Determinants of Anemia Severity among Children Aged 6-23 Months in Myanmar*

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Abstract

Purpose: To examine the prevalence of anemia severity and the predictability of child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia, and fever in last 2 weeks on the severity of anemia among children aged 6-23 months in Myanmar.

Design: A predictive correlational study.

Methods: Data record forms were used to collect the required information with specific inclusion and exclusion criteria from the original data source, the Myanmar Demographic and Health Survey 2015-2016. Data analysis was conducted using descriptive statistics, the chi-square test, and binary logistic regression.

Main findings: Among the 846 children assessed, 57.3% had moderate to severe anemia and 42.7% had mild anemia. The chi-square test indicated significant associations between anemia severity and factors including the child's sex, consumption of dark green leafy vegetables, and maternal anemia ($p < .05$). Binary logistic regression identified the male sex (OR = 2.14, $p < .001$), consumption of dark green leafy vegetables (OR = 0.65, $p = .010$), and maternal anemia (OR = 1.37, $p = .029$) as significant predictors of moderate to severe anemia.

Conclusion and recommendations: These results emphasize the necessity for nutritional interventions for both mothers and children. The prevention of maternal anemia should be urgently considered and prioritized as an essential component of antenatal care programs in Myanmar.

Keywords: anemia, mothers, Myanmar, young children

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ปัจจัยทำนายความรุนแรงของภาวะโลหิตจางในเด็กอายุ 6-23 เดือนในประเทศเมียนมา*

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาความชุกระดับความรุนแรงของภาวะโลหิตจาง และอำนาจทำนายของเพศของเด็ก ดัชนีฐานะทางเศรษฐกิจ การบริโภคอาหารที่มีธาตุเหล็ก การบริโภคผักใบเขียวเข้ม ภาวะโลหิตจางของมารดา และการมีไข้ในช่วง 2 สัปดาห์ที่ผ่านมา ต่อความรุนแรงของภาวะโลหิตจางในเด็กอายุ 6-23 เดือนในประเทศเมียนมา

รูปแบบการวิจัย: การศึกษาความสัมพันธ์เชิงทำนาย

วิธีดำเนินการวิจัย: แบบบันทึกข้อมูลถูกใช้ในการเก็บรวบรวมข้อมูลที่จำเป็นโดยคัดเลือกตามเกณฑ์คัดเข้าและคัดออกที่กำหนดไว้ โดยเลือกจากแหล่งข้อมูล Myanmar Demographic and Health Survey 2015-2016 การวิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา การทดสอบไคสแควร์ และการวิเคราะห์การถดถอยโลจิสติกทวิ

ผลการวิจัย: จากข้อมูลเด็กจำนวน 846 คนพบว่า เด็กที่มีภาวะโลหิตจางระดับปานกลางถึงรุนแรง ร้อยละ 57.3 และภาวะโลหิตจางระดับเล็กน้อยร้อยละ 42.7 ผลการทดสอบไคสแควร์แสดงให้เห็นว่าระดับความรุนแรงของภาวะโลหิตจางมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับเพศของเด็ก การบริโภคผักใบเขียวเข้ม และภาวะโลหิตจางของมารดา ($p < .05$) การวิเคราะห์การถดถอยโลจิสติกทวิ พบว่าเพศชาย (OR = 2.14, $p < .001$) การบริโภคผักใบเขียวเข้ม (OR = 0.65, $p = .010$) และภาวะโลหิตจางของมารดา (OR = 1.37, $p = .029$) เป็นปัจจัยสำคัญที่สามารถทำนายโอกาสเกิดภาวะโลหิตจางระดับปานกลางถึงรุนแรงได้

สรุปและข้อเสนอแนะ: ผลการศึกษานี้เน้นย้ำถึงความจำเป็นในการดำเนินมาตรการด้านโภชนาการสำหรับทั้งมารดาและเด็ก การป้องกันภาวะโลหิตจางของมารดาควรพิจารณาอย่างเร่งด่วน และถูกกำหนดให้เป็นองค์ประกอบสำคัญของโปรแกรมการดูแลสตรีตั้งครรภ์ในประเทศเมียนมา

คำสำคัญ: ภาวะโลหิตจาง มารดา ประเทศเมียนมา เด็กเล็ก

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Background and Significance

Anemia represents a condition whereby the concentration of blood hemoglobin (Hb) or the amount and form of red blood cells (RBC) falls less than a certain threshold, impairing the blood's ability to transport oxygen throughout the human circulatory system.[1] Anemia is a sign of poor nutrition as well as poor health.[1] Severe anemia accounts for a tiny fraction of occurrences in children but can result in significant morbidity and mortality.[2] It can happen at any age, however, it is frequently seen in children below the age of five, particularly in children under the age of two.[3] During the early couple of years of life, minors experience fast bodily development, cognitive, and an elevated dietary demand, which is exacerbated by the beginning of supplemental feeds that are insufficient in iron and may end up in anemia. As a result, poor nutrition has permanent short and long-lasting impacts on the physical and emotional progression.[4]

Anemia is a common dietary problem in many parts of the globe, particularly in emerging nations. According to WHO research, 53.8% of Southeast Asia's approximately 96.7 million kids less than the age of five were anemic.[5] Anemia affected 35.6% of youngsters aged 6-59 months, according to the Myanmar Micronutrient and Food Consumption Survey MMFCS (2017-2018).[6] Children aged 6-23 months had the highest rate of anemia (59.9%), followed by children aged 9-11 months with the highest rate (67.3%), and children aged 18-23 months with the lowest rate (54.6%).[6] Furthermore, 27.5% of children aged 6 to 23 months experienced mild anemia, 31.1% experienced moderate anemia, and 1.5% experienced severe anemia and the problem continues to have public health relevance.[6] In addition, WHO released an organization of categories to facilitate worldwide evaluations of anemia as an issue of public health as severe (rate of 40% or more), moderate (20% to 39.9%), and mild (5% to 19.9%).[7] According to the MMFCS prevalence of anemia rate, anemia is a severe public health problem affecting young children aged 6-23 months in Myanmar.

When the associated literature for anemia in young children was reviewed, it was discovered that underlying and immediate determinants from the characteristics of the mother, child, and household characteristics such as child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia and fever in last 2 weeks also considerably influenced anemia in young children based on many previous studies. To begin with the causes of underlying determinants, the gender of the child was connected with anemia.[8] A study[9] found that a child's sex was associated with only moderate/severe anemia. Similarly, other studies found that the female gender was accompanied by a lower risk of anemia[10] and were less likely to have anemic ranks exceeding those

of males.[8] In contrast, a study indicated that females were twice as susceptible as male kids to being anemic ($p < .001$).[11] According to the findings from previous studies, either boys or girls may affect the anemia severity in young children. For that reason, the influence of child sex is necessary to evaluate the anemia severity in young children in Myanmar.

The second significant factor from the underlying determinants is the wealth index. It can also influence anemia in young children aged 6-23 months.[9] Socioeconomic status is a fundamental indicator of food instability, a lack of nutrients and a tendency to transmissible illnesses, all of which ultimately accelerate the progression of pediatric anemia.[12] In Myanmar, a family's annual capita income of less than 100 US dollars was a factor figured out to be a cause of anemia ($p < .001$), and children from low-income families (<100 US dollars) were more susceptive to anemia.[2] The greater number of anemia in families with lower incomes may also be related to the shortage of accessibility to medical care, educational opportunities, and diminished chances for buying nutrient-rich meals.[13] Thus, it is essential to learn to understand the anemia severity in young children among families with different wealth quantile.

The third factor that is noticeably associated with anemia severity is iron-rich food consumption in children aged 6-23 months. Brain growth is greatest in the initial two years of life, when the brain's nerve cell walls are most permeable to iron, signaling that this is the most essential time for its usage.[14] Iron-rich food ingestion is the primary contributing factor to anemia, and a plan aimed at increasing iron intake might be achieved and enhanced.[15] The occurrence of anemia was considerably lower in youngsters who consumed iron-rich or iron-fortified meals than in children who did not ($p < .05$).[16] This study[16] discovered that iron-rich food feeding was indirectly attributed to moderate anemia, with the circumstances being moderate anemia across kids aged from six to twenty-three months who ingested iron-rich foods 32% lower than those who did not (AOR = 0.66; 95%CI [.46, .96]). This could be because eating patterns and religious practices modified the nutritional consequences of children in Myanmar.[17] According to traditional beliefs in Myanmar, some mothers avoid eating nutritious foods or meat during the postnatal period. As a result, children are sometimes given fewer meals and inadequate diets, especially during illness, due to a lack of awareness about proper nutritional needs.[17] This factor is a key determinant to evaluate the anemia severity in young children.

Consumption of dark green leafy vegetables is the fourth feature that was associated to anemia severity in young children. Dark green leafy vegetables (DGLVs) consumption refers to the receiving of any dark green leafy vegetables within

24 hours by the child before the survey. Lack of access to micronutrient-rich green leafy vegetables may be the primary cause of anemia.[18] DGLVs are high in minerals like iron and vitamins and beneficial to iron absorption. Many studies presented that the greater the quantity of DGLVs children consumed, the less anemia occurred among young children. Children who ate GLVs twice or more per week had a lower rate of anemia than those who ate them once per week.[19] GLVs are cheap and the most readily available source of micronutrients in Myanmar, where the daily diet is primarily constituted of rice. Little research has been conducted on this topic concerning vegetables, and the implications for early children's vegetable consumption remain uncertain. Therefore, the association between a diet of dark green leafy vegetables and the seriousness of anemia in younger kids must be assessed as well.

Last but not least, maternal anemia could influence anemia in children aged 6-23 months. Maternal anemia is characterized by a hemoglobin saturation level of less than 12.0 g/dl in mothers.[1] Maternal anemia has been proven to be a risk marker for anemia among youngsters. In Myanmar, mothers' Hb levels were powerfully linked with the Hb levels of children aged 6 to 23 months ($r^2 = .51$, $p < .001$).[2] Another study from Myanmar pointed out that kids born to anemic mothers were 1.74 times more prone to be anemic than their counterparts (AOR = 1.74; 95%CI [1.27, 2.39]).[16] As a result, monitoring the anemic condition of mothers is critical when considering anemia disorders in young children.

A factor from the immediate determinants such as child's fever in the last two weeks is another predictor of anemia severity in children. Fever can be caused by minor sicknesses such as the ordinary cold or by serious medical conditions such as parasitic infections (malaria), dengue hemorrhagic fever, and Japanese encephalitis.[20] Children between the ages of 6 and 23 in Sub-Saharan Africa who had suffered from an elevated temperature in the two weeks prior to the event had 1.40 times (AOR = 1.40, 95%CI [1.35, 1.45]) greater opportunity to develop anemia versus those who had not suffered.[21] In Myanmar, fever is the most profound sign of childhood sickness. With the various horrible conditions of the season, fragile youngsters are easily ill. Therefore, fever is a necessary factor for assessing the anemia severity in young children.

Based on a review of the sources and the outcomes of existing research, child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia, and fever in last 2 weeks were selected as factors to examine the predictability of the anemia severity in Myanmar children aged 6-23 months. These factors were chosen based on prior studies conducted in similar

settings, data availability, and their established or hypothesized association with anemia in children. Although sex and wealth index of the family are non-modifiable, they were included because sex influences anemia prevalence through biological and behavioral factors, and wealth index reflects socioeconomic status, which affects nutrition and healthcare access. These variables help identify vulnerable groups and understand disparities.

Regarding the methodological perspective, numerous studies have examined the prevalence and risk factors of anemia in children, most of them have focused on anemia as a binary outcome (anemic vs. non-anemic). However, few studies have explored the factors associated with varying degrees of anemia severity[16] particularly in the Myanmar context. By focusing on anemia severity as the dependent variable, the current study aims to address this specific gap. Understanding the determinants of different levels of anemia severity is crucial for designing more targeted and effective public health interventions. Furthermore, the determinants may be altered for mild and moderate to severe anemic groups. Moreover, the impact of anemia differs based on severity level, thus, the group of mild anemia shows the early warning signs, and moderate to severe anemia leads to a serious risk of life-threatening. Therefore, this study can help to provide perceptive knowledge and information for health policymakers to determine priorities to develop an advantageous intervention for young babies aged 6-23 months who suffer from an anemic problem in Myanmar.

Objectives

The objectives of the study were to examine the prevalence of anemia severity and the predictability of child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia, and fever in last 2 weeks on the severity of anemia among children aged 6-23 months in Myanmar.

Research Hypothesis

Child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia, and fever in last 2 weeks could predict the severity of anemia among children aged 6-23 months in Myanmar.

Methodology

Research design and participants

The study was a secondary data analysis using the primary data from the Myanmar Demographic Health Survey 2015 to 2016 with a predictive correlational study design. The Ministry of Health and Sports (MoHS) conducted the first survey in Myanmar as part of the global Demographic and Health Surveys (DHS) in 2015-2016; and the current study accessed the data from that survey with the

permission from MoHS because there was no newly surveyed dataset afterwards. The survey used a representative sample from the entire country. It implemented a stratified two-stage sample design with participants from each of Myanmar's seven States and eight Regions. 76,999 people made up the MDHS sample as a whole, which was determined using the Myanmar Housing Census frame. The present study used child recode files from the nationally representative dataset Myanmar DHS 2015-2016 to obtain information and data for analysis. The population data were collected from mothers 15 to 49 years who had children aged between 6 to 23 months at the survey time.

Complete data on mother, child, and household characteristics were included and other inconsistent data and no anemic children were excluded. The original data set included 4,815 mothers who had children under five years and the participants for this study were 846 children aged 6 to 23 months after excluding data based on exclusion criteria. The flow chart of processing the data extraction of MDHS (2015-2016) was shown in Figure 1. Although there is no formal sample size calculation due to the nature of secondary data use, the adequacy of the sample was evaluated based on the events-per-variable (EPV) rule. A minimum of 10 events per predictor variable is recommended for logistic regression to yield stable estimates.[22] The model included six independent variables, and the number of cases in each anemia severity category exceeded, supporting the appropriateness of the sample size for logistic regression.

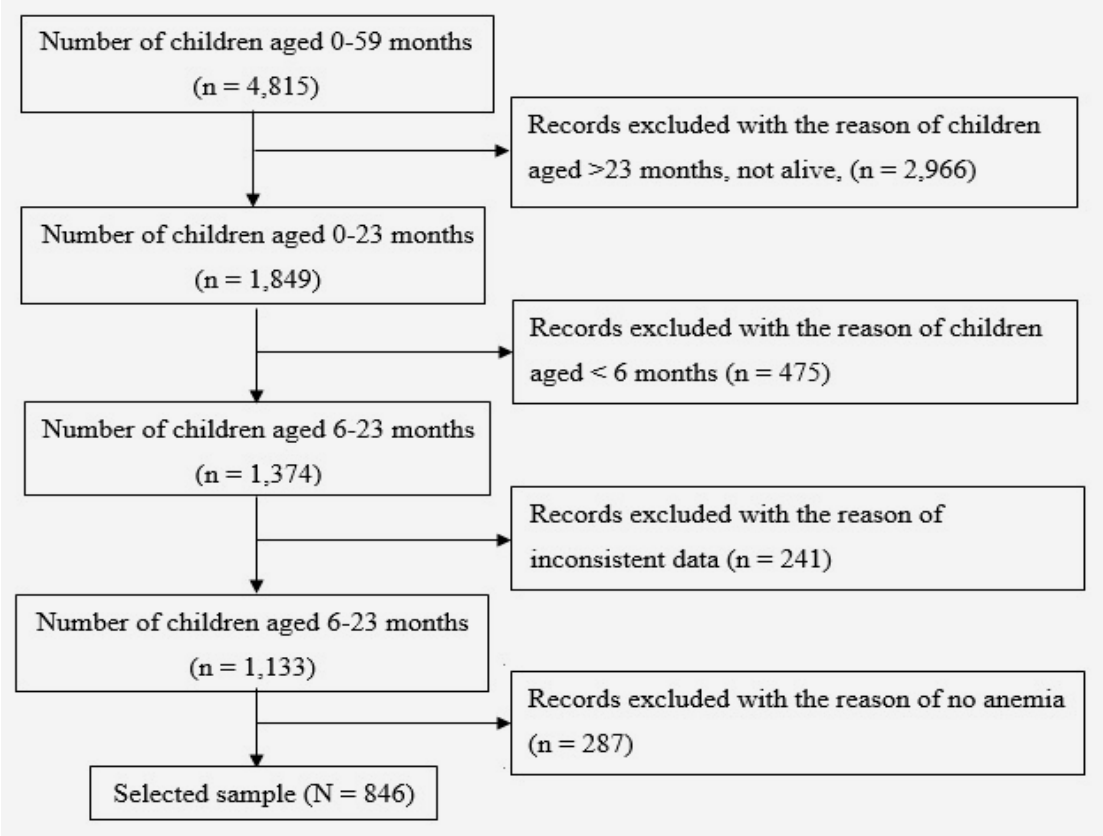

Figure 1: Diagram selecting subjects from Myanmar demographic and health survey (2015-2016)

Research instruments and variables

This study used secondary data from the 2015-16 Myanmar Demographic and Health Survey (MDHS), which employs standardized instruments developed by the Demographic and Health Surveys (DHS) Program. These instruments have undergone extensive pretesting, piloting, and validation across multiple countries and survey rounds. The quality of the MDHS instruments, including those used to measure hemoglobin concentration, household wealth, dietary intake, maternal anemia, and child health indicators, was rigorously assessed by the DHS Program. As this was a secondary data analysis, no additional instrument validation was performed in this study and recognized as high-quality instruments in global health research. Moreover, certain previous studies used the MDHS (2015-16) to investigate feeding practices and nutritional status of children aged 6-23 months in Myanmar[16] and age-specific risk factors for child anemia in Myanmar.[23]

In the present study, the researchers developed the data record form for extracting the necessary information from the original data source of MDHS. There were three parts in data record form in the study; Part I: Mother's characteristics, Part II: Child's characteristics, and Part III: Household characteristics.

Part I: Mother's characteristics

In this part, four items were developed to evaluate the information of the mother such as the mother's age, education, number of ANC visits, and hemoglobin level of the mother.

Part II: Child's characteristics

This part included ten items to evaluate the characteristics of children such as the child's age, sex, birth weight, weight, height, height/age standard deviation, breastfeeding status, iron-rich foods consumption, consumption of dark green leafy vegetables, fever in last 2 weeks and hemoglobin level.

Part III: Household characteristics

In this part, two items were used to assess the information of households such as the wealth index and place of residence.

The dependent variable of this study, severity of anemia, referred to the different grading of blood hemoglobin (Hb) levels in young children based on the severity at the time of the survey in the Myanmar Demographic and Health Survey (MDHS 2015-2016). In the present study, it was recoded as "0 = mild anemia" if the child's Hb level is 10 to 10.9 g/dl, and "1 = moderate to severe anemia" if the Hb level is "below 9.9 g/dl" according MDHS 2015-16.[20] The blood test was carried out on-site and recorded.

For the independent variables, child sex was stated to be a set of biological attributes normally categorized as "0 = female" or "1 = male". The wealth index was the proxy measure of household living standards derived from household asset ownership and housing characteristics (television, types of housing, etc.). In MDHS 2015-2016, scores were given based on the number and types of consumer goods they own and categorized as wealthiest,

fourth, middle, second, and poorest. In the present study, it was recoded into "0 = Poor" combined second and poorest quantile, "1 = Middle" retained as the middle quantile, and "2 = Rich" combined the wealthiest and fourth quantile.

Relating to iron-rich foods consumption, this was dichotomized as "1 = good" if the child consumed at least one of four foods such as meat (beef, pork, lamb, chicken, etc.), egg, organ meat (liver, heart, or other organs), and fish or shellfish and "0 = poor" if the child has no history of iron-rich foods consumption in the last 24 hours period preceding the interview. Consumption of dark green leafy vegetables was classified as "1 = yes" if the child consumed any dark green leafy vegetables and "0 = no" if the child had no history of any dark green leafy vegetables in the last 24 hours preceding the interview.

Maternal anemia was defined as a blood hemoglobin level below 12.0 g/dl in all women in MDHS 2015-2016. In the present study, it was categorized as "0 = no anemia" if the mother's Hb level is equal to or higher than 12 g/dl, and "1 = anemia" if the Hb level is lower than 12 g/dl. Concerning the fever in last two weeks, referred to the child having a history of fever within the last two weeks at any time, divided as "0 = no" if the child has no history of fever in the last two weeks and "1= yes" if the child had a fever in the last two weeks before the interview.

Ethical consideration

The National Health Sciences Research Committee in Myanmar approved the Myanmar Demographic and Health Survey (MDHS) (2015-2016), which was carried out by the Ministry of Health and Sports of the Republic of the Union of Myanmar. Researcher requested the permission from the DHS program (U.S.) to use data from MDHS (2015-2016) and got a permission letter. The study was approved by the Ethics Committee of the Institutional Review Board, Faculty of Nursing, Mahidol University, Thailand (Ethical Code: COA No.IRB-NS2022/721.2009). The findings of the study were reported in summary. The electronic datasets of DHS were retained strictly for privacy.

Data analysis

The researcher used Statistical Package for the Social Science (SPSS) software version 18.0 for data analysis and the significance level was set at .05. Descriptive statistics were used to examine the characteristics of the mother, child, and household related to anemia severity in children 6 to 23 months of age. The chi-square test was used to examine the relationship between independent variables and dependent variable. Binary logistic regression analysis was used to determine the prediction of independent variables based on the assumptions (dichotomous dependent variable, no multicollinearity, linearity of logic model).

Findings

In this secondary data analysis, the selected sample was 846 mothers who had aged 6-23 months children with anemia as study respondents. Table 1 shows that among all anemic children aged 6 to 23 months, more than half of the children 453 (53.5%) were male, and 393 (46.5%) were female. Around half of the families (52.8%) lived in the poor quantile, while nearly one-third of the families (27.8%) lived in the rich quantile. According to the mothers' responses, their children who had a history of consuming at least one of four iron-rich food items were 493 (58.3%) and only 226 (26.7%) consumed dark green leafy vegetables within 24 hours before the survey. Nearly half of the mothers 401 (47.4%) suffered from anemia and 441 (52.1%) did not have anemia at the time survey. Concerning health status, 620 (73.3%) of children had a history of fever in the last 2 weeks, and moderate to severe anemia had the higher rate with 485 (57.3%) while around half of total children with anemia, 361 (42.7%) had mild anemia in the present study.

Table 1: Descriptive analysis of participants' characteristics (N = 846)

Participants Characteristics	n	%
Child sex		
Female	393	46.5
Male	453	53.5
Wealth index		
Poor	447	52.8
Middle	164	19.4
Rich	235	27.8
Iron-rich foods consumption		
Poor	353	41.7
Good	493	58.3
Child's consumption of dark green leafy vegetables		
No	620	73.3
Yes	226	26.7
Maternal anemia (n = 842)		
No	441	52.1
Yes	401	47.4
Fever in last two weeks		
No	620	73.3
Yes	226	26.7
Hemoglobin level (n = 1,133)		
Mild anemia (Hb from 10 to 10.9 g/dl)	361	42.7
Moderate to severe anemia (Hb < 9.9 g/dl)	485	57.3

Table 2 displayed that child sex, consumption of dark green leafy vegetables, and maternal anemia were significantly associated with the severity of anemia in young children at a significant level .05. Male children (61.6%) were more likely to suffer moderate and severe anemia than females (38.4%) ($p < .001$). Children who consumed any dark green leafy vegetables were less likely to have moderate/ severe anemia than those who did not consume any dark green leafy vegetables (30.3% vs 69.7%, respectively with $p = .006$). Lastly, the prevalence of children with moderate to severe anemia was high in anemic mothers (50.8%) when compared to no anemic mothers (49.2%) ($p = .031$).

Table 2: Relationship between child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia, and fever in last 2 weeks and anemia severity (N = 846)

Variables	Severity of anemia				χ^2	p-value
	Mild		Moderate/Severe			
	n	%	n	%		
Underlying determinants						
Child sex					30.01	< .001*
Female	207	57.3	186	38.4		
Male	154	42.7	299	61.6		
Wealth index					3.98	.137
Poor	183	50.7	264	54.4		
Middle	65	18.0	99	20.4		
Rich	113	31.3	122	25.2		
Iron-rich foods consumption					0.43	.514
Poor	146	40.4	207	42.7		
Good	215	59.6	278	57.3		
Child's consumption of dark green leafy vegetables					7.50	.006*
No	282	78.1	338	69.7		
Yes	79	21.9	147	30.3		
Maternal anemia					4.64	.031*
No	204	56.7	237	49.2		
Yes	156	43.3	245	50.8		
Immediate determinant						
Fever in last 2 weeks					2.75	.097
No	254	70.4	366	75.5		
Yes	107	29.6	119	24.5		

In Table 3, child sex, consumption of dark green leafy vegetables and maternal anemia could significantly predict the severity of anemia among children aged 6 to 23 months ($p < .05$) among the total of six independent variables. Males had a 2.14 times increased risk of moderate to severe anemia than females (OR = 2.13, 95%CI [1.61, 2.83], $p < .001$). Children who consumed dark green leafy vegetables had lower odds of moderate to severe anemia by 35% (OR = 0.65, 95%CI [.47, .91], p = .012). Children who consumed dark green leafy vegetables (DGLV) are 35% less likely to experience the moderate to severe anemia compared to those who did not consume them (OR = 0.65, 95%CI [.46, .90], p = .010. Also, the odds of moderate/severe anemia in children with anemic mothers were 1.37 times higher than those of mothers with no anemia group (OR = 1.37, 95%CI [1.03, 1.82], p = .029). In this study, all independent variables could explain 7.3% (Nagelkerke R^2 = .07) and the Hosmer-Lemeshow goodness-of-fit test yielded a chi-square statistic of 4.77 with a corresponding p = .78 (Table 3).

Table 3: Logistics Regression Analysis of child sex, wealth index, iron-rich foods consumption, consumption of dark green leafy vegetables, maternal anemia, and fever in last 2 weeks and anemia severity on moderate to severe anemia (N = 846)

Variables	Odds ratio	95%CI Lower, Upper	p-value
Underlying determinants			
Child sex			
Female	(Reference)		
Male	2.14	1.61, 2.83	< .001
Wealth index			
Poor	1.32	.94, 1.84	.106
Middle	1.31	.86, 1.99	.207
Rich	(Reference)		
Iron-rich foods consumption			
Poor	(Reference)		
Good	0.90	.67, 1.20	.502
Child's consumption of dark green leafy vegetables			
No	(Reference)		
Yes	0.65	.46, .90	.010
Maternal anemia			
No anemia	(Reference)		
Anemia	1.37	1.03, 1.82	.029
Immediate determinant			
Fever in last 2 weeks			
No	(Reference)		
Yes	.77	.56, 1.06	.108

Nagelkerke R^2 = .073, Hosmer and Lemeshow test: χ^2 = 4.77, p = .78

Discussion

This study recognized the factors that could affect the anemia severity of children aged 6 to 23 months in Myanmar. In the present study, child sex was found to be a significant predictor of the severity of anemia among young children. Males had double higher risk of moderate to severe anemia than females. This disparity could be explained by many facts, first, this study focused on moderate to severe anemia as compared with mild anemia. The second is that boys have a higher growth rate than girls. The third reason is that boys are naturally playful and they use more energy and nutrients than girls. The data of the present study have the same findings as the other research and support the previously documented relationships between lower Hb levels and male gender.[12] One biological explanation is that several genetic forms of anemia are X-linked (for example, G6PD deficiency and X-linked sideroblastic anemia) and are more common in males.[1] Additionally, sociocultural practices in some communities may influence nutrition and care, potentially affecting boys and girls differently. However, in Myanmar, while most families raise children without gender preference, variations may still exist across different ethnic groups or socioeconomic backgrounds. These findings highlight the need for sex-specific strategies in anemia prevention and intervention programs, particularly targeting the early nutritional needs of male children.

Children eating dark green leafy vegetables is a significant predictor of the severity of anemia among young children in the study. This result confirms the study's hypothesis regarding the protective effect of vegetable consumption on anemia severity. The finding are consistent with previous study conducted in Ethiopia[18] where inadequate consumption of DGLVs has been identified as a key contributor to childhood anemia. The possible cause is that the percentage of eating those vegetables in the current study was only 26.7% within 24 hours before the survey based on the mother's memory recall which may lead to recall bias. Another clarification is cultural habits of cooking as overcooking foods for an extended period which may lose the important nutrients. Even though the youngsters ate the vegetables, they did not reap the full benefits of nutrition. Furthermore, most of the study population were living in rural areas of Myanmar and in the poor quantile, which had difficult access to health knowledge and could not afford to get a variety of foods. A deficiency in macro- and micronutrients including iron, B12, and folate which are abundant in dark green leafy vegetables, is essential for the creation of blood cells, can result in anemia. A lack of DGLVs consumption frequently indicates a lack of dietary diversification, which exacerbates anemia by weakening the immune system and causing malnutrition. Additionally, low hemoglobin levels have been associated with the issue as well as nutrient impairment, poor absorption,

insufficient absorption of bioavailable nutrients, bleeding, and immune-based RBC breakdown.[12] These findings suggest that relying solely on green leafy vegetables without considering iron bioavailability and dietary context may not effectively reduce anemia severity. Nutritional interventions should focus on improving both iron intake and absorption to combat childhood anemia effectively.

Another predictive factor for the severity of childhood anemia in the study was maternal anemia. Children of anemic mothers had a higher chance of developing moderate to severe anemia. This result was aligned with the previous studies in Myanmar.[16,23] This study explained that the maternal anemia quantity was the largest in magnitude, while child and mother variables had the highest incremental explanatory power. There may be several shared characteristics between mother and child that contribute to anemia, explaining the substantial correlation between maternal and pediatric anemia.[8] Another study showed that the strong links between maternal anemia and their offspring raise the possibility of intergenerational anemia, which has long-term detrimental impacts on a child's physical and mental health as well as their development.[24] Maternal anemia reflects the nutritional problem of the children, particularly during pregnancy and the postpartum period. If mothers have anemia, children are likely to be more suffer the risk of anemia. Because they share the same food items even though they have different requirements for daily intake. Besides this, mother and child share the same socioeconomic circumstances, which may eventually have an impact on the child's dietary quality in a similar manner as the mother. Improving maternal anemia is essential for both maternal and childhood anemia.

The wealth index could not significantly predict the severity of anemia in the study. One possible explanation for why wealth status did not predict the severity of anemia in children in this study was that half of the children studied were in the low quantile in the current study. The age of the sample is young children under 23 months ($\overline{X}$ = 14.64, SD = 4.96), the food appropriate for this age is easy to find such as eggs, fish, and vegetables, and also some mothers provide breastfeeding. They need a small amount for their daily requirement as compared with the adult. That might not be the biggest burden for the family. It is possible that even wealthier families may lack awareness of proper nutritional needs for children or may follow traditional dietary restrictions that contribute to poor iron intake. Therefore, public health interventions should focus not only on economic disparities but also on education and behavior change to effectively address childhood anemia.

The consumption of iron-rich foods by the children could not significantly predict the severity of anemia in the study. The reason for not supporting the hypothesis of the study was more than half of the participants (58.3% in Table 1) expected good habits in the consumption of at least one of four

iron-rich food items during the last 24 hours. Also, anemia is influenced by the body's uptake of iron, which is inadequate or insufficient so the caloric needs in the body are lacking in daily food composition and the lack of variety in foods, particularly those containing high iron, can affect the absorption or absorption of inadequate iron in the body, which in turn affects anemia.[25] However, this study only investigated moderate to severe anemia compared with the mild anemia group.

According to the present study, fever in the last 2 weeks could not significantly predict the severity of anemia in the study; the study's hypothesis was not supported according to this outcome. This can be explained by three reasons. The first reason is the mothers need to recall the memories of the past two weeks at the time of the survey. That is why there might be missing or wrong information. And the second one is that among the received information almost 73% of the babies did not have a fever. The difference between the percentage of no fever and fever is relatively high, which might not show the actual result. Due to the design of secondary data analysis and data limitations, some factors are not considered, such as iron status pointers (ferritin, iron, zinc, or retinol), infection/inflammation biomarkers, the knowledge, and attitude of mothers that are vital for promoting children's nutrition and preventing anemia. Therefore, the study could not reflect the current situation, and further studies are needed.

Conclusion and Recommendations

The study found that the three study variables including child sex, consumption of dark green leafy vegetables, and maternal anemia could together predict 7.3% of the anemia severity among children aged 6 to 23 months. Among the study variables, child sex is one of the significant determinants, boys have a twofold risk of moderate/severe anemia than girls. Nurses should pay more attention to taking care of boys with anemia and not shift from mild anemia to moderate/severe anemia which leads to serious health problems. Furthermore, the prevalence rate of anemia in males is primarily higher than in females in this study. That information should be considered by the nurses in providing health education about nutrition or infant feeding practice during the pregnancy period at the Antenatal Care Visit (ANC) or postnatal period. Nurses also should make sure and check the knowledge and understanding level of mothers relating feeding to their children, especially the mothers of baby boys.

Another significant predictor of childhood anemia severity in this study was the consumption of dark green leafy vegetables. Nurses should explain and encourage mothers how to prepare and feed DGLVs to young children. Besides this, nurses should establish a special health education program about cooking and food preparations for all pregnant and lactating mothers. For policymakers, it is recommended to provide health promotion through different media and community outreach about infant and young child feeding practices.

Maternal anemia was the last significant determinant of anemia severity in young children. Nurses should raise awareness about anemia signs in both mothers and children and stress the importance of proper nutrition, address harmful traditional practices during pregnancy and the postnatal period. Therefore, nurses should develop and apply programs about the nutrition education of mothers at ANC clinics or hospitals. The authorities should make a mandatory policy in all healthcare sectors to get easily accessible blood testing for the mothers' hemoglobin and provide treatment as early as possible based on the blood results. To conclude, this study suggests that multiple health and nutrition programs are necessary to control childhood anemia severity in Myanmar.

Limitations of the study

To begin, the study used the Myanmar Demographic Health Survey (2015-2016) to identify only mothers with children aged 6 to 23 months. As a result, the report did not accurately reflect the current state of practice. As a result, updated data or studies for the most recent situations are required to develop. Second, because MDHS 2015-2016 was a cross-sectional study, the data cannot be used to draw any inferences regarding the causality of the correlations. Third, the MDHS 2015-2016 did not measure the status of micronutrients such as iron status pointers (ferritin, iron, zinc, or retinol), infection/ inflammation biomarkers, limiting the understanding of anemia causation in terms of IDA or non-IDA prevalence. Future research is needed to investigate these indicators to gain a better understanding of anemia. As a result of the incompleteness of the questions and material, some major potential factors that could affect practices were overlooked.

Strength of the study

Despite that the present study used secondary data analysis, it focused on anemia severity among children 6 to 23 months and the predicting factors while limited primary studies were found in Myanmar. Therefore, this study provides information about anemia severity and its determinants among children aged 6 to 23 months in Myanmar. Moreover, the findings of the present secondary data analysis have generalizability for the whole country, as the original data source was nationally representative data.

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