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Prevalence of Malaria Parasitaemia and Anaemia among Primary School Children in Enugu Suburban, Enugu state, Nigeria

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ABSTRACT

INTRODUCTION: Malaria parasitaemia and anaemia are municipal health predicament affecting children with high morbidity and mortality. Therefore, investigating the prevalence of malaria parasitaemia and anaemia associated with malaria is of great important. **METHODS:** A cross sectional study was conducted between March and October 2019 from primary school pupils in 5 selected communities in Enugu North Local Government Area of Nigeria. Blood samples were collected from the participants whose parents gave their consent to take part in the study. Thick blood film stained with geimsa was examined to detect malaria parasite. Heamoglobin concentration (Hb) was done using a portable haemocue analyzer. **RESULTS**: Five hundred and fifty-seven pupils participated in this study. Prevalence of malaria parasitaemia, anaemia and anaemia associated with malaria parasitaemia observed were 65.5%; 37.0%; and 29.1% respectively. There was a significant negative association between malaria parasitaemia, density count and Heamoglobin concentration (Hb). The mean Hb of those infected by malaria parasitaemia and anaemic differed from that of pupils not infected. Association between malaria parasitaemia and anaemia in this study posed a very significant public health menace in the study area.

Keywords: malaria parasitaemia, anaemia, prevalence, children, Nigeria.

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INTRODUCTION

Malaria parasitaemia is ranked high among public health diseases affecting children in Africa with a high morbidity and mortality rate in sub-Saharan Africa taking the life of a child every minute [1]. Malaria parasitaemia is caused by plasmodium parasites. There are 5 parasitic species that cause malaria in humans and 2 of these species namely *P. falciparum and P. vivax* poses a serious threat causing anaemia [2]. Malaria parasitaemia brings about suffering and death which is a public health problem in tropical and sub-tropical countries [3]. The parasite is spread by the bite of an infected female Anopheles mosquito which is termed 'malaria vectors. In spite of the drastic increase in prevention and control measures reported globally between 2000-2015, malaria still causes death of children [1]. A total of 219 million cases of malaria were reported in 87 countries with an estimated death of 435,000 in 2017 according to WHO malaria fact sheet 2019.

The population groups considered to be at higher risk of contracting malaria and developing severe parasitaemia than others include children; infants; pregnant women and patients with HIV/AIDS as well as non-immune migrants; travellers. The major determinants of intensity of malaria transmission include biting habit of the malaria vectors, its density, longevity and efficiency of the local malaria vectors [4]. In places with high transmission, it is infant and children that are mostly at risk of having high level of malaria parasitaemia and anaemia because they are bitten severally within a day by mosquitoes [4, 5, 6, 7] . However; it is important to have a regular updates of diseases from communities; public health service providers and evaluate properly the control measures in the country.

Malaria is believed to be the cause of anaemia in children [3]. The degree of anaemia is totally dependent on the intensity of the malaria infection [5, 8, 9, 10, 11]. Severe malaria causes cerebral malaria (arising from adhesion of infected erythrocytes with the endothelium in the brain causing coma), lactic acidosis and severe anaemia which develops rapidly [1,2, 12, 13]. Severe anemia causes increase in cardiac rate to maintain oxygen delivery, tissue ischaemia and hypoxia.[14, 15,16]

WHO in partnership with the Roll Back Malaria (RBM) recommends that anaemia be used as one of the indicators to monitor malaria parasitaemia burden at community level [5,17,18].

The mechanism by which anaemia occur include lysis and phagocytosis of infected red blood cells [19, 20] causing impairment in meeting the oxygen demands of the body. In African children particularly, anemia is dependent on combination of many factors such as nutritional deficiencies; infectious diseases like malaria parasitaemia pathogeneses and intestinal helminthiasis infection; HIV) and the genetic composition of red blood cell hemoglobin. [21, 22].

When anaemia occur in malaria parasitaemia the it causes sequestration of parasite erythrocytes, removal of parasitized and non parasitized red blood cells, destruction of erythrocytes by immune –mediators, low erythroblast proliferative rates within the bone marrow [23,24,25]. The effect of the aforementioned is dependent on the local endemicity of malaria immune status of individual; patient 's age ; genetic makeup and anti-malaria drug . The objective of this study is to determine the prevalence of malaria parasitaemia in primary school pupils in selected communities in Enugu suburban, Nigeria.

METHODS

Study Design

This cross sectional study was carried out to determine the prevalence of malaria parasitaemia in primary school pupils in selected communities in Enugu suburban, Nigeria. A stratified random sampling technique was used to select the schools in the selected communities. The study period was from May to October 2019.

Study Area

This work was carried out in Enugu suburban communities, the capital city of Enugu state in South East Nigeria. Enugu is located in the tropical rainforest zone of Nigeria. It has a maximum temperature of 29 – 34.5°C and minimum between 20 – 32°C with an annual rainfall of 1500mm. The climate oscillates between a dry season (November to April) and a wet season (May to October). The people of Enugu state live in an area of approximately 7,625Km^2 of land. The population density per square kilometer is quite high (248 persons per sq. km), (National Population Census, 2016).

This work was carried out in five sub urban communities in Enugu State namely: Ngenevu, Bonker, Coal-camp, Ogbete and Iva- valley The environmental condition of the schools in the communities is hygienically poor, with Inadequate drainage and waste disposal facilities creating a breeding ground for mosquitoes and most of the schools lack functional toilet facilities. There were also bushes around the classrooms and some schools with a nearby un-cleared refuse dump sites. The major sources of drinking water included poorly managed spring, surface wells, streams and bore hole. Above **all, these areas were not f**ully linked to the state waste disposal network Enugu State Waste Management Agency (ESWAMA).

Study Population

The study population was primary school pupils from five selected communities in Enugu sub urban. At least two primary schools from each of the selected community, was used with at least 70 pupils all within 5 – 16 years that fulfilled the inclusion criteria. A total of 557 pupils was enrolled.

Inclusion Criteria

1. Apparently healthy school pupils 5-16 years within the study area were included in the study 2. Pupils who are not on anti malaria medication and have not taken it in the past one month were also included.

Exclusion Criteria:1. Pupils below 5 years and above 16 years were excluded
2. Pupils on Anti malaria medication or have taken it in the past one month were excluded from the study. 3. Sick and debilitating pupils were excluded

Sampling Technique

The enlisted pupils were selected from the class register by random sampling. After volunteering based on age and sex of the pupils (by the parents via informed consent form). Age range of 5-16 from both sex and were include. Pupils from primary 1-6.

Ethical Clearance and Permission

Ethical clearance was collected from the Ethics Committee of College of Medicine University of Nigeria Enugu Campus with Protocol NO: 046/07/2018. Permission to sample school children was obtained from the Executive Chairman, Enugu State Education Board thru Education Secretary Enugu North Local Government Area. Permission was also obtained from the various School Heads and parents via informed consent given to the pupils to take home.

Method of Data Collection
A questionnaire was completed for each of the recruited, English language combined with vernacular where necessary, was used in administering the questionnaire. Demographic information like age, sex, parent occupation, number of people in the family and other variables was assessed by oral interview and was recorded at the end of the data collection.

Sample collection and processing

The pupils whose parents signed informed consent upon return of the form, had their blood samples collected

Blood sample
Two millimeter of blood was obtained from the pupil by venipuncture according to the method of (Cheesbrough [4] and dispensed into an appropriately labelled EDTA container.
Blood sample was collected in EDTA anti-coagulant container and kept in cold chain, after collection and during transportation from the school to the laboratory and analyzed within 4 hours of collection.

Malaria parasite test
Thick blood smear was prepared with 6µl of blood and stained with Giemsa stain and examined according to the procedure described by Cheesbrough, [4]. Malaria parasite is graded as 1-10 per 100 high power field + and 11-100 parasite per high power field ++

Parasite density count
The positive samples were further examined to determine the number of parasite per µl of blood from the thick film using Greenwood and Armstrong method as was described in (Cheesbrough [4]. This was done by multiplying the average number of parasite per high power field (100 x objectives) by 500. Forty fields were examined to determine the average number of parasite per high power field.
Malaria parasite density is classified as; PD ≤100 parasite per µl is low; 100 < PD<10,000 parasite per µl is intermediate; and PD>10,000 parasite per µl is high..

Haematological test:
Haemoglobin cconcentration was determined using HemoCue Hb 301 system, and the result displayed numerically in g/dl. The range used for anemia areless than 11g/dl. Anaemia was further grouped into severe anaemia {<7.0g/dl), Moderate anaemia 7.0- 10.0g/dl, Mild anaemia 10.0-10.9g/dl and the normal range is 11 – 14g/dl in the study group.

Statistical analysis
Statistical analyses were performed using the statistical software package SPSS Windows Version 20.0 (IBM Corp. Armonk, NY: USA). Means and standard deviations (SD) were used for descriptive purposes for scale data whilst frequencies and percentage (%) were calculated for category variables in the studied population. Mean values were compared, using Student t-tests and ANOVA were appropriate. Correlation was done to describe relationship between two variables. Category data (proportions) were compared using chi-square. A $p < 0.05$ was considered statistically significant.

RESULTS

Out of 557 pupils enrolled for this study and were examined for malaria parasitemia and anaemia; 302 (54.2%) were male and 225 (40.4%) female. The prevalence of pupils with bushes/ refuse dump site around their homes was 374 (67.1%). The parents of the pupils had at least primary education. Table 1. Three hundred and sixty-five (65.5%) had malaria parasitaemia. The prevalence was higher among males 203 (36.4%) than females 162 (29.1%) as shown in Table 2. However, no **statistical** significant

difference was observed between the prevalence of malaria parasitaemia and gender (X=0.549, p=0.760). The prevalence of malaria parasitaemia was highest among pupils from Iva-valley community 107(19.2) and the least was seen in pupils from Bunker community 42(7.5%). There is a **statistical** significant difference between the prevalence of infection in the different communities (X=40.780), (p=0.0001). Pupils from Ogbete community had the highest prevalence of anaemia 62(11.1%) compared to their counterparts pupils from Ngenevu community 21(3.8 %) and pupils from Iva- valley community 36 (6.5) which recorded the least prevalence. There was a **statistical** significant difference between anaemia across the different communities (X=29.542, (p=0001) (Table 2). Pupils of age group 13-16 years had the highest prevalence of malaria parasitaemia 144 (25.8%). There was no statistical difference in age, between pupils infected by malaria parasitaemia (X^2 5.801, (p=0.446). Greater percentage of the pupils had 1-10 parasite (+) 318(57.1%) while 47(8.4 %) of the pupils had 10 -100 (++). The mean parasite destiny count was 4845.93±2104 pd/µl (parasite density per micro liter) /(Table 3). The prevalence of pupils who were anaemic was 206 (37.0%). The prevalence of mild and moderate anaemia were 172(30.9%) and 34(6.1%) respectively no pupil had severe anaemia. Pupils in age group 13-16 years had the highest prevalence 70(12.6%). There was a significant difference between anaemia and age of the pupils in the study. (X^2=21.368), (P=0.001). (Table 4). The prevalence of pupils with anaemia associated with malaria parasiteamia is significantly higher from prevalence of pupils with anaemia without having malaria parasitaemia X^2 = 35.153, p = 0.0001. A significant negative correlation was observed between haemoglobin (the indicator of anaemia) and malaria parasite density count (Fig 1)

TABLE .1 Socio-demographic characteristics of the studied population/areas (n=557)

VARIABLE	FREQUENCY	PREVALENCE %
Family size		
2-4	126	22.6
5-7	199	35.7
7-10	164	29.4
>10	68	12.2
Sleep under mosquito treated nets		
Yes	192	34.5
No	365	65.5
Occupation of Parents		
Farmer	33	6.0
Trader	188	34.0
civil servant	108	19.3
Artisan	224	40.2
Presence of bush/refuge dump site near house/school		
Yes	374	67.1`
No	183	33.0

Table 2 : Prevalence of Malaria Parasitemia And Anemia in the study group

Communities	No Examined	Malaria parasitaemia n (%)			Anaemia n (%) (Hb <11g/dl)		
		No Infeced	Infected Male	Infected Female	No Anaemic	Anaemic Male	Anaemic Female
Bunker	75	42 (7.5)	19(3.4)	23(4.1)	29(5.2)	12(2.1)	17(3.0)
Ngenevu	70	50 (8.9)	23(4.1)	27(4.8)	21 (3.7)	9(1.6)	12(2.1)
Iva-valley	130	107(19.2)	68(12.2)	39(7.0)	36 (6.5)	19(3.4)	17(3.0)
Ogbete	143	84 (15.1)	39(7.0)	45(8.1)	62(11.1)	30(5.4)	32(5.7)
Coal- camp	139	82 (14.7)	54(9.7)	28(5.0)	58(10.4)	27(4.5)	31(5.6)
Total	557	365(65.5)	203(36.4)	162(29.1)	206(37.0)	97(17.4)	109(19.6)
X^2 = valve P-value		40.780 0.0001*			29.542 0.0001*		

Table 3: Prevalence and intensity of malaria parasitaemia by age group.

AGE GROUPS	NO EXAMINED	INFECTED	NOT INFECTED	LEVEL OF PARASITAEMIA +	++	PARASITE COUNT Pd/µl
5-8	141	90 (16.2)	51(9.1)	86(15.4)	4(0.8)	3662.5
9-12	206	131 (23.5)	75(13.5)	108(19.4)	23(4.1)	4952.7
13-16	210	144(25.8)	66(11.8)	124(22.3)	20(3.6)	4198.9
Total	557	365(65.5)	192(34.5)	318(57.1)	47(8.4)	4845.93
X^2		5.801				
P-Value		0.446				

+ ---- 1-10 Parasite Per high power field , ++ ---- 10 -100 Parasite Per high power field
Pd/µl – parasite density per micro liter of blood
Malaria parasite density is classified as
PD ≤100 parasite per µl is low
100 < PD<10,000 parasite per µl is intermediate
PD>10,000 parasite per µl is high.
Source hammani et al [26].

TABLE 4 : PREVALENCE OF ANAEMIA WITHIN THE CHILDREN AGE GROUPS

AGE GROUPS	**NO EXAMINED**	**No Anaemic (<11g/dl) N(%)**	**Not Anaemic (>11g/dl) N(%)**	**Level of anaemia N(%) Mild (10.0 – 10.5g/dl)**	**Moderate 7.0 -10g/dl**	**Sever (<7.0g/dl)**
5-8	141	69(12.4)	72(12.9)	57(10.2)	12(2.1)	-
9-12	206	67 (12.0)	139(24.9)	53(9.5)	14(2.5)	-
13-16	210	70(12.6)	140(25.1)	62(11.1)	8(1.4)	-
Total	557	206(37.0)	351(63.0)	172(83.5)	34(16.5)	-
X^2 value		21.368				
P- value		0.0001				

TABLE 5: OVERALL PREVALENCE OF MALARIA PARASITAEMIA ASSOCIATED WITH ANAEMIA.

	Hemoglobin level n (%)		
	(Anaemic) <11g/dl	**(Not Anaemia) >11g/dl**	
Malaria parasitaemia			
No parasitaemia	44(7.9)	146(26.2)	
+	138(24.8)	182(32.7)	X^2 = 35.153, p = 0.001*
++	24(4.3)	23(4.1)	

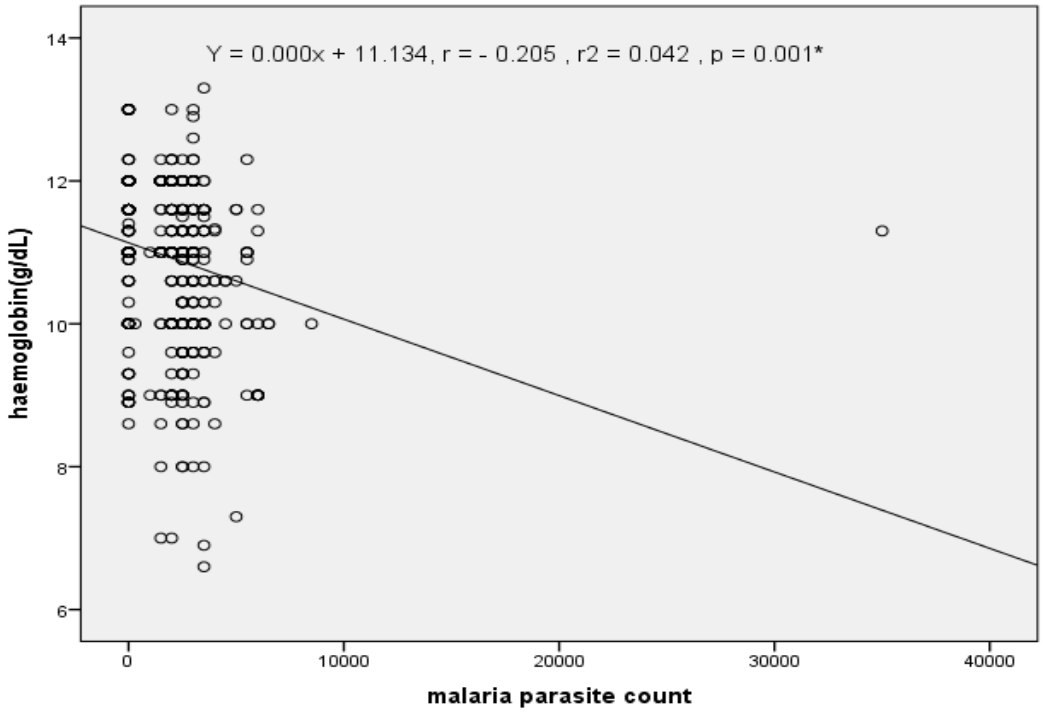

Fig 1: Correlation of haemoglobin (the indicator of anaemia) and malaria parasite count

DISCUSSIONS

Out of 557 pupils, tested for malaria parasite infection, prevalence of 365(65.5%) was obtained. This was higher than findings of Richard *et al* [27] who reported 44.3% of malaria parasitaemia among residents of Emohua Local Government Area in Port Harcourt Metropolis, Nigeria. Umeanaeto *et al* [28], 32.4% mosquito dynamics and malaria in Alulu-Nike Community, Enugu East Local Government Area, Enugu State, Nigeria and similar to the findings of Rufina *et al* [29] 58.9% in their study of iron status of children less than15 years and associated factors in rural Nigeria, Ikeoluwapo *et al* [30] 52.3% . Nwaorgu and Orajaka [31] reported a prevalence of 58.2% among children aged 1-10 years old. It is lower than Njunda *et al* [32]. 98.5%. The high prevalence of malaria in this study can be attributed to a number of factors. The areas were with pockets of stream that criss-crossed the areas, serving as good bredding sites for mosquitoes. The low social economic status of parents in the communities contributed in the transmission of malaria as most of these parents cannot afford screening of their homes, insecticides treated bed nets for mosquito. Bushes and un-cleared refuse dump sites surrounding most of the homes and schools, poor drainages, inadequate treatment of infested children with the correct doses of anti malaria drugs, illiteracy among the people in these communities also encouraged the breeding of mosquitoes and eventual transmission of the parasites. Children in these areas were less protected and are more prone to mosquito bite. Brown (1980) stated that in hyper endemic area, the malaria is mild and asymptomatic in older children. Age and nnutritional status of the host might represent natural or acquired resistance and can play a role in the severity of the disease produced [31].

This study also recorded higher prevalence of malaria parasitaemia in males (36.4%) than female (29.1%) Richard *et a*l,[27], recorded similar results but differ from Ojurongbe [33] who reported a higher prevalence in female. This could be attributed to the fact that male expose their bodies more than female especially when the weather is warm, at home and when working in the farm. Female on the other hand were usually not naked which reduces their contact with mosquito vector.

This study further evidenced that malaria transmission can vary widely across communities. Therefore, malaria case management remains a vital component of the malaria control strategies and this entails early diagnosis and prompt treatment with effective ant malaria medicines.

From this study a prevalence of 206(37.0%) anaemia was obtained. This is lower than that recorded by Rufina *et al* [29] who recorded a prevalence of 85.5% Sumbele, *et al* [34], 62.0% but this value is similar to that obtained in Edo state by Osazuwa and Oguntade [35] (38.6 %.) in 2010. Pupils with mild and moderate anaemia is 172(30.9%) and 34(5.7%) respectively.

The prevalence of anaemia associated with malaria is 162(29.1%). This is similar with Rufina *et a* [29] 62.3%.This is because malaria reduces haemoglobin concentrations through a destruction and removal of parasitized red cells, shortening of the life span of non parasitized red cells and decreasing the rate of erythrocyte production in the bone marrow. Some of the mechanism that cause anaemia during malaria illness such as haemolysis and cytokine disturbance might be associated with acute clinical state whereas chronic or repeated infestations are more likely to involve dyserythropoiesis [3].

Out of 365 (65.5%) pupils who were infected with malaria 162(29.0%) were anaemic. This did not conform to Hirpasa, *et al*., [36], who recorded that almost all school children with malaria parasite developed anaemia.

CONCLUSION

Malaria parasitaemia infection is a menace in the study area, which is aggravated by the life style and social economic conditions of people residing in the area. It is of paramount importance that adequate awareness on the prevention and control measures be put in place in the area by health workers and relevant agencies.

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