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Prevalence of Malaria-Related Anaemia among Secondary School Children in Egor Local Government Area

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Abstract

Anaemia is a major public health problem in developing countries. Anaemia is one of the complications seen in malaria infection and a common cause of morbidity and mortality especially in developing countries. Children and young adolescents are among the major risk group for malaria. The aim of this study was to determine the prevalence of malaria-related anaemia among secondary school children in Egor local government area, Edo State Nigeria, as well as to assess the level of use of insecticide-treated bed nets and its impact on prevalence of malaria and anaemia among the study population. After ethical committee clearance and informed consent from parents and the relevant authorities, a total of two hundred and four (204) children were recruited for the study. One hundred and ten (110) were males and ninety-four (94) females. Blood samples were collected and examined for malaria parasite using Malaria Rapid Diagnostic Test (RDT) and confirmed with the microscopic examination of thick blood film. Haemoglobin concentration of all children was also determined using standard method. The data obtained using structured questionnaires were analyzed using Chi-square (X^2) to compare the frequency data while odd ratio was calculated for potential risk factors. A total of 53 out of the 204 children that were tested were anaemic. The prevalence of anaemia among children was 26%. Age significantly affected the prevalence of anaemia. Gender and use of insecticide-treated bed nets (ITN) did not significantly affect the prevalence of anaemia in children. A total of 38(18.6%) out of the 204 examined were infected with malaria parasites. Age was a risk factor for infection with malaria parasite, with children aged 11 years having the highest prevalence of 36.8%, ($p=0.014$). A significantly higher number of malaria parasite positive

cases was observed among male children (OR=2.115; 95%CI=1.000 - 4.471; $p =0.044$). Use of Insecticide treated bed nets (ITN) did not significantly affect the prevalence of malaria parasite infection in children. Use of insecticide-treated bed nets were recorded in 11(5.4%) of children. The prevalence of anaemia among malaria parasite infected children was 56.2%. Malaria was a risk factor for having anaemia in school children (OR= 3.166; 95% CI= 1.818 - 5.512; $p <0.001$). Presence of malaria parasites without the use of insecticide-treated nets significantly affected the prevalence of anaemia among school children (OR=2.720; 95% CI=1.764 – 4.194; $p <0.001$). Malaria and anaemia among children was high. Strengthening of malaria intervention programmes by the three tiers of government and other relevant agencies is strongly advocated.

Keywords: Prevalence, Malaria, Anaemia, School children, Egor Local Government.

Introduction

Anaemia is a major public health problem in developing countries. According to WHO, anaemia is defined as haemoglobin level of less than 11g/dl, mild anaemia is defined as haemoglobin level of (10 - 10.9 g/dl), moderate anaemia is haemoglobin level of (7 - 9.9 g/dl) and severe anaemia is haemoglobin level less than 7g/dl (WHO, 2014). The global estimate of childhood anaemia indicates that over 293.1 million of children, approximately 43%, are anaemic worldwide and 28.5% of these children

are residing in sub-Saharan Africa (McLean *et al.*, 2009). It is considered to be a major public health problem with prevalence of 67%, equivalent to 83.5 million children in sub-Saharan Africa (McLean *et al.*, 2009). Anaemia is one of the largest killers of children admitted to hospitals in sub-Saharan Africa. Even where blood transfusions are available, there is a case significant fatality rate of 6-18% (Schellenberg *et al.*, 2003). The risk factors for anaemia vary in different settings and include intestinal worms, malaria, HIV infection, nutritional deficiencies, haematological malignancies and chronic diseases like sickle cell disease. Anaemia in childhood can also result not only from events in childhood but also from socioeconomic status and maternal factors like iron deficiency (Schellenberg *et al.*, 2003).

Malaria is a mosquito-borne infectious disease of humans and other animals caused by parasitic protozoan belonging to the genus *Plasmodium* (WHO, 2014). Anaemia is one of the complications seen in malaria infection and contributes to its morbidity and mortality especially in developing countries. Children and young adolescents are among the major risk group for malaria and anaemia. It has been reported that over half of malaria-related deaths are attributable to severe anaemia. Severe anaemia is among the major causes for admission and mortality in the paediatric wards. Although mild and moderate anaemia are associated with long-term and debilitating side effects. Little attention is given to these conditions. Plasmodium parasitaemia differs in instances of asymptomatic and clinical malaria, and the degree of parasitaemia may influence the pathological and biochemical presentations of individuals presenting with either of these conditions (Magalhaes *et al.*, 2011). Reports have shown that in most clinical cases of malaria, anaemia is a prominent factor, which is caused by destruction of infected blood cells by the reticuloendothelial system and haemolysis of infected cells (Achidi *et al.*, 1996).

Each year, 500 million infections and up to 2.7 million deaths are attributable to malaria, with about 90% of these deaths occurring in children

in sub-Saharan Africa (Newton *et al.*, 1998). It is estimated that an average of one person dies every 12 seconds from malaria. Despite a better understanding of the pathophysiology and management of malaria, childhood mortality remains unacceptably high. Preventing fatal outcomes in malaria cases requires recognition of infection, accurate laboratory diagnosis, and prompt therapy. 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 (Dzeing *et al.*, 2005) while others find an increase in malaria prevalence with age (Eliades *et al.*, 2005). While many studies have focused on the prevalence of malaria-related anaemia in pre-school children and pregnant women. There is a paucity of data on the prevalence of malaria-related anaemia in school children and young adolescents in developing countries in the complex ecologic context of poverty, parasitism and malnutrition. The aim of this study was to determine the prevalence of mild, moderate and severe malaria related-anaemia among school children within the age range of ten to fifteen years old in Egor Local Government Area of Edo state and to examine the effect of age and gender on prevalence.

Materials and Methods

Study Design

The subjects were counseled on the purpose of the study. A questionnaire containing demographic question and other relevant questions (both open and close-ended questions). Two hundred and four students were enrolled for the study. Laboratory analysis of the blood sample collected was carried out at the Medical Laboratory Science Department Main Laboratory, University of Benin, Benin City.

Study Site

Egor local government area is located in the capital of Edo state, Benin City. It is 90% urban and 10% rural with a total population of 339,899



at the 2006 census (NIPOST, 2009). The climate is that of a typical Tropical Rain Forest with rainfall almost throughout the year (Osaghae and Eghosa, 1998).

Subjects of The Study

The subjects of the study were secondary school children aged 10 to 15 years in Egor Local Government Area of Edo state.

Inclusion criteria

Non- haemorrhaging school children without history of bleeding disorders and heamatological malignancies aged 10 to 15 years in Egor Local Government Area of Edo state whose guardian or parents consented to participate in the study were consecutively-recruited as subjects in this study.

Exclusion criteria

The following who did not meet the inclusion criteria (haemorrhaging children with history of bleeding and heamatological malignancies age <10 and those > 15 years, non-residence in Egor Local Government Area of Edo, whose guardians or parents refused to offer a verbal informed consent to participate in the study) were excluded from this study.

Sample Size Calculation

Sample size was calculated using Kish and Leslie formula

$$N = \frac{z^2 p (1 - p)}{d^2} \text{ (Naing } et al., 2006)$$

Where:

z = Z score for 95% confidence interval, which was 1.96

p = prevalence was 25%

d = tolerable error, which was 5%

A minimum sample size (N) is 288.

Sample Collection

A tourniquet was tied tightly on the arm close to the elbow of the subject to occlude and expose the cubital veins. Sterile cotton wool soaked in methylated spirit was used to sterilize the surface of the skin overlying the vein and 5ml of blood was collected from the vein by venipuncture using a sterile 5ml syringe. A dry

cotton wool was placed over the surface of the punctured vein to arrest the bleeding. The sample was transferred immediately into an EDTA anticoagulant containing tube and mixed properly. The sample was then transferred to the laboratory.

Study Population

The study population was a total of two hundred and four school children within the ages of 10-15 years schooling in Egor Local Government Area of Benin City, Edo state whose parents or guardian consented to participate in the study.

Methods of Analysis

The samples collected would be analyzed for; Packed cell volume (PCV), Haemoglobin concentration and Malaria parasite determination.

Packed Cell Volume Estimation

The packed cell volume of the samples was estimated using the microhaematocrit method. The packed cell volume is that proportion of whole blood occupied by red cells, expressed as a ratio (litre/litre). Anticoagulated blood in a glass capillary of specified length, bore size, and wall-thickness is centrifuged in a microhaematocrit centrifuge at RCF 12 000–15 000g for 3–5 minutes to obtain constant packing of the red cells. The PCV value is read from the scale of a microhaematocrit reader (Cheesbrough, 2009).

Haemoglobin Estimation

The haemoglobin concentration was estimated using the Cyanmethaemoglobin method. Whole blood is diluted 1 in 201 in a modified Drabkin's solution which contains potassium ferricyanide and potassium cyanide. The red cells are haemolyzed and the haemoglobin is oxidized by the ferricyanide to methaemoglobin. This is converted by the cyanide to stable cyanmethaemoglobin. Absorbance of the cyanmethaemoglobin solution is read in a spectrophotometer at wavelength 540 nm or in a filter colorimeter using a yellow-green filter. The absorbance obtained is compared with that of a reference

haemoglobin standard solution. (Bain *et al.*, 2012)

Malaria Parasite

Malaria was diagnosed by two methods; Microscopy and Malaria rapid diagnostic test.

Microscopy

This method involves the microscopic examination of a Giemsa stained thick blood film and Leishman stained thin blood film for the presence of Malaria parasites (CDC, 2014).

Malaria Rapid Diagnostic Test

Malaria RDTs used in this study is Care Start™ (ACCESS BIO, U.S.A.). The test is a qualitative immunochromatographic lateral flow tests in dipstick (strip) form that detect malaria antigen in peripheral blood. Malaria antigen from a haemolysed blood sample is reacted with anti-malaria monoclonal antibody conjugated to colloidal gold (pink-mauve) particles. The antigen-antibody colloidal gold complex migrates along the nitrocellulose membrane where it becomes bound (captured) by a line of specific monoclonal antibody, producing a pink line in the test result area. This line can be seen after a washing buffer has removed the background haemoglobin. A further pink line,

i.e. inbuilt positive control, is produced above the test line indicating that the test reagents have migrated satisfactorily (it is not a malaria antigen control (Cheesbrough, 2009).

Statistical analysis

Data obtained were double entered using Microsoft excel 2007, cleaned and analyzed using Chi-square (X^2) or Fischer's exact test as appropriate and Odds Ratio analysis using the IBM statistical software SPSS version 20. Statistical significance was set at $p \leq 0.05$. The 95% confidence interval was also determined.

Results

A total of two hundred and four children were recruited for the study. One hundred and ten (110) were males and ninety-four (94) females.

Prevalence of Anaemia Among School Children

A total of 53 out of the 204 children that were tested were anaemic. The prevalence of anaemia among children was 26%. Age significantly affected the prevalence of anaemia ($p < 0.05$). Gender and use of Insecticide treated bed nets (ITN) did not significantly affect the prevalence of anaemia in children ($p > 0.05$) (Table 1).

Table 1: Prevalence of Anaemia among school children

Characteristics	N Tested	N Anaemic (%)	OR	95%CI	p- value
Gender					
Male	110	27(24.5)	0.851	0.455 - 1.5922	0.613
Female	94	26(27.7)	1.175	0.628 - 2.199	
Age (Years)					
11	19	10(52.6)			0.041
12	48	15(31.3)			
13	32	6(18.8)			
14	63	13(20.6)			
15	42	9(21.4)			
Use of ITN					
Yes	11	2(18.2)	0.619	0.129 - 2.961	0.530
No	193	51(26.4)	1.616	0.338 - 7.729	

N=number; OR=odd ratio; CI=confidence interval; ITN =insecticide treated bed net



Prevalence of Malaria Among School Children

A total of 38(18.6%) out of the 204 examined were infected with malaria parasite. Age was a risk factor for infection with malaria parasite, with children within the age group of 11 years having the highest prevalence of 36.8%, (p=0.014). A significantly higher number

of malaria parasite positive cases was observed among male children (OR=2.115; 95%CI=1.000 - 4.471; p =0.044). Use of Insecticide- treated bed nets (ITN) did not significantly affect the prevalence of malaria parasite infection in children. Use of Insecticide- treated bed nets were recorded in 11(5.4%) of children (Table 2).

Table 2: Prevalence of Malaria among school children

Characteristics	N Tested	N Positive (%)	OR	95%CI	p- value
Gender					
Male	110	26(23.6)	2.115	1.000 – 4.471	0.044
Female	94	12(12.8)	0.473	0.224 – 1.000	
Age (Years)					
11	19	7 (36.8)			0.014
12	48	14 (29.2)			
13	32	2 (6.2)			
14	63	8 (12.7)			
15	42	7 (16.7)			
Use of ITN					
Yes	11	1 (72.7)	0.889	0.729 – 1.085	0.404
No	193	52(82.3)	2.109	0.318 – 13.974	

N=number tested; OR=odd ratio; CI=confidence interval; ITN –insecticide treated bed net

Effect of Malaria Parasitaemia And Use of Insecticide Treated Bed Net on Prevalence of Anaemia

The prevalence of anaemia among malaria parasite infected children was 56.2%. Malaria was a risk factor for having anaemia in school

children (OR= 3.166; 95% CI= 1.818 - 5.512; p <0.001). Presence of malaria parasite and not using insecticides treated net significantly affected the prevalence of anaemia among school children (OR=2.720; 95% CI=1.764 – 4.194; p <0.001) (Table 3).

Table 3: Effect of malaria parasitaemia and ITN use on prevalence of anaemia

Characteristics	N	N Anaemic (%)	OR	95%CI	p- value
Malaria status					
Positive	38	20(52.6)	3.166	1.818 - 5.512	<0.001
Negative	166	33(19.9)	0.707	0.569 - 0.879	
Malaria status based on ITN					
Positive (with ITN use)	1	0(0)			
Positive (without ITN use)	37	20(54.1)	2.720	1.764 – 4.194	<0.001

N=number tested; OR=odd ratio; CI=confidence interval; ITN=insecticide treated bed nets.

Discussion

Despite recent advances made in malaria prevention and control globally, malaria still remains a major health concern in sub Saharan Africa with very high mortality rates being recorded among children. This study focused on determining the prevalence of malaria-related anaemia among school children in Egor local government area, Edo State Nigeria, as well as the level of use of Insecticide- treated bed nets and its impact on prevalence of malaria and anaemia.

Malaria parasite infection was recorded among 38(18.6%) of children studied. This is not as high as was expected (Akinbo *et al.*, 2009). Differences in environmental factors, existing malaria intervention and prevention strategies, and class of children examined, may be responsible for the observed variation. *Plasmodium falciparum* was the only specie of malaria parasite found in this study.

Age was a significant risk factor for malaria parasite infection among children. This is consistent with an earlier report (Gahutu *et al.*, 2011; Okungbowa and Okungbowa, 2007). Children aged 11years were mostly at risk of acquiring malaria. Elsewhere severe malaria tends to occur in older children (Sanou *et al.*, 1997). Differences in the age of presentation of severe malaria may be the result of lower background immunity or other unidentified variables (Gahutu *et al.*, 2011).

The prevalence of anaemia among children was 30.0%. This is lower than a finding in Benin City (Akinbo *et al.*, 2009), and higher than figures reported in other African studies (Anumudu *et al.*, 2007). An important factor to consider is that the etiology of anaemia is multifactorial, and thus several underlying morbid and co- morbid conditions could cause wide variations in prevalence of anaemia among children in different clinical settings. The endemicity of malaria in this area coupled with the general worsening economy in Nigeria may account for this observation.

Use of insecticide treated bed net by children in Egor local government area was poor (5.4%). This is lower than findings in other Nigerian studies (Tobin-West and Alex-Hart, 2011). Widespread distribution of free insecticide treated bed net in Nigeria is still a dream unlike other African countries where wide coverage among the people has been reported (Larson *et al.*, 2010). The high cost of its purchase amongst other factors may account for its low use in this study. The use of ITN which has been proven to be effective in reduction of malaria and anaemia (Eisele *et al.*, 2010).

Malaria was strongly associated with anaemia in this study. This has been earlier reported (Eisele *et al.*, 2011). Interestingly however, among malaria parasite infected children, the use of ITN was found to significantly reduce the prevalence of anaemia. The improvement in haemoglobin level may be associated with



significant reduction of mosquito contact with children using the malaria prevention tool. Again, insecticide treated bed nets are expensive to procure and not freely distributed in Egor Local Government Area of Edo State. Some studies have found that higher socio-economic status is related to ownership and use of ITN (Wiseman *et al.*, 2007). It is possible that children in this study in possession and use of ITN may very well have been from well-to-do homes, with better nutritional status than those who did not use the malaria intervention tool.

Conclusion

The prevalence of malaria, anaemia and malaria-related anaemia among school children in Egor local government area was 18.6%, 30% and 9.8% respectively. Use of insecticide-treated bed nets were poor and was shown to significantly reduce malaria and anaemia generally among children studied. Its use however was also found to significantly reduce anaemia among malaria infected children. Community based malaria intervention programmes, targeted at enlightenment on modes of malaria transmission, provision of ITNs, prompt identification and treatment of all cases are needed to stem malaria and associated sequel.

Conflict of interest: There is no conflict of interest associated with this work.

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