Prevalence and Intensity of Malaria Parasite infection 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 in Dunukofia Local Government Area of Anambra State, Nigeria.

Study Design: A cross sectional study of 301 children was carried out in Dunukofia Local Government Area of Anambra State. The study adopted a retrospective descriptive survey and diagnostic cohort design by examination of blood samples across three variables: gender, age group and mosquito net usage.

Duration: The study lasted for six months in a rural community of Dunukaofia, Anambra State, Nigeria.

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: Retrospective studies from RDT showed that the prevalence and intensity of malaria was higher in females (72.7%) compared to males (58.7%) (x^2 = 3.248, P = .08), higher in children from one year and below (76.5%), followed by children between the ages of 2-3 years (66.7%), lowest in children between the ages 4-5 years (59.4%) (x^2 = 3.746, P= .15) and also higher in children not sleeping under mosquito treated bed nets (80.0%). Furthermore, current result from microscopy revealed that malaria prevalence and intensity was higher in males (38.1%) when compared to the females (12.6%) (x^2 = 13.232, P = .00). Similarly there was higher prevalence of malaria infection in children of one year and below (69.2%), followed by children within the age of 4-5 years (19.4%) and lowest in children between 2-3 years (17.6%)(x^2 = 3.746, P =.15). Children not sleeping under mosquito treated bed net had a higher prevalence (44.4%) compared to children sleeping under mosquito treated bed-net (11.5%) (x^2 = 21.021, P = .00).

Conclusion: Prevalence of malaria parasitaemia was still high in Dunukaofia, Anambra 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. 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 are sporadic reports of simian malaria parasite being found in the human's body, most reports associating *P. knowlesi* has not yet been determined. 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 afflicted 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.

In the under-five age group, mortality rates have declined by 53 % globally, and by 58 % in Africa. ~~WHO~~ World Health Organization noted that progress in adopting and rolling out preventive therapies for children has been even slower than ever. In 2013, only six of the 16 countries where WHO recommend preventive therapies for children under five have adopted the treatment as a national policy [2].

The decline in malaria incidence and mortality may be attributed to the volume of RDT sales and microscopic examination. Rapid Diagnostic Test 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 and 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 conducted 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]. Dunukofia 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

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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 adopted diagnostic cohort designs that investigate the prevalence and intensity of malaria parasites among under-five children in Dunukofia L.G.A. Anambra State Nigeria with the use of RDT and microscopy parasitological tools. The study lasted for six months.

2.3 Study Population: The study was carried out among under-five children in Dunukofia L.G.A. Anambra State, Nigeria. Blood samples of under-five children from Six (6) towns were used for the study. Also, the retrospective malaria status of the children in the communities was gotten from the population's medical files. The six (6) towns studied were labelled as A, B, C, D, E and F.

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. They were visited once every week for three months.

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 aged 0 – 14.9 months with the professional help of a laboratory scientist. Two (2) mL venous blood was collected from each child on the scheduled days of a visit by tying a tourniquet tied to the upper arm of each of the children, after cleaning with spirit. Blood samples were collected and emptied into anticoagulant specimen bottles, already labelled with children's names and mixed gently. The chemicals therein prevented the blood from clotting by removing calcium [6].

Comment [AO4]: Name the anticoagulant

2.6 Preparation and examination of Blood Film: The laboratory method employed for staining and identification of malaria parasites in collected blood samples is ~~was~~ as described in Malaia Microscopy Quality Assurance Manual ~~by~~ [6]. ~~Both thick and thin films were prepared.~~ Both thick and thin smears prepared were examined microscopically after staining under ×100 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

Table 1 below shows the retrospective prevalence of malaria in the studied population-based population based on the Rapid Diagnostic Test (RDT) among one hundred and fifty-one (151) children below the age of five in Dunukofia Local government, Anambra State, Nigeria. Gender

results show that the prevalence of malaria was higher in females (72.7%) compared to males (58.7%), this difference was, however, not statistically significant (x^2 = 3.248, P = 0.08). Based on the age groups, the result revealed that children from one year and below (<1) had the highest prevalence of malaria parasitaemia (76.5%), followed by children between the ages of 2-3 years (66.7%) and lowest in children between the ages 4-5 years(59.4%). There was no significant difference in the prevalence of malaria based on the age distribution (x^2 = 3.746, P= 0.15). A high number of malaria prevalence was also observed in children who do not sleep under mosquito treated bed-nets (80.0%) compared to those using mosquito treated bed-nets (27.3%). There was a significant difference in malaria prevalence among the children based on the utilization of mosquito net (x^2 = 30.869, P = 0.00).

Table 1: Prevalence of malaria parasitaemia amongst children 0 -14 months based on RDT in Dunukofia Community, Anambra State, Nigeria

Variables	Infected	Not-infected	Number Examined	Prevalence	x^2	*P*-value
Gender						
Female	64	24	88	72.7%	3.248	0.081
Male	37	26	63	58.7%		
Age groups						
<1	39	12	51	76.5%	3.746	0.154
2-3 years	24	12	36	66.7%		
4-5 years	38	26	64	59.4%		
Use of ITNs						
Usage	9	24	33	27.3%	30.869	0.000
Non-usage	92	26	118	80.0%		

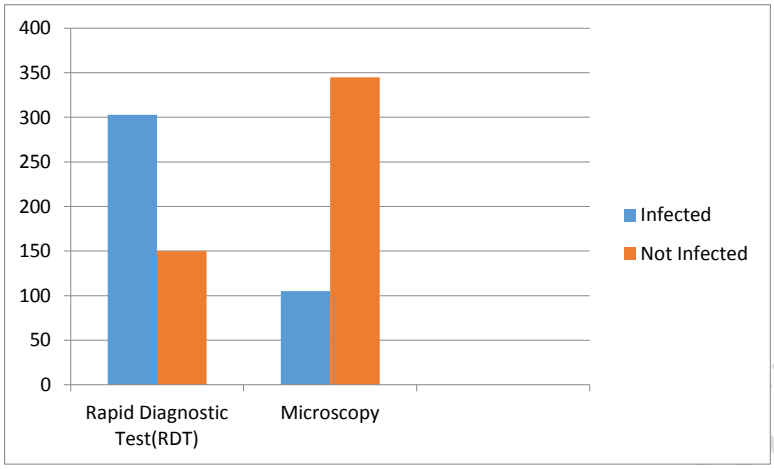
* Statistically significant $P < 0.00$

Furthermore, the result from the microscopic examination of samples among children below the age of 5 years in Dunukofia Local Government Area, Anambra State is shown in Table 2 below. The result reveals that the prevalence of malaria was higher in males (38.1%) when compared to females (12.6%), also, there is a significant difference in the prevalence of malaria based on gender (x^2 = 13.232, P = .00). The prevalence of malaria parasite was seen to be higher in children of one year and below (69.2%), followed by children within the age of 4-5 years (19.4%) and lowest in children between 2-3 years (17.6%). The difference in the prevalence of malaria parasitaemia based on age distribution is not significant (x^2 = 3.746, p =0.154). Also, the prevalence of malaria was higher in children who do not sleep under mosquito treated presented bed-nets (44.4%) when compared to children using mosquito treated bed-nets (11.5%), there is a significant difference in the malaria prevalence (x^2 = 21.021, P = 0.00).

Table 2: Prevalence of malaria parasitaemia amongst children 0 -14 months based on Microscopy test

Variables	Infected	Not-infected	Number Examined	Prevalence	x^2	*P*-value
Gender						
Female	11	76	87	12.6%	13.232	0.000
Male	24	39	63	38.1%		
Age groups						
<1	9	4	13	69.2%	3.746	0.154
2-3 years	6	28	34	17.6%		
4-5 years	20	83	103	19.4%		
Use of ITNs						
Usage	11	85	96	11.5%	21.021	0.000
Non-usage	24	30	54	44.4%		

*Statistically significant P < 0.05



(x^2=1.735, P =0.00)

Comment [AO5]: The difference in prevalence by microscopy and RDT diagnosis is not discussed at all

Figure 1: Distribution of RDT and Microscopy Results

The distribution of positive malaria tests (infection) by microscopy and RDT was determined and is presented in figure 1 below. Overall, more malaria infections were detected by RDT (303, 74.3%) when compared to microscopy (105, 25.7%). There was a significant difference in the distribution of positive tests by microscopy and RDT among the sampled population (x^2=1.735, P=0.00)

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 result of the Rapid Diagnostic Test (RDT) showed that the prevalence of malaria was higher in females (72.7%) compared to males (58.7%). 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. Although age is an important determinant of malaria parasitaemia in malaria stable areas, the prevalence of malaria infection in this study did not differ significantly between the age groups (x^2 = 3.248, P = 0.08). 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. The result from the microscopic examination of the prevalence of malaria reveals that the prevalence of malaria was higher in males (38.1%) when compared to females (12.6%). There was significance difference in the prevalence of malaria based on gender (x^2 = 13.232, 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 counterparts the fact the males are more outdoor players than their female counterparts.

Both results from RDT and microscopy revealed that children from one year and below (<1) had the highest prevalence and intensity of malaria parasitaemia, followed by children between the ages of 2-3 years and 4-5 years respectively. 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, ownership but non-usage scenario [14]
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]. These studies all used microscopy for parasite detection. The result of positive test distribution by microscopy and Rapid Diagnostic Test in this study revealed that more malaria infections were detected by RDT (303, 66.9%) when compared to microscopy (105, 23.3%). There was a significant difference in the distribution of positive tests by microscopy and RDT among the sample population (x^2=1.735, P =0.00). This difference is quite significant. 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 is a result of continued support for malaria preventive interventions including specific diagnosis and treatment [20].

Conclusions: Prevalence of malaria parasitaemia was high in the population studied despite various control measures. Age and 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. The usefulness and reliability of RDT kits for malaria diagnosis in the absence of expert microscopy is also reinforced.

Comment [AO6]: Only ITNs had a significant effect on the prevalence of malaria

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.

References

1. Wang, J., Xu, C., Wong, Y. K., He, Y., Adegnika, A. A., Kremsner, P. G. And Tu, Y. (2020). Preparedness is essential for malaria-endemic regions during the COVID-19 pandemic. *The Lancet*, 395(10230): 1094-1096.
2. WHO, (2019).W.H.O. World Malaria Report 2019. http//www.who.int/malaria/publication/world-malaria-report-2019/report/report/en.
3. Center for Disease Control, (2020). Malaria's Impact Worldwide. https://www.cdc.gov/malaria/malaria_worldwide/impact.html.
4. Nwaorgu, O. C. and Orajaka, B. N. (2011). Prevalence of malaria among children 1–10 years old in communities in Aawka North Local Government Area, Anambra State South East Nigeria. *African Research Review*, *5*(5): 264-281.
5. MLS (2010). Map of Anambra State. Ministry of Lands and Survey, Awka, Anambra State, Nigeria.
6. WHO, (2016). Malaia Microscopy Quality Assurance Manual, Version 2. World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland.
7. Fawole, O.I. and Onadeko M.O. (2011). Knowledge and Management of Malaria in Under Five Children by Primary Health Care Workers in Ibadan South East Local Government Area. Nigeria. *Post Graduate Medical Journal*, **8**(1): 1- 5.
8. Okeke, O. P., Imakwu, C. A., Eyo, J. E. and Okafor, F. C. (2015). A Six Year Review of the Trends in Prevalence of Malaria Infection in Children in Secondary and Tertiary Health Care Outlet in Anambra State, Nigeria. *Animal Research International* 12(3): 2311 – 2315.
9. Okafor, H.U and Nwaiwu, H.O. (2015) Anaemia of Persistent malarial parasitemia in Nigerian children. *Journal of Tropical Pediatrics*, 47(5): 271-275.
10. Langford, S., Douglas, N. M., Lampah, D. A., Simpson, J. A., Kenangalem, E., Sugiarto, P. and Price, R. N. (2015). *Plasmodium malariae* infection associated with a high burden of anemia: a hospital-based surveillance study. *PLoS neglected tropical diseases*, *9*(12), e0004195
11. Gbadegesin, R.A., Sodeinde, O., Adeyemo, A.A and Ademowo, O.G. (2017). Body temperature is a poor predictor of malaria parasitaemia in children with acute diarrhoea. *Annual Journal of Tropical Paediatry*,*17*(1):89-94.
12. Oboro, M., Bob-Manuel, I. N., Chijioke, N., Maduka, O.,Kasso,T and Nwauche ,C.A (2021). Prevalence of Malaria among Children under Five Years in the Niger Delta Region of Nigeria. *Asian Journal of Paediatric Research*, 5(4): 10-17.
13. Yusuf, O.B., Adeoye, B.W., Oladepo, O.O., Peters, D.H. and Bishai, D. (2017). Poverty and fever vulnerability in Nigeria: a multilevel analysis. *Malaria Journal*, 9:235.

14. Tabue, R. N., Awono-Ambene, P., Etang, J., Atangana, J., Antonio-Nkondjio, C., Toto, J. C. and Bigoga, J. D. (2017). Role of *Anopheles* (Cellia) rufipes (Gough, 1910) and other local anophelines in human malaria transmission in the northern savannah of Cameroon: a cross-sectional survey. *Parasites and vectors*, 10(1): 1-11.
15. Abah, A.E. and Temple, B. (2015). Prevalence of Malaria Parasite among Asymptomatic Primary School. *Tropical Journal for Medicine and Surgery*, 4(1): 2–4.
16. Alain, I.S., Ejemot-Nwadiaro, R., Anuqua, I.J. and Ebi, E.J. (2017). Prevalence of Malaria among Pregnant Women and Children Under Five Years in Abi Local Government Area, Cross River State, Nigeria. *Asian Journal of Medicine and Health*, **7**(1):1-7.
17. Simon-Oke, I.A., Ogunseem, M., Afolabi, O. and Awosolu, O. (2019). Prevalence of Malaria Parasites among Pregnant Women and Children under Five years in Ekiti State, Southwest Nigeria. *Journal of Biomedicine and Translational Research*, 5(1):5- 10.
18. National Malaria Elimination Programme- NMEP, (2015). Nigeria Malaria Indicator Survey 2015. https://dhsprogram.com/pubs/pdf/MIS20/MIS20.pdf
19. Amir, A., Cheong, F.W., DE Silva, J.R. and Lau, Y.L. (2018). Diagnostic tools in childhood malaria. *Parasite Vectors*, 11(1):1–12
20. Maharaj, R., Kissoon, S., Lakan, V. and Kheswa, N. (2019). Rolling back malaria in Africa– challenges and opportunities to winning the elimination battle. *South Africa Medical Journal*, 109(11b):53-56