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Prevalence of infection and malaria parasite density among under Five Children: a Case Study of Dunukofia rural Community in Anambra State, Nigeria

Abstract

Aim: Malaria still remains an overwhelming cause of morbidity and mortality among children under five years of age, especially in sub-Saharan Africa. The study was carried out to evaluate malaria prevalence amongst children less than five years old.

Study Design: A cross sectional study was carried out. The study adopted a retrospective descriptive survey using the hospital records and diagnostic cross sectional survey by examination of blood samples across three variables: gender, age group and mosquito net usage.

Duration: The study was done in 2021 from the month of March to April in the rural community.

Methodology: Parasitological diagnosis was with *Plasmodium falciparum* histidine-rich protein 2-based malaria Rapid Diagnostic Test (RDT) and microscopy of giemsa-stained blood smears. Demographic information was collected using questionnaire.

Results Three hundred (300) **children aged less than five years malaria infection status was investigate,** 174 (58.00%) of them were females while 126 (42.00%.) were males. Twenty one percent (21.00%) of the respondents are <1 year, 23.33% (70) of them are between the ages of 2 to 3 years, while 55.67% (167) were 4 years and above. Current malaria prevalence was higher with microscopy (67.33%) than that of RDT (23.33%). Also, previous RDT results showed that there was a higher prevalence (73.56%) of malaria parasites in females than males (58.73%). The microscopy results showed that males had a higher prevalence (38.10%) of malaria parasites than females (12.64%). Overall gender result also revealed that males had a higher prevalence (96.83%) of malaria parasites than females (86.21%). There was a significant difference in the prevalence result with gender ($P<0.05$). Females had higher parasite density (28.05±15.390) than males (23.22±19.171), there was no significant difference ($P>0.05$). It further revealed that children from 4 years and above had higher intensity (29.68±17.357) while those of 1 year and below had the least (14.89±16.069). However, there was no significant difference in the malaria parasite among the age groups of patients ($P>0.05$).

Conclusion: Prevalence of malaria parasitaemia was still high in Dunukaofia, Anamba State, Nigeria despite various control measures and interventions put in place by WHO.

Keywords: Malaria prevalence, under-five children, Dunukofia Local Government Area, Rapid Diagnostic Test (RDT), Microscopy Test, Anambra State, Nigeria.

1. Introduction

Malaria is a major public health problem and the cause of suffering and premature death in tropical and subtropical countries [1]. Malaria is the main cause of illness and death in children in sub-Saharan Africa. It is estimated that more than one million children living in Africa die yearly from direct and indirect effects of malaria infection. This preventable disease has reached epidemic proportions in many regions of the world and continues to spread unchecked [2]. The causative organism of malaria is *Plasmodium* which is a blood parasite. Four species were considered a true parasite of humans as they exploited humans practically exclusively as natural

intermediate hosts. The species are *P. falciparum*, *P. vivax P. ovale* and *P. malariae*. However, there has been recent report of fifth specie known as *P. knowlesi* which are found in monkeys, suggesting zoonotic infection. Over 80% of malaria infections are caused by *P. falciparum* while up to 15% are caused by *P. malariae* and less than 5% are caused by *P. ovale* infections. Mixed infections with *P. falciparum* are common [2].

African children under five years and pregnant women are the groups most at risk of malaria. Critically infected children often die less than 72 hours after developing symptoms. In those children who survive, malaria drains vital nutrients from them impairing their physical and intellectual development [3]. Nwaorgu and Orajaka [4], in a study conducted in children between 1–10 years old in Communities in Awka North Local Government Area, Anambra State South-East Nigeria discovered that malaria infection is most prevalent among 1- 4 years old, highest being among 3 years old (76.4%), followed by 1 and 4 years old with 71.3 and 71.2% respectively, and 62.04% for 2 years old. This shows that the infection decreases as the children get older. The most prominent species in the community is *Plasmodium falciparum* (51.8%). Among the positive cases, 85.5% were observed in age group 2-3 while 33% were in 0-1years indicating that the prevalence of *Plasmodium* infections among under-5 children is significantly affected by age. Sex in their findings did not affect the prevalence rate of malaria parasites. The degree of endemicity of malaria infection is measured based on the spleen rate in children aged 2-9 years in their order of severity.

Children aged under 5 years are the most vulnerable group affected by malaria; in 2019, they accounted for 67% (274 000) of all malaria deaths worldwide. World Health Organisation noted that progress in adopting and rolling out preventive therapies (Artemisinin-based combination therapies – ACTs) for children has been even slower than ever. In 2013 only six of the 16 countries recommended by WHO enforced the recommendation as a national policy. [2].

The decline in malaria incidence and mortality may be attributed to the volume of RDT (Rapid Diagnostic Test) sales and microscopic examination. RDT sales to the public and private sectors of endemic countries increased from 46 million in 2008 to 319 million in 2013. Also, the number of patients tested by microscopic examination increased to 197 million in 2013, with India accounting for over 120 million slide examinations globally. In 2013 the total number of diagnostic tests (RDTs and microscopy combined) provided in the public sector in Africa exceeded the total number of Artemisinin Combination Therapy (ACT) distributed [2]. This study, therefore, is an update on the effects of the new WHO policy on the prevalence and intensity of malaria parasites among under-five children in Dunukofia L.G.A. Anambra State Nigeria.

2. Materials and methods

2.1 Study Area: The study was done in 2021 from the month of March to April in Dunukofia LGA in Anambra State. Anambra State is located in south-eastern Nigeria with a population of over 4 million people made up of 2,117,984 males and 2,059,844 females [5]. The community is made up of seven towns viz: Ukpo, Ifitedunu, Dunukofia, Umunnachi, Umudioka, Ukwulu and Nawgu. They belong to the Guinea Savannah vegetation type with localized clustered growth of the deep-rooted tall trees (6 metres or more), tall grasses mostly Elephant grass, Awolowo weed and climber trees with durable roots. These vegetations provide enough shade for the breeding of mosquitoes both during and after the rainy seasons [5].

The main occupation of the people is subsistence farming; crops produced are yams, cassava, maize, rice and vegetables. The people live in scattered compounds surrounded by farmland with economic trees (palm trees, banana, mango, pear, breadfruit tree). Apart from agriculture, the people engage in trading. Some of their agricultural products are sold for money to supply food to other surrounding Local Governments Areas. The nature of their occupation (farming) predisposes them to frequent mosquito bites.

2.2 Study Design: The study is a cross sectional survey that investigated the prevalence and parasite density of malaria parasites among under-five children. A retrospective study using the results of RDT and microscopy parasitological diagnosis were carried out. The study lasted for three months.

2.3 Study Population: The study was carried out among under-five children. Blood samples of under-five children from Six (6) towns were used for the study. Also, the retrospective malaria status of the children was gotten from the communities Health Centres medical files. The six (6) towns studied were labelled as A, B, C, D, E and F to ensure proper identification.

2.4 Sampling Technique: Simple random sampling was used for the collection of blood samples from house to house. Blood sample of children (both febrile and clinically well) was collected from households that consent to participate in the study.

2.5 Ethical Clearance and permission: Ethical clearance (COOUTH/CMAC/ETH.C/VOL.1/FN:04/10) was obtained from Chukwuemeka Oduegwu Ojukwu University Teaching Hospital Awka, Anambra State Ethical Committee. Informed consent was obtained from the mothers/caregivers of the sampled children before the collection of blood samples.

2.6 Collection of Blood Samples: Blood samples were collected from malaria symptomatic and asymptomatic children less than 5 years of age with the professional help of a laboratory scientist. Two (2) mL venous blood was collected from each child by tying a tourniquet at the upper arm of each of the child, after cleaning with spirit. Blood samples collected were emptied into anticoagulant specimen bottles, already labelled with the child's names and mixed gently. The chemicals therein (ethylenediaminetetraacetic acid -**EDTA**) prevented the blood from clotting by removing calcium [6].

2.6 Preparation and examination of Blood Film: The laboratory method employed for staining and identification of malaria parasites in collected blood samples is as described in WHO Malaia Microscopy Quality Assurance Manual [6]. Both thick and thin smears prepared were examined microscopically after staining under X100 magnification objective lens.

2.7 **Statistical Analysis:** The data collected were analyzed using IBM SPSS statistics (version 25). Chi-square (χ^2) test was used to establish the relationship between malarial infections, sex and age of the children at 0.05 (P<0.05) significant levels.

3. Results

Characteristics of Participants

From table 1, it was observed that out of the 300 participants, 174 of them were females while 126 were males. This distribution shows that the female constitutes 58.00% of the participants while the male makes up 42.00%. The participants were made up of more females than males.

The age distribution of the respondents revealed that 21.00% (63) of the respondents are <1 years, 23.33% (70) of them are between the ages of 2 to 3 years, while 55.67% (167) of the respondents were 4 years and above.

Table 1: Gender and Age distribution of the Participants

Gender	Frequency	Percentage
Female	174	58.00
Male	126	42.00
Total	**300**	**100**
Age (years)		
<1	63	21.00
2-3	70	23.33
4-5	167	55.67
Total	**300**	**100**

Table 2 revealed that the blood samples tested with microscopy had a higher prevalence (67.33%) of malaria parasites than the previous diagnosis with RDT (23.33%). There was a significant difference in the prevalence result with the diagnostic techniques ($P<0.05$). Also, the blood samples tested with RDT had a higher prevalence (73.56%) of malaria parasites in females than males (58.73%). The current microscopy results showed that males had a higher prevalence (38.10%) of malaria parasites than females (12.64%). Overall gender result also revealed that males had a higher prevalence (96.83%) of malaria parasites than females (86.21%). There was a significant difference in the prevalence result with gender ($P<0.05$).

Table 2: Prevalence result of malaria infection based on diagnostic technique and gender.

Diagnostic Technique	No. samples examined	No. of positive cases	Prevalence	
Microscopy	150	101	67.33	
RDT	150	35	23.33	
Total	300	136	45.33	
Gender		**Positive cases**	**Total**	
		RDT	Microscopy	**Total**
Female	87	64(73.56)	11(12.64)	75(86.21)
Male	63	37(58.73)	24(38.10)	61(96.83)
Total	150	101(67.33)	35(23.33)	**136(90.67)**

Table 3 revealed that the blood samples tested with RDT had the higher prevalence (78.00%) of malaria parasites in patients <1 year old while least in those of 4-5 years (59.38%). The microscopy results showed a higher prevalence (69.23%) of malaria parasites in patients < 1-year-old while least in those of 2-3 years (17.65%). There was no significant difference in the prevalence of malaria parasites among age groups diagnosed with RDT and microscopy (P>0.05).

Table 3: Age-related Prevalence pf malaria infection

	RDT		**Microscopy**	
Age (years)	**Number Examined**	**Number Infected**	**Number examined**	**Number Infected**
1 and below	50	39(78.00)	13	9(69.23)
2-3	36	24(66.67)	34	6(17.65)
4-5	64	38(59.38)	103	20(19.42)
Total	**150**	**101(67.33)**	**150**	**35(23.33)**

Table 4 revealed that females had higher density of malaria parasites (28.05±15.390) than males (23.22±19.171). There was no significant difference in the malaria parasite density between male and female patients (P>0.05). It further revealed that patients from 4 years and above had higher intensity (29.68±17.357) while those of 1 year and below had the least (14.89±16.069). However, there was no significant difference in the malaria parasite among the age groups of patients (P>0.05).

Table 4: Parasite density of malaria infection and the use of ITNs amongst children less than five years of old

Gender			Mean parasite density			
Female			28.05±15.390			
Male			23.22±19.171			
Age (years)						
1 and below			14.89±16.069			
2-3			24.13±18.978			
4 -5			29.68±17.357			
Use of ITNs	Infected	Not-infected	Number Examined	Prevalence	x^2	*P*-value
Usage	11	85	96	11.5%	21.021	0.000
Non-usage	24	30	54	44.4%		

4. Discussion

The high prevalence of malaria parasitaemia in this study suggests that malaria remains a major cause of morbidity among the under-five age group in Dunukofia Local Government Area of Anambra State despite several control measures. The observed prevalence is similar to the report by Fawole and Onadeko [7] from Ibadan. The high prevalence may be as a result of the fact that the survey was carried out at the beginning of the rainy season and also the fact that caregivers do not use insecticide-treated bed-nets for the children. Okeke *et al*. [8] reported a seasonal prevalence of 52.3% malaria parasite infection during the rainy season in Anambra state, Nigeria. Differences in malaria prevalence can also be attributed to other parameters such as the educational background and economic background of the caregivers and other demographic factors of the population studied.

The results of the retrospective study were Rapid Diagnostic Test (RDT) was used as diagnostic test showed that the prevalence of malaria was higher in females (73.56%) compared to males (58.73%). A similar result was reported by Okafor and Nwaiwu [9] who recorded a prevalence of 74.6% among female children under the age of five. However, Nwaorgu and Orajaka [4] in their studies on the prevalence of malaria among children between 1 – 10 years old in communities in Awka-North Local Government Area, Anambra, observed a high prevalence of malaria among male children in the sampled population.The result from the microscopic examination of the prevalence of malaria reveals that the prevalence of malaria was higher in males when compared to females. There was significance difference in the prevalence of malaria based on gender (*P*= 0.00). This agrees with the recent findings of Oboro [12] who reported high malaria prevalence in males under-five years in the Niger Delta region using microscopy. The disparity in the prevalence may be as a result of differences in the number of sample or that males are more outdoor players than their female counterparts.

Similarly, microscopy results showed that females had higher parasite density (28.05±15.390) than males (23.22±19.171), but there was no significant difference (P>0.05). The observed

differences in prevalence may be as a result of the difference in the number of participants (64 female to 37 males).
The percentage of children who tested positive by either RDT or microscopy was above 20% in all the three variables sampled. Previous local studies have also reported higher values such as 63.3% in a 2015 study in Bayelsa State [15], 66.3% in Cross Rivers [16], and 63% in a 2019 study in Ekiti State [17]. Also, the Nigeria Malaria Indicator Survey (NMIS), which was a household study, reported a prevalence of 19% in the South-South region [18]. Both studies are likely to reflect the true prevalence rates based on the thorough description of their methods and processes. Ami [19] opined that the slightly lower prevalence rates of 5.4%, 8.3% and 9.4 % in Akwa Ibom, Delta and Rivers States respectively in their studies reflect a downward trend in malaria infections in Nigeria which is consistent with global reports. This trend may be as a result of continued support for malaria preventive interventions including specific diagnosis and treatment [20].

Although age is an important determinant of malaria parasitaemia in malaria endemic areas, the prevalence of malaria infection in this study did not differ significantly between the age groups. This finding may not be surprising as a comparison was within the under-five age group who are known to have fragile immunological immunity to malaria [10]. This is similar to the findings of Gbadegesin [11] from Benin City, Nigeria.

Both results from RDT and microscopy revealed that children from one year and below (<1) had the highest prevalence and parasite density. Yusuf [13] opined that in malaria stable areas like Nigeria, most children experience their first malaria infections during the first year or two of life.

In line with the well-established positive impact of Insecticide Treated Net (ITN) on the prevalence of malaria, usage of ITN had a significant effect on the prevalence of malaria parasitaemia in this study as the prevalence of malaria was high in children not using the mosquito nets as given by the RDT and microscopic tests. A similar finding has been reported by other workers. This finding may be attributed to several factors, for instance, not being comfortable sleeping under nets and ownership but non-usage scenario [14].

Conclusions: Prevalence of malaria parasitaemia was high in the population studied despite various control measures. Gender as well as the use of ITN had a significant effect on the prevalence of malaria in this study. Hence, there is a need to strengthen and scale up various malaria control programs while ensuring proper implementations of programs and activities through effective monitoring and evaluation.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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