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Epidemiological Factors in Prevalence of Malaria Parasites in Primary Health Facilities Attendees, Ogun State, Nigeria

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Abstract

Malaria caused by *Plasmodium* species is often observed in areas where malaria is endemic. Malaria prevalence in metropolitan Abeokuta of Ogun State, Nigeria was studied between October, 2012 and January 2013. Oral interviews were used to get personal data of participants. Blood samples were obtained from 384 consented participants from the seven primary health centers. Blood film examination using *Giemsa* staining techniques was used to detect malaria parasites in the blood. From the 384 participants examined 273 (71.1%) were positive with malaria parasites. Species detected included *Plasmodium falciparum* (95.6%), *Plasmodium malariae* (3.3%), *P. ovale* (0.7%) and *P. vivax* (0.4%). The age-group 1-11 years had the highest malaria prevalence 94 (81%) while 51-60 had the least 6(54.5%). The malaria prevalence in relation to age was significant ($p=0.011$, $p<0.05$). The males 110 (73.8%) were slightly more affected than the females 163 (69.4%), but not statistically significant ($p=0.347$, $p>0.05$). Malaria prevalence was significantly higher among those with no formal education 80 (81.6%) and least among post-secondary educational. Prevalence among occupational groups showed significant difference, where the unemployed group were more infected and the retiree group had the least infection ($p=0.014$, $p<0.05$). The singles (56.4%) were more infected than the married (43.6%). The prevalence in relation to age was significant ($p=0.000$, $p<0.05$). The study has revealed that malaria disease can affect all age groups and both males and females' sexes irrespective of their educational and occupational cadre. Public enlightenment efforts need to be intensified towards the prevention of malaria.

Keywords: Prevalence; Malaria parasites; *Plasmodium*

Introduction

Malaria parasites cause a life-threatening protozoan disease called malaria. This disease has been a plague to the human race for over 50,000 years and may have been a human pathogen for the entire history of the species [1]. It is the most important of all the tropical diseases in terms of morbidity and mortality [2]. Each year, it causes diseases in approximately 650 million people and kills between one and three million people, most of whom are young children and pregnant women, non-immune travellers, refugees of labor forces entering into endemic areas in Sub-Saharan Africa, Asia and the Americas [3].

Malaria is holo-endemic and stable in Nigeria. More than 90% of the total population is at risk of malaria and at least 50% of the population suffers from at least one episode of malaria each year. Beyond the impact on children and pregnant women, it affects the general population [4,5]. This problem is compounded by the increasing resistance of malaria to hither to cost effective antimalarial drugs. The disease is the commonest cause of outpatient attendance across all the age groups with about 66% of clinic attendance due to malaria and thus constituting a greater burden on the already depressed economy [6]. According to Jimoh et al. [7], about 12% of gross domestic product is lost to malaria in Nigeria.

There are four species of human *Plasmodium* namely; *P. falciparium, P. malariae, P. ovale and P. vivax* [8-10]. Malaria is holo-endemic in Nigeria with *P. falciparum* as the dominant species [11]. *P. falciparum* is responsible for about 82% of the infections while *P. malariae* and *P. ovale* are responsible for approximately 14% and 5% respectively [12]. Infection with *P. vivax* is rare in indigenous West African populace because of absence of Duffy blood group antigens on the erythrocytes surface [13,14].

Prevalence surveys give insights into the transmission patterns in any given area and acts as useful tools for control purposes. In Ogun State, there have been a number of researches on malaria [15-19]. The indication is that malaria is still endemic. The study is aimed at investigating the prevalence of malaria caused by *Plasmodium* and how demographic factors influence malaria parasites transmission among persons attending primary health facilities in Ogun State, a state in the tropical rain forest zone of South West, Nigeria.

Materials and Methods

Study Area

The study was conducted in seven primary health care (PHC) facilities in four local government areas (LGA) as presented in Figure 1 namely; PHC Enu-gada (N7.15542˚, E3.32981˚), PHC Iberekodo (N7.18172˚, E3.34046˚) and PHC Sabo (N7.16843˚, E3.32015˚) in Abeokuta North LGA, PHC Oke-ilewo (N7.13512˚, E3.33939˚) in

Abeokuta South LGA, PHC Owode-egba (N6.94391˚, E3.50269˚) and PHC Ofada (N6.86379˚, E3.42645˚) in Obafemi-owode LGA and PHC Obantoko (N7. 17890˚, E3.39567˚) in Odeda LGA between October, 2012 and January, 2013. Total population of the four LGAs was estimated to be 947,695 people. Occupation was mainly by trading, farming, and tie and dye.

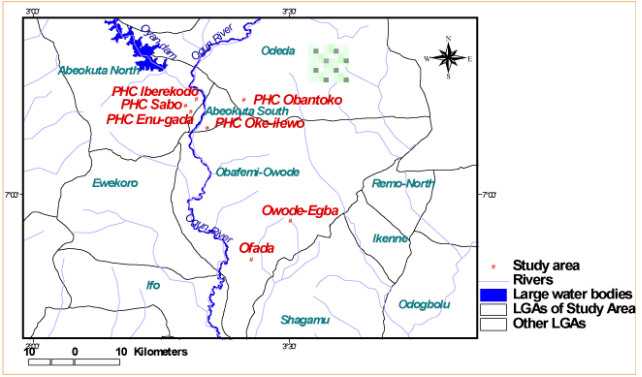

Figure 1: Showing the study area of the selected Primary Health Centres (PHCs) in Abeokuta, Ogun State.

Selection of Participants

Consents were given by the Chairmen and Medical Health Officers of the Local Government Areas. Selection was through the stratified sampling method. A total of 384 persons consented. Approval consents were gotten from the participants and care givers.

Sample collection

The method of sample collection employed was venipuncture technique [20]. Soft tubing tourniquet was fastened to the upper arm of the subject to enable the index finger feel a suitable vein. The puncture site was then cleansed with methylated spirit and veni puncture made with the aid of a 21G needle attached to a 5ml syringe, Sufficient blood was collected, the tourniquet released and the needle removed immediately while the blood was transferred into an ethylene-diamine-tetra-acetic acid (EDTA) bottle [20].

Laboratory Analysis

The collected blood samples were analyzed within 1 to 2 h of collection. Thick and thin blood films were prepared. The thin films were fixed in methanol for 30 seconds dabbing with a cotton wool pad. Care was taken not to allow contact between the thick film and the methanol. The slides were stained in 3% Giemsa stain for 45 minutes and dried. The stained slides were examined with 100× objective and the features in the thin film seen were used to identify *Plasmodium* species. Presence of ring forms of *Plasmodium* and Trophozoites of *Plasmodium* indicated positive results. The degree of parasitaemia was determined by counting and calculating the percentage of infected Red Blood Cells (RBC). Parasitized red cells in thick films was determined by counting a total of at least eight hundred (800) red cells taking note of the number that contained parasites (excluding gametocytes) in at least 5 fields on the thin blood film. Counting was done by hand tally counter [21]. A blood smear was considered negative if no parasite seen after 10 minutes of search or examination under 100 high power fields of microscope. Standardized questionnaires were used to obtain information such as age, sex, educational status, marital status and occupational status from respondents and caregivers.

Data Analysis

The obtained results from the questionnaires were analyzed and analyzed using EPI INFO 10. Data from blood samples were analyzed using SPSS version 16. The data generated from this study were presented using descriptive statistics. Chi-square was used to obtain level of significant ($p<0.05$).

Results

Out of the 384 persons examined for malaria parasite, 273 were positive, thus giving a prevalence of 71.1%. PHC Enugada had the highest prevalence 27 (84.4%) while PHC Obantoko had the least 35 (66.0%). The prevalence of malaria of was not significant among the different primary health centres studied (P=0.635, p>0.05) (Table 1).

Parameters LGAs	Primary Health Facilities	Number examined	Number positive	Prevalence (%)
Abeokuta-south	Oke-ilewo	121	83	68.6
Abeokuta-north	Enugada Iberekodo Sabo	32 32 32	27 22 24	84.4 68.8 75
Obafemi/owode	Owode-egba Ofada	57 57	40 42	70.2 73.7
Odeda	Obantoko	53	35	66
Total		384	273(71.1)	71.1

Table 1: Malaria prevalence in the primary health centers in parts of Ogun State; LGA s – Local Government Areas.

Abeokuta-north LGA had highest mean parasiteamia intensity of 45.7% of the infected persons; others were Abeokuta-south LGA with 44.7%, Odeda LGA with 41.5% and Obafemi/owode LGA with 39.5% the least mean parasiteamia as shown in Table 4. The overall mean parasiteamia intensity per infected person was 43.0% (Table 2).

Parameters LGAs	PrimaryHealth Facilities	Number examined	Number positive	Percentage Parasitized red blood cells (PPRBCs)
Abeokuta-south	Oke-ilewo	121	83	3708(44.7)
Abeokuta-north	Enugada Iberekodo Sabo	32 32 32	27 22 24	1253(46.4) 990(42.3) 1096(45.6) 3339(45.7)
Obafemi/owode	Owode-egba Ofada	57 57	40 42	1692(42.3) 1552(36.9) 3244(39.5)

Odeda	Obantoko	53	35	1454(41.5)
Total		384	273	11745(43.0)

Table 2: Intensity of malaria parasites in infected persons detected by microscopy.

Males 110 (73.8%) were mostly affected than the females 163 (69.4%) as shown in Table 3, malaria prevalence according to sexes was not significant (0.0347, p>0.05).

The *Plasmodium* species isolated were *P. falciparum* (95.6%), *P. malariae* (3.3%), *P. ovale* (0.7% and *P. vivax* (0.4%) (Figure 2). The age-group 0-10 years had the highest malaria prevalence 94(81%) while the age group 51-60 years had the least 6 (54.5%) as shown in Table 3. The results were significant (P=0.011 p<0.05).

Sex	Number examined	Number positive	Prevalence rate (%)
Male	149	110	73.8
Female	235	163	69.3
Total	384	273	71.1

Table 3: Prevalence of malaria parasitaemia by sex.

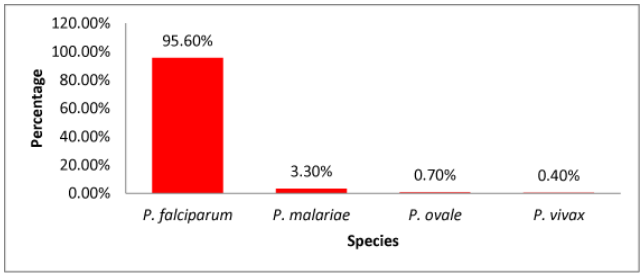

Figure 2: Graph showing the percentage of different plasmodia of man as found in the study.

Age - groups	Number examined	Number positive	Prevalence (%)
0–10	116	94	81.3
11–20	68	54	79.4
21–30	105	68	64.8
31–40	57	33	57.9
41–50	20	13	65
51–60	11	6	54.5
61 and above	7	5	71.4
Total	384	273	71.1

Table 4: Prevalence of malaria parasitaemia by age.

Considering the educational status of the subjects in relation to malaria prevalence (Figure 3), showed significant difference (P=0.003, p<0.05) between the post-secondary education group 0% and those with no formal education at all 80% (81.6%).

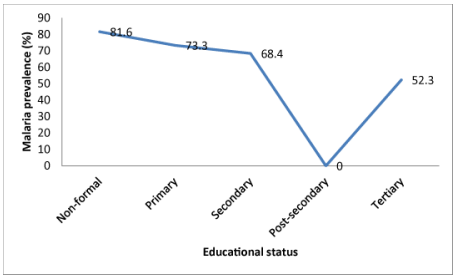

Figure 3: Line graph showing malaria prevalence with respect to educational status of the participants.

Further stratification of malaria prevalence with respect to occupational status, it was statistically significant (P=0.014, p<0.05), the unemployed group were infected most while the retiree group had the least infection (Figure 4).

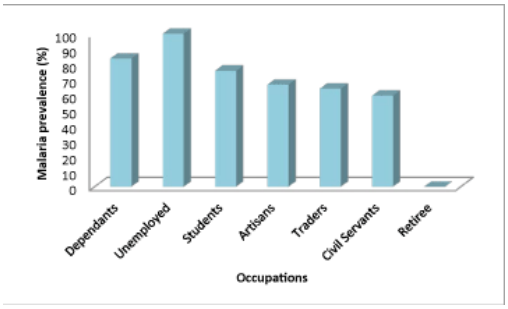

Figure 4: Bar chart showing malaria prevalence with respect to occupation of the participants.

In respect to marital status results showed that the singles 154/273 i.e. 56.4% were more infected than the married patients 119/273 i.e. 43.6% (Figure 5). It was statistically significant (P=0.000, p<0.05).

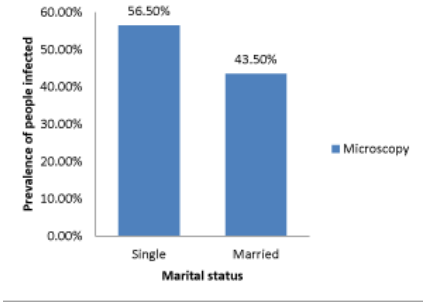

Figure 5: Overall prevalence of malaria parasites by microscopy in the study in area in relation to marital status.

Discussion

The high rate of malaria prevalence in the blood samples examined was quite worrisome. This is a reflection of the high rate of malaria parasitaemia in endemic malaria regions. The overall malaria prevalence of 71.1% found in the study area was higher than the 53.5% obtained in Ogun State by Sam–Wobo et al. [18]. The overall malaria prevalence was also substantially higher than other similar studies reported in other parts of Nigeria [12,22-28]. Anumudu et al. [24] reported 17%; Igbenegbu et al. [28] who reported 21.1% in Iwo community, Oyo State and Onyido et al. [12] in Anambra State, Nigeria who reported 70.8%.%. The result was also higher than previous estimates reported in other parts of the world [29-31].

The prevalence was lower than the prevalence reported by Okonko et al. [17] which revealed an overall prevalence of 85.1% in Abeokuta. In other parts of Nigeria it was much lower [32-34]. Aribodor et al. [33] reported a malaria prevalence of 76% in Azia, Anambra State. Ukpai and Ajoku [32] reported prevalence of 80.25% in Okigwe and Owerri, south-eastern Nigeria. Kalu et al. [34] reported 80.4% in some parts of Abia State. Nigeria. This wide range of difference may be attributed to difference in climatic factors and behavioral patterns of people in the area which promote mosquito breeding and susceptibility of the people to vector bites. Ogun State is located in the tropical rainforest of south-west Nigeria has higher seasonal rainfall and more surface water which support vector life.

Prevalence rate of 71.1% in this study represents a substantial level of illness, especially when one considers that the severity of the disease is likely high given the low level of acquired immunity among this population [35]. This high prevalence underscores the fact that, malaria is still a heavy burden on the continent, despite all that has been done. The prevalence of *Plasmodium* is attributed to its ability to resist attack of most drugs that are commonly in use in the study area. The stagnant drainage systems in its environs created favorable environmental conditions all year round for the breeding of mosquitoes that act as vectors of malaria parasites and so this enhances the proliferation of the *Plasmodium* species.

Plasmodium falciparum, *P. malariae* and *P. ovale* and *P.ovale* were recorded in the study as the same as Kela [22]. The presence of all four human *Plasmodium* was also reported in Nigeria [36-38]. However the distributions of the species are not even across the country [39]. It was observed that *P. falciparum* outnumbered other species. According to Markell and Voge [40], *falciparum* malaria is almost entirely confined to the tropics and subtropics and is therefore not surprising that *P. falciparum* recorded the highest prevalence rate. In Tanzania, malaria prevalence studies conducted in urban areas of Dodoma and Iringa by Mboera et al. [41] indicated that *P. falciparum* was the predominant malaria parasite (Iringa=100%, Dodoma=97.8%). Also Umeanaeto et al. [25] recorded predominance of *P. falciparum* in the prevalence and intensity of malaria in blood donors in Nnewi, Anambra State, Nigeria. *Plasmodium vivax* is rare because this population lacks the Duffy blood group antigens on their red blood cells. The presence of *Plasmodium vivax* in the study area could have been as a result of migration by travellers.

Malaria prevalence among the sexes was not statistically significant (P>0.05), malaria parasitaemia was slightly higher among the males than the females (Table 2). This agrees with the result obtained by Mendel and White; Pelletier et al.; Malcom and Ukpai and Ajoku [32,42-44]. Studies have shown that females have better immunity to malaria and varieties of other parasitic diseases and this was attributed to hormonal and genetic factors [42]. Portilo and Sullivan [45] suggested that genetic factors could play a role by endowing females with immuno-regulatory potentials to cope better with some disease infections. This may equally be attributed to the fact that males expose themselves to the bites of mosquitoes and other vectors more than females, especially when the weather is hot and during farm work. Exception is found during pregnancy and reproductive ages, when females are more vulnerable to malaria attacks due to immune suppression [33].

Malaria prevalence was statistically significant in the various age groups (P<0.05). The children were more affected and this was also reported by Syafruddin et al. [46]. This may be attributed to low – transferred maternal immunity or infection acquired through the mother. Prevalence of malaria in other age groups was also high which was in agreement with Uneke et al. [47], who recorded higher prevalence among the older age groups in a similar study in Jos, Nigeria. During hot weathers, adults are mostly seen sleeping outdoors, sometimes for the whole night exposing themselves to the risk of rate of exposure to mosquito bites.

Prevalence of malaria parasitaemia was statistically significant (P>0.05) among different occupational groups, though it was highest in dependants and unemployed. This suggested inadequate protection greater exposure to mosquito bites due to the nature of their contact with the unclean environment exposing themselves to the risk of mosquitoes especially during the hot weathers. The unemployed may have engaged in other kinds of jobs at places in order to make ends meet before getting permanent jobs. People in different occupational groups were equally exposed to malaria attack. Ahmed et al. [23] noted that poor people from low socio-economic status, with inadequate housing facilities and financial constraints are unable to engage in malaria preventive and control measures. They are also unable to purchase effective anti-malaria drugs.

Further stratification of the prevalence according to educational status gave a significant result (p<0.05). The high prevalence was found among those with non-formal and primary education. This could be could be attributed to ignorance and poverty. Ejezie [48] noted that in addition to abundant mosquito breeding sites in the environment ignorance, poverty, unsanitary conditions, poor behavioral attitudes and inadequately planned socio-economic projects tended to increase malaria transmission in the rural areas. Education invariably affects people's perceptions about causes of certain diseases of which malaria was not an exception. Lack of

knowledge about the consequences of undue exposure to mosquito bites accounted for high prevalence rate of malaria infection. High morbidity and decrease in students' academic performance is inevitable.

Marital status showed that the singles were more infected than the married. This could be attributed to the married patients been more conscious of their environment also coupled with the fact that responsibilities of keeping their children safe and healthy were of utmost priorities.

Although several efforts have been made to effectively control the high incidence of malaria in Nigeria, as long as there are stagnant gutters and swamps in our environment where mosquitoes breed in millions, there shall be no respite to the malaria scourge and its attendant effect on the health and socio-economic life of Nigerians and by extension Africans [49]. Atif et al. [31] reported that reducing poverty and improving sanitation and access to health care in malaria endemic regions would go a long way to reduce the malaria burden in Africa. For those living in malaria endemic countries, limited resources frequently makes malaria prevention very difficult to implement. Vector control (reducing the breeding grounds by spraying or destruction of habitat) has only had very limited success. More successful strategies could include (WHO, 2005) [50]: Use of insecticide-treated bed nets (ITNs), indoor residual spraying, and targeted chemoprophylaxis for those most at risk for pregnant women and travelers [31].

In light of the current progress of malaria control efforts in Nigeria, where most states are not malaria free and the total number of cases has been steadily increasing, Nigeria is not yet on its way to achieving those original eradication goals. A key aspect of future research in Nigeria should therefore focus on understanding treatment-seeking behavior, barriers to accessing health services among febrile persons, and quantifying patterns of malaria transmission [35]. Future malaria intervention and preventive measures for the future hopes in the development of fatal malaria should include reducing poverty and improving access to health care in malaria endemic regions in Africa [49]. According to Suh et al. [51] and [31], malaria prevention for effective result should include measures taken both against mosquitoes' vectors and against the malarial parasite. Such interventions include vector control programs managed by government health authorities, personal protection measures to avoid mosquito bites and the use of chemoprophylaxis. However, due to the development of drug resistant parasites, drug side-effects and contraindications, the control of vector mosquitoes and avoidance of their bites have become increasingly important [31,51].

Okonko et al. [17] reported that the development of new antimalarial drugs for prophylaxis and treatment as well as vaccines against malaria is also one important area under grand challenge exploration and the Malaria Genome project researches which involve molecular manipulation of the mosquito genome to produce transgenic mosquitoes that cannot infect humans will hopefully to provide new targets for both drugs and vaccines against malaria infection. Nonetheless, future malaria interventions in Nigeria should also be directed toward controlling malaria in the context of a moderate transmission setting; thus, mass education of the people on malaria infection, large-scale distribution of insecticide-treated nets or widespread use of indoor residual spraying may be less cost-effective than enhanced surveillance with effective case management or focused larval control.

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