Research Article

Trends and Determinants of Anemia in Children Under Five: A Retrospective Study at Morogoro Regional Referral Hospital, Tanzania

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Abstract

Anemia remains a significant public health issue among children under five, particularly in developing countries, where it contributes to impaired cognitive and physical development, increased morbidity, and mortality. This study aimed to assess the prevalence and determinants of anemia among children attending Morogoro Regional Referral Hospital, Tanzania, using a retrospective cross-sectional approach. Data were collected from medical records of 374 children from 2015 to 2020, and statistical analyses were conducted to identify trends and risk factors. The findings revealed a steady decline in anemia prevalence from 72% in 2015 to 33% in 2020, suggesting improved healthcare interventions. However, anemia remained prevalent, particularly among children under two years old (AOR=7.8, P=0.001), those with malaria infections (AOR=19.66, P=0.001), and those consuming tea with sugar (AOR=0.052, P=0.007). While female children were more affected in 2015, male children had higher prevalence rates in subsequent years. Dietary habits also played a crucial role, with low consumption of iron-rich foods and high intake of inhibitory substances such as tea contributing to anemia. The study underscores the multifactorial nature of anemia, involving nutritional deficiencies, infectious diseases, and cultural dietary practices. The observed decline in prevalence reflects progress in healthcare services, yet the persistence of high anemia rates highlights the need for sustained interventions. It is recommended that targeted public health measures be intensified, including community-based nutrition education programs, increased access to iron supplementation, malaria prevention strategies, and awareness campaigns on dietary practices. Policymakers, healthcare providers, and stakeholders should collaborate to develop culturally sensitive and sustainable anemia control programs. Further research is needed to explore additional underlying causes and evaluate the effectiveness of current intervention strategies in reducing anemia burden among children in Tanzania.

Keywords

Anemia, Children, Risk Factors, Morogoro Hospital, Tanzania

1. Introduction

Anemia is a condition characterized by a decrease in the number of red blood cells or a reduction in the blood's capacity to carry oxygen, leading to symptoms such as fatigue, weakness, and impaired development [1, 2]. Globally, anemia affected approximately 1.62 billion people, with the highest burden observed among children under five years old, particularly in developing nations [1, 2]. According to the World Health Organization [3], anemia in children under five was defined by hemoglobin levels below 110 g/L.

Iron deficiency was the leading cause of anemia, accounting for nearly 50% of cases globally among children under five years old. This was primarily due to insufficient consumption and poor absorption of iron-rich foods such as meat and its derivatives [4]. In 2011, global data indicated that 43% of children under five were anemic, with the highest prevalence found in developing regions. For example, sub-Saharan Africa recorded prevalence rates of 58% in Southern Africa and 55% in Eastern Africa [5]. Studies from Kenya, South Africa, and Tanzania revealed even higher prevalence rates, ranging from 71% to 79% [6]. In Tanzania, the 2015 Tanzania Demographic and Health Survey (TDHS) reported that 58% of children under five were anemic [7]. A subsequent study conducted in Mwanza, Tanzania, recorded an anemia prevalence of 77.2%, with 16.5% of children suffering from mild anemia, 33% from moderate anemia, and 27.7% from severe anemia [6]. Similarly, research in Arusha, Tanzania, reported an alarming prevalence of 84.6%, identifying low birth weight and dietary deficiencies as the primary contributors [8].

The consequences of anemia in children extended beyond immediate health concerns. It adversely impacted mental, physical, and social development, resulting in poor motor and cognitive skills, reduced school performance, and diminished productivity in adulthood [8]. These long-term effects contributed to decreased earning potential and hindered national economic growth. Additionally, anemia compromised immune function, increasing susceptibility to infections and leading to higher morbidity and mortality rates. Despite global efforts to address childhood anemia, it remained a persistent public health challenge, particularly in resource-limited settings like Tanzania. Anemia significantly hindered cognitive and physical development, further impeding children's future academic and professional achievements [9]. Limited resources for diagnosing and treating underlying causes exacerbated the severity of anemia in African children.

Assessing the prevalence and risk factors of anemia in specific populations was essential to formulating effective interventions. Factors such as nutritional deficiencies, genetic disorders, and infections contributed to the condition's complexity [8]. However, the lack of comprehensive data in regions like Morogoro underscored the need for targeted research. Understanding local trends and causes would aid in developing tailored prevention and treatment strategies, ultimately improving child health outcomes and reducing socioeconomic burdens. This study aimed to determine the prevalence and associated factors of anemia among children under five attending Morogoro Regional Referral Hospital. The findings were expected to provide valuable insights into the trends of anemia in this population and inform evidence-based strategies for prevention and management.

2. Materials and Methods

2.1. Study Area and Duration

The study was conducted at Morogoro Regional Referral Hospital, a key healthcare facility situated near Old Dar es Salaam Road in Morogoro, Tanzania, January 2021. This hospital is a pivotal referral center, providing specialized medical services to patients referred from a network of 14 district-level hospitals, 26 health centers, and 240 dispensaries across the region. The hospital plays a crucial role in the healthcare system, serving a large population of approximately 1.76 million people [10]. In addition to its referral function, the hospital also serves as a key point for medical research and training, offering a unique environment for studies that aim to assess health trends, healthcare practices, and disease burden in the region. The diverse patient population from rural and urban areas alike also provides a rich source of data for understanding health challenges and the effectiveness of various healthcare interventions. As such, the findings of studies conducted at this hospital have the potential to inform public health policies and interventions aimed at improving healthcare outcomes in Tanzania.

2.2. Study Design

A retrospective study design was utilized to assess the prevalence and identify the associated risk factors of anemia among children under five years of age attending Morogoro Regional Referral Hospital. This study design involved reviewing existing medical records and data from patients who had previously been treated at the hospital. By analyzing these records, the researchers aimed to determine how widespread anemia was among young children in the region and to identify potential risk factors that might contribute to its occurrence.

2.3. Sampling and Sample Size

A total sample size of 374 children was determined. The formula used to calculate sample size is $n = (Z^2 P (1-P))/d^2$ whereby; Z= (level of confidence interval 95%= 1.96), P=

(prevalence of anemia 58% =0.58) [11], and d= (precision in proportion of 5%= 0.05). Systematic random sampling was used to select participants.

2.4. Data Collection and Analysis

Data for the study were collected from hospital records, including laboratory test results and medical reports, for children under five years old between 2015 and 2020. Data analysis was conducted using SPSS version 20. Descriptive statistics were initially applied to summarize the data, followed by univariate analysis to assess individual variables. Multivariate logistic regression was then used to identify the factors influencing the prevalence of anemia among the children. The independent variables included sex, age, body weight, diet, and illness history, while the dependent variable was the prevalence of anemia.
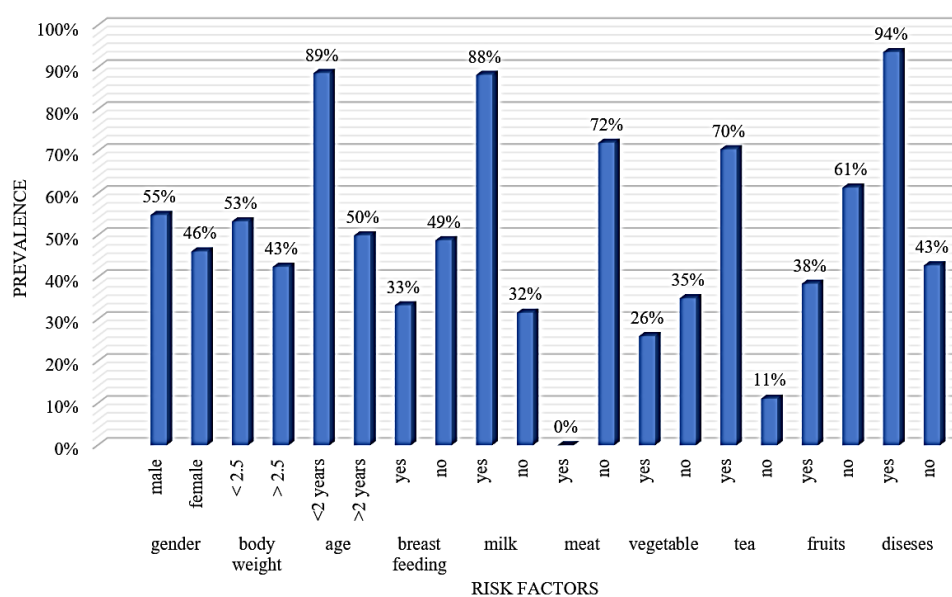
3. Results

3.1. Prevalence of Anemia

Between 2015 and 2020, a total of 374 children participated in the study each year. The study involves the collection of data from 2015-2020 whereby the prevalence of each year was calculated. The overall prevalence of anemia decreased from 72% in 2015 to 33% in 2020. While female children were more affected in 2015, male children showed higher prevalence rates in subsequent years (Table 1).

Table 1. Counts and prevalence of anemia of under-five years children from 2015 to2020.

Year	Counts per Sex			Prevalence per sex		Mean	Overall Prevalence
	Male	Female	Sum	Male%	Female%		
2015	122	148	270	45%	55%	26%	72%
2016	135	76	211	64%	36%	20%	56%
2017	121	60	181	67%	33%	17%	48%
2018	98	47	145	68%	32%	14%	39%
2019	70	54	124	56%	44%	12%	33%
2020	84	40	124	68%	32%	12%	33%
TOTAL	630	425	1055	60%	40%		

Figure 1. Prevalence of anemia based on risk factors.

3.2. Prevalence of Anemia Based on Risk Factors

The findings indicate that children under two years of age had the highest prevalence of anemia (89%), while those above two years had a significantly lower prevalence (50%). Dietary factors played a crucial role, as children who consumed meat (72%) and tea (70%) had a higher prevalence compared to those who did not, whereas fruit and vegetable intake was associated with lower prevalence rates (38% and 26%, respectively). Additionally, the presence of disease was the strongest predictor, with 94% of children with diseases affected by anemia, compared to 43% of those without (Figure 1).

3.3. Associated Risk Factors

Multivariate logistic regression revealed significant associations between anemia and factors such as age below two years, malaria, consumption of tea with sugar, and milk intake. For instance, children below two years were 7.8 times more likely to develop anemia (P=0.001), while those with malaria were at a significantly (P=0.001) higher risk (Table 2).

Table 2. Logistic regression analysis showing the associated risk factors of anemia.

Variable		Number	Anemia%	AOR (95% C. I)	p-value
Body weight	>2.5 kg	16	53%	1.74(0.6-4.4)	0.200
	< 2.5 kg	17	43%		
Age	< 2 years	39	89%	7.8(2.3-26.1)	0.001
	> 2 years	13	50%		
Meat	consumed	0	0%	0.00(00-)	0.999
	not consumed	49	72%		
Milk	consumed	45	88%	16.25(4.47-58.79)	0.0000
	not consumed	6	32%		
Vegetable	consumed	45	90%	0.653(0.214-1.990)	0.451
	not consumed	6	30%		
Fruits	consumed	10	38%	2.54(0.938-6.882)	0.067
	not consumed	27	61%		
Tea with sugar	drink	43	70%	0.052(0.006-0.449)	0.007
	do not drink	1	11%		
Malaria	diseased	59	94%	19.66(3.22-119.84)	0.001
	not diseased	3	43%		
Breasting	yes	9	33%	0.524(0.193-1.42)	0.202
	no	21	49%		

4. Discussion

The observed decline in anemia prevalence in Morogoro from 2015 to 2020 signifies notable progress in public health interventions aimed at anemia prevention and treatment. This improvement is likely attributed to enhanced healthcare infrastructure, increased distribution of iron supplementation programs, and improved access to fortified foods. For instance, a study by Gunaratna *et al* [12] demonstrated the positive impact of iron-fortified foods and supplements in reducing anemia prevalence globally, supporting the potential contribution of similar programs in Morogoro. Nonetheless, the current anemia prevalence rates remain alarmingly high, indicating that further efforts are required to address the underlying determinants.

The higher anemia prevalence observed among younger children highlights their vulnerability due to rapid growth and increased nutritional needs [13]. Inadequate complementary feeding practices during this critical period likely exacerbate

the issue. Previous studies in Tanzania and Sub-Saharan Africa have similarly reported that younger children are at a higher risk of anemia due to insufficient dietary iron intake and poor dietary diversity [14]. This emphasizes the importance of promoting optimal infant and young child feeding practices, including the timely introduction of nutrient-dense complementary foods.

The association between malaria and anemia observed in this study aligns with established evidence that malaria significantly contributes to anemia through hemolysis and impaired hemoglobin synthesis [15, 16]. The findings reinforce the need to strengthen malaria control measures, such as scaling up the use of insecticide-treated nets (ITNs), enhancing access to effective antimalarial treatments, and implementing community-based malaria education programs. A study in rural Tanzania by Smithson *et al*. [17] reported a significant reduction in malaria-related anemia following widespread ITN distribution, illustrating the potential of integrated malaria control strategies.

Dietary practices, such as the frequent consumption of tea with sugar and excessive milk intake, were identified as contributors to anemia. Tea contains tannins that inhibit iron absorption [18], while high milk consumption can interfere with iron absorption due to calcium-iron competition [19]. These cultural dietary habits are consistent with findings from other African countries where similar practices were linked to iron-deficiency anemia [20]. Nutrition education programs targeting caregivers are critical to promoting dietary practices that enhance iron bioavailability, such as pairing iron-rich foods with vitamin C sources to improve absorption.

This study underscores the multifactorial nature of anemia, where dietary habits, infections, and socioeconomic factors interact to influence its prevalence. Addressing anemia effectively requires a holistic approach that integrates healthcare access, nutritional interventions, and disease prevention strategies. Engaging stakeholders, including healthcare providers, community leaders, and policymakers, is essential for designing and implementing sustainable solutions. For example, community-based initiatives that combine nutritional education, disease prevention, and healthcare services have shown success in reducing anemia in other low-resource settings [21]. Future research should focus on longitudinal studies to evaluate the impact of existing anemia reduction programs and identify persistent gaps. Additionally, investigations into the role of emerging factors such as climate change, which may affect agricultural productivity and food security, could provide insights into new challenges and solutions for combating anemia.

5. Conclusion

The decline in anemia prevalence in Morogoro from 2015 to 2020 reflects the positive impact of public health interventions, particularly improvements in healthcare infrastructure, iron supplementation programs, and access to fortified foods.

However, despite these gains, anemia remains a significant public health concern, especially among younger children, due to inadequate complementary feeding practices and increased nutritional demands. Malaria remains a major contributor to anemia, reinforcing the need for continued malaria prevention strategies such as insecticide-treated nets (ITNs), prompt access to antimalarial treatment, and enhanced community education. Additionally, dietary practices, such as excessive milk consumption and tea intake, further exacerbate iron deficiency, highlighting the importance of targeted nutritional education. The findings emphasize that anemia is a multifactorial issue requiring a comprehensive and integrated approach that combines healthcare access, nutrition, and disease prevention strategies. To further reduce anemia prevalence, it is essential to strengthen nutritional interventions by expanding iron supplementation programs, promoting optimal infant and young child feeding practices, and educating communities on dietary habits that enhance iron absorption. Additionally, enhancing malaria control strategies, improving healthcare accessibility, and fostering multisectoral collaboration among policymakers, healthcare providers, and community stakeholders will ensure sustainable and impactful anemia prevention efforts.

Abbreviations

NIMR	National Institute for Medical Research
ITNs	Insecticide-treated Nets
SPSS	Statistical Package for the Social Sciences
AOR	Average Odd Ratio

Acknowledgments

Author Contributions

ASS participated in the conceptualization of the idea, data collection, and analysis, while ARI also participated in the conceptualization and manuscript writing. All authors reviewed and approved the publication of the manuscript.

Ethical Considerations

The study protocol was evaluated and approved by the Ethical Review Committee of the National Institute for Medical Research (NIMR). Additionally, Sokoine University of Agriculture and Morogoro Regional Health Authorities granted permission to conduct the study.

Funding

Data Availability Statement

The data supporting the outcomes of this research have been reported in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Amina Ramadhani Issae is a Researcher and Consultant at the Institute of Pest Management, Sokoine University of Agriculture, Tanzania. She holds a PhD in Public Health and has extensive experience in zoonotic diseases, vector control, and sustainable pest management. Her research focuses on bacterial, viral, and parasitic diseases of public health importance. She is an expert in metagenomic studies of various pathogenic and zoonotic microbes in humans, rodents, and dogs. Additionally, she has conducted research on malaria cases and the use of bed nets in malaria-endemic areas of Tanzania. Dr. Issae has led and participated in multiple research projects, addressing innovative strategies for pest and vector management, climate change and antimicrobial resistance. She is actively involved in the development of sustainable interventions, including community outreach initiatives and field trials for innovative pest control technologies. In addition to her research, she contributes to scientific conferences, proposal writing, capacity-building programs and serve as a reviewer of various academic journals.

Research Field

Asha Shaibu Saidi: She is a graduate of the Bachelor of Science in Biotechnology and Laboratory Sciences program at Sokoine University of Agriculture (SUA) in Morogoro, Tanzania. This program equips students with a comprehensive understanding of biotechnology applications, molecular biology techniques, and laboratory practices essential for addressing challenges in public and animal health sectors.

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