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Malaria parasitaemia among patients in Ibadan, Southwestern Nigeria

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ABSTRACT

Objective: To investigate the prevalence of malaria parasitaemia caused by *Plasmodium falciparum* between ages and genders among patients in Ibadan city, southwestern Nigeria.

Methodology and results: Two hundred (200) patients attending University College Hospital in Ibadan, comprising 95 males and 105 females (ages 0.7-109 years; mean age = 31.2 years) were examined for malaria parasites using 3% Giemsa stained thick and thin films. The study was carried out between March, 2009 and July, 2009, a period characterized by peak rainy season, but no significant seasonal variation was noted. Of the 200 samples examined, 100 were *Plasmodium* slide-positive indicating an overall prevalence of 50%. The findings show that malaria parasitaemia and intensity are dependent on age and sex, but there was no significant difference in the ages and sex of the patients studied (P>0.05). Of the 105 samples from females, 58 (55.2%) were positive for malaria parasitaemia while 42 (44.2%) of the samples from 95 males were positive for malaria parasitaemia showing a higher prevalence of malaria parasitaemia in females than their male counterparts. Higher prevalence was noted in age-groups >46 years, 20/36 (55.6%)] and 16-30years [36/69 (52.1%)]. The age-specific profiles of malaria prevalence in younger infants (<4 years of age) were much higher (66.7%) than those observed in older children (5-9 years and 10-14 years of age) having 44.4 and 35.7% prevalence rates respectively. It showed that children >4years were more infected compared to persons ≥5 years of age, irrespective of season.

Conclusion and application of findings: The study showed that a substantial number people in Ibadan were infested by malaria parasites. This could be attributed to lack of appropriate accommodation and poor sanitary conditions in the area of study. Although there were several limitations to this study, the results can contribute to national efforts towards reducing the malaria burden in local hospitals. These findings can

represent the situation in many hospitals in Nigeria. The findings of this study will be valuable as a public health tool for planning, delivery, monitoring and evaluation of malaria interventions.
Keywords: Malaria, interventions, microscopy, plasmodium, thin and thick films

INTRODUCTION

Malaria remains a global health problem, and current public health sector efforts in high risk countries focus on controlling it. The disease remains a major public health problem in Nigeria where it is endemic especially in rural populations, as is the case elsewhere in Africa (Klinkenberg *et al*., 2005). Malaria remains one of the leading causes of morbidity and mortality worldwide, causing about 3000 deaths per day (Mbanefo *et al*., 2009). Every year, between 300 and 500 million clinical cases of malaria, accounting for over one million deaths are recorded globally. Over 90% of these deaths occur in sub Sahara Africa thereby making it a leading cause of mortality in children less than five years old, killing a child every 30 s (WHO, 2005a). Pregnant women and their unborn children are also particularly vulnerable to malaria, which is a major cause of prenatal mortality, low birth weight and maternal anaemia. The disease accounts for 40% of public health expenditure, 30 - 50% of in-patient admissions and up to 50% of out-patient visits in areas with high malaria transmission (WHO, 2005b; Abdullahi *et al*., 2009; Mbanefo *et al*., 2009).

Human malaria is commonly caused by *Plasmodium falciparum, P. vivax, P. malariae,* and *P. ovale*. Current data suggest that human knowlesi malaria is strictly a zoonotic disease. Further knowledge of the dynamics of human infection is needed to confirm this theory (Luchavez *et al*., 2008). However, various species of malaria parasite are found in thickly populated rural areas especially after rains and floods where stagnant water, overcrowding and improper sanitation predisposes to malaria (Atif *et al*., 2009). In malaria infection, the red blood cell-infectious form of the *Plasmodium* parasite causes illness and the possible death of infected hosts. Pre-erythrocytic malaria parasite stages are attracting more research efforts since they are the most promising targets for malaria vaccine development (Vaughan *et al*., 2008).

In Nigeria, malaria results in 25% infant and 30% childhood mortality (FMH, 2005a). 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 (RBM, 2005; FHM, 2005b). Currently, a worldwide effort is under way to develop a vaccine against the disease. Research coordinated by the World Health Organisation (WHO) has found that sleeping under nets treated with insecticide can greatly reduce deaths from malaria, especially among children (Microsoft Encarta, 2009). By 2025, an estimated 700 million people will live in urban communities in Africa (UNPDDESAUNS, 2002). With such rapid expansion, identification of the risk factors for urban malaria requires urgent attention (Keiser *et al*., 2004). However, location specific data can help in designing tailor-made interventions (Abdullahi *et al*., 2009). This current study reports the prevalence of malaria parasitaemia caused by *Plasmodium falciparum* between ages and genders among patients in Ibadan city in the forest zone of southwestern Nigeria.

MATERIALS AND METHODS

Study area: The study area was the municipal area of Ibadan, which is made up of five local government areas. Ibadan is the capital city of Oyo State located in the forest zone of southwestern Nigeria. The city lies 3°5' E; 7°23' N and is characterized by poor housing and environmental sanitation especially in areas with high density of low income populations.

Study population: After obtaining verbally informed consent, a total of 200 patients; (95 males and 105 females; ages 0.7 to 109 years; mean age = 31.2

years) were selected from patients attending the Out-Patients Department of the University College Hospital (UCH), Ibadan. Blood samples were collected and carried to the Department of Medical Microbiology and Parasitology, for analysis. The distribution of subjects selected for the study by gender and age-groups is shown in Table 1.

Table 1: Distribution of subjects selected for the study by gender and age-groups

Age Groups	No. of subjects	No. of males	No. females
< 5	03	01	02
05-09	09	06	03
10-15	14	08	06
16-30	69	31	38
31-45	69	34	35
46 & Above	36	15	21
Total	**200**	95	105

Laboratory analysis: The collected blood samples were analyzed within 1-2 h of collection. Thick and thin blood films were prepared according to the technique described by Hanscheid (1999) and Cheesbrough (2006). A drop of each blood sample was placed in the center of a grease-free clean glass slide. The reverse side of the slide was cleaned with cotton wool, air-dried and stained with Field's stain. The slide was held with the dried thick film side facing downward and dipped in 3% Giemsa solution for 45 min; washed off gently in clean water and then dipped in Field's stain B (methyl azure) for 5 s and washed again in clean water. The back of the slide was cleaned with cotton wool and kept in the draining rack to air-dry for eventual examination under the microscope. The number of asexual parasites per 200 white blood cells (WBCs) was counted and parasite densities were computed assuming a mean WBC count of 8,000/l. A slide was defined as negative if no asexual forms were found after counting 1,000 WBCs. Thin films were used for species identification of *Plasmodium* parasites. Using standard methods (CDC, 2007), trained Medical Laboratory Scientists interpreted the malaria blood slides.

Data analysis: Prevalence of *Plasmodium* was calculated as the proportion of positive samples. The data generated was presented using descriptive statistics and subjected to Chi-square statistical analysis using Statistical Package for Social Sciences (SPSS) version 15.0 for Windows to determine significance in the relationship of infection rate with age and gender.

RESULTS

A total 100 (50.0%) positive samples were detected among the 200 subjects selected for this study. Presence of ring forms of *Plasmodium* and Trophozoites of *Plasmodium* indicated positive results. Figure 1 shows the frequency and distribution of Malaria parasitaemia in relation to age. The results showed that higher *Plasmodium* positive slides were from age group 46 years and above (55.6%) indicating that a higher proportion of subjects with malaria parasitaemia were from this age group. This was followed by age group 16-30 years (52.1%), 31-45 years (49.3%) and the least from age group <15 years of age (38.5%). Though the ages of the subjects were different, malaria parasitaemia did not vary significantly between the different age groups (P > 0.05). Of the 100 positive samples, 42 (44.2%) of the male patients and 58 (55.2%) of the female patients were positive for malaria parasites. However, this difference was not significant.

Results in Table 2 showed the comparative prevalence of malaria parasitaemia by age as classified by WHO. Adults (>15 years) showed a higher prevalence [89(51.1%)] compared to children (<15 years) with 42.7%.

Results in Table 3 further showed the prevalence of malaria parasitaemia among children. *Plasmodium* slide-positive were higher in children <5 years of age compared to children ≥ 5 years of age

irrespective of the season. This showed that parasite densities reduce dramatically with age.

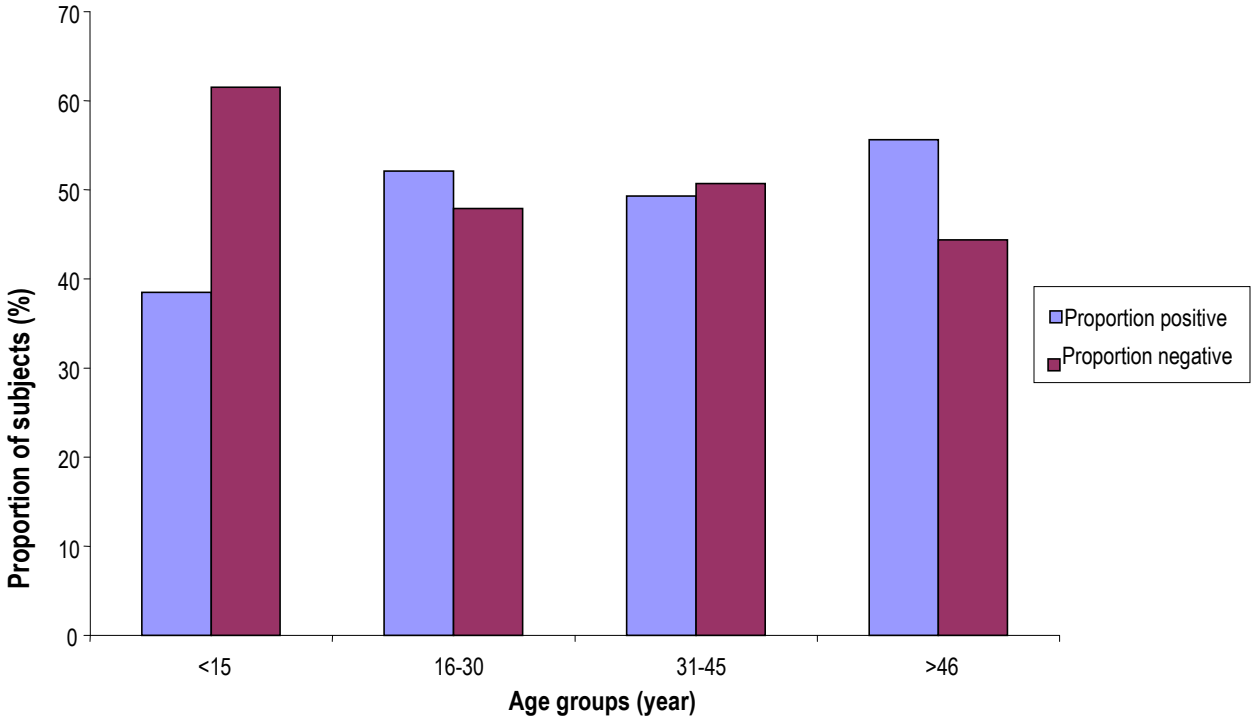

Figure 1: Frequency and distribution of malaria parasitaemia in relation to age

Table 2: Comparative prevalence of malaria by age in Ibadan, Nigeria, as defined by WHO (2004) and UNAIDS/WHO (2009)

Age (years)	No. of samples examined (%)	No. of positive samples (%)	No. of male samples (%)	No. of positive male samples (%)	No. of female samples (%)	No. of positive female samples (%)
Children (<15 years)	26 (13.0)	11 (42.7)	15 (57.7)	06 (40.0)	11 (42.3)	05 (45.5)
Adults (>15 years)	174 (87.0)	89 (51.1)	80 (46.0)	36 (45.0)	94 (54.0)	53 (56.4)
Total	200 (100.0)	100 (50.0)	95 (47.5)	42 (44.2)	105 (52.5)	58 (55.2)

Table 3: Prevalence and distribution of malaria parasitaemia among children in Ibadan, Nigeria (<15 years of age) in relation to gender

Age (years)	Total		Males		Females	
	No. of samples examined (%)	No. of positive samples (%)	No. of samples examined (%)	No. of positive samples (%)	No. of samples examined (%)	No. of positive samples (%)
<5	03 (11.5)	02 (66.7)	01 (33.3)	00 (00.0)	02 (18.2)	02 (100.0)
5-9	09 (34.6)	04 (44.4)	06 (55.6)	02 (33.3)	03 (27.3)	02 (75.0)
10-14	14 (53.8)	05 (35.7)	08 (61.5)	04 (50.0)	06 (54.5)	01 (16.7)
Total	26 (100.0)	11 (42.7)	15 (33.3)	06 (40.0)	11 (18.2)	05 (45.5)

DISCUSSIONS

In sub-Saharan Africa, malaria epidemics are common in mostly remote, disadvantaged settings without effective alert systems. Large-scale interventions can be organized during such epidemics to increase diagnostic and treatment output. Both preparedness and control, however, has been seriously deficient in rural Africa. Although levels of transmission in urban areas may be lower than in contiguous rural areas, high population densities and possible lower immunity (due to lack of repeated infections with multiple strains of malaria parasites) may result in more disease impact in urban settings (Klinkenberg *et al*., 2005;). Immunity (or, more accurately, tolerance) to malaria parasitaemia does occur naturally, but only in response to repeated infection with multiple strains of malaria, especially among adults in areas of moderate or intense transmission conditions (Färnert et al., 2009; WHO, 2010).

In this study, the overall prevalence of malaria in the study population was 50%. This is comparable to the overall prevalence of 59.9% reported in a study by Ojo and Mafiana (2005) among children under15 years in Abeokuta, also in Southwestern Nigeria and 51.5% reported by Epidi *et al*. (2008) among blood donors in Abakaliki, Southeastern Nigeria. Our results are substantially higher than previous estimates from passive surveillance of suspected malaria case-patients (FMH, 2005a; Anumudu *et al*., 2006; Umeanaeto & Ekejindu, 2006; Beatty *et al*., 2007; Faulde *et al*., 2007; Abdullahi *et al*., 2009; Atif *et al*., 2009). Anumudu *et al*. (2006) reported 17% prevalence in Eastern Nigeria while Umeaneato and Ekejindu (2006) reported 46% prevalence in Nwewi, Anambra State. Atif *et al*. (2009) reported an incidence of 10.5% malaria infection among 1000 patients in Hyderabad, Pakistan.

The prevalence rate of 50% in this study represents a substantial level of illness, is likely high among this population (Klinkenberg *et al*., 2005). Malaria can affect humans at all age groups and both male and female sexes. Studies have also shown seasonal variations in the rate of infections and differences in the types of malarial parasite depending upon the climatic condition (Ghulam *et al*., 2004). In this study, we found that women have a significantly higher risk of being infected with malaria compared to men. Though a predominance of malaria infections in male patients has been documented (Askling *et al*., 2005; WHO, 2005b; WHS, 2006; Atif *et al*., 2009; Abdullahi *et al*., 2009); similar predominance as in our case has also been reported (Ibekwe *et al*., 2009; Okonko *et al*., 2009). However, there does not appear to be scientific evidence linking malaria prevalence to gender.

Generally, our findings showed that the highest prevalence of malaria was in age groups above 46 years, followed by age groups 16-30 years and 31-45 years. This also correlate well with the findings of Atif *et al*. (2009) who reported infection rate to be higher among ages 12-35 years and 35-60 years of age in Pakistan. Generally, there is slow acquisition of active immunity to malaria (Perlmann & Troye-Blomberg, 2000). The high prevalence of malaria infections in adults in this study suggests that these persons have lost some degree of immunity as a result of poor living conditions in addition to lifelong exposure. Also, children born to immune mothers are protected against the disease (malaria) during their first half year of life by maternal antibodies. As they grow older, after continued exposure from multiple malaria infections over time, they build up an acquired immunity and become relatively protected against disease (Plebanski & Hill, 2000). Also, going by the World Health Organization (2004) and UNAIDS/WHO (2009) age grouping, we found children <15 years of age (42.7%) to be significantly at high risk of being reported with malaria. This correlate well with the findings of Askling *et al*. (2005) that children <1–6 years of age had a higher risk of being reported with malaria than other age groups among travelers in Sweden. Munyekenye *et al*. (2005) also reported a high prevalence of *P. falciparum* malaria (>80%) in school children in the low-altitude region of Lake Victoria basin, which is much higher than malaria prevalence in the highlands.

There is usually a rapid fall in parasite density as age increases which suggests age-dependent immunity to *Plasmodium* among adults (Munyekenye *et al*., 2005) however, our finding showed otherwise. The stagnant drainage systems in the Ibadan Metropolis and its environs create favorable environmental conditions for the breeding of mosquitoes that act as vectors of malaria parasites which enhances the proliferation of the *Plasmodium* species. However, malaria epidemics create daunting medical emergencies. Vector control (reducing mosquito breeding grounds by spraying or destruction of habitat) has only had very limited success. More successful strategies could include) use of insecticide-treated bed nets (ITNs), indoor residual spraying, and targeted chemoprophylaxis for those most at risk, e.g. pregnant women and travelers.

CONCLUSION

The findings of the present study have revealed the presence of malaria infection between ages and gender in Ibadan, Souhtwestern Nigeria. Further studies should be undertaken to investigate epidemiological parameters and strategies to efficiently expand treatment access. Arguably, focusing resources on predicting and responding to epidemics might lead policymakers to overlook basic problems with access to effective treatment and tools for prevention. Policymakers should thus aim for a balanced approach that includes improved capacity for epidemic prediction and response and long-term improvements in access to proper care and vector control. Future interventions in Nigeria should be directed toward controlling malaria in the context of a moderate transmission setting, in which case 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. We believe that our findings represent the endemic malaria situation in many hospitals in Nigeria and thus the study will be of immense value as a tool for planning in public health.

Conflict of interest: The authors have no conflict of interest to declare.

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