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ORIGINAL ARTICLE

# Profil Hemoglobins Status of MA Muallimat NWDI Pancor Students

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**Abstract:** Hb (Hemoglobin) is an important component of red blood cells that transports oxygen and serves as an indicator of anemia. Anemia is a major public health problem, particularly among adolescent girls who are vulnerable due to menstruation, increased nutritional needs, and inadequate iron intake. It may have long-term consequences, including impaired cognitive development and increased health risks during future pregnancy. Studies on adolescent girls in religious-based senior high schools remain limited. MA Muallimat NWDI (Nahdlatul Wathan Diniyah Islamiyah) Pancor focuses on religious and character education and plays an important role in preparing adolescent girls as future mothers. However, health and balanced nutrition education, particularly regarding iron intake and anemia prevention, remains limited. This research to determine Hb levels among MA Muallimat NWDI Pancor students as baseline data for adolescent health and nutritional status. This quantitative descriptive study used a cross-sectional design. Hb levels were measured using POCT (Point of Care Testing) method. Based on the research results on 100 students, the average Hb level was found to be 13.6 g/dL, with a median of 13.4 g/dL, a mode of 12.8 g/dL, and a standard deviation of 1.73 g/dL, with the lowest Hb level at 9.9 g/dL and the highest at 18.4 g/dL. Based on categories, 78 students had normal Hb levels, 15 students had low levels, and 7 students had high levels. The majority of students had normal Hb levels

**Keywords:** Hemoglobins, Adolescent, Anemia

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## INTRODUCTION

Hb (Hemoglobin) is one of the components of red blood cells, consisting of conjugated proteins that function to transport oxygen and carbon dioxide. Measuring Hb can serve as an indicator for assessing anemia conditions (Sri Atik et al., 2022). Anemia can have long-term impacts that extend to the next generation. In mothers, anemia can increase the risk of complications during pregnancy and childbirth, as well as increase the risk of morbidity and mortality. Meanwhile, in children, anemia can hinder the development of cognitive and motor skills (WHO, 2025).

The prevalence of anemia among women aged 15-14 in 2023 reached 30.7%. In 2025, it showed that anemia remains a serious public health issue. Only 18 countries (10% of the world) have shown a decrease in anemia cases. This indicates that the world is currently on an unsuitable path to achieve the target of a 50% reduction in anemia prevalence by 2030 (WHO, 2025). 191 million adolescent girls worldwide suffer from anemia. Indonesia ranks 8th out of 11 countries in Asia, with around 7.5 million sufferers (Ministry of Health Republic Indonesia, 2025).

Anemia is more commonly found in women and teenage girls compared to men. Adolescent girls have a higher risk of experiencing anemia because menstruation causes regular blood loss, increasing their iron requirements (Indra et al., 2023). Research on the young age group requires more attention in monitoring Hb levels because changes in metabolism and high activity can increase the risk of anemia if not balanced with adequate nutritional intake. Efforts in education and regular Hb testing become crucial strategies to detect this risk early, especially in adolescent girls who are more vulnerable (Dewi & Cita, 2026). In addition, adolescence is a period of growth that requires higher energy and nutrient intake. On the other hand, the pressure to meet

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beauty standards can drive some teenage girls to follow overly strict diets to achieve a certain body shape. This condition can cause energy and nutrient intake to be insufficient for the body's needs, including iron, thereby increasing the risk of anemia (Indra et al., 2023). In addition, physical activity can also affect iron metabolism and erythrocyte production thru the stimulation of erythropoietin, which plays a role in the formation of red blood cells. factors such as health knowledge and the behavior of consuming iron supplements are also important determinants related to cases of anemia (Dewi & Cita, 2026)

Anemia in adolescent girls can persist throughout their teenage years and poses a risk of becoming pregnant mothers with anemia, which can lead to premature births or low birth weight babies, due to the disruption in red blood cell formation, placenta formation, and the fetus, which will then give birth to the next generation of stunted children who not only suffer from stunting but also have low IQs and are at risk of various chronic diseases (Indra et al., 2023).

Similar research has previously been conducted in the environment of senior high schools, including at SMAN 2 Denpasar (Indra et al., 2023) , then at SMK-TI Jimbaran Bandung (Komang et al., 2025), and SMK Tarunatama (Sri Atik et al., 2022). Similar research has previously been conducted in the environment of senior high schools, one of which was on students at SMAN 2 Denpasar. Then at SMK-TI Jimbaran, Bandung, and SMK Tarunatama. Hb profile examinations have also been conducted on adolescents in the environment of a religious-based junior high school, namely MTS Darul Hikmah in Mataram City. However, not many have researched adolescents in religious-based school environments at the high school level. At the high school level, adolescents are closer to adulthood and the reproductive period. Health conditions and nutritional status at this age are important because they can affect their health as future mothers.

MA Muallimat NWDI (Nahdlatul Wathan Diniyah Islamiyah) Pancor, which focuses on character building and deepening religious knowledge, has great potential in shaping future mothers with noble character. However, the students' knowledge about health and balanced nutrition has not yet become a main part of the learning process. This condition is important to pay attention to because nutritional adequacy, especially iron, plays a role in preventing anemia in adolescent girls. Therefore, this research was conducted to determine the Hb levels in the students of MA Muallimat NWDI Pancor as one of the indicators of anemia conditions in adolescent girls. The results of this study are expected to serve as initial data in increasing attention to the health and nutritional status of adolescent girls in the madrasah environment.

## MATERIAL AND METHODS

This research uses a quantitative descriptive method with a cross-sectional approach and use simple random sampling. This study aims to obtain an overview of Hb levels in the students of MA Mu'allimat. Data collection was carried out thru Hb level examination using the POCT method on respondents within a specific time period. The number of samples in this study was 100 respondents from the population is 200 all of whom were female. Data analysis was conducted univariately to describe the characteristics and distribution of respondents' Hb levels. The Hb level data were analyzed using mean, median, mode, and standard deviation values, and then categorized based on reference Hb level values into low, normal, and high categories according to the criteria used in the study.

## RESULTS

1. The results of the Hb level examination on MA Muallimat students can be seen in Table 1.

**Table 1.** The results of the Hb level examination on MA Muallimat students

| Category of Hb Level | Frequency (n) | Percentage (%) |
|---|---|---|
| Low (< 12 g/dl) | 15 | 15 |
| Normal (12 – 16 g/dl) | 78 | 78 |
| High (> 16 g/dl) | 7 | 7 |
| **Total** | **100** | **100** |

The table of Hb level examination results on 100 MA Mu'allimat students shows that the majority of respondents have Hb levels in the normal category, with 78 individuals (78%). Respondents with low Hb levels numbered 15 individuals (15%), while those with high Hb levels numbered 7 individuals (7%). Based on the criteria used in the study, Hb levels are categorized as low if <12 g/dL, normal if 12–16 g/dL, and high if >16 g/dL. Thus, the research results indicate that the majority of MA Muallimat students have Hb levels within the normal range, while some others have Hb levels below or above the normal range.

2. Statistical Overview of Hb Levels in MA Muallimat Students

**Table 2.** Statistical of Hb Levels in MA Mu'allimat Students

| Statistic | Result |
|---|---|
| Number of respondents | 100 |
| Mean | 13.6 g/dL |
| Median | 13.4 g/dL |
| Mode | 12.8 g/dL |
| Standard deviation | 1.73 g/dL |
| Minimum | 9.9 g/dL |
| Maximum | 18.4 g/dL |

Based on the statistical analysis table of Hb levels in 100 MA Mu'allimat students, the mean value obtained is 13.6 g/dL, the median is 13.4 g/dL, the mode is 12.8 g/dL, the standard deviation is 1.73 g/dL, the minimum value is 9.9 g/dL, and the maximum value is 18.4 g/dL. The mean value of 13.6 g/dL indicates that the overall average Hb level of the 100 students is 13.6 g/dL. Compared to the criteria used in the study, which are low Hb <12 g/dL, normal 12–16 g/dL, and high >16 g/dL, this average value falls within the normal category. This indicates that, in general, the Hb levels of the respondents are within the normal range.

The median value of 13.4 g/dL indicates that if all the respondents' Hb levels are arranged from lowest to highest, the value in the middle position is 13.4 g/dL. Thus, about half of the respondents have Hb levels ≤13.4 g/dL, while the other half have Hb levels ≥13.4 g/dL. The mode value of 12.8 g/dL indicates that the Hb level most frequently found among the respondents is 12.8 g/dL. This value falls within the normal category based on the criteria used.

The standard deviation value of 1.73 g/dL illustrates the level of dispersion or variation in the respondents' Hb levels relative to the average value. This means that the respondents' Hb levels vary by approximately 1.73 g/dL from the average value of 13.6 g/dL. The larger the standard deviation, the greater the dispersion of the data from the average. In this study, a standard deviation of 1.73 g/dL indicates that there is variation in Hb levels among respondents, as evidenced by the presence of respondents with Hb levels both below and above the average value.

The minimum value of 9.9 g/dL indicates that the lowest Hb level found among respondents is 9.9 g/dL. Based on the research criteria, this value falls into the low category because it is below 12 g/dL. Meanwhile, the maximum value of 18.4 g/dL indicates that the highest Hb level found is 18.4 g/dL, which falls into the high category because it is above 16 g/dL.

## DISCUSSION

Based on statistical analysis and frequency distribution, most female students have normal Hb levels. Hb levels can be influenced by various factors, one of which is physical activity. The activities of the female students, such as studying, exercising, and other activities, generally fall into the category of moderate physical activity, while physical activities that can affect Hb levels are heavy activities. The results of this study are in line with Rizkiyah et al. 2023 at Pondok Pesantren Darul Hikmah, Mataram City, which showed that normal Hb levels were more commonly found compared to low or high Hb levels (Rizkiyah et al., 2023).

Physical activity can stimulate the production of erythropoietin, which plays a role in the formation of red blood cells, thereby increasing Hb levels. Regular physical activity also helps improve the body's ability to transport oxygen and the efficiency of the cardiovascular system. However, its effect depends on the intensity and duration of the activity. Light or irregular activities generally do not have a significant impact on Hb levels. Therefore, physical activity needs to be performed with sufficient intensity, duration, and frequency to affect the blood formation system and increase Hb levels (Dewi & Cita, 2026).

There are 15 female students (15%) with low Hb levels, which can be influenced by several factors, one of which is the variety of food and drinks consumed. One of the drinks that teenagers often consume is iced tea, which contains tannins. Tannins can bind with iron, calcium, and aluminum, making them difficult for the body to absorb. As a result, iron (Fe) absorption decreases and can lead to a reduction in Hb levels(Rizkiyah et al., 2023). 7 other female students (7%) have high Hb levels. High Hb levels can be caused by dehydration because when dehydration occurs, the volume of blood plasma decreases, which can automatically increase the Hb levels in the blood.

Physiologically, Hb levels are influenced by hormonal factors and the individual's biological condition. Men have higher testosterone levels, which stimulate the production of erythropoietin and the formation of red blood cells in the bone marrow. Conversely, reproductive-age women experience blood loss during menstruation, which can reduce iron reserves and lower Hb levels. Hb is a protein in erythrocytes that carries oxygen from the lungs to the body's tissues. The formation of Hb is influenced by iron, vitamin B12, folate, erythropoietin, and the individual's physiological condition. Therefore, women of reproductive age are at a higher risk of experiencing anemia compared to men. This result is in line with Karimah et al. 2024, who state that women are at a higher risk of experiencing anemia due to blood loss during menstruation and a higher iron requirement (Karimah et al., 2024). Another study by Aswandani et al., 2024, also shows that the menstrual cycle is related to the incidence of anemia in adolescent girls (Aswandani et al., 2024).

Age affects metabolism, iron requirements, and the stability of hormones related to erythrocyte production. Hb formation is influenced by nutritional balance, erythropoietin activity, and metabolic adaptation as one ages. In more mature age, lifestyle, dietary patterns, and physiological adaptations tend to be more stable, thereby supporting optimal Hb production (Dewi & Cita, 2026).The results of this study are in line with Santy et al., (2025), who state that age is related to the incidence of anemia in adolescents due to physiological changes and nutritional needs. Adolescents require monitoring of Hb levels because changes in metabolism and high activity can increase the risk of anemia if not accompanied by sufficient nutritional intake. Therefore, education and regular Hb checks are important to detect anemia early, especially in adolescent girls who are more vulnerable (Santy et al., 2025).

Symptoms of anemia include weakness, easy fatigue, lethargy, dizziness, and blurred vision. These symptoms can lead to decreased concentration during the learning process, which is closely related to students' academic performance (Made & Saraswati, 2021) (Rotua, 2018). Research at SMA Idhata Kendari shows a significant relationship between high

Hb levels and students' academic performance after the administration of Fe tablets. Adequate Hb levels can improve students' physical condition, fitness, and concentration, thereby supporting the enhancement of academic performance (Amin NA, 2021).

Based on previous research, nutritional status is related to Hb levels in adolescent girls, and poor nutritional status can increase the risk of anemia. Measuring food consumption is important to assess nutritional status and identify food factors that can cause malnutrition. The level of consumption is determined by the quality and quantity of food, specifically the content and amount of nutrients consumed. Both need to be met to achieve good nutritional status. Poor nutritional status can lower the body's resistance and increase vulnerability to diseases, including infections. Conversely, good nutritional status can enhance immunity, maintain normal body weight, increase productivity, and reduce the risk of chronic diseases and premature death (Ina & Maulina, 2024).

Hb levels in malnutrition status tend to be low. This is due to the body's lack of nutrient intake that supports the hemoglobin synthesis process, such as iron, folic acid, vitamin C, vitamin B12, and protein (Hikmah et al., 2023) (Herdiansyah et al., 2024). The research conducted by Ayuningtyas et al., 2020 in 2020 showed that the incidence of anemia was most commonly experienced by teenage girls with undernourished nutritional status, amounting to 92.7% (Ayuningtyas et al., 2020). Low hemoglobin levels are also found in the group with excessive nutritional status beyond the normal limits because excess fat in the body causes an inflammatory process, leading to an increase in inflammatory markers in the blood, such as pro-inflammatory cytokines and acute phase proteins like IL-6 (Interleukin-6) and CRP (C-Reactive Protein). The increase in IL-6 and CRP triggers the production of hepcidin in the liver and adipose tissue, resulting in disrupted iron metabolism (Syah, 2022). This is evidenced by the research of Nisa et al., 2019, which stated that the average hemoglobin levels in the obese group were lower compared to the non-obese group (Nisa et al., 2019).

Poor knowledge about anemia can cause teenagers to be unable to control their nutritional intake. The lack of knowledge is due to teenagers not understanding or only receiving incomplete information (Mularsih, 2017). With the ignorance of teenagers about the dangerous risks that will occur if they experience anemia, they make less effort to avoid habits or prevent behaviors that can cause anemia. The lack of knowledge among teenagers about anemia makes them very vulnerable to negative eating behaviors (Subratha & Ariyanti, 2020). Like a very strict diet, irregular eating patterns, and frequently eating fast food (Martini, 2015). The level of knowledge among adolescents will influence their attitudes and behaviors in choosing food at school and at home, which determines how easily someone understands the benefits of Fe tablets. Iron supplementation or the provision of Fe tablets is one of the important efforts in preventing and addressing anemia. Good knowledge about the benefits of Fe tablets can affect the consumption of good food, thereby achieving good nutritional status (Martini, 2015). This is in line with the research by Fauziyah et al., 2024, which states that there is a relationship between the level of knowledge of adolescent girls about anemia and hemoglobin levels with a p-value of 0.03 (Fauziyah et al., 2024).

Prevention that can be undertaken by students thru the behavior of consuming nutritious foods such as meat, fish, chicken, or eggs, vegetables, nuts, tempeh, and fruits. Because prevention is a behavior, good knowledge is something that must be prioritized (Fathony et al., 2022). There is a need for health education related to that matter. Health education is an effort to shape community behavior that supports health so that the community becomes aware of or knows how to maintain their health. According to L Green's theory, health behavior can be influenced by predisposition factors, enabling factors, and reinforcing factors. Predisposition factors include knowledge, perception, understanding, and values that one believes in. The enabling factor is a facilitating factor such as the availability of facilities and easy access to perform the behavior. Meanwhile, the reinforcing factor is a strengthening factor such as the attitudes of community leaders and officials (Mahda et al., 2025).

## CONCLUSION

Based on the research results on 100 MA Mu'allimat students, the average Hb level was found to be 13.6 g/dL, with a median of 13.4 g/dL, a mode of 12.8 g/dL, and a standard deviation of 1.73 g/dL, with the lowest Hb level at 9.9 g/dL and the highest at 18.4 g/dL. Based on categories, 78 students (78%) had normal Hb levels, 15 students (15%) had low levels, and 7 students (7%) had high levels. Thus, the majority of students had Hb levels in the normal category

## STRENGTHS AND LIMITATION

The strengths of this study lies in the adequate number of respondents, which is 100 female students, thus providing a representation of Hb levels in the studied group. All respondents are female, making the characteristics of the respondents more homogeneous and aligned with the research objectives. The examination of Hb levels used the POCT method, allowing for direct measurement and relatively quick results. However, the limitation lies in the design used, which is descriptive cross-sectional, thus only depicting Hb levels at one point in time and unable to show changes in Hb levels over time. The study only describes Hb levels and does not analyze factors that may directly relate to Hb levels, such as diet, nutritional status, menstruation, physical activity, or health conditions. Possible influencing factors are only analyzed based on previous literature. The examination still uses the POCT method, and has not yet employed more accurate and precise automatic tools.

## CONFLICT OF INTEREST

The author declares that there is no conflict of interest in the conduct of this study and the preparation of this manuscript.

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## ETHICAL APPROVAL

This study did not obtain formal ethical approval from an institutional ethics committee. Ethical considerations were addressed through obtaining permission from MA Mu'allimat NWDI Pancor and written informed consent from all participants prior to data collection. The participants were informed about the purpose and procedures of the study, and their participation was voluntary.

## DECLARATION OF USING AI

The authors affirm that artificial intelligence (AI) tools were used to assist in the writing process solely for language enhancement purposes, such as grammar checking, paraphrasing, and improving clarity. No Al tools were employed to generate original content, conduct data analysis, or interpret research findings. The authors take full responsibility for the content, interpretations, and conclusions presented in this manuscript

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