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Research Article

Malaria Parasitaemia, Anaemia and Malnutrition in Children Under 17 Years in Awing-Santa Health District North West Region of Cameroon

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Abstract

Introduction: Malaria parasitaemia and malnutrition are major factors contributing to high mortality rates, especially among children in sub-Saharan Africa. In regions where malaria is endemic, it plays a significant role in causing anaemia, further exacerbating the health burden. The study aimed to assess the prevalence of malaria parasitaemia, anaemia and malnutrition in children less than 17 years in Awing - Santa health district.

Methodology: This was a hospital-based cross -sectional study. Malaria parasitaemia was confirmed through light microscopy and FIRST RESPONSE rapid diagnostic test was used. Haemoglobin levels were measured with an ACCU Answer ISAW analyzer, while malnutrition was assessed using mid-upper arm circumference measurements. Socio-economic and socio-demographic data of the children were collected using questionnaires. The World Health Organization defines anaemia based on Haemoglobin concentration in the blood, with thresholds that vary by age, sex, and pregnancy status. For children aged 6months to 15 years Haemoglobin levels less than 11.5g/dl is considered anaemic. The World Health Organization uses several indicators to assess malnutrition, Mid-upper Arm Circumference was used to identify severe acute malnutrition, especially in children. A MUAC of less than 11.5cm is often used as a cutoff for severe malnutrition. Data was analyzed using SPSS version 27.

Results: A total of 340 children aged from (9months -17years) were enrolled into the research while 58.2% of them were female and 41.8% were male, 61.2% were of school going age and 94.1% were from Christian homes. Out of the 340 children 19.7% tested positive for malaria, and 10.6% of the malaria cases were moderate parasitaemia. The prevalence of anaemia was 9.4% and was common among males. According to Mid- upper arm circumference classification the prevalence of acute malnutrition was 15.3%, Moderate malnutrition was higher within the age range 10 years and above with the mid-upper arm circumference of 16cm-17.9cm, Severe malnutrition was higher within the age range 10years and above with the mid-upper arm circumference of less than 16cm.

Conclusions: Moderate malaria parasitamia, moderate aneamia and acute severe malnutrition was recorded in the childern. There was a statistically significant relationship ($p < 0.001$) between the occurrence of malaria and anemia in the sample population. Campaigns should be carried out by community health experts in Awing to sensitize parents on proper nutrition of children to prevent the children from infections and aneamia.

Keywords: Malaria Parasitemia; Malnutrition; Arm Circumference Measurements; Aneamia

Introduction

Malaria is a critical public health issue, with 247 million cases reported globally in 2021 across 84 endemic countries. Significant progress was made from 2000 to 2019, with the malaria death rate halving and the death among children under 5 decreasing nearly 45%. However, there was a 10% increase in malaria death from 2019 to 2020, attributed to COVID-19 service disruption, followed by a decline in 2021 [1]. In Cameroon, malaria is the leading endemic disease, with 2.7 million reported cases annually, affecting school and work attendance, after a stagnation since 2011, cases have risen since 2017, with rising deaths prompting the government to prioritize malaria control using treated bed nets and strategic plan. Malaria is a major cause of child mortality in the country, claiming a child's life every two minute. Malaria infection contributes to high rates of anemia and malnutrition. Particularly among children in sub-Saharan Africa. Anemia results from low hemoglobin levels in blood, impairing oxygen delivery to the body [2].

Malaria significantly contributes to anemia in endemic regions, particularly in Cameroon, where over 75% of the population has access to insecticide-treated nets. It is essential to re-evaluate the impact of malaria parasitaemia on anemia and to developed tailored management strategies that reflect local variations, while there is a recognized link between nutritional status and immune response to infection, studies on the relationship between malnutrition and malaria have yielded mixed results [3]. Some research indicates that malnutrition increases the risk of *Plasmodium* infection, while others find no connection to mortality from malaria. In Sahelian countries, malnutrition and malaria frequently co-occur, causing high morbidity and mortality rates in children under five. The United Nations Children's Fund reported that 38% of children under five in sub-Saharan Africa are chronically malnourished or stunted, with malaria and malnutrition being the leading causes of child mortality [4].

Anemia is a significant factor contributing to stunting, a prevalent type of malnutrition in children. Stunting can hinder cognitive development, educational achievements, and physical work capacity in adulthood, adversely affecting economic growth in societies [5]. Although global stunting rates decreased from 39.6% to 23.8% between 1990 and 2014, Africa has experienced an increase. The relationship between nutritional status and malaria can differ due to variations in the study population and parasite species [6].

Material and Methods

Type and duration of study

A cross-sectional descriptive study was conducted at Awing Medicalized Health Center in children aged 9months to 17 years from February to May.

Study site and participants

The study population is made up of children aged 9 months to 17 years in Awing. In Awing Village children make a submental amount of the population.

Sample collection and processing

The mid-upper arm circumference was measured to evaluate malnutrition in children MUAC measurements utilized a color-coded tape made of three colors, the Green indicating nutritional status, yellow indicating moderate acute malnutrition and red indicating severe acute malnutrition.

Venous blood was collected into an EDTA tube from all participants. The tubes were labeled with each participants' name; hemoglobin concentration was measured in the laboratory using (Accu-Answer isaw Hemoglobin test meter. A drop of blood was placed on the hemoglobin strip, the device shines light through the blood sample, the meter measures the amount of light absorbed by the hemoglobin in blood and based on the absorption data, and the device calculates the hemoglobin concentration and displays the results which are compared to normal ranges.

Samples were screened for malaria parasite using a rapid diagnostic test kits specific for P. falciparum (FIRST RESPONSE) and by microscopic examination of thick and thin blood films.

Ethical consideration

Ethical clearance for the research was gotten from the Ethical Review Committee/Institutional Review Board of the University of Bamenda. Administrative authorization for the research was also obtained from the Regional Delegation of Public Health for the North-West region. Authorization was also obtained from the General Supervisor of the Awing Medicalized Health Center. Only participants who agreed to participate in the study after receiving clear explanations about the research were asked to sign the consent form and complete the questionnaire.

The data of this study are confidential. At the time of publication, no identification of the participants has been disclosed to anyone.

Results

Socio-demographic characteristics of the study participants

A total of 340 participants were included in this study. A Socio-demographic characteristic of the study participants showed that most of the participants (198; 58.2%) were female and were neonates and infants between the ages of 3m-5years (214; 62.9%). Most participants (132; 38.8%) were not of school going age and most of the participants were Christians (320; 94.1%).

Variables	Category	Frequency	Percentage (%)
Gender	Female	198	58.2
	Male	142	41.8
Age range/ Years	9m-5	214	62.9
	>5-10	86	25.3
	>10-17	40	11.8
Educational Level	None	132	38.8
	Nursery	49	14.4
	Primary	126	37.1
	Secondary	33	9.7
Religion	Christian	320	94.1
	Muslim	20	5.9
Total		340	100.0

Table 1: Socio-demographic characteristics of study participants (N = 340).

Prevalence of malaria parasitaemia among children in awing

Out of 340 participants tested for malaria, 67 were positive for malaria infection. The prevalence of malaria was thus 19.7%.

Malaria Results	Frequency	Percentage
Negative	273	80.3
Positive	67	19.7
Total	340	100.0

Table 2: Prevalence of malaria (N = 340).

Determination of hemoglobin levels

The results indicated that out of 340 children whose Hb levels were measured, 32 participants had hemoglobin levels which were anemic. The prevalence of anemia among study participants was 9.4% the severity of anemia showed that most of the participants (18; 5.3%) had mild anemia.

Anemia results	Frequency	Percentage (%)
Normal (>11g/dl)	308	90.6
Mild (10-10.9g/dl)	18	5.3
Moderate (8.0-9.9g/dl)	13	3.8
Severe (<8g/dl)	1	.3
Total	340	100.0

Table 3: Prevalence of Anemia in children (N = 340).

Assessment of acute-malnutrition using Mid-upper arm circumference measurements

In a study of 340 children, 52.9% of those aged 9months to 4 years had a mid-upper arm circumference greater than 13 cm,

indicating normal nutrition. For children aged 5 to 9 years, 26.5% had a MUAC greater 14.5cm, also classified as normal. Among children aged 10 years and older, 5.3% had a MUAC greater than 18cm and were considered normal.

Additionally, 0.6% of the children aged 9months to 4 years were moderately malnourished with a MUAC between 11 to 13 cm. For those aged 5 to 9 years, 3.5% were moderately malnourished with a MUAC between 13.5 to 14.5 cm, and 4.1% of the children aged 10 and over were similarly classified with a MUAC between 16 to 18 cm.

Severe malnutrition was identified in 0.65 of children aged 9 months to 4 years with a MUAC under 11 cm, 0.6% of those aged 5 to 9 years with a MUAC below 13.5% and 0.75% of children aged 10 and older with a MUAC less than 16 cm.

Age Range	MUAC (cm)	Frequency (%)	Classification
9m-4 years	>13	180(52.9)	Normal (Healthy)
5-9	>14.5	90(26.5)	
10+	>18	18(5.3)	
9m-4	11-13	2(0.6)	Moderate malnutrition
5-9	13.5 -14.5	12(3.5)	
10+	16-17.9	14(4.1)	
9m-4	<11	2(0.6)	Severe malnutrition
5-9	<13.5	2(0.6)	
10+	<16	20(5.9)	

Table 4: Classification of malnutrition using MUAC in children according to age range.

Relationship between malaria and anemia

The results showed that most of the participants who had malaria were non-anemic (39; 11.5%). Milder (16; 4.7%), and moderate (12; 3.5%) anemia occurred in participants who had malaria. However, the greater majority of the participants (269; 79.1%) was non-anemic and didn't have malaria. There was a statistically significant relationship (p <0.001) between the occurrence of malaria and anemia in the sample population.

Malaria Results	Anemia Results				p-value
	Non-Anemic (>11g/dl) (%)	Mild Anemia (10-10.9g/dl) (%)	Moderate Anemia (8.0-9.9 g/dl) (%)	Severe Anemia (<8g/dl) (%)	
Negative	269(79.1)	2(0.6)	1(0.3)	1(0.3)	<0.001
Positive	39(11.5)	16(4.7)	12(3.5)	0(0.0)	
Total	308(90.6)	18(5.3)	13(3.8)	1(0.3)	

Table 5: Relationship between malaria and anemia of study participants (N = 340).

Discussion

Malaria, a parasitic infection, significantly impacts the nutritional status of children, which in turn influences their immune response to infections. Malaria often coincides with other diseases and poor socioeconomic conditions, acerbating health risks and child development challenge Abass., *et al.* [7].

Socio-demographic characteristics of the participants

Results from this study showed that most of the children were female, neonates and infants. This corresponded to a study carried out by Abass., *et al.* [7] which was due to the differences in cultural, social, behavioral and environmental aspect which influences

one's risk of exposure to the parasite, preventive measures and perception of illness and seeking timely treatment. Most of the participants were children from 9 months to 5 years old as their immune system is still immature and prone to infections. Christians were more in this study as compared to Muslims.

Prevalence of malaria parasitaemia among children in Awing

The prevalence of malaria parasitaemia in the study was 19.7%, lower than a study carried by Sumbele., *et al*. around the slopes of Mount Cameroon shows higher results of 41.7% [1] and a study conducted in Nanoro in Burkina Faso among children under five years also shows higher results of 26.7% [8]. The results from these study were lower than national prevalence of 30.3% of the malaria parasite in Cameroon [9]. The decline may be linked to recent government interventions in Cameroon, such as distributing insecticides-treated nets, along with changes in treatment approaches. Reduced malaria burden has also been observed in other endemic countries like Kenya [10] and Tanzania [9]. In 2004, initiative in Cameroon, including free treatment of children under five, likely helped reduced malaria incidence. The study indicated that boys had a higher risk of malaria infection 10.6% compared to girls 9.1%, particularly those aged 9 months to 5 years, likely due to their underdeveloped immune system and lack of preventive measures which was same as reported in male children in mount Cameroon region [11]. Also, a study in a high-risk malaria area found that children under five are particularly vulnerable to the transmission and impact of malaria, mainly because of their immature immune systems and increased exposure to the malaria parasite [7]. Also Christians 18.8% were more likely to be infected with the malaria parasite than Muslims. In this study the prevalence of anemia was 9.4%, which was lower 56.2% in a study done by Sumbele., *et al*. at mount Cameroon [1]. The lower prevalence of anaemia in this study could be as a result that the malaria parasitaemia levels were moderate. The level of hemoglobin represents an independent risk factor for malaria infection, because anemia is a symptom of malaria and severe anemia is among the main criteria for the severity of the infection of malaria [12]. The Hb level was surprisingly higher in girls than in boys which was in line with a study carried out by Pongou., *et al*. Which suggested that, gender difference in Hb level was usually observed in male adolescence [15]. The prevalence anemia was higher in children 3m to 5 years aligns with previous research indicating that malaria and anaemia were more severe in areas with high transmission. This age group is particularly susceptible to malaria infections, which can lead to serious and potentially fatal complications.

Acute-malnutrition in the study participants

The prevalence of acute malnutrition was 15.2% which was lower than 25.7% in a study carried out by Sumbele., *et al*. in children less than 15 years [1]. Increased caregiver awareness of health and nutrition may have contributed positively to children's nutritional status. Results from this study was higher than a study carried out by Sumbele., *et al*. in a malaria meso-endemic area which was 5.5% [14]. Acute malnutrition was higher in girls 8.2% compared to boys 7%, contradicting previous study done by Kamugisha., *et al*. [13] indicated higher rates in boys across age groups. A meta-analysis showed boys in sub-Saharan Africa were generally more affected by acute malnutrition than girl. Infectious diseases exacerbate malnutrition, creating a harmful cycle [12]. Wasting, an acute form of malnutrition, has been linked as a risk factor for malaria due to poor immune responses, although this study found lower malaria parasitaemia in malnourished children compared to those well-nourished. This suggests malnourished children may have some protection from the infection's clinical effects but not form the parasite itself. Further studies are needed to explore this phenomenon in endemic areas [14].

Conclusion

The aim of this research was to assess the prevalence of malaria parasitaemia, anaemia and malnutrition in children less than 17 years in Awing.

The prevalence of malaria parasitaemia in children was moderate parasitaemia and the male children were more infected than the females, between the age range 9 months -5 years. Anemia was mostly moderate anaemia and higher in males as compared to females and between the age range 9months -5 years. The study also revealved that, among the children who were malnourished, most of them suffered from severe acute malnutrition.

Recommendations

Routine malaria test should be carried out once a month on children in malaria endemic setting like Awing and if malaria is suspected Haemoglobin test should be done.

Campaigns should be carried out by community health experts in Awing to sensitize parents on proper nutrition and health education of children.

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Authors' Contributions

BSB, conceived the study, designed the method, did the laboratory work, collected and transported samples, analysed data and drafted the manuscript. MCG, supervised the study, provided nutritional expert advice, drafted, edited and finalized the manuscript for publication. NON, approved the study, supervised and monitored the experimental design and laboratory work and reviewed the data analysis. All authors read and approved the final manuscript.

Conflict of Interest

None of the authors have a conflict of interest to disclose.

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