study had moderate levels of physical activity. This is in line with research conducted by Hasan *et al*., (2019) regarding the level of physical activity of junior high school students, it was found that the average physical activity carried out was included in the moderate physical activity category with 1202.2 METs (Hasan *et al*., 2019). One of the factors that caused the level of moderate physical activity to be found was the free time spent playing online games (Hasan *et al*., 2019). According to Damayanti (2020), adolescent girls usually carry out physical activities in the house, such as doing housework (Damayanti, 2020).

Research data was obtained from 100 respondents studied; 33 respondents were anemic, and 67 other respondents were not anemic. A person is anemia if the hemoglobin level is <12gr/dl and not anemia if the hemoglobin level is ≥12gr/dl.

Anemia can cause various symptoms, such as lethargy, fatigue, weakness, tiredness, inattentiveness or what is also known as the five Ls (5Ls). In addition, the 5L symptoms are also accompanied by headaches and dizziness, eye fogginess, drowsiness, fatigue and difficulty concentrating. Clinically, a person with anemia is characterized by pallor of the face, eyelids, lips, skin, nails and palms. Shortness of breath can also occur as a result of low blood counts, reducing oxygen levels in the body. The situation that can occur in adolescents is a decrease in fitness and concentration which causes a decrease in learning achievements and the ability to participate in activities both inside and outside of school. Anemia will also reduce the body's resistance, making it more susceptible to infections (Anitasari, 2021; Indonesian Ministry of Health, 2018a; Utami *et al*., 2021).

Hemoglobin levels in the blood are influenced by physical activity. Someone who does physical activity regularly will have an impact on increasing hemoglobin levels in the blood. The need for cells or tissues in oxygen will increase so that it has an impact on increasing Hb levels in the blood. Physical activity with heavy and excessive intensity will affect hemoglobin levels because hemolysis occurs in the blood so that the oxygen transportation process in the blood is disrupted and causes low hemoglobin levels (Kurniasih *et al*., 2021).

Based on statistical tests using the Chi-Square test, the p-value = 0.684 (>0.05), meaning that there is no relationship between physical activity and the incidence of anemia in junior high school girls in Kupang City. This study's results align with research by Chibriyah and Anita (2018) and Kurniasih *et al*., (2021), which showed no significant relationship between physical activity and hemoglobin levels in adolescent girls. Physical activity is one factor affecting hemoglobin levels; the physical activity carried out regularly, namely at least 150 minutes/week or at least 30 minutes/day for 3-5 days, will increase hemoglobin levels in the blood (Chibriyah & Anita K, 2018; Heriyanto *et al*., 2022; Indonesian Ministry of Health, n.d.).

Physical activity provides many benefits to the body, one of which is that it can stimulate the process of erythropoiesis. Stimulation of this process occurs because, during physical activity, the body will need more oxygen, which needs to be fulfilled by increasing the release of oxygen from hemoglobin to body tissues (Mairbäurl, 2013).

During physical activity, the body requires more oxygen (Mairbäurl, 2013). The increased oxygen demand is met by increasing the release of oxygen from hemoglobin (Mairbäurl, 2013). This oxygen release is achieved by a decrease in the affinity of oxygen and hemoglobin (HbO2). If the affinity of HbO2 decreases, hemoglobin will release more oxygen thereby increasing oxygen delivery to the muscles (Heriyanto *et al*., 2022; Mairbäurl, 2013).

In addition, during physical activity, tissues or cells will require more oxygen which then at the cellular level will trigger the synthesis of the HIF-1 (Hypoxia Inducible Factor - 1) factor which plays a role in tissue adaptation to low oxygen conditions. Hypoxia Inducible Factor - 1 (HIF-1) found in tissues in the kidney and liver will trigger the production of erythropoietin (EPO) (A. V. Hoffbrand & Moss, 2016; A. V Hoffbrand *et al*., 2005; Mairbäurl, 2013). Furthermore, erythropoietin will stimulate erythropoiesis by binding to the Erythropoietin Receptor (EPOR) which is dominated in the bone marrow (A. V. Hoffbrand & Moss, 2016; A. V Hoffbrand *et al*., 2005). After erythropoietin binds to the erythropoietin receptor, there is an increase in the process of erythropoiesis from pluripotent cells to proerythroblasts in the erythroid pathway with the help of Colony Stimulating Factor - Erythroid or CSF-E, then to 16 reticulocytes, while erythrocytes containing hemoglobin are the final product of the process (Faetheda, 2017; Mairbäurl, 2013).

The erythropoiesis process increases hemoglobin levels that deliver oxygen to all body tissues. Increased hemoglobin levels due to stimulation by physical activity in a state of increased oxygen demand is a long-term response to physical activity performed (Faetheda, 2017).

The results of this study are not in line with the results of the research reported by Yulita *et al*., (2022), which showed a relationship between physical activity and the incidence of anemia in adolescent girls at MAN 1 Banjarmasin in 2020 (Yulita *et al*., 2022). Another study by Irmawati *et al*., (2022) showed a relationship between physical activity and the incidence of anemia in adolescent girls at SMKN 1 Batumandi in 2020 (Irmawati *et al*., 2021). Heavy physical activity is one of the factors that affect hemoglobin levels. This happens because heavy physical activity and vigorous exercise will cause hematuria, hemolysis, and gastrointestinal bleeding, affecting iron levels in a person's body (Chibriyah & Anita K, 2018; Heriyanto *et al*., 2022; Kurniasih *et al*., 2021). In addition, strenuous physical activity causes muscular muscle contractions; then compression occurs, resulting in hemolysis. Hemolysis causes iron loss due to the destruction of the red blood cell membrane, affecting hemoglobin levels in the blood (Kurniasih *et al*., 2021).

Hemoglobin levels in the blood are influenced by other factors that, if not controlled, can become confounding factors. One of the factors that can affect hemoglobin levels is diet. According to the research results reported by Chibriyah and Anita (2018), someone with a good diet tends to have higher hemoglobin levels (Irmawati *et al*., 2021). Diet is a way for a person to maintain nutritional status and health, prevent and assist in the healing process of disease by paying attention to how to regulate the amount and type of food (Muhayati & Ratnawati, 2019).

Adolescent girls with a good diet have adequate nutritional intake, and the nutrients the body needs, such as iron intake, are met. Iron intake comes from dietary supplements such as blood supplement tablets and mainly from the food consumed, such as animal protein, which has more iron (between 6.0 mg and 14.0 mg) (Faetheda, 2017; Indonesian Ministry of Health, 2018a; Muhayati & Ratnawati, 2019; Priyanto, 2018). Iron is an essential element in the formation of hemoglobin in red blood cells and myoglobin in muscle cells, so if there is an iron deficiency, the process of hemoglobin formation will be inhibited (Faetheda, 2017).

According to the research results reported by Muhayati and Ratnawati (2019), there is a significant relationship between diet and the incidence of anemia in adolescent girls at SMA Negeri 97 Jakarta. Of the 188 respondents, 99 had an irregular diet, and 63 experienced anemia. Teenage girls who have an intermittent diet tend to have restrictions on certain foods, do not eat breakfast, often eat unhealthy snacks, and go on a strict diet because they want to have a slim body (Muhayati & Ratnawati, 2019). A strict diet can cause the body to lack nutrients that the body needs, such as iron, which is an essential element in the formation of hemoglobin (Muhayati & Ratnawati, 2019). Based on the discussion above, diet can be a confounding factor in this study, with a good diet tending to increase hemoglobin levels so as not to experience anemia.

The cause of the results of this study is not significant and different from the results of other studies. It is not only caused by factors that affect hemoglobin levels but can also come from the instruments used in data collection. Physical activity data collection in this study used IPAQ - Short Form, where physical activity data was collected based on recalling research subjects for the last seven days, so it became a limitation for researchers to determine whether physical activity was carried out for a long time and repeatedly or only in the previous seven days. In this IPAQ-SF questionnaire, it is also challenging to determine the exact duration of hours and minutes in an activity performed. In addition, data collection using the recalling method has the risk of recall bias, which can affect the study results (Faetheda, 2017). This is affected by several factors, such as memory factors of respondents who forget or find it challenging to recall activities carried out in the last seven days.

Based on the discussion above, the researcher assumes that physical activity carried out by junior high school adolescent girls in Kupang City is still in the moderate category so that it does not affect the occurrence of anemia in most respondents, and nutritional intake and a good diet can be a factor that causes most respondents not to experience anemia. Therefore, from the results of this study, it is concluded that H1 is rejected and H0 is accepted, meaning that there is no significant relationship between physical activity and the incidence of anemia in junior high school girls in Kupang City.

CONCLUSION

Based on the discussion, it can concluded that there was no significant relationship between physical activity and the incidence of anemia in junior high school girls in Kupang City, with a p-value = 0.684. The prevalence of physical activity among junior high school girls in Kupang City was 20 respondents (20%) for the category of heavy physical activity, 44 respondents (44%) for the category of light physical activity, and 36 respondents (36%) for the category of light physical activity. The prevalence of anemia among junior high school girls in Kupang City was 33 respondents (33%) and 67 respondents (67%) who were not anemic.

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