PATTERN OF MALARIA PARASITAEMIA IN A HIGH TRANSMISSION SETTING OF OBA-ILE, AKURE NORTH, SOUTHWESTERN NIGERIA

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ABSTRACT

Malaria is an infectious disease of major public health importance worldwide. This study was carried out to investigate the malaria parasitaemia in a high transmission setting of Oba-Ile, Akure North Local Government Area (LGA), Ondo State, Nigeria. Thick and thin blood smeared slides were prepared and examined under the light microscope. Out of 210 individuals examined, 148(70.50 %) were positive for malaria infection. The infection pattern among age groups revealed that the highest (84.61 %) and the lowest (66.67 %) infection rate were observed among age group 6 – 10 years and 5 years and below respectively. No significant difference (p>0.05) occurred between age-related malaria infection. Additionally, male had the highest (75.89 %) prevalence of infection compared to their female counterpart (64.28 %) though significant difference (p>0.05) did not occur. Parasite densities vary significantly (p<0.05) across age group and sex. The highest (4428 parasite/µl of blood) and lowest (824 parasite/µl of blood) parasite density was recorded among age group ≥ 21 years and ≤ 5 years respectively. Similarly, male significantly (p<0.05) had the highest parasite density (6484 parasite/µl of blood) compared to their female counterpart (4316 parasite/µl of blood). Furthermore, prevalence of malaria infection varied significantly (p<0.05) with respect to occupation and income. This study revealed that malaria is prevalent in Oba-Ile. Thus, appropriate intervention programme should be designed to curtail the disease.

Keyword: Malaria, Parasite density, Parasitaemia, *Plasmodium falciparum*, Oba-Ile, Nigeria

INTRODUCTION

Malaria is a highly devastating infectious disease of public health. Approximately 3.2 billion people are at risk of contracting malaria infection worldwide (WHO, 2015a). It is caused by parasite of the genus *Plasmodium* and transmitted by female *Anopheles* mosquitoes. There are currently five major *Plasmodium* species causing malaria in human, and includes *Plasmodium falciparum*, *P. vivax*, *P. malariae*, *P. ovale* and the most recently discovered, *P. knowlesi*, that is zoonotic. Generally, *P. falciparum* is the most widespread, deadly and pathogenic in Africa (Phillips *et al.*, 2017). Malaria is a major public health concern with an estimated 229 million cases and 409,000 deaths globally in 2019 (WHO, 2020). It occurs mostly in the tropical regions, particularly countries in sub-Saharan Africa. Africa alone accounted for about 94 %, while South-East Asia region recorded about 3 % of all malaria cases worldwide (WHO, 2020). Malaria is a disease common among pregnant women and children, thus leading to the death of approximately a child every two minutes worldwide in 2016 and this has led to great adverse impact on national development (WHO, 2017). Similarly, Nigeria

has the highest malaria cases worldwide which was estimated to be 25 % of all global malaria cases in 2018 (WHO, 2018). Thus, transmission of malaria parasite remains very high and occurs throughout the year in Nigeria (Adigun *et al*., 2015).

Previous studies have reported that malaria is widespread in Nigeria due to many contributing risk factors such as favourable climatic condition that enhance the breeding, growth and development of mosquito vectors (De Silva and Marshall, 2012; Amaechi *et al*., 2018; Segun *et al*., 2020). Moreover, poor socioeconomic condition and behavioural attitudes common in resource-poor settings have been shown to aggravate malaria transmission rate (Mutero *et al*., 2004; Clark *et al*., 2008; Hiscox *et al*., 2013). Factors associated with malaria transmission have been documented in Nigeria (Fana *et al*., 2015; Simon-Oke *et al*., 2016), however, in order to support World Health Organization's Global Technical Strategy for Malaria 2016 – 2030 which aimed to reduce malaria by 90 % by 2030 (WHO, 2015b), there is need to update the epidemiological information on variables enhancing malaria transmission in Akure North. This in turn can assist policy makers on appropriate control and management strategy. Thus, this study was carried out in order to determine the malaria parasitaemia in a high transmission setting of Akure North, Nigeria.

MATERIALS AND METHODS

Study Area: The study was carried out in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria. Akure North is located between latitudes 5°22′14″N and longitudes 6°37′31″E (Opaluwa *et al*., 2018). The local climate is tropical with rainy season (April – October) and dry season (November - March) (Opaluwa *et al*., 2018), thus, malaria is hyper-endemic due to conducive environment for mosquito breeding. It has a population of 185,596 (Opaluwa *et al*., 2018). The major occupation is farming and trading while few individuals are engaged as civil servants.

Study Population and Sample Size: A cross-sectional community-based study was carried out from February to July 2017 in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria. A total of 210 consented individuals were recruited for this study. Before the study commenced in Oba-Ile Town, detailed information about the importance of the study was explained to the community leaders and individuals that volunteered through focus group discussion. The sampled size was calculated from the following equation: $N = t2 \times P (1 - p) / M2$, where N = Sample size, t = the normal standard deviate (t = 1.96), P = the frequency of occurrence of malaria (0.16 %) and M = degree of precision (0.05 %) (Araoye, 2004). From the formula, 210 participants were recruited for the study.

Ethics: Prior the commencement of the study, approval was obtained from Ondo State Ministry of Health Ethical Committee (Reference Number: OSHREC/21/08/2017/013) and Federal University of Technology Ethical Committee. Additionally, written informed consent was obtained from each adult participant and the parent or guardian of each child examined.

Data Collection: A well designed and structured questionnaire was administered to the participants in order to collect information on their age, sex, occupation, education and income. The questionnaire was face validated, pretested, and tested for reliability before administration (Roopa and Rani, 2012).

Blood Sample Collection and Examination: With the assistances of a trained Medical Laboratory Technician, 2 – 3 mL of blood was aseptically collected from the veins of the subjects using a sterile syringe into EDTA bottles for thin and thick blood film preparation. Thin and thick smears of the samples was prepared on sterile slides and subsequently stained with Giemsa stain. The smears were viewed under x100 objective lens of the light microscope to detect the presence or absence of *Plasmodium* spp. Subsequently, the thin smear was examined and used to identify parasite species. The absence of malaria

parasites in 200 microscopic fields of the slides from the thick smears per subject was considered negative for the subject. The level of parasitaemia was recorded as low when parasitaemia is <1000 parasites/µl of blood, moderate: 1000 – 9999 parasites/µl of blood and severe: ≥10,000 parasites/µl of blood (Atroosh *et al.*, 2015).

Statistical Analysis: Data obtained was analysed using the SPSS version 20. Pearson's Chi-square was used to determine the differences in prevalence of malaria by age, sex, occupation, education and income. P-values less than 0.05 were considered statistically significant. Parasite densities were compared using Student's t-test and one-way ANOVA.

RESULTS

General Demographic Characteristics of the Participants in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria: Out of 210 individuals that participated in this study, 112(53.3 %) were male while 98(46.6%) were female. Adults aged 21 years and above constitute 54.76 %. The majority of the participants were traders (35.30 %) and farmers (31.10 %). Most of the participants (43.30 %) earned below 18, 000 Naira (Table 1).

Table 1: General demographic characteristics of the participants in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria

Variables	Number (%)
Age group (years)	
≤ 5	3(1.4)
6 – 10	13(6.2)
11 – 15	21(10.0)
16 – 20	58(27.6)
≥ 21	115(54.8)
Sex	
Male	112(53.3)
Female	98(46.7)
Occupation	
Trading	75(35.3)
Farming	41(31.1)
Student	48(22.9)
Civil servants	17(8.1)
Artisan	14(13.8)
Income (Naira)	
≤ 18, 000	91(43.3)
19000-30000	82(39.0)
≥ 31,000	37(17.6)

Prevalence of *Plasmodium falciparum* among the Participants with Respect to Age and Sex in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria: This study revealed that a total of 148(70.50 %) of the individuals were infected (Table 2).

Table 2: Prevalence of *Plasmodium falciparum* among the participants with respect to age and sex in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria

Variables	Number Examined	Number Infected (%)
Age group (years)		
≤ 5	3	2(66.67)
6 – 10	13	11(84.61)
11 – 15	21	16(76.19)
16 – 20	58	40(68.96)
≥ 21	115	79(68.69)
P-value		0.77
Sex		
Male	112	85(75.89)
Female	98	63(64.28)
P-value		0.07
Total	210	148(70.47)

The age pattern of infection showed that age group 6 – 10 years has the highest prevalence rate of 84.61 %, while age group 5 years and below had the least prevalence of 66.67 %. However, there was no significant difference in the age-related prevalence of infection among the participants (X^2-1.84, p>0.05).

Regarding prevalence by sex, males had the highest prevalence of infection (75.89 %) compare to their female counterpart (64.28 %) (Table 2). There was no significant association in gender related prevalence of malaria parasite among the individuals sampled (X^2 – 3.38, p>0.05).

Malaria Parasite Density among the Respondents with Respect to Age and Sex in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria: The highest parasite density was recorded among age group ≥ 21 (4,428 parasites/µl of blood), while the lowest was recorded among age group ≤ 5 (824 parasites/µl of blood) (Table 3). There was significant association in the age-related parasite density among the participants (p<0.05).

Table 3: Malaria parasite density among the respondents with respect to age and sex in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria

Variables	Number Examined	Parasite Density (Parasite/µl of Blood)
Age group (Years)		
≤ 5	3	824
6 – 10	13	1720
11 – 15	21	2321
16 – 20	58	3764
≥ 21	115	4428
P-value		0.001
Sex		
Male	112	6484
Female	98	4316
P-value		0.001

Additionally, this study showed that males had higher malaria parasite density (6,484 parasites/µl of blood) compared to their female counterparts (4,316 parasites/µl of blood) (Table 3). Malaria parasite density varied significantly among the male and female in the study area ($p<0.05$).

Prevalence of *Plasmodium falciparum* among the Participants with Respect to Income in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria: In this study, the highest prevalence rate of infection was recorded among those who earn ≤ 18,000 Naira per month (82.42 %), while the least prevalence rate was recorded among those who earn ≥ 31,000 Naira per month (54.05 %). Prevalence of infection with respect to income varied significantly among the participants ($p<0.05$) (Table 4).

Table 4: Prevalence of *Plasmodium falciparum* among the participants with respect to income in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria

Variables	Number Examined	Number Infected (%)
Income per month (Naira)		
≤ 18, 000	91	75(82.42)
19000-30000	82	53(64.63)
≥ 31,000	37	20(54.05)
Total	210	148(70.47)

With regards to the prevalence of malaria infection with respect to occupation, malaria was most prevalent among traders (43.91 %) followed by farmers (20.27 %), students (16.89%), Artisan (12.83 %) and the least is among civil servants (6.08 %) (Figure 1). The associations varied significantly ($p<0.05$).

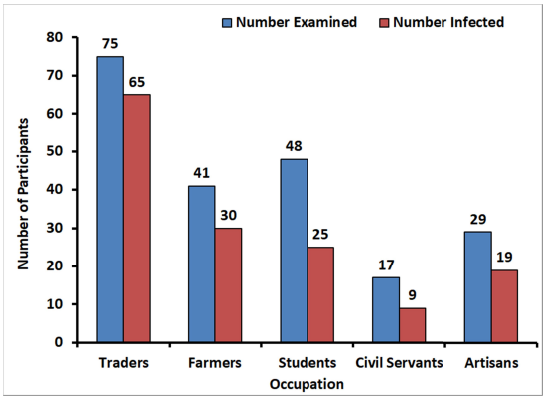

Figure 1: Prevalence of *Plasmodium falciparum* with respect to occupation in Oba-Ile, Akure North Local Government Area of Ondo State, Nigeria

DISCUSSIONS

This study reports the baseline epidemiological data on malaria in Oba-Ile community, Ondo State, Nigeria. Malaria is prevalent in Oba-Ile as found in other resource-poor setting. This current study agreed with reports of other studies from malaria-endemic regions outside and within Nigeria (Worku *et al.*, 2014, Egbewale *et al.*, 2018, Mogaji *et al.*, 2018, Awosolu *et al.*, 2019).

The high prevalence rate of malaria (70.50 %) reported in this study was consistent with other previously reported studies in Ekondo Titi sub-division, Cameroon and other places near the study area (Tientche *et al.*, 2016; Obimakinde and Simon-Oke, 2017; Awosolu *et al.*, 2019; Simon-Oke *et al.*, 2019). However, malaria prevalence report of this study was higher than the 58.0 % and 59.9 % reported by Nwagha *et al.* (2009) and Ogbodo *et al.* (2009) respectively, among pregnant women in a rural community of Nigeria. Recent malaria risk maps estimated that malaria prevalence in Nigeria varied from less than 20.0 % in certain areas to over 70.0 % in others (Onyiri *et al.,* 2015). In

the study area, malaria transmission was usually high and occurred all year-round, though there was variation across the seasons due to variation in rainfall, temperature and mosquito vector abundance (FMOH, 2010). The high malaria prevalence in this study may be attributed to high mosquito vector abundance with high vectorial capacity, failure to constantly use mosquito net, lack of treatment-seeking behaviour due to ignorance of malaria infection, and outdoor sleeping among others.

Additionally, the findings of this study showed that the prevalence and parasite density of malaria infection was higher among males than their female counterparts. This was similar to the reports of Tientche *et al*. (2016) on the prevalence of asymptomatic malaria among school children of Ekondo Titi Sub-division, Cameroon, Egbewale *et al*. (2018) on the prevalence of asymptomatic malaria among elderly population in Osun State, Nigeria and Awosolu *et al*. (2019) on the pattern of malaria parasitaemia and genotype among residents of Orita Obele, Akure, Nigeria. However, the report of Abossie *et al*. (2017) showed that females were more infected was in sharp contrast to the report of this study. The reported high prevalence of infection among male subjects in this study may be due to frequent exposure of male subjects to the malarial vector as they tend to engage in various outdoor activities than the females who may usually prefer to stay indoor most of the time especially during the evening time when mosquito bite are more prevalent. Lack of prevention and control strategies may have also contributed to this menace in Oba-Ile.

The pattern of prevalence of infection according to age indicated that age group 6 – 10 years significantly had the highest prevalence of malaria compared to age group 5 year and below which had the least malaria prevalence and was in close agreement with the report of Abossie *et al*. (2017) on the prevalence of asymptomatic malaria among school children of Mirab Abaya district, Southern Ethiopia. Conversely, other reports have shown decrease in malaria infection with respect to increasing age as a result of high immunity due to increased exposure (Ganguly *et al*., 2013; Nankabirwa *et al*., 2014; Worku *et al*., 2014). This variation could be as a result of treatment with Intermittent Preventive Treatment (IPT) in children of 5 years and below and the constant use of mosquito net compared to other age groups. Younger children with little or no immunity tend to respond seriously to malaria infection which could call for quick health care unlike in older age group who could accommodate high levels of malarial parasites without being symptomatic. Low income and occupation were major socio-economic variables associated with malaria in the study area which significantly impacted negatively on the population and lead to increased burden of malaria infection. Traders and farmers were the most infected with malaria parasites. Similar results in occupation related rate of infection was reported by Robert and Boudin (2003). The high infection rate among traders could be due to the nature of their job which exposes them in the late hours of the day when mosquito vectors are active. Unfortunately, the daily hustle and bustle involved in commercial activities might cause fatigue which in turn could lead to deep sleep in the nights which favours the uninterrupted blood sucking tendency of mosquito vector.

Additionally, low household monthly income of less than 18,000 Naira increased the odd of malaria among participants. This was consistent with previous reports from other African countries that showed malaria to be common among people of lower socio-economic status who often live in poor housing conditions that increases their exposure to infection and lack the financial capacity to treat malaria and buy mosquito net (Kepha *et al.,* 2016). Thus, malaria and poverty are intimately and intricately connected (WHO, 2014).

Conclusion: Conclusively, malaria disease is prevalent in the study area and some of the contributory variables include low level of income, trading and farming. Thus, control intervention should be deployed to the study area in order to alleviate the menace.

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