



Effect of Morning Walking on the Hemoglobin Levels of Adolescents with Anemia

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Abstract

Anemia is a global health problem that affects the physical fitness, cognitive function, and academic performance of adolescents. In Indonesia, the prevalence of anemia in adolescents is still relatively high. One of the factors contributing to this condition is the lack of physical activity that could potentially support the increase of hemoglobin levels. This study aims to observe if there is a significant effect of morning walking activity on the hemoglobin levels of adolescents with anemia at Al-Amanah Cileunyi Junior High School. This study used quantitative methods with a quasi-experimental approach and a one-group pre-test and post-test design. A sample of 30 people was selected using a purposive sampling technique from a population of 57 students in class VIII based on inclusion and exclusion criteria. Interventions in the form of morning walking activities were held twice a week for three weeks. Measurement of hemoglobin levels was collected before and after the intervention using the EasyTouch GCHb digital device. Data analysis used the Wilcoxon signed-rank test and the Mann-Whitney U test. There was a significant increase in hemoglobin levels after the intervention ($P < 0.05$), and there was a significant difference between male and female. Morning walking has a positive effect on increasing the hemoglobin level of adolescents with anemia. It is recommended that this activity be implemented as a promotive and preventive strategy in the school environment.

How to Cite

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INTRODUCTION

Anemia is a global health issue that affects a quarter of the world's population and contributes to increased morbidity, mortality, decreased work productivity, neurological development (Chaparro & Suchdev, 2019), lower physical fitness, and school performance (Pulingmuding et al., 2024). According to the World Health Organization (WHO), the prevalence of anemia in adolescents in the world ranges from 40-80% of 1.2 billion people, with anemia rates in adolescent girls reaching 57.3% in developing countries (Sihombing et al., 2023). The results of the Survey Kesehatan Indonesia (SKI) (2023) showed that the prevalence of anemia in Indonesia reached 16.2%, with a rate of 16.3% in the 5-14 year age group and 15.5% in the 15-24 year age group.

Anemia is a condition in which the number of red blood cells (erythrocytes) or hemoglobin (Hb) levels are insufficient to meet the body's physiological needs (Vaira et al., 2022). Hemoglobin plays a role in transporting oxygen; when a person has an insufficient number of red blood cells or the hemoglobin level is too low, the blood's capacity to carry oxygen to the body's tissues will decrease (WHO, 2023). Therefore, people with anemia often show signs such as lethargy, fatigue, weakness, and exhaustion, commonly known as the 5Ls (lesu, lelah, letih, lemah, lunglai) (Sitawati & Amanda, 2023).

Anemia in adolescents can cause a decrease in endurance, difficulty in concentrating, and decreased fitness and productivity, which have an impact on their learning achievement (Yuliandi et al., 2023). This happens because anemia can cause hypoxia, which is a lack of oxygen in the body due to a disturbance in the transport of oxygen due to a lack of hemoglobin needed to transport oxygen to body tissues (Rhodes et al., 2022). In addition, adolescence is an important stage in development, so anemia in adolescents can also affect growth, slow menarche, and cause menstrual cycle irregularities in adolescents who have started menstruating (Bindra, 2017).

Kementerian Kesehatan Indonesia has made various preventive efforts to reduce the incidence of adolescent anemia, especially among adolescent girls, such as providing blood supplement tablets (Tablet Tambah Darah/TTD), education, and promotion of balanced nutrition to increase adolescent girls understanding of the importance of iron (Sitawati & Amanda, 2023). However, based on the findings of research conducted by Nasir (2024), it shows that 33.1% of adolescent girls from the total respondents were

reluctant to take TTD drugs due to several things, such as bad taste, unpleasant smell, and uncomfortable effects such as nausea and vomiting. This is reinforced by the findings of Baderan (2024), which show that there are several obstacles in efforts to overcome and prevent anemia through TTD supplementation in adolescent girls at MAN 1 Gorontalo, such as not all adolescent girls getting TTD due to budget constraints and low compliance in consuming TTD due to side effects such as nausea and dizziness.

In addition, various factors can affect a person's hemoglobin level, such as age, gender, smoking habit (Akaishi et al., 2024), low income level, number of family members, nutrition, illness (Pulingmuding et al., 2024), and poor sleep quality (Susanto et al., 2024). Currently, adolescents are often too focused on other activities and tend to ignore a healthy lifestyle (Lubis et al., 2023). Research conducted by Oktavianis (2023) showed that lifestyle factors such as irregular rest patterns, excessive use of gadgets, and low physical activity can be a trigger for anemia.

Physical activity such as exercise plays an important role in determining hemoglobin levels (Sepriadi et al., 2020). Insufficient or excessive physical activity can decrease the body's metabolism, which will affect iron metabolism. Iron is the main component of hemoglobin formation, and a decrease in iron production will inhibit hemoglobin formation, which results in reduced oxygen transport throughout the body and risks causing anemia (Hamidi & Dhilon, 2022). Individuals who regularly exercise will experience an increase in hemoglobin because cells and body tissues require more oxygen (O₂) during activity (Bahrah et al., 2020).

The type of exercise that can help increase hemoglobin levels is aerobic exercise, such as brisk walking, jogging, swimming, dancing, and cycling, which are done with different intensities (Sepriadi et al., 2020). The results of previous research conducted by Fitria (2019) showed that gymnastics performed 3 times a week with a duration of 15-20 minutes for 4 weeks can increase the hemoglobin levels of adolescent girls. Research conducted by Sepriadi (2020) showed that jogging 3 times a week for 6 weeks can improve physical fitness and hemoglobin levels if done regularly and by paying attention to the intensity, frequency, and duration of exercise.

However, each individual has their own exercise dose (Giriwijoyo et al., 2020), especially when someone suffering from anemia sometimes shows symptoms such as lethargy, palpitations, headaches, and shortness of breath, especially

during exercise (Hoffbrand et al., 2016). Therefore, regular walking can be an exercise of choice because walking is a physical activity with self-determined intensity (Majed et al., 2024). Bhusal (2017) claims that walking is a simple physical activity because it does not require special skills and can be done by almost all age groups. Salian (2023) also added that walking is a simple physical activity with low intensity, making it suitable for beginners to start exercising. Recently, aerobic exercise has become increasingly popular among teenagers, as seen from the number of teenagers who have started cycling, walking, jogging, and participating in marathon running activities on weekends (Agus & Sari, 2020)

The novelty of this study lies in the choice of mild-intensity aerobic exercise, that is, morning walking performed at a frequency of 2 times a week for one month. In contrast to previous studies that focused more on moderate-intensity aerobic exercise such as jogging and gymnastics with a frequency of 3-4 times a week for one month, this study aims to explore whether exercise with lighter intensity and lower frequency is still able to provide physiological benefits, especially on changes in hemoglobin levels of adolescents with anemia.

METHODS

This study used quantitative methods with a quasi-experimental approach. The one-group pre-test and post-test design was applied to determine changes that occurred before and after the intervention was carried out on the same group without a control group. This research was conducted at Al-Amanah Cileunyi Junior High School, which is located at Jalan Raya Cinunuk No. 186, Cinunuk, Cileunyi District, Bandung Regency, West Java 40623. The independent variable in this study is morning walking activity as a form of intervention provided in an effort to increase hemoglobin levels, and the dependent variable in this study is hemoglobin levels, which is the value of hemoglobin concentration in the blood measured before and after the intervention as the main indicator to assess the effectiveness of the intervention provided. A sample of 30 people was selected using a purposive sampling technique from a population of 57 class VIII students based on inclusion and exclusion criteria.

The inclusion criteria in this study were students aged 13-15 years who had hemoglobin (Hb) levels of 9-13 g/dL for boys and 8-12 g/dL for girls, did not have chronic diseases or health problems that could affect hemoglobin

levels, were not taking iron supplements regularly, and were willing to sign an informed consent sheet and follow all research procedures. While the exclusion criteria in this study are students with a history of thalassemia, hyperglycemia, leukemia, and those with physical limitations.

The instrument used was an observation sheet that serves to record data related to the respondent's identity and physical activity of morning walking, including time, duration, number of steps, and distance travelled, as well as to monitor changes in hemoglobin levels of respondents before and after the intervention. Hemoglobin level measurement was done using the Easy-Touch GCHb digital hemoglobin meter by taking a capillary blood sample from the fingertip.

The research procedure begins with giving informed consent to the respondent, then data collection is carried out by measuring hemoglobin levels before (pre-test) and after (post-test) the intervention. The sample was given a morning walking intervention with a frequency of 2 times a week for 3 weeks, or 6 meetings. The intervention was conducted in the morning (between 06.00-09.00) and under the same environmental conditions (temperature \pm 22°C). The duration of morning walking was at least 30 minutes per meeting with moderate intensity or walking speed around 4-5 km/hour, and the distance travelled was as far as 3-5 km or around 3.000-7.000 steps, calculated using the Pacer application, which can be downloaded on the App Store or Play Store.

Data collection techniques were carried out directly at the school after obtaining permission from the school and obtaining research ethics approval from the Health Research Ethics Commission of the Faculty of Health Sciences and Technology, University of Jenderal Ahmad Yani Cimahi with number 029/KEPK/FITKes-Unjani/II/2025. The research stages began with measuring hemoglobin levels before (pre-test) and then continued by observing respondents for 3 weeks and again measuring hemoglobin levels after (post-test) given the intervention.

Data analysis was conducted using IBM SPSS Statistics® version 27.0 statistical software. Before performing statistical tests, a normality test was performed using the Shapiro-Wilk or Kolmogorov-Smirnov test to determine whether the data were normally distributed or not. If the data is normally distributed, then proceed with the paired t-test, but if the data is not normally distributed, then proceed with the Wilcoxon signed-rank test to see if there is a significant difference between hemoglobin levels before and after treatment with an $\alpha = 0.05$ value. The

Mann-Whitney U test was conducted to determine whether there was a statistically significant difference between two independent groups on a variable with non-normally distributed data with an $\alpha = 0.05$ value.

RESULTS AND DISCUSSION

The results of the tests and measurements carried out are the findings of the research conducted within a period of 3 weeks. Data collection was carried out in the area around Al-Amanah Cileunyi Junior High School and in the residential area of Summarecon Bandung. The sample in this study consisted of 30 adolescents, 15 males and 15 females. In this study, the sample was selected using the purposive sampling method, which is based on the criteria or characteristics of the population that have been determined previously by the researcher. The sample's measured hemoglobin levels were before (pre-test) the given intervention.

After the initial measurement results were obtained, the sample was given a morning walking intervention with a frequency of 2 times a week for 3 weeks, or 6 meetings conducted during February to March 2025. The intervention was conducted in the morning (between 06.00-09.00) and under the same environmental conditions (temperature $\pm 22^{\circ}\text{C}$). The duration of the morning walk was at least 30 minutes per meeting, with moderate intensity or walking speed around 4-5 km/hour, and the distance travelled was as far as 3-5 km or around 3.000-7.000 steps, calculated using the Pacer application, which can be downloaded on the App Store or Play Store. After being given the morning walking intervention for 3 weeks, a final measurement was taken to see the hemoglobin level after the intervention (post-test) with the same method as the initial measurement. From the tests and measurements at the beginning and end of the study, data was obtained from the sample, which will then be analyzed using the statistical tests **Table 1**.

Table 1. Difference in Hemoglobin Level of Respondents Before and After Morning Walking Intervention

Hb Levels (g/dL)	Minimum	Maximum	Mean \pm SD
Pre-test	7	12.9	8.97 ± 2
Post-test	7.3	18.2	12.68 ± 2.6

Based on the data presented in **Table 1**, it can be seen that the average hemoglobin level of

respondents before the intervention was $8.97 \text{ gr/dL} \pm 2.0$ and after the intervention was 12.68 ± 2.6 . This shows that there is a significant increase in hemoglobin levels after the intervention. This increase is also supported by an increase in the minimum hemoglobin level from 7 g/dL to 7.3 g/dL and the maximum hemoglobin level from 12.9 g/dL to 18.2 g/dL, which indicates an improvement in the distribution range of respondents' hemoglobin levels.

The World Health Organization (WHO) states that the normal limit value of hemoglobin levels for ages 5-11 years is 11.0-16 g/dL, ages 12-18 years is $>12.0 \text{ g/dL}$ for females and $>13.0 \text{ g/dL}$ for males (Gunadi et al., 2016), and 13.5-18.0 g/dL for adults male and 11.5-16.5 g/dL for adults female (Nuarti et al., 2019). This supports Hoffbrand's (2016) statement that from the age of 2 years to puberty, hemoglobin less than 11.0 g/dL indicates anemia.

Table 2. Wilcoxon Signed-Rank Test Results on Hemoglobin Levels Before and After Morning Walking Intervention

Z-Score	P-Value	Conclusion
-4.783	$<.001$	Significant

Based on the results of statistical tests using the Wilcoxon Signed-Rank test displayed in **Table 2**, the value of $Z = -4.783$ was obtained with a P-value = $<.001$. The p-value, which is smaller than $\alpha = 0.05$, indicates that there is a statistically significant difference between the values before and after the intervention, meaning that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. These results support the conclusion that the intervention conducted in this study had a significant effect on increasing the hemoglobin levels of the respondents.

Table 3. Mann-Whitney Test Results on Hemoglobin Levels Before and After Morning Walking Intervention

Z-Score	P-Value	Conclusion
-3.653	$<.001$	Significant

Based on the results of statistical tests using the Mann-Whitney test shown in **Table 3**, the Z value = -3.653 with a P-value = $<.001$. The p-value which is smaller than $\alpha = 0.05$ indicates that there is a statistically significant difference between hemoglobin levels before and after the morning walking intervention in the female and male groups.

Gender affects the physiological response

to aerobic exercise in adolescents, mainly due to differences in body composition, morphology, respiratory physiology, and maximal oxygen uptake (VO₂max). Males have larger muscle mass and lower fat percentage than females, females tend to have more body fat which affects aerobic work capacity (Bredella, 2017) moreover, higher testosterone in males makes muscle growth, strength, and aerobic capacity increase. Meanwhile, estrogen in females plays a role in fat storage and increases blood vessel flexibility (Ben Mansour et al., 2021).

Females typically have smaller lungs and airways than males (Dominelli & Molgat-Seon, 2022). In addition, men usually have a larger body size than females and thus have a larger heart size overall (Bara et al., 2019). A smaller heart size leads to a lower maximum systolic volume and, consequently, a lower cardiac output. With lower cardiac output, oxygen supply to muscle tissue is more limited, which in turn lowers VO₂max values and affects the physiological response to aerobic exercise (Santisteban et al., 2022).

Table 4. Mean Rank of Mann-Whitney U Test Results on Hemoglobin Levels Based on Gender

Hb Levels (g/dL)	Gender	N	Mean Rank
Pre-test-Post-test	Females	15	15.93
Hb Level Change	Males	15	15.07
	Total	30	

Based on the data presented in **Table 4**, it can be seen that the average rank (mean rank) in females is higher, with a value of 15.93, compared to the average rank (mean rank) in males, with a value of 15.07. This shows that there is a significant difference between the hemoglobin levels of females and males after the morning walking intervention.

Santisteban (2022) claimed that, on average, females usually have smaller heart size, lungs, and hemoglobin mass than males, limiting their capacity to deliver oxygen to working muscles. Hemoglobin concentration in men is inherently higher than in females (Nuarti et al., 2019), so when interventions such as morning walking are performed, females have a more visible increase in hemoglobin because their bodies are trying harder and adapting to the increased oxygen demand.

The main finding in this study shows that morning walking intervention has a significant effect on increasing the hemoglobin level of adolescents with anemia. Based on the results of the Wilcoxon Signed-Rank test, a Z score of -4.783

was obtained with a P-value <0.001, indicating a significant difference between hemoglobin levels before and after the intervention.

Anemia is a condition in which the number of red blood cells (erythrocytes) or the amount of hemoglobin, a protein rich in iron (Fe) that carries oxygen in red blood cells, is below normal (P. P, 2009). According to the Kementerian Kesehatan Republik Indonesia (Kemenkes RI) in 2011, under normal conditions, hemoglobin levels in the blood range from 13-18 g/dL in male and 12-16 g/dL in female. While the number of normal erythrocytes in male is in the range of 4.4-5.6 x 10⁶ cells/mm³ and 3.8-5.0 x 10⁶ cells/mm³ in female (Dwi Aridya et al., 2023)

Erythrocytes have an important role in the gas exchange process, which is to transport oxygen (O₂) from the lungs to all body tissues and bring back carbon dioxide (CO₂) from the tissues to the lungs to be excreted (Kiswari, 2014). Most of the erythrocyte cytoplasm contains hemoglobin. Hemoglobin contained in erythrocytes consists of protein and iron components that play an important role in binding and distributing oxygen throughout the body so that it can affect the level of oxygen saturation in the blood (Taşkın, 2022). Elsherif (2021) mentioned that exercise training has a positive effect on hemoglobin mass by increasing the stimulation of erythropoiesis, which helps the blood carry larger amounts of oxygen. Erythropoiesis is a term used to describe the process of erythrocyte formation in the bone marrow (Kiswari, 2014).

Exercise can stimulate erythropoiesis and increase hemoglobin levels, thereby increasing the body's capacity to transport oxygen. This can help resolve anemia and improve patient fitness (Hu & Lin, 2012). When the body performs physical activities such as exercise, there will be high metabolic activity. The production of hydrogen ions and lactic acid increases, which in turn lowers blood pH. This decrease in pH will reduce the affinity of oxygen to hemoglobin so that hemoglobin will release more oxygen and accelerate the supply of oxygen to the muscles (Gunadi et al., 2016). With exercise, blood volume and hemoglobin levels tend to increase (Cicek, 2018) because regular exercise can affect blood parameters depending on the type, intensity, and duration of exercise (Tayebi et al., 2010). This is in agreement with Sepriadi's research (2020), which claims that physical activity, such as exercise, plays an important role in determining hemoglobin levels.

Walking is an aerobic exercise that contributes to increasing hemoglobin because it is

designed to increase oxygen consumption and improve respiratory and cardiovascular function (Sepriadi et al., 2020). This is supported by Balpande's (2022) statement that walking is an aerobic exercise that can increase oxygen flow in the blood and help train the lungs. The increase in oxygen in the blood occurs due to the secondary impact of increased cardiac output due to hypertrophy of the heart muscle and the development of the respiratory system triggered by aerobic exercise and an increase in the amount of hemoglobin through physical activity (Taşkin, 2022). Walking uses almost half of the body's muscle mass and increases oxygen demand (Kelly et al., 2017), which can stimulate hemoglobin production to support oxygen supply to the muscles (Bahrah et al., 2020).

Balpande (2022) claims that regular walking for 20-30 minutes or as far as 5 kilometers in the morning without stopping is good for health. Walking done in the morning can stimulate the hormones erythropoietin (EPO) and erythroferon (EFO), which are hormones that stimulate the formation and multiplication of red blood cells (Dziembowska et al., 2021) especially because the air quality in the morning is better because at this time plants absorb more carbon dioxide (CO₂), so that air circulation in the human respiratory system gets more oxygen intake (O₂) (Isprayoga, 2015). The relatively high oxygen in the morning can help the body optimize oxygen transport and metabolic processes that contribute to increased hemoglobin levels (Rhodes et al., 2022), as approximately 98% of the total oxygen transported in the blood is bound to hemoglobin, while only 2% is dissolved directly in plasma (Kauffman et al., 2023).

The results of this study indicate that morning walking has a significant effect on increasing hemoglobin levels in adolescents with anemia. This simple physical activity is proven to stimulate erythrocyte production and improve oxygen circulation in the body, which directly contributes to increasing hemoglobin levels. Therefore, morning walking can be one of the non-pharmacological or alternative interventions that can support the treatment of anemia in adolescents. This is in accordance with the research of El Nahas (2017), which states that the addition of aerobic exercise is proven to have a more positive impact on increasing hemoglobin levels and reducing anemia symptoms than just medication. So this activity can be implemented in school programs as part of the students' daily routine or combined with other physical activities such as morning exercises or light stretching to improve students' overall health.

CONCLUSION

This study shows that morning walking has a significant effect on hemoglobin levels in adolescents with anemia at Al-Amanah Cileunyi Junior High School. Statistical test results show that there is a significant difference between hemoglobin levels before and after the intervention. This intervention is proven to be effective as a form of light activity that can stimulate erythrocytes and increase oxygen circulation in the body, which in turn can increase hemoglobin levels.

Following the results of the study, there are several recommendations that can be made. First, schools and health workers are expected to provide education on the importance of regular physical activity to maintain students' health and fitness. In addition, the school is also expected to integrate this morning walk activity as part of the students' daily routine to improve physical fitness and prevent the incidence of anemia. Second, adolescents and parents are advised to familiarize themselves with regular morning walking activities and pay more attention to children's physical activity in the home environment. Third, future researchers are expected to conduct similar studies with a larger sample size and a more progressive intervention duration and consider other variables that can affect hemoglobin levels, such as diet or nutritional intake and stress levels.

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