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Review Article

Correlation between Malaria and Anemia among 5 Years Children Attending Some Primary Health Facilities in Kano Metropolis

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Abstract

Background: Despite recent advances made in malaria prevention and control globally, malaria still remains a major health concern in Sub Saharan Africa, especially among children.
Objective: This study aimed to determine the correlation between malaria and anemia among 5 years children attending some primary health facilities in Kano Metropolis, Kano Nigeria.
Method: The research was conducted at 3 different primary health care (Yan-Awaki, Sharada and Tukuntawa) centers in Kano Municipal. Demographic characteristics of the patients were collected using questionnaire. About five ml of blood was collected from each subject and malaria was diagnosed by examination of stained thick blood films. Hemoglobin concentration was determined using an auto-analyzer. Anemia was defined a hemoglobin concentration <11g/dl (13).
Results: The results showed that 163 out of 200 febrile subjects were positive for malaria and this accounted for 81.5% of the study population. From the result, more male were infected (with prevalence of 83%) than the female counterparts (80%). On the basis of the age of the study subject, infection is more prevalent among subjects aged 24 – 35 month (85.9%), followed by those less than 12 month (80.9%) and least prevalence was recorded among 48 – 60 month (75%). Also 84.6% of anemia positive subjects were anemic while only 13.5% of the non-malaria patients were anemic.
Conclusion: It is concluded that there is strong correlation between malaria and anemia among study subjects in the study.

Keywords: anemia; children; infection; kano municipal; malaria

Introduction

Parasitic infections such as malaria are common in the tropical and subtropical regions. They lead to high rates of morbidity and mortality, especially in children [1]. In 2020, approximately 241 million people worldwide were infected with malaria, and an estimated 627,000 of these individuals died [2]. Furthermore, the World Health Organization (WHO) African Region has been the most affected by malaria, accounting for 95% of malaria cases and 96% of malaria deaths worldwide. Children under 5 years of age in the same region accounted for approximately 80% of all deaths from malaria [3]. Malaria is responsible for acute or chronic anemia in populations in the tropics [4]. A 2022 WHO report on anemia estimated that the global prevalence of anemia was 39.8% in children aged 6–59 months and 29.9% in women of childbearing age (defined as women aged 15–49 years) [4]. This equates to 269 million anemic children and over half a billion anemic women aged 15–49 years [4]. Malaria kills roughly 435,000 people each year, most of the deaths are reported in Africa and among children under the age of 5 years old [5,6], a public health crisis that must be halted. Nigeria accounted for 25% of all the cases of malaria disease in sub-Saharan Africa [7]. Cameroon, Chad, and Niger have similar malarial burden as Nigeria and are among the 11 countries with the biggest malaria problems and complications [8]. If the current trend continues, the WHO Global Technical Strategy for Malaria 2016-2030's plan intended to reduce malaria incidence, and its associated deaths, by 40% would not be met [9]. Despite the advances made to reduce the cases of malaria, the current stalling of the progress is of public health and epidemiological concerns [9]. As malaria remains a major killer of children in Cameroon, Chad, Ghana, Niger, Nigeria, and other sub-Saharan Africa countries, continued evaluations of the control measures must be conducted regularly [5,6]. Therefore, to prevent the loss of a child every 2 minutes in sub-Saharan Africa, public health efforts must stride to eradicate or substantially reduce malaria cases in the region [10]. Malaria is a major cause of anemia and a common reason for blood transfusion in children [5]. While malaria is one of the factors that contribute to the public health problem of anemia, other factors such as blood loss by bleeding, decreased or faulty red blood cell production, and destruction of red blood cells via acute bacterial and viral infections can cause anemia as well [5]. Sumbele *et al*. [10] emphasized that anemia causes significant morbidity and mortality, but only seem like a moderate or severe public health problem. Malaria-Induced anemia is only partially defined in its severe

form, and the main clinical presentations of severe malaria-Induced anemia are those caused by *Plasmodium falciparum* [11]. Anaemia is a major cause of morbidity and mortality among children. According to Global Burden of Disease (GBD) models, there were 8.3 million to 12.1 million years lived with disability worldwide among children under 5 years old due to anaemia in 2019, the majority of which 7.8 million to 11.5 million were due to moderate or severe anaemia [8]. The highest rates of anaemia (adjusted haemoglobin concentration <110 g/L) and severe anaemia (<70 g/L) among preschool-aged children are reported from sub-Saharan Africa [12]. Nigeria is Africa's most populous country and experiences a high childhood anaemia burden. Previously, 60% of Nigeria's moderate and severe anaemia among children under 5 years old has been attributed to iron deficiency and only 12% and 2% to malaria and sickle cell disorders, respectively. Anemia is one of the complications seen in malaria infection and contributes to its morbidity and mortality. It has been reported that over half of malaria-related deaths are attributable to severe anemia [13]. Preventing fatal outcomes in malaria cases requires recognition of infection, accurate laboratory diagnosis, and prompt therapy [14]. This is further stressed by its importance in the millennium development goals. In relation to age, the prevalence of malaria differs between studies. Some studies report an inverse relationship between age and malaria prevalence [15], while others find an increase in malaria prevalence with age [16]. Against this background, this study aimed to determine the correlation between malaria and anemia among 5 years children attending some primary health facilities in Kano Metropolis, Kano Nigeria.

Materials and Methods

Ethical Approval

The study was conducted following ethical approval obtained from the Health Services Management Board, Kano State based on the consent of Ethical Committee of health department of Kano Municipal Local Government Area of Kano State.

Study Site

The research was conducted at 3 different primary health care (Yan-Awaki, Sharada and Tukuntawa) centers in Kano Municipal Local Government Area of Kano State, Nigeria. The Local Government has an area of 14.9 km² and population of 365, 525 according to 2006 population and projected population of six hundred and ten thousand, six hundred (610,600) residents with population density of 40,966/ km^2 [17]. It is coordinates on a map are $11^0$57'07"N latitudinally and $8^0$32'25"E longitudinally [18]. Trading remains a major occupation in the area. However many educated indigenes in the area are employed in the formal sector while others engaged in various artisan activities.

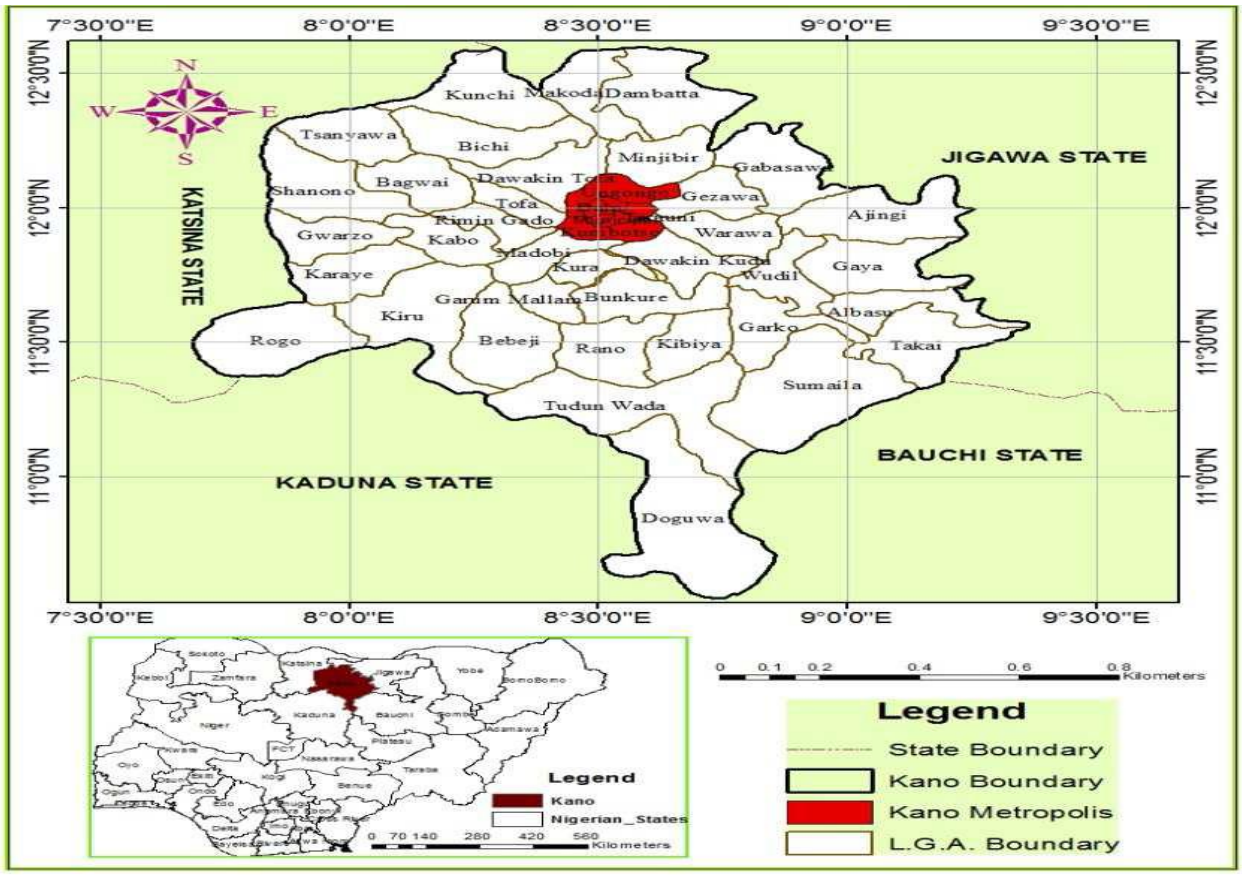

Figure 1: Map of Kano State showing Kano Municipal

Determination of Sample Size

Sample size for the study was determined from a standard formula for the calculation of minimum sample size. Sample size was given by the formula; $N = (Z_1\text{-}a)^2 (p) (1\text{-}p) / d^2$

N = minimum sample size

Z_1-a = value of standard normal deviate which at 95% confidence interval has found to be 1.96.

P = the best estimate of prevalence obtained from literature review (87.7%) **[**19**],** and;

d = difference between the true population rate and sample that can be tolerated, this is the absolute precision (in percentage) on either side of the population.

N = (1.96)2 (0.877) (1-0.877)/ $(0.05)^2$ = 173.79 as the minimum number of samples for the study. Therefore, a total of 173 with 10% (17) of this subject will be added to the research for attrition, making a total of approximately 200 samples.

Questionnaire Administration

A total of two hundred (200) simple structured questionnaires were designed using closed ended questions to provide information about the socio-demographic factors of participants and predisposing factors to both infections. Informed consent was obtained from all participants before inclusion.

Collection and processing of specimen

About five ml of blood was collected from each subject and dispensed into Ethylene Diamine Tetra-acetic Acid (EDTA) container and mixed. Malaria was diagnosed by examination of stained thick blood films. Thick blood films were made from each blood sample and allowed to air dry. Slides were stained in 3% Giemsa stain for 30 minutes, rinsed in tap water, and allowed to air dry. The stained films were examined for malaria parasite by microscopy using a × 100 oil immersion objective lens. A total of 200 fields per film were examined. Hemoglobin concentration was determined using an auto-analyzer. Anemia was defined a hemoglobin concentration <11g/dl [20].

Statistical Analysis

The data on the prevalence and associated risk factors among study subjects with malaria and anemia were analyzed using Chi-square (X^2) and Pearson correlation tests to assess relationships between the infections and selected categorical variables such as age, gender and residential area. Significance level for the differences for both the tests will be set at $p<0.05$.

Results

Characteristics of the Study Population

The demographic distribution of the study population showed that a total of 106 of the subjects which accounted for 53% were male while 47% of the subjects were female. Based on the age of the subjects, those ranged between 25 - 35 months have the highest frequency 64 (32%), followed by those ranged between 13 - 23 months with frequency of 46 (23%). Least number was recorded by subject ranged between 48 - 60 months with frequency of 24 (12%). From the data obtained, most of the study subject 154 (77%) do not use insect treated net while 46 of the study subjects which accounted for 23% used insect treated net.

Characteristics	Number (n)	Percentage (%)	*P*-value
Sex			
Male	106	53	.39614**
Female	94	47	
Age (month)			
Less than 12	26	13	.00002*
13 – 23	46	23	
24 – 35	64	32	
36 – 47	40	20	
48 – 60	24	12	
Using ITN			
Yes	46	23	.00001*
No	154	77	

Key: ** = Result not significant, * = Result is significant

Table 1: Characteristics of the Study Population

Prevalence of Malaria

Table 2 below shows the prevalence of malaria among study subjects. The results showed that 163 out of 200 febrile subjects were positive for malaria and this accounted for 81.5% of the study population. From the result, more male were infected (with prevalence of 83%) than the female counterparts (80%). On the basis of the age of the study subject, infection is more prevalent among subjects aged 24 – 35 month (85.9%), followed by those less than 12 month (80.9%) and least prevalence was recorded among 48 – 60 month (75%)

Characteristics	Number (n)	Positive (n)	Prevalence (%)	*P*-value
Sex				
Male	106	88	83	.30856**
Female	94	75	80	
Total	**200**	**163**	**81.5**	
Age (month)				
Less than 12	26	21	80.7	.00002*
13 – 23	46	37	80.4	
24 – 35	64	55	85.9	
36 – 47	40	32	80.0	
48 – 60	24	18	75.0	
Total	**200**	**163**	**81.5**	

Key: ** = Result not significant, * = Result is significant

Table 2: Prevalence of Malaria among Study Subjects

Effect of Malaria on Anemia Prevalence

The influence of malaria on the status and prevalence of anemia among the study subjects is presented in Table 3. The result indicated that 84.6% of anemia positive subjects were anemic while only 13.5% of the non-malaria patients were anemic. Statistical analysis of the result shows strong correlation between malaria and anemia among study subjects in the study.

Malaria Status	Number (n)	No. Anemic (n)	Prevalence (%)	*P*-value
Positive	163	138	84.6	.002446*

Negative	37	05	13.5	
Total	**200**	**143**	**71.5**	

Table 3: Effect of Malaria on Anemia Prevalence

Key: R-value = 0.9839, * = the result is significant

Discussion

Despite recent advances made in malaria prevention and control globally, malaria still remains a major health concern in Sub Saharan Africa, especially among children, and anemia has been reported to be responsible for over half of malaria related deaths [20]. This study aimed to determine the correlation between malaria and anemia among 5 years children attending some primary health facilities in Kano Metropolis, Kano Nigeria. The malaria parasite was recorded in 163 out of 200 febrile subjects were positive for malaria and this accounted for 81.5% of the study population. This finding is higher than that of Akinbo *et al.* [20] in Edo state Nigeria and also higher than some other African studies [21-23]. However, the finding of the study was in conformity with that of Oladeinde *et al*. [24] who study malaria and anemia among children in a low resource setting in Nigeria. The high prevalence, of malaria in this study is presumably attributed to poor control measures. The population density of the study area is high and there is poor use of insecticide treated net among the study subject (23% only) as well as the study was conducted during rainy season. The collections of water after heavy rainfall during the rainy season can serve as favorable breeding places for vectors of malaria. Bushes around the residential area are often left to grow out of proportion in rainy seasons creating a niche for larval proliferation in the study areas. From the result, more male were infected (with prevalence of 83%) than the female counterparts (80%). This indicated that male sex was a risk factor for malaria infection (the result is not significant at $p<0.05$). This finding was in agreement with the finding of Akinbo *et al.* [20] who recorded higher incidence among male. However, the finding contradicts that of Oladeinde *et al*. [24]. The reason for the high prevalence of malaria among males in this study is not clear but it is common practice in the study area that females always remain indoor compared to their male counterparts. This may be explained by the fact that male child are likely to be spending most of their time running errands or playing outside in various environmental setting which can be a risk factor

Age was a significant risk factor for malaria parasite infection among children. The prevalence of malaria infection differ significantly differ between the age groups of the study population ($p<0.005$), but infection is more prevalent among subjects aged 24 – 35 month and least prevalence was recorded among 48 – 60 month. This finding was in conformity with those of Gahutu *et al*. [25] and Oladeinde *et al*. [24] in Rwanda and Nigeria respectively. Differences in the age of presentation of severe malaria may be the result of lower background immunity or other unidentified variables. An important factor to consider is that the etiology of anemia is multifactorial, and thus several underlying morbid and co- morbid conditions could cause wide variations in prevalence of anemia among children in different clinical settings [24]. In this study, 84.6% of anemia positive subjects were anemic while only 13.5% of the non-malaria patients were anemic. This indicated that malaria was strongly associated with anemia. Finding of this study was in conformity with that of Ehouman *et al*. [26]. This study indicated that malaria can be strong contributor to malaria although anemia can be possible without malaria among the study subject Anemia has been reported as an important cause of malaria-related deaths [13]. Therefore, there is need to treat patients for both malaria and anemia. There is also the need for an effective control program for malaria.

Conclusion

Malaria remains a major health concern in Sub Saharan Africa, especially among children. The malaria parasite was recorded in 163 out of 200 febrile subjects were positive for malaria and this accounted for 81.5% of the study population. From the study, more male were infected (with prevalence of 83%) than the female counterparts (80%). This indicated that male sex was a risk factor for malaria infection. The study indicated strongly associated between malaria and anemia. It is recommended that there is need for an effective control program for malaria in the study areas such as use of insecticide treated net and proper environmental sanitation. There is need to treat malaria patients for both malaria and anemia

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