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ORIGINAL ARTICLE

Prevalence and trend of malaria with anemia among under-five children in Jasikan District, Ghana

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Abstract

Background: Malaria remains a major killer of children under-five, claiming the life of one child every two minutes globally. Despite the several interventions to reduce malaria and anemia, these diseases remain global public concerns. **Aim:** This study assessed the prevalence and trend of malaria and anemia in children under-five years from 2012 to 2016. **Subjects and methods:** We conducted a descriptive cross-sectional study among children under-five with malaria and anemia who received care at the hospital in Jasikan town, Ghana from 2012 to 2016. We computed descriptive statistics to describe the data. STATA version 14 was used to carry out the analyses. Binary logistic regression was used to determine the strength of association at a 5% significance level (P<0.05). **Results**: Out of 30,082 malaria cases, 835 were with anemia from 2012 to 2016. This study found an overall proportion of malaria with anemia as 28 per 1,000. The year 2014 recorded the highest proportion of 38 per 1,000 malaria cases of malaria with anemia. Overall, the prevalence rate of malaria and anemia cases were found to be 61.5% and 4.4% respectively. Children within 24-35 months' age group contributed the highest (28.3%) and 0-11 months accounted for the lowest (12.9%) malaria with anemia cases. The majority of malaria with anemia cases 63.6% occurred in the rainy season, between June to July. **Conclusion:** The proportion of malaria with anemia was high among children under-five and most children having malaria with anemia live in rural areas and during the rainy season.

Keywords: Prevalence, Trend, Malaria, Anemia, Under-five, Children, Jasikan, Ghana.

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1 Introduction

Malaria and anemia are often co-existing diseases that cause significant morbidity and mortality, especially among children under five years [1]. Studies have shown that children below the age of five years are at the greatest risk of being diagnosed and admitted for malaria infection than any other age group [2]. The predisposing factors of anemia in children under-five are diverse, ranging from low immunity, nutritional deficiencies, hookworm infection, HIV, hemoglobinopathies, and malaria [3]. In the tropical regions, malaria contributes to the high case fatality rate (>13%) of anemia in young children [3]. A category-specific study in Nigeria shows a high prevalence of anemia (51.4%) as a result of malaria parasites among children under-five [4].

Globally, almost half of the world's population live in malaria-endemic areas [5] and this disease remains a major killer of children under-fives, claiming the life of one child every two minutes worldwide [6, 7]. Malaria killed an estimated 303,000 children under-five years globally, including 292,000 in the Africa Region between 2010 and 2015 [7]. The disease accounted for more than 85% and 78% of deaths among African children under-five years in 2008 and 2013, respectively [8]. The burden is heaviest in sub-Saharan Africa, where an estimated 90% of all malaria deaths occur in children under five years, which accounts for 78% of all deaths [2, 3]. A survey among under-five children in Rwanda revealed that the prevalence of malaria with anemia was high among older children within the age-group 24-35 months compared to other age-groups [9]. Reduction in malaria and anemia trends among children under-five has been observed in several studies over the period 2000-2018 in Nigeria, Zanzibar and Rwanda [10, 11].

A study in Nigeria showed that malaria (77.6%) was the commonest condition causing severe anemia among children under-five [12]. Studies in Kenya and Indonesia have revealed anemia diagnosis status of a child positively associated with malaria in patients [13, 14]. Increased prevalence of malaria with anemia (1.6-22.0%) was shown in Papua New Guinea [13, 15]. Even though there was a decline in the prevalence of malaria among children under-five, the number of malaria infections was observed to increase during harmattan and the months of the rainy season, especially September in 2012 and 2013; and June in 2014 [10, 11, 16].

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In Ghana, malaria is hyper-endemic and accounts for 44% of outpatient attendance, 13% of all hospital deaths, and 22% of mortality among children under-five years of age presenting a serious health problem in the country [16, 17]. Furthermore, a retrospective study on malaria and associated co-morbidity in children admitted with fever manifestation in Western Ghana revealed the proportion of children with malarial anemia significantly increased, from 50% in 2010 to 79.2% in 2012 [18]. Findings from studies in Ejisu-Juaben and Hohoe, Ghana, reported that the prevalence of malaria and anemia was significantly higher during the pre-rainy season than the post-rainy season [19, 20]. The authors elaborated that rainfall increases the possible breeding grounds for mosquito larvae, eventually resulting in more vectors to spread the disease during the pre-rainy season.

Despite the above findings elsewhere, little information of this nature is known among children under-five in the Jasikan District of the Volta Region of Ghana. This type of information is important, as it will help to inform management decision making in the prevention and control of malaria with anemia among this population sub-group. The objective of the study was to assess the level and trends of malaria with anemia in young children, in the Jasikan district in Ghana.

2 Subjects and Methods

2.1 Study setting

The study was conducted in the Jasikan District Hospital located in the northern part of the Volta Region of Ghana, which is about 110 kilometers north-east of Ho, the regional capital. The District covers a total land area of 555.8 square kilometers representing 6.6 percent of the entire land area of the Volta Region. The district experiences a double maxima rainfall regime. The major season starts from May and ends in July with its peak while the minor season is from September to October with its peak in October. While the dry season is mostly between December and April, and it is generally characterized by cool and dry wind. A greater percentage (74.3%) of households in the district are involved in agriculture. The provision of health services is mainly by the government through the Ghana Health Service (GHS). The district has one hospital with six health centers or posts, three community health planning services (CHPS zones), and a private clinic distributed in the district [21].

2.2 Study design

The study was a hospital-based cross-sectional study in which patients' case files and consulting room registers were used to gather information for the assessment of the prevalence and trend of malaria with anemia at the hospital over five years (2012-2016).

2.3 Study population

The study population comprised children under-five years of age who attended the hospital between 2012 and 2016 and whose records were available for the period of study. Children without hospital records or incomplete records were excluded from the study. Also, children under-five years of age without any provisional or definitive diagnosis were excluded. A sample size of eight hundred and thirty-five (n=835) children under-five with malaria and anemia cases were extracted and compiled within the period. The population at risk was the group of children under-five years in the Jasikan District of Ghana, healthy or sick (susceptible), who were counted as the event of interest or if they had the disease (malaria with anemia) being studied at or during the period of interest. The population-at-risk was used as the denominator in calculations of measures of disease frequency [22].

2.4 Data collection

A pre-tested structured compilation sheet was used to retrieve data. Data were collected from relevant registers from January 2012 to December 2016. Criterion approach [23], which is a subset of purposive sampling, was used to select all malaria with anemia cases. Data on children under-five years of age that attended the hospital were collected. Also, data on the month and year of admission, age, sex, diagnosis, and treatment outcome were collected. A child under five years was considered as a case if s/he was diagnosed with malaria as principal disease and anemia as an additional disease. An indicator was selected and included in the analysis if more than 60% of participant information was available for the consecutive months and years.

2.5 Data processing and analysis

The data completeness and consistency were checked, variables were coded, and entered into IBM SPSS version 24.0 software. Data analysis was done using STATA version 14.0 (Stata Corp, Texas, USA) on two levels. Firstly, Analysis of proportions, prevalence, and relationship tests were done. We described the data by computing descriptive statistics, including percentages, frequencies, summary measures, while proportions were used to visualize the data, augmented with graphs. Bivariate analysis was conducted using the Pearson Chi-square test and binary logistic regression to determine the association and strength respectively of malaria with anemia predictors; secondly, a simple cross-tabulations analysis was used in generating the trends of malaria with anemia cases within the period of study. A descriptive interpretation was used to understand the nature and pattern of graphs. Binary logistic regression, which is more appropriate for the dichotomous outcome variable, was used to examine the strength of association between sex, age, community, seasonality, malaria with anemia among children under-five. Statistical significance was considered at a 5% significance level ($P<0.05$).

Table 1: Demographic characteristics and treatment outcome among children under-five with malaria and anemia in Jasikan District, 2012-2016

Variable	Category	Frequency [N=835]	Percentage (%)
Age group (months)			
	0-11	108	12.9
	12-23	191	22.9
	24-35	236	28.3
	36-45	189	22.6
	46-59	111	13.3
Sex			
	Male	413	49.5
	Female	422	50.5
Community			
	Rural	553	66.2
	Urban	282	33.8
Season			
	Rainy	531	63.6
	Dry	304	36.4
Treatment outcome			
	Treated	822	98.4
	Died	13	1. 6

3 Results

3.1 Background characteristics of participants

We recorded a total of 30,082 malaria cases among children under-five from 2012 to 2016. Out of the total cases, 835 had anemia with 50.5% being females. The age of the children with malaria and anemia cases ranged between 1 and 58 months, with the mean age being approximately 26 months. More than half (63.6%) of the cases were recorded in the rainy season. Similarly, the utmost (66.2%) of the cases were from the rural setting. The majority (98.4%) of the children with malaria and anemia who were admitted were treated and discharged, while the rest died. (Table 1).

3.2 The proportion of children having malaria infection and are anemic

Cumulatively 30,082 malaria cases were recorded from 2012-2016. Of which the year 2016 contributed utmost (62.7%). As shown in Table 2, the overall proportion of malaria with anemia cases among the children was 27.8 per 1,000 malaria cases. The highest proportion (38.4 per 1,000) of malaria with anemia cases was recorded in 2014. The prevalence of malaria and anemia cases separately among the children ranged from approximately 58.7% to 62.7% and 2.6% to 6.7% respectively. The highest (62.7%) prevalence of malaria cases was observed in both years 2015 and 2016 while that of anemia was 6.7% in the year 2016. The overall prevalence of malaria among all the children was 61.5% whereas that of anemia was 4.4%.

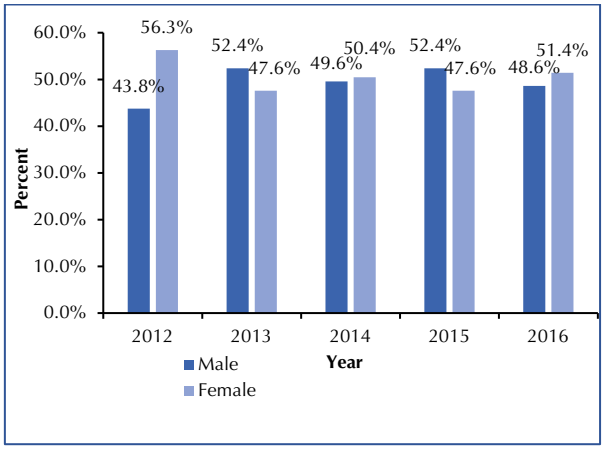

Figure 1: Trend of malaria with anemia among children under five in Jasikan District from 2012-2016

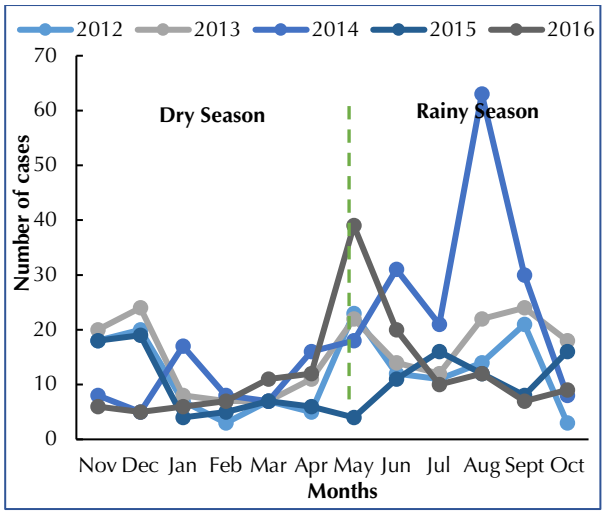

Figure 2: Seasonal trend of malaria with anemia among under-five children in Jasikan District from 2012-2016

3.3 Annual levels and trends in malaria and anemia

Figure 1 depicts the distribution of malaria with anemia among children under-five by sex from 2012-2016. Compared to males, females contributed to most of the total cases recorded in 2012 and 2016. While the number of cases tended to be slightly higher among males than females in 2013 and 2015, it was almost the same for both sexes in 2014.

3.4 Seasonal trend in malaria with anemia cases

Figure 2 depicts the seasonal trend of malaria with anemia cases. There was a rise and fall pattern of malaria with anemia cases. In general, cases were higher in the rainy season than in harmattan. As expected, there are usually water bodies around homes, in which mosquitoes breed, therefore contributing to the high cases.

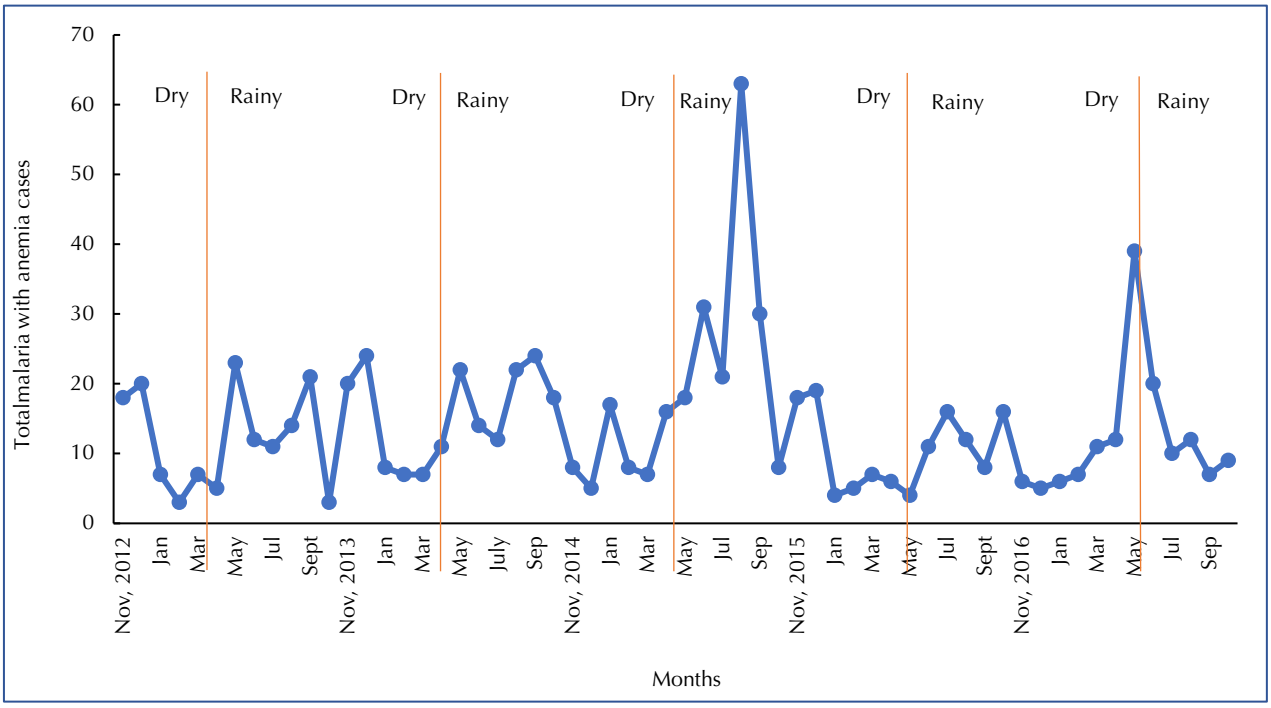

Figure 3: Seasonal pattern of malaria with anemia cases among under-five children in Jasikan District from 2012-2016

Table 2: Yearly prevalence rate and proportion of malaria with anemia among the study children from 2012-2016

Year	Population at risk	Malaria Cases		Anemia Cases		Malaria with Anemia Cases	
		Total (N)	Prevalence (%)	Total (N)	Prevalence (%)	Total (N)	Proportion Per 1000
2012	9,517	5,861	61.6	505	5.3	144	24.6
2013	9, 649	5,663	58.7	260	2.7	189	33.4
2014	9,781	6,037	61.7	464	4.7	232	38.4
2015	9,913	6,220	62.7	255	2.6	126	20.3
2016	10,043	6,301	62.7	670	6.7	144	22.9
Total	**48,903**	**30,082**	**61.5**	**2,154**	**4.4**	**835**	**27.8**

3.5 Seasonal pattern of malaria with anemia cases

There was no regular seasonal pattern of malaria with anemia cases within the period 2012-2016. The pattern depicts a fluctuating one, as shown in Figure 3. However, it is noticed that generally, cases of malaria with anemia are higher during the rainy season than in the harmattan season.

3.6 Bivariate analysis of factors contributing to malaria with anemia in children under five

With reference to table 3, the proportion of malaria with anemia is marginally higher among female children compared to their male counterparts. Children aged 24-35 months contributed more than one-fourth of overall malaria with anemia cases. Nearly three fourth (n=553; 66.2%) of malaria with anemia cases among the under-five children were from rural communities. Also, most of the cases occurred in the rainy season (n=531; 63.6%). In the bivariate logistic regression analysis, none of the factors (sex, age, community, seasonality) was found to be significantly associated with malaria and anemia at p-value<0.05.

4 Discussion

The purpose of this study was to assess the prevalence and trends of malaria with anemia among children under-five in the Jasikan District of the Volta region of Ghana. Regarding age distribution, about 28% of the participants who had malaria and anemia were within the age group of 24 – 35, followed by 12 – 23 months (22.9%) and 36 – 45 (22.6%). This may imply that the increased prevalence of malaria with anemia in children aged 24-35 months in this study may be an indication of persistent anemia after treatment of malaria due to prolonged weak immune response.

Though the National Malaria Control Program (NMCP) in Ghana has made laudable strategic plans to reduce the burden by 75% across the country by 2020, the policy needs to implement a scale-up community-based treatment of malaria,

Table 3: Bivariate analysis of factors contributing to malaria with anemia in children under five

Characteristics	Malaria n [a] (%)	Malarial and Anemia n [b] (%)	COR	95% CI	p-value
Sex					
Male	14,564 (49.8)	413 (49.5)	1		
Female	14.683 (50.2)	422 (50.5)	1.01	0.88, 1.16	0.848
Age in months					
0-11	3,814 (13.0)	108 (12.9)	1		
12-23	6,456 (22.1)	191 (22.9)	1.04	0.82, 1.33	0.720
24-35	8,275 (28.29)	236 (28.3)	1.01	0.80, 1.27	0.952
36-45	6,713 (23.0)	189 (22.6)	0.99	0.78, 1.26	0.962
46-59	3,989 (13.6)	111 (13.3)	0.98	0.75, 1.29	0.899
Community					
Urban	9,856 (33.7)	282 (33.8)	1		
Rural	19,391 (66.3)	553 (66.2)	1.00	0.86, 1.15	0.9656
Season					
Dry	10,058 (34.4)	304 (36.4)	1		
Rainy	19,199 (65.6)	531 (63.6)	0.91	0.79, 1.05	0.219

n [a] (total malaria cases) = 29,249; n [b] (total malaria with anemia cases) = 835; COR: Crude Odds Ratio (Unadjusted) and were determined using binary logistic regression

targeting children under five years particularly those who live in rural areas and have limited access to health care.

Furthermore, the study showed that there were slightly more females who had malaria infection with anemia than males. In contrast, some studies have revealed that, when it comes to health, males are the weaker sex throughout life [24].

Our study revealed no statistically significant association between sex, age, community, seasonality, and malaria with anemia in our bivariate binary logistic regression. Contrary to our results, a study in southern highland Rwanda found that the child's age was a significant risk factor for malaria parasite infection [25]. Moreover, earlier reports in Ghana showed that children <1-2 years were at increased risk of malaria [19, 20]. Elsewhere [26] severe malaria tends to occur in older children. Although we found no significant association between the place of residence and risk of malaria with anemia, the majority of cases (66.2%) was observed among children living in rural areas. These results are consistent with previous studies conducted elsewhere [26-28] which found that children in urban communities were less prone to malaria with anemia infection as compared to their peers in the rural settings. This could be attributed to the fact that better houses and access to bed nets provide the urban population with reliable means of protection from mosquito bites that cannot be easily accessed by poor communities from rural villages [26].

Malaria burden in Jasikan district, as in most parts of Ghana, contributes significantly to the occurrence of anemia cases in the study population. The prevalence of anemia among children under-five could be reduced following malaria control programs in endemic areas. The low prevalence of anemia found in this study differs from that reported by Kiggundu *et al.* (2013) who found a high prevalence of anemia (56.3%) among children under-five with malaria in Southwestern Uganda [29]. Furthermore, a higher prevalence of anemia among children under-five years with malaria was observed in the Navrongo Municipality, Northern part of Ghana [16].

We found that approximately 28 out of every 1,000 children under-five having malaria infection are anemic, and variations were observed between age groups (20-38 per 1,000 malaria cases). The Jasikan District situated in the Volta Region of Ghana is located in the malaria-endemic zone and might have contributed to the increased proportion of malaria with anemia cases as compared to Western Ghana. Ghana committed itself to the Roll Back Malaria (RBM) initiative in 1999 and developed a strategic framework to emphasize the reduction of the disease by 75% by the year 2020 in line with the attainment of the Millennium Development Goals (MDGs). Concerning the RMB initiative policy, our findings indicate that there is still much effort need by the policy to reduce malaria until it is no longer of public health significance. However, we suggest multiple strategies such as overall health sector development, improved strategic investments in malaria control, and increased coverage towards universal access to malaria treatment and prevention interventions.

Trends in the number of malaria patients with anemia among children under-five can be a powerful indicator to measure the effectiveness of malaria and anemia interventions. Hence, regular trend analysis regarding malaria with anemia among children under-five years is very crucial for planning and prevention. This study has shown that malaria with anemia cases is more common during the rainy season, as in August which recorded the highest prevalence of infection in 2013 and 2014.

More so, there was a peak prevalence of malaria with anemia cases during the rainy season, between August and September in our study. This finding supports new intervention "seasonal malaria chemoprevention (SMC)" by the World Health Organization (WHO) in 2013, in the prevention of malaria among children less than 5 years of age in areas with highly seasonal malaria transmission. Since the mosquito vectors rest inside houses after taking a blood meal, implementation of indoor residual spraying (IRS) in malaria-endemic areas would contribute to the reduction and prevention of malaria which is serving as the underlying cause of anemia. The IRS policy would also add to the attainment of the Sustainable Development Goals (SDGs) by 2030.

The high peak of malaria with anemia cases in August and September could be due to heavy rainfall during that time of the year as well as environmental factors such as improper environmental management. The presence of stagnant water

during the rainy season provides breeding sites for mosquitoes that might have resulted in the high prevalence of malaria with anemia cases [30]. Interventions targeting the larval stages of the mosquito (Larval control) may be implemented during the rainy season through environmental modification such as draining and filling or through the use of larvicides is recommended.

Limitation of the study. Missing and incomplete information in the registers were the most important limitations of the study. However, each source of data was used to compliment the other under such a difficult circumstance.

5 Conclusion

Results from this study have shown that the proportion of malaria with anemia was high among children under-five in the Jasikan District of the Volta region of Ghana. This was associated with the rainy season and demographic characteristics such as age and sex. The rainy season is the period with the highest cases of malaria infection with anemia. Most (66.2%) of the study children having malaria with anemia live in rural areas. It is thus imperative for the intensification of malaria intervention programs in rural areas during the rainy season. Future studies should be carried out to elucidate the likely factors contributing to malaria with anemia in rural areas.

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