



Profile of Nutritional Status and Hemoglobin Levels among School-Aged Children in a Coastal Area of North Lombok

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Abstract

Anemia remains a significant public health problem among school-aged children in Indonesia. This study aimed to describe hemoglobin levels and nutritional status among primary school children in a coastal area of North Lombok. A descriptive cross-sectional study was conducted among 102 children aged 7–12 years from three elementary schools in Malaka Village, West Nusa Tenggara. Nutritional status was assessed using body mass index-for-age Z-scores, while hemoglobin levels were measured using a portable hemoglobin device. The results showed that 57.9% of children were anemic, including 16.7% with mild anemia and 41.2% with moderate anemia, while most children (72.5%) had a normal nutritional status. No severe anemia cases were identified. These findings suggest that anemia remains common despite predominantly normal anthropometric status among school-aged children in this coastal population.

Keywords

school-aged children;
nutritional status;
anemia;
hemoglobin;
coastal area.

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Introduction

Anemia remains a major public health problem among school-aged children in low- and middle-income countries, including Indonesia. It is defined as a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs (Garcia-Casal et al., 2019). According to the World Health Organization, approximately 39.8% of children aged 6–59 months globally were affected by anemia in 2019, and the burden remains substantial among school-aged children, particularly in developing

countries (World Health Organization, 2021). Anemia has been associated with impaired growth, cognitive development, reduced immune function, and poorer academic performance (Gardner & Kassebaum, 2020; Gutema et al., 2023). In Indonesia, anemia among children aged 5–12 years remains a moderate-to-severe public health concern, with prevalence exceeding 20% in several regions (Putri et al., 2021; Riawan et al., 2023).

Iron deficiency is recognized as the leading cause of anemia in children. However, anemia is increasingly understood as a multifactorial condition influenced by inadequate dietary quality, micronutrient deficiencies, infections, and socioeconomic factors (Camaschella, 2018; Juffrie et al., 2020). Recent evidence suggests that hemoglobin status is influenced not only by overall nutritional intake but also by micronutrient adequacy and dietary diversity (Helmyati et al., 2024; Karomah et al., 2024). A national study in Indonesia further demonstrated that micronutrient deficiencies, particularly iron and zinc deficiency, remain common among school-aged children despite varying anthropometric profiles, indicating that normal growth indicators may not necessarily reflect adequate micronutrient status (Ernawati et al., 2023).

Anthropometric indicators such as body mass index-for-age are widely used to evaluate nutritional status because they reflect growth patterns and overall nutritional adequacy in pediatric populations (Kamruzzaman et al., 2021; Kobylińska et al., 2022). Nevertheless, increasing evidence highlights a mismatch between anthropometric status and micronutrient sufficiency. Children with normal or even excessive body weight may still experience anemia or other micronutrient deficiencies, a phenomenon commonly referred to as “hidden hunger” (Riawan et al., 2023). This issue is increasingly relevant in Indonesia, where the nutritional transition has contributed to the Triple Burden of Malnutrition (TBM), characterized by the coexistence of undernutrition, anemia, and overweight or obesity (Andriani et al., 2023).

Children living in coastal areas may face additional nutritional vulnerabilities related to limited dietary diversity, socioeconomic constraints, sanitation problems, and dependence on specific food sources (Darni et al., 2025). Coastal populations in Indonesia have also been reported to experience persistent micronutrient deficiencies and growth problems associated with inadequate nutritional intake and household food insecurity (Darubekti & Hanum, 2023). Despite these potential risks, studies evaluating both hemoglobin levels and anthropometric nutritional status among school-aged children in Indonesian coastal populations remain limited, particularly in Eastern Indonesia, including North Lombok. Most previous studies have focused primarily on either anemia or anthropometric status separately, resulting in a limited understanding of their coexistence in vulnerable coastal populations. Therefore, this study aimed to describe the nutritional status and hemoglobin profile among school-aged children in a coastal area of North Lombok, Indonesia.

Materials and Methods

Study Design and Sampling

This study employed a descriptive cross-sectional design to assess the nutritional status and hemoglobin levels among school-aged children, enabling simultaneous measurement of anthropometric indicators and hemoglobin concentration within a defined population and time frame. The study was conducted in coastal areas of Malaka Village, Pemenang District, North Lombok Regency, West Nusa Tenggara, Indonesia. This area represents a coastal community with specific nutritional and environmental characteristics. Data collection was conducted over eight months, from April to November 2019.

Study Population and Sampling

The study population consisted of elementary school children aged 7–12 years enrolled in SDN 1, SDN 2, and SDN 3 in Malaka. This age group corresponds to school-aged children undergoing rapid physical growth and increased nutritional requirements.

Participants were recruited using consecutive sampling from three elementary schools, with all eligible students included until the required sample size was achieved. The minimum sample size was calculated to be 56 subjects. However, 102 students were ultimately included in the analysis.

Inclusion criteria were children aged 7–12 years who were present at the time of data collection and whose parents or guardians provided informed consent. Exclusion criteria included children who were ill during measurement, refused blood sampling, or did not complete all study procedures.

Study Variables

The main variables in this study were nutritional status and hemoglobin level. Nutritional status was assessed using the BMI-for-age indicator and expressed as Z-scores based on WHO 2007 growth standards, which were further categorized into severely underweight, underweight, normal, overweight, and obese (World Health Organization, 2007). Hemoglobin level was measured as an indicator of anemia status, which was subsequently classified into normal, mild anemia, moderate anemia, and severe anemia following WHO criteria (World Health Organization, 2011)

Data Collection Procedures

Body weight was measured using a calibrated digital weighing scale with 0.1 kg precision, while height was measured using a micrometer with 0.1 cm precision. All measurements were conducted following standardized procedures to ensure accuracy. Trained enumerators performed anthropometric measurements following standardized procedures to minimize measurement error. BMI was calculated and converted into BMI-for-age Z-scores using WHO reference standards. Hemoglobin levels were measured using a portable hemoglobin testing device (BeneCheck Hb Hemoglobin). The device was operated according to the manufacturer's instructions to ensure measurement consistency. Capillary blood samples were obtained through finger-prick using a sterile lancet and an autoclick device, following aseptic procedures. Additional information, such as demographic characteristics, was collected through direct interviews using a structured questionnaire after obtaining informed consent.

Data Analysis

Data were checked for completeness and accuracy before analysis. Statistical analysis was conducted using SPSS version 21.0. Descriptive statistics were applied to summarize participants' characteristics, nutritional status, and anemia prevalence. Continuous variables were reported as means, whereas categorical variables were presented as frequencies and percentages, with findings presented in tables and bar charts accompanied by narrative explanations.

Ethical Considerations

This study was conducted in accordance with ethical principles for research involving human participants and received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, University of Mataram (No. 155/UN18.F7/ETIK/2019; 11 July, 2019), which found the study ethically acceptable and free of violations. Written informed consent was obtained from parents or legal guardians before participation after providing clear information regarding the study objectives, procedures, benefits, and minimal risks. Participation was voluntary, and confidentiality and anonymity of all participants were strictly maintained. All procedures, including anthropometric measurements and capillary blood sampling, were performed using standardized and sterile techniques to ensure safety and minimize discomfort.

Results and Discussions

Results

Sociodemographic and Anthropometric Characteristics

A total of 102 school-aged children were included in this study. The mean age of participants was 11.3 ± 1.2 years, with 55 males (53.9%) and 47 females (46.1%). Anthropometric measurements showed a mean height of 130.8 ± 9.3 cm and a mean weight of 30.6 ± 8.5 kg, resulting in an average BMI of 17.7 ± 3.3 kg/m². The mean hemoglobin level was 11.1 ± 1.2 g/dL with values ranging from 8.7 to 13.6 g/dL

Table 1
Sociodemographic and Anthropometric Characteristics of the Study Participants

Variable	Mean $\pm$ SD / n (%)
Age (years)	11.3 ± 1.2
Male	55 (53.9)
Female	47 (46.1)
Height (cm)	130.8 ± 9.3
Weight (kg)	30.6 ± 8.5

BMI (kg/m ²)	17.7 ± 3.3
Hemoglobin (g/dL)	11.1 ± 1.2

Hemoglobin Status Distribution

Among the participants, 43 children (42.1%) had normal hemoglobin levels, while 59 (57.9%) were anemic. Mild anemia was identified in 17 children (16.7%), whereas moderate anemia was observed in 42 children (41.2%). No cases of severe anemia were found.

Table 2
Distribution of Hemoglobin Status of the School-Aged Children in Malaka Village

Hemoglobin Status	n	%
Normal	43	42.1
Mild anemia	17	16.7
Moderate anemia	42	41.2
Severe anemia	0	0

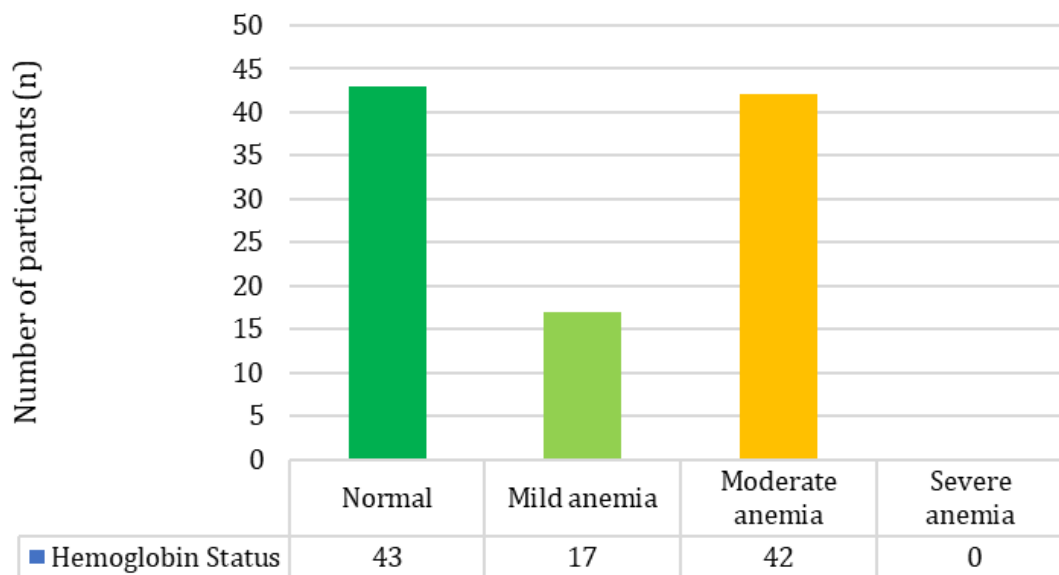


Figure 1. Distribution of Hemoglobin Status of the School-Aged Children in Malaka Village

Nutritional Status Distribution

Most participants had a normal nutritional status (72.5%). Severely underweight and underweight categories accounted for 5.8% of participants, while overweight and obesity were identified in 21.6% of children.

Table 3
Distribution of Nutritional Status of the School-Aged Children in Malaka Village

Nutritional Status	n	%
Severely underweight	1	0.9
Underweight	5	4.9
Normal	74	72.5
Overweight	15	14.7
Obese	7	6.9

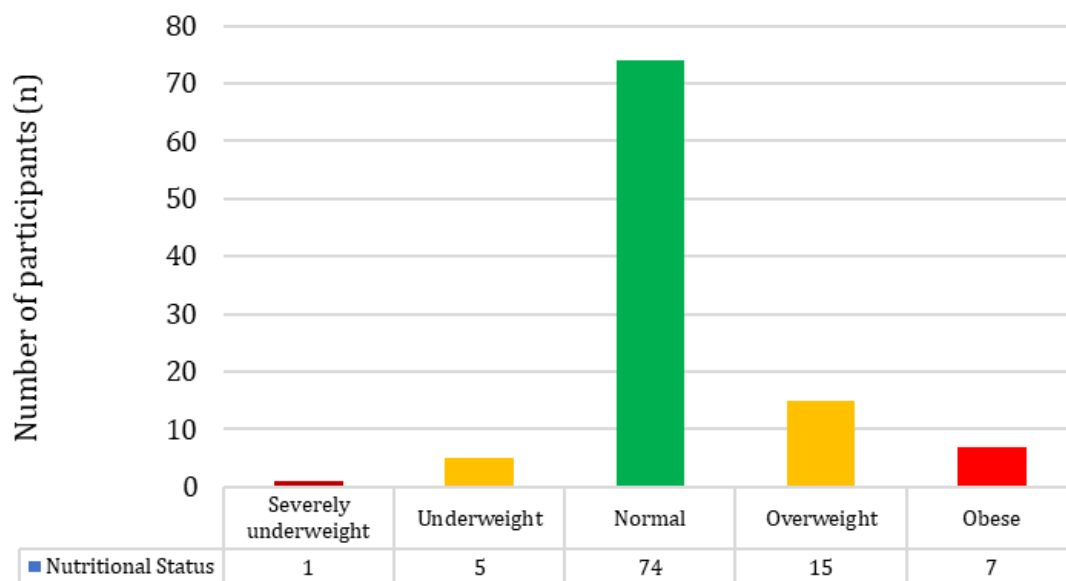


Figure 2. *Distribution of Nutritional Status of the School-Aged Children in Malaka Village*

Discussions

This study demonstrated a high prevalence of anemia (57.9%) among school-aged children in coastal North Lombok, indicating a severe public health problem based on WHO classification thresholds (>40%) (Gardner & Kassebaum, 2020; World Health Organization, 2021). The proportion observed in this study was also higher than the general prevalence reported among school-aged children in many low- and middle-income countries, where anemia commonly ranges from 20% to 40% (Gardner & Kassebaum, 2020; Juffrie et al., 2020). The elevated burden observed in this coastal population suggests persistent nutritional vulnerability and potential environmental and socioeconomic determinants.

Similar findings have also been reported in other Indonesian studies. Riawan et al. (2023) reported an anemia prevalence of 58.8% among primary school children in Bogor, suggesting that anemia remains a persistent problem across different regions and community settings in Indonesia. Similar observations have been documented internationally. A systematic review and meta-analysis in Ethiopia reported that anemia prevalence among children reached 57.76%, which was also categorized as a severe public health problem according to WHO criteria (Azmeraw et al., 2023). Together, these findings indicate that anemia among children remains a major nutritional and public health concern in developing countries.

The high prevalence observed in this study may be associated with inadequate intake of iron-rich foods and limited dietary diversity. Previous studies have shown that low consumption of animal-source foods and poor micronutrient intake contribute substantially to anemia among children and adolescents (Helmyati et al., 2024; Juffrie et al., 2020). In addition to iron deficiency, inadequate intake of other hematopoietic nutrients, including folate, vitamin B12, vitamin B6, and protein, may further impair erythropoiesis and exacerbate anemia (Helmyati et al., 2024; Sunardi et al., 2021). In coastal communities, food consumption patterns are often influenced by socioeconomic conditions and limited access to nutritionally diverse foods, which may increase the risk of micronutrient deficiencies (Karomah et al., 2024).

Interestingly, most children in the present study had normal BMI-for-age status (72.5%) despite the high prevalence of anemia. This finding suggests that normal anthropometric status does not necessarily reflect adequate micronutrient intake or status. Similar findings have been reported among Indonesian school-aged children, where normal BMI coexisted with iron deficiency anemia (Riawan et al., 2023). This phenomenon is often described as “hidden hunger,” a condition in which children appear nutritionally normal based on anthropometric indicators but still experience deficiencies in essential micronutrients (Camaschella et al., 2020; Oktarina et al., 2024).

Evidence from the Indonesian Basic Health Research further demonstrated that micronutrient deficiencies among children aged 5–12 years remain prevalent, including ferritin deficiency (13.4%), zinc

deficiency (19.7%), vitamin D deficiency (12.7%), and vitamin A deficiency (3%) (Ernawati et al., 2023). The study also found only weak correlations between BMI-for-age and several micronutrient levels, indicating that anthropometric indicators alone are insufficient to detect micronutrient inadequacies. Therefore, assessment of nutritional problems among school-aged children should not rely solely on BMI indicators, but should also include evaluation of micronutrient status, particularly iron-related parameters, to identify children at risk of anemia and hidden hunger.

This study has several limitations. First, it was conducted in a limited number of schools within a single coastal area, using consecutive sampling, which may limit the generalizability of the findings to broader populations. Second, potential factors associated with anemia, including dietary intake, micronutrient status, socioeconomic conditions, infectious diseases, and sanitation factors, were not evaluated. As a result, the underlying contributors to anemia in this population could not be comprehensively determined. Future studies incorporating dietary assessment and biochemical evaluation are warranted to provide a more comprehensive understanding of anemia among school-aged children in coastal settings.

Conclusion

This study demonstrates that anemia remains highly prevalent among school-aged children in the coastal area of North Lombok, despite most participants having a normal nutritional status as indicated by BMI-for-age. The findings indicate that adequate anthropometric status does not necessarily reflect sufficient micronutrient intake, particularly iron, highlighting the presence of hidden hunger in this population.

These results are consistent with the study objective stated in the introduction and confirm that hemoglobin and nutritional status may not always align in coastal school-aged populations. The results reflect a persistent nutritional and hematological burden among children in coastal settings, where limited dietary diversity and reliance on less nutrient-dense food sources may contribute to suboptimal iron status. Although the majority of children were categorized as nutritionally normal, the high proportion of anemia underscores the need for greater attention to diet quality rather than energy intake alone.

From a practical perspective, these findings emphasize the importance of strengthening school-based nutrition interventions, including iron supplementation, nutrition education, and promotion of diversified dietary intake rich in bioavailable iron. Community-level strategies to improve access to nutrient-dense foods are also essential in coastal areas to reduce the burden of anemia.

In conclusion, hemoglobin status is a critical indicator of child health that may not be fully explained by anthropometric measures alone. Integrated nutritional strategies targeting both dietary quality and micronutrient adequacy are necessary to improve health outcomes and support optimal growth and development among school-aged children in coastal regions.

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