Vol. 7, No. 1, April 2025, pp 43-52
https://doi.org/10.36590/jika.v6i3.897
http://salnesia.id/index.php/jika
jika@salnesia.id, p-ISSN: 2337-9847, e-ISSN: 2686-2883
Penerbit: Sarana Ilmu Indonesia (salnesia)

RESEARCH ARTICLES

Kombinasi *Progressive Muscle Relaxation* dan *Cat Stretch Exercise* terhadap Hemoglobin pada Remaja

Combination of Progressive Muscle Relaxation and Cat Stretch Exercise on Adolescents' Hemoglobin

Heni Wijayanti[1], Poppy Fransisca Amelia[1] , Ni Nyoman Maryaningtyas Adinatha[1] , Dwi Kustriyanti[2*]

[1]Biomedical Study Program, University of Karya Husada Semarang, Semarang, Indonesia
[2]Nursing Study Program, University of Karya Husada Semarang, Semarang, Indonesia

Abstract

The menstrual period is one of the triggers for adolescents to experience anemia, characterized by a decrease in hemoglobin levels. This study aims to analyze the effectiveness of combining progressive muscle relaxation and cat stretch exercise in improving hemoglobin levels among adolescent girls, a population at high risk of anemia, particularly during menstruation. This study was quasi-experimental with a pretest-posttest design with two group designs in June-August 2023. Fifty adolescent girls meeting the inclusion criteria were selected using purposive sampling and proportionally divided into two groups, the progressive muscle relaxation and cat stretch exercise combination group, and the walking group. The Point of care testing (examinations carried out near the patient outside the laboratory) method measured adolescent hemoglobin and hemodynamic levels before and after the intervention. The intervention was given for 4 weeks whith weekly monitoring. Data were analyzed using the paired t-test and Mann-Whitney test. The combination of progressive muscle relaxation and cat stretch exercise was effective in increasing hemoglobin levels in both groups with an average increase of 0,484 and 0,184 repectively, but there was no difference in average hemoglobin in the two groups after the intervention (p-value 0,011 and 0,004). Physical activity, such as either the combination of PMR and cat stretch exercise or walking, was proven effective in increasing hemoglobin levels. These findings suggest that both methods have the potential to serve as simple and affordable interventions for reducing anemia in adolescent girls during menstruation.

Keywords: *menstruation, anemia, cat stretch exercise*

Article history:

Submitted 02 Januari 2024
Accepted 06 Maret 2025
Published 30 April 2025

PUBLISHED BY:
Sarana Ilmu Indonesia (salnesia)
Address:
Jl. Dr. Ratulangi No. 75A, Baju Bodoa, Maros Baru, Kab. Maros, Provinsi Sulawesi Selatan, Indonesia

Email:
info@salnesia.id, jika@salnesia.id
Phone:
+62 85255155883

Abstrak

Masa menstruasi merupakan salah satu pemicu remaja mengalami anemia yang ditandai dengan penurunan kadar hemoglobin. Penelitian ini bertujuan untuk menganalisis efektivitas kombinasi relaksasi otot progresif dan latihan peregangan kucing dalam meningkatkan kadar hemoglobin pada remaja putri, populasi yang berisiko tinggi mengalami anemia, khususnya saat menstruasi. Penelitian ini bersifat *quasi eksperimental* dengan *desain pretest-posttest* dengan desain dua kelompok pada bulan Juni-Agustus 2023. Lima puluh remaja putri yang memenuhi kriteria inklusi dipilih menggunakan *purposive sampling* dan secara proporsional dibagi menjadi dua kelompok, kelompok kombinasi relaksasi otot progresif dan latihan *cat stretch*, dan kelompok jalan kaki. Metode *Point of Care Testing* (pemeriksaan dilakukan dekat pasien di luar laboratorium) mengukur kadar hemoglobin dan hemodinamik remaja sebelum dan sesudah intervensi. Intervensi diberikan selama 4 minggu yang memantau pencatatan mingguan. Analisis data menggunakan uji *t* berpasangan dan uji *Mann-Whitney*. Rata-rata peningkatan hemoglobin pada kelompok latihan PMR dan *cat stretch* sebesar 0,484 mg/dl, sedangkan pada kelompok jalan kaki sebesar 0,184 mg/dl. Tidak terdapat perbedaan rerata hemoglobin pada kedua kelompok setelah intervensi *(p-value 0,011* dan *0,004).* Aktivitas fisik seperti kombinasi PMR dan latihan peregangan kucing serta jalan kaki terbukti efektif meningkatkan kadar hemoglobin. Temuan ini menunjukkan bahwa kedua metode ini berpotensi menjadi intervensi yang sederhana dan terjangkau untuk mengurangi anemia pada remaja putri selama menstruasi.

Kata kunci: menstruasi, anemia, latihan fisik, relaksasi otot

*Correspondence Author:
Dwi Kustriyanti, email: dwikus3yanti@gmail.com

Highlight:

- Progressive Muscle Relaxation combined with Cat Stretch Exercise effectively increases hemoglobin levels in adolescent girls during menstruation.
- Regular physical activity whether stretching or walking can serve as a simple, low-cost intervention to reduce anemia risk.
- These non-pharmacological methods offer promising alternatives for improving adolescent health without relying on dietary supplements.

INTRODUCTION

Adolescence is a time of physical, mental, and activity development, so it requires highly nutritious food at this time (Ahmed and Mohammed, 2022; Mengistu et al., 2019). Adolescents experience a growth spurt requiring increased nutritional intake to support weight gain, height growth, and tissue development (Juffrie et al., 2020; Wakwoya et al., 2023). This is because adolescent girls experience blood loss due to menstruation and lose iron through menstruation every month, adolescent girls being one of the groups most at risk of anemia (Fernandez-Jimenez et al., 2020; Kumar et al., 2022). Anemia prevalence is measured by hemoglobin (Hb) levels, which indicate the oxygen-carrying capacity of red blood cells. Low Hb levels signify anemia (Low et al., 2016; Sunuwar et al., 2023). The increase occurs due to the erythropoietin process which results in the formation and release of red blood cells from the bone marrow as a result of which Hb also increases (Faizi and Kazmi, 2017; Kung et al., 2021).

The increase depends on plasma changes, changes in plasma volume will cause an increase in erythrocyte reconstruction and iron circulation from the bone marrow to erythrocytes resulting in increased Hb production. Physical activity causes an increase in the hormone erythropoietin, increased blood flow, and finally, an increase in red blood cells thus increasing Hb mass (Fukushima et al., 2020; Hodeida et al., 2022). Iron deficiency anemia is one of the four nutritional problems that must be faced by developing countries such as Indonesia. The World Health Organization (WHO) states that the prevalence of anemia worldwide ranges from 40 - 88% (Habtegiorgis et al., 2022; Hodeida et al., 2022). The highest prevalence was in preschool-aged children (47,4%) and the lowest prevalence in males (12,7%). However, the population group with the highest number of individuals is non-pregnant women (468,4 million or 30,2%) (Petraglia and Dolmans, 2022). According to data from the Indonesian Ministry of Health in 2020, the national prevalence rate of anemia in all age groups is 33,7%, in women it is relatively higher.

Anemia can lead to cognitive impairment, reduced concentration, and emotional or behavioral issues (Petry et al., 2016; Samson et al., 2022). Anemia can lead to cognitive impairment, reduced concentration, and emotional or behavioral issues. In adolescent girls, its effects are more severe, potentially increasing the risk of maternal mortality, low birth weight, and premature births due to malnutrition (Chen et al., 2020; Faizi and Kazmi, 2017; Endale et al., 2022). The actions to overcome anemia include education and giving Fe tablets to adolescents, changing a healthy lifestyle through the fulfillment of balanced nutrition, physical exercise, and relaxation to overcome mental conditions (Nahas and Gabr, 2017; Chen et al., 2020; Ayupir, 2021; Rahfiludin et al., 2021; Nurjanah and Azinar, 2023). Progressive Muscle Relaxation (PMR) and Cat Stretch Exercises are body movements produced by skeletal muscles and require energy. Energy is needed from metabolism, body movements that involve the availability of oxygen (Chen et al., 2020).

Oxygen is carried by hemoglobin (Hb) from the lungs to all body tissues and brings back carbon dioxide from all cells to the lungs and expelled from the body during exhalation. So that the function of hemoglobin is regulate the exchange of oxygen and carbon dioxide in body tissues. If the Hb level in the blood is less than 12g/dL it will interfere with physical activity, because it causes fatigue and dyspnea occurs during daily activities (Low et al., 2016; Rahfiludin et al., 2021). Progressive Muscle Relaxation (PMR) and Cat Stretch Exercises involve muscle movements that increase oxygen-carrying capacity. These exercises utilize energy from sustained oxygen consumption, boosting metabolism and oxygen demand**.** When the need for oxygen increases, the work of the cardiorespiratory system such as the heart, lungs, and blood will also increase (Nahas and Gabr, 2017).

Physical activity can improve blood circulation and increase muscle needs for oxygen so that oxygen consumption in the muscles is 100 times that of rest time. When doing physical exercise there is an increase in blood oxygen concentration which is seen secondary to increased cardiac output because hypertrophied heart muscle allows more Hb to form and the development of the respiratory system during physical exercise (Mansour et al., 2021). In addition, the main driver of erythropoietin production is the amount of oxygen available to meet the metabolic needs of body tissues which is one of the causes of increased body tissue needs for oxygen for physical activity, causing hypoxic conditions during exercise and adaptation due to exercise causing an increase in erythropoietin hormone from the kidneys and liver in small amounts (Fernandez-Jimenez et al., 2020; Kumar et al., 2022). This study aims to analyze the effectiveness

of Progressive Muscle Relaxation (PMR) and Cat Stretch Exercise on hemoglobin levels in adolescent girls at MA Daarul Taqwa Semarang.

METHODS

This research was conducted in June-August 2023 at MA Daarul Taqwa, Semarang, Central Java. This research has passed the ethical test from the ethics committee of Universitas of Karya Husada Semarang with number 296/KEP/UNKAHA/SLE/VII/2023. This study was quasi-experimental with pretest-posttest design with a group design. A sample of 50 young women were selected using purposive sampling and proportionally divided into two groups: the progressive muscle relaxation and cat stretch exercise combination group, and the walking group. The inclusion and exclusion criteria of this study are adolescents who have experienced menstruation, have moderate anemia, are aged 15-17 years, are in good health and have no history of blood disorders, are willing not to consume foods high in iron during the study and are willing to be respondents. The excluded respondents were teenagers who took blood-boosting tablets. Respondents were divided into two groups, namely the group given a combination of progressive muscle relaxation and cat stretch exercises as many as 50 adolescent girls meeting the inclusion criteria were selected using purposive sampling and proportionally divided into two groups, the progressive muscle relaxation and cat stretch exercise combination group, and the walking group.

The preparatory stage, by compiling relaxation instruction guidelines in the form of a relaxation *guide audiotape* and stretch exercise paint. Intervention facilitators are sports teachers who have previously carried out perception equations related to the research to be carried out demographic data was taken along with the initial screening of hemoglobin levels of adolescent girls using the POCT (*point of care testing*) method. All adolescents who meet the inclusion and exclusion criteria are taught treatment according to their group. The intervention group teens were taught a combination of PMR and cat stretch exercises and the control group was given walking guidance first. The intervention was conducted twice a week for four weeks, with each session lasting 30 minutes. In the first week, adolescents are given simultaneous interventions, then adolescents intervene independently and record activities in the daily record book given to adolescents to record the time and type of intervention performed.

Monitoring the filling of the daily record book is carried out by creating a WhatsApp group and sending messages to respondents in the afternoon assisted by the students in charge of each class to remind each other to fill in notes. Respondents were asked to send a video of the implementation of the intervention when carried out independently. In the final fourth week, young women are checked for hemoglobin levels using the same method as at the beginning. The results of the study were analyzed by computer using SPSS 20.0. Univariate analysis was used to describe the characteristics of respondents including age and age of *menarche*. Test data normality using *Shapiro Wilk* if the sample size is only 50. The *paired t-test* was used to see the difference in hemoglobin before and after the intervention in both groups, while the Mann-Whitney test was used to see the effectiveness of both groups in raising hemoglobin levels. The flow of this research can be seen in Figure 1. *Research flow chart.*

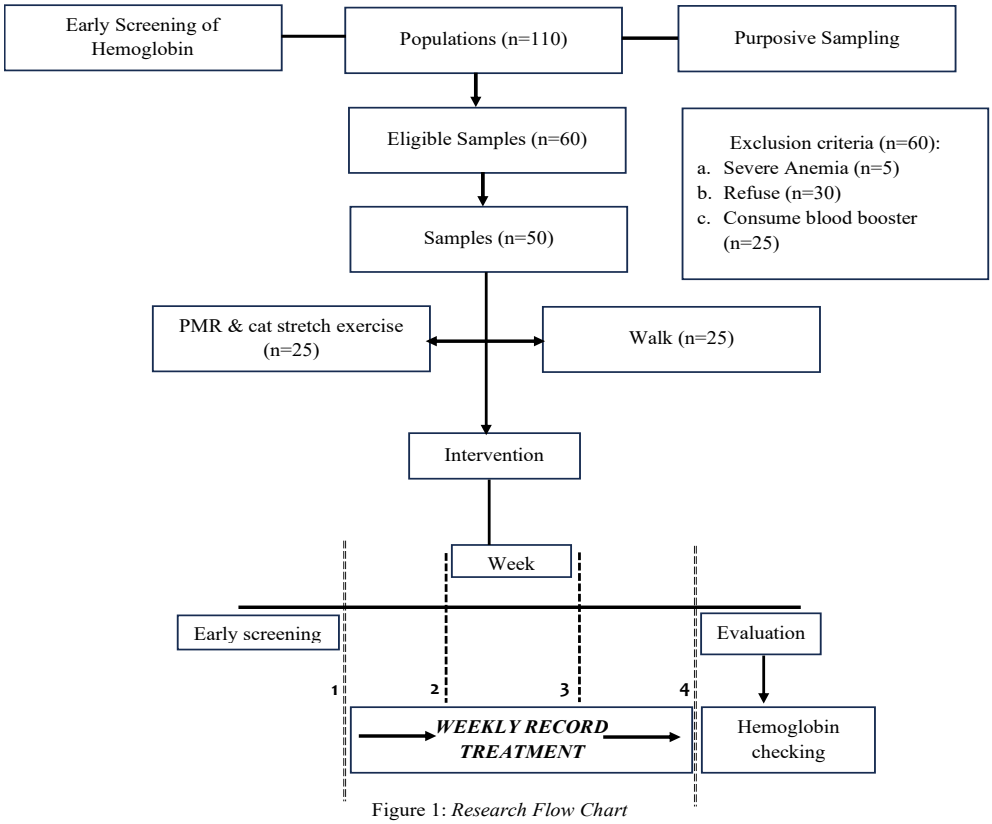

Figure 1. Research flow chart

RESULTS AND DISCUSSIONS

Table 1 shows that there was no difference between the age and age of menarche in the two groups, which shows that both groups were homogeneous, because the results of the homogeneity test obtained a *p value > 0,05*. The average age of the PMR & cat stretch exercise group was 16,04 years, while the walking group was 16,08 years. The average age of menarche was at the age of 10,52 years, and 10,64 years, while the age of menarche was youngest at the age of 9 years and the longest at the age of 13 years.

Table 1. Characteristics of adolescents MA Daarul Taqwa Semarang (n=50)

Characteristic	PMR & Cat Stretch Exercise (n=25)		Walking (n=25)		p-value
	Mean ± SD	Min - Max	Mean ± SD	Min - Max	
Age	16,04 ± 0,790	15-17	16,08 ± 0,759	15-17	0,860
Age of Menarche	10,52 ± 1,005	9-13	10,64 ± 1,114	9-13	0,742

Source: Primary data, 2023

Table 2 shows the difference in hemoglobin level before and after treatments, both groups indicate significant results with *p-value <0,005*. Although both groups showed significant increases in hemoglobin levels, the walking group demonstrated a slightly

higher mean increase. This suggests that walking might offer additional benefits warranting further investigation.

Table 2. Differences in hemoglobin before and after in the PMR & cat stretch exercise group and the walking group (n = 50)

Hemoglobin	Before		After		p-value
	Mean ± SD	Min - Max	Mean ± SD	Min - Max	
PMR and Cat Stretch Exercise	10,18 ± 0,62	9-11	10,37 ± 0,58	9-12	0,011*
Walk	10,03 ± 0,73	9-12	10,52 ± 0,72	9-12	0,004*

Note: *The paired t-test, significant if p-value <0,05

Table 3 illustrates that both treatment effectively increase hemoglobin level in adolescents with anemia in their period. The results showed that the average hemoglobin before being given a combination of PMR and Cat Stretch Exercise was 10,18 mg/dl and after the intervention averaged 10,38 mg/dl, so the average hemoglobin increase was 0,484 mg/dl. Hemoglobin is a protein in red blood cells that carries oxygen from the lungs to the rest of the body and returns carbon dioxide to the lungs for breathing (Kumar et al., 2022). PMR and Cat Stretch Exercise is a physical activity that can affect the body, including potential changes in hemoglobin levels. Hemoglobin levels in the blood can be affected by a variety of factors, including diet, hydration, overall health, and medical history (Cristina et al., 2018; Fukushima et al., 2020; Ahmed and Mohammed, 2022; Habtegiorgis et al., 2022). Physical activity such as progressive muscle relaxation and stretching exercises can increase oxygen demand in the body. As a result, the body will produce more red blood cells to deliver oxygen to the muscles and tissues involved in exercise. This increase in oxygen demand can lead to an increase in hemoglobin levels.

Table 3. The effectiveness of PMR and stretch paint and walking combination on Hemoglobin levels (n = 50)

Group	*Mean Rank*	*p-value*
PMR & Cat Stretch Exercise	23,08	*0,238*
Walk	27,92	

Note: *Mann Whitney Test, significant if p-value <0,05

This research is supported by research Nahas and Gabr (2017) which found that aerobic exercise and cycling effectively raised hemoglobin levels by 5-8% and performed regularly three times a week for 12 weeks with a duration of 30 minutes. The findings align with previous research demonstrating that physical activities can enhance hemoglobin levels. This study contributes novel insights by combining relaxation and stretching techniques to achieve comparable increases in hemoglobin levels. Exercise can improve blood circulation, ensuring oxygen is transported more efficiently to the body's cells. This increase in circulation can contribute to better oxygen delivery and contribute to changes in hemoglobin levels. During activity, the body will need fluids to replace electrolyte fluids lost from sweat, so that the body remains hydrated to maintain blood volume and composition (Kumar et al., 2022). Dehydration can lead to an increase in the concentration of hemoglobin in the blood. When consuming fluids during or after this exercise, it can affect hemoglobin levels. Regular and consistent exercise over time can lead to physiological adaptations, such as increased red blood cell production. Regular exercise has the potential to increase hemoglobin levels in the

long run (Chen et al., 2020; Mansour et al., 2021).

Nutritional factors such as consuming iron-rich foods (egg, red meat, beans, green vegetables) can increase hemoglobin levels, as iron is a key component of hemoglobin (Alaunyte et al., 2015; Nurjanah and Azinar, 2023). While nutritional factors influence hemoglobin levels, this study highlights the significant role of physical interventions even without substantial dietary changes. Progressive muscle relaxation is a relaxation technique that can help reduce stress and promote relaxation and overall well-being. Relaxation exercises can improve blood circulation, which can indirectly support the body's ability to transport oxygen and nutrients to various tissues, including the bone marrow where red blood cells, including hemoglobin, are produced. Relaxation techniques can reduce anxiety and depression, so you will be motivated to maintain a healthy lifestyle that can indirectly affect hemoglobin levels (Nahas and Gabr, 2017; Samson et al., 2022).

Physical activity walking is one sport to helps blood circulation, and can increase hemoglobin levels by an average of 0,184 mg/dl after being done regularly twice a week for four weeks with a duration of 30 minutes. Increased oxygen demand, such as in response to hypoxia of high altitude or chronic living, can stimulate the body to produce more red blood cells resulting in increased hemoglobin levels. Previous research has shown that resistance training can increase hemoglobin levels in patients with Diabetes mellitus (Clénin, 2017). Walking increases oxygen demand thereby stimulating the production of erythrocytes containing hemoglobin which is responsible for transporting oxygen from the lungs to body tissues. Increased iron absorption more efficiently When walking and balanced from nutrients, walking also stimulates the bone marrow to produce more red blood cells (Alaunyte et al., 2015; Jobda et al., 2022). Smooth blood circulation can improve blood circulation so that it helps transport nutrients and oxygen to the bone marrow, where erythrocytes are produced.

CONCLUSIONS

The hemoglobin levels of adolescent girls increased after receiving a combination of progressive muscle relaxation and cat stretch exercises, as well as walking. The PMR and Cat Stretch Exercise group showed an average hemoglobin increase of 0,48 mg/dl, compared to 0,18 mg/dl in the walking group. Regular physical activity, such as PMR and stretching exercises, can effectively improve hemoglobin levels, making it a viable strategy to prevent anemia during menstruation. This emphasizes the importance of implementing simple and routine physical activity interventions among adolescents. This study was limited by the small sample size (25 per group) and the lack of random sampling. Future research should adopt randomized controlled trial (RCT) designs to enhance the validity of the results. This study did not evaluate the nutritional status of adolescent girls, which is a crucial factor in anemia cases. Future studies should integrate analyses of nutritional factors such as iron intake and dietary patterns.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Ministry of Research, Technology, and Higher Education for their financial support to carry out the study the Head Master and staff of MA Daarul Taqwa Semarang for their collaboration, and the students for their participation.

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