



ORIGINAL RESEARCH

EPIDEMIOLOGY // INFECTIOUS DISEASES

Malaria and HIV Infection among Febrile Patients in a Large Area of Southwestern Nigeria

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ABSTRACT

Background: Malaria and HIV/AIDS are two major diseases that represent serious public health threats in Nigeria. They have been ascribed diseases of poverty, and therefore their distribution is expected to be overlapping. **Aim:** The aim of this study was to determine the prevalence of malaria parasites and HIV among febrile patients in the Ikeja area of Lagos State, Nigeria. **Materials and Methods:** The study was conducted on 300 patients attending medical consultation and referred to blood screening for malaria parasites at Reddington Hospital, Lagos State. Malaria parasites were identified microscopically, and HIV screening was carried out using rapid diagnostic tests (RDT). **Results:** The prevalence of malaria and HIV was 98.7% and 3.7%, respectively. All HIV-positive individuals were also infected by malaria parasites. Mean parasitemia was significantly higher in HIV-positive individuals (16,507.9 \pm 2,280.7 P/μL) than in HIV-negative subjects (3,252.505 \pm 236.3 P/μL) (p <0.05). **Conclusions:** Our results suggest that HIV-infected individuals are more susceptible to infection with malaria parasites. Prompt HIV management is necessary in malaria-endemic areas to reduce disease severity in case of coinfection with HIV.

Keywords: malaria, HIV/AIDS, association, morbidity, Nigeria

BACKGROUND

Malaria and HIV/AIDS are two major diseases with serious public health implications in Nigeria. Globally, Nigeria is ranked number one and two in the total number of people affected by malaria and HIV/AIDS, respectively.^{1,2} Both diseases are poverty-related, as the poorest segment of the population is the most vulnerable due to the lack of access to information, quality education, and good health facilities.³ Each year, malaria and HIV cause over 2 million deaths globally.⁴ Children under the age of 5 and pregnant women have the highest morbidity associated with malaria parasites infection,^{5,6} while women and adolescent girls have the highest risk of HIV infection.⁷ During concurrent malaria parasites and HIV infections, approximately 1 million pregnant women experience vari-

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ous degrees of complications in countries of sub-Saharan Africa,⁸ thus endangering the lives of both the mothers and the fetuses.

The geographical overlap between malaria parasites and HIV infections has generated research interest in terms of co-morbidity impact of concomitant infections. Some studies have suggested that there is no association between malaria parasites and HIV infection,9 especially in populations where the prevalence of HIV is low.¹⁰ However, others have reported a bidirectional and synergistic interaction.¹¹ Evidence has implicated concomitant malaria parasite and HIV infection in facilitating the progression of malaria. Importantly, malaria and HIV coinfection has been linked to an increased risk of severe malaria in adults, congenital infection, and increased transmission dynamics of the two diseases. 12-14 On the other hand, malaria has been reported to cause a reduction in CD4 cell count, thus exacerbating the clinical course of those infected with HIV.15 Another study showed a significant rise in HIV-1 plasma load in individuals infected with malaria parasites compared to those without infection, even after up to 10 weeks of treatment.¹⁶ Factors influencing the clinical impact of these interactions could include extent of malaria transmission in the area, host immunity, and the individual affected (e.g., adult, child, or pregnant woman).17

The aim of this study was to determine the prevalence of malaria and HIV among febrile patients in the Ikeja area of Lagos State, Nigeria. The study also sought to gather more evidence on the susceptibility of individuals to malaria parasites infection in case of concomitant infection with HIV.

MATERIALS AND METHODS

The study was carried out in Ikeja, a city with a population of about 437,400 people, located in Lagos State, Nigeria. The city is close to the popular Murtala Muhammad International Airport. It is the capital of Lagos State with a very large residential zone, and it is set near the Lagos Lagoon. There were over 60,000 cases of malaria in Ikeja in 2013. The closeness of the city to Lagos Lagoon and the poor drainage system found in some of its areas could provide suitable breeding sites for mosquito malaria parasite vectors, enabling stable transmission of malaria. As far as HIV/AIDS is concerned, its transmission is largely associated with large population sizes and fluid movement of people in and out of the state. 19

A descriptive cross-sectional study was conducted among febrile patients who presented themselves for medical examination at Reddington Hospital, one of the many hospitals in Ikeja receiving malaria patients. To calculate our sample size, we used the prevalence of malaria and HIV coinfection (2.9%) previously reported in Ikeja, 20 and a precision (d) of 2%. Using the method of Daniel, 21 a minimum sample size of approximately 270 participants was calculated. The study included 300 subjects, regular dwellers of the area or Lagos. Only febrile patients with signs and symptoms of uncomplicated malaria, such as fever \geq 40°C, chill, headache, rigor, and joint pain, were included. 22

Venous blood samples were obtained from the subjects by a trained laboratory staff on duty. Clean and grease-free labeled glass slides were prepared, and then thick and thin blood films were made by spreading a drop of blood on the slides. The blood was allowed to dry and then stained with 10% Giemsa stain solution. After 10 min, the stain was washed with clean running water and then dried. A drop of immersion oil was applied to each slide and was examined under $\times 100$ objective lens for malaria parasites. Parasitemia was estimated using the methods described by Cheesbrough. 23

All subjects were screened using Determine (DT) HIV-1/2 test kits (Alere Medical Company Limited, Chiba, Japan). About 3–5 mL of blood was collected by venipuncture and transferred to an EDTA bottle. The blood was properly mixed and then centrifuged at 1,500 rpm for 10 min. The plasma was stored in a plain tube and kept at $-20\,^{\circ}\mathrm{C}$ until used. For testing, 50 $\mu\mathrm{L}$ of the plasma was added to the test spot on the kit, and the result was read after 15 min. The result was interpreted according to the kit instructions.

All kits were purchased centrally and were stored at the temperature specified by the manufacturer. Malaria and HIV tests were performed independently and were confirmed by another trained personnel. Participation in the study was voluntary, and only those who gave their consent were included. Children were included based on their parents' consent. Institutional ethical approval was obtained from Olabisi Onabanjo University Teaching Hospital (OOUTH), Ogun State, Nigeria.

Data were analyzed using SPSS for Windows version 22.0 (IBM Corp, Armonk, NY, USA). Counts and percentages were used to summarize categorical variables, and the mean \pm SE was used to summarize numerical variables. Differences in prevalence by subject categories were analyzed using the chi-square and Fisher's exact test, while malaria parasitemia was analyzed using one-way ANOVA. Tukey's post-hoc test was used to compare significant differences between groups. Significant differences in malaria parasitemia in relation to the participant's HIV status was tested using Student's t-test. A p value less than 0.05 (p <0.05) was considered statistically significant.

TABLE 1. Characteristics of the subjects

Variables	Number	Proportion (%)	
Age			
Children (1–17 years)	93	31.0	
Adults (18-59 years)	160	53.3	
Elderly (≥60 years)	47	15.7	
Gender			
Male	153	51.0	
Female	147	49.0	

RESULTS

The study population comprised children (n = 93, 1–17 years; 31%), adults (n = 160, 18–59 years; 53.3%), and elderly subjects (n = 47, \geq 60 years; 15.7%) (Table 1). The mean age of the participants was 32.3 \pm 22.8 years. The overall prevalence of malaria parasites was 98.7%, and mean parasitemia was 3,695.2 \pm 281.2 parasites/µL of blood (P/µL). The prevalence of malaria in children (95.7%) was not significantly different from that of adult (100%) and elderly subjects (100%) (p >0.05). There was also no significant variation in the prevalence of malaria in male (98.7%) and female subjects (98.6%) (p >0.05). However, the intensity of infection due to malaria parasites varied significantly by

age and gender (p <0.05). The mean parasitemia (5,012.7 \pm 807.1 P/ μ L) of elderly subjects was significantly higher than that of adults (4,273.0 \pm 424.7 P/ μ L) and children (2,035.1 \pm 287.4 P/ μ L) (p <0.05) (Table 2). Also, male subjects had significantly higher parasitemia (3,722.4 \pm 411.0 P/ μ L) than female participants (3,666.8 \pm 384.1 P/ μ L) (p <0.05).

The prevalence of HIV in the population was 3.7%. Although the prevalence of HIV was higher in adults (5.6%) than in the elderly (4.3%) and in females (4.1%) compared to males (3.3%), the prevalence of HIV was neither agenor gender-dependent (p >0.05) (Table 3). All HIV-positive subjects were infected with malaria parasites, while 98.6% of HIV-negative individuals had malaria. Also, mean parasitemia was significantly higher in HIV-positive individuals (16,507.9 \pm 2,280.7 P/ μ L) than in HIV-negative subjects (3,252.505 \pm 236.3 P/ μ L) (p <0.05).

DISCUSSION

The study has shown that malaria is still a major problem in Lagos despite all efforts put in place to curtail the spread of the disease. Generally, the prevalence of malaria is higher among febrile patients, and malaria is the most common cause of fever in Nigeria, especially in children.²⁴ The prevalence reported in this study was the highest ever recorded in

TABLE 2. Prevalence and intensity of malaria parasite

Variables	Number examined	Number infected	Proportion (%)	Parasitemia (P/μL)
Age				
Children (1–17 years)	93	89	95.7	2,035.1 ± 287.4 ^a
Adults (18-59 years)	160	160	100.0	4,273.0 ± 424.7b
Elderly (≥60 years)	47	47	100.0	5,012.7 ± 807.1°
Gender				
Male	153	151	98.7	3,722.4 ± 411.0 ^a
Female	147	145	98.6	3,666.8 ± 384.1 ^b

Different superscripts denote significant differences by Tukey's post-hoc test (p < 0.05). Similar superscripts denote no significant difference by Tukey's post-hoc test (p > 0.05).

TABLE 3. HIV status among febrile patients

Variables	Number examined	Number infected	Proportion (%)	p value
Age				
Children (1–17 years)	93	0	0.0	0.287
Adults (18-59 years)	160	9	5.6	
Elderly (≥60 years)	47	2	4.3	
Gender				
Male	153	5	3.3	0.766
Female	147	6	4.1	

any region of Nigeria among febrile patients. Previous studies reported a prevalence of 7.4% in Ilorin,²⁵ 29.7% in Oyo town,²⁶ and 37.6% in Ikare-Akoko, Ondo.²⁷ Higher prevalences of 54%,²⁸ 56%,²⁹ 63%,³⁰ 56.8%,³¹ and 65.5%³² were reported in Jos, Sokoto, Simawa Ogun State, Keffi, and Birnin Kudu in Kano State, respectively. In Lagos, our previous study found a prevalence of 39.5%, 61% and 61.3% among febrile infants, non-pregnant women, and pregnant women, respectively.²² Another study in Lagos reported a very high prevalence (92.1%) among febrile infants (age 0–5 years).²⁴

This study confirmed that Lagos State is a suitable region for stable transmission of malaria. Evidence from the State's report on malaria cases showed that malaria transmission is far from being under control. Reports have shown an increase in malaria cases from 488,780 in 2012 to 547,150 in 2014.33 The probable reasons for this unabated increase in transmission include the presence of abundant water bodies in close proximity to human dwellings, suitable for the breeding of mosquitoes and subsequent transmission of malaria parasite to humans. Due to poor draining systems in many areas, this expanse of water bodies sometimes finds its way into canals and drainage systems, especially during flooding, to create further temporary breeding sites for these mosquitoes. Another possible reason could be the very low utilization of long-lasting insecticide-treated nets (LLIN) in Lagos, with a reported utilization rate of 18%.34 This value is significantly lower than the 59% and 67.6% LLIN utilization rates recorded in Osun and Ekiti State, respectively.34,35 Lagos is a megacity, and LLIN distribution through the government's malaria control program may pose some difficulties. In another study, adherence to current malaria treatment guidelines in Lagos was generally poor, as only 7% of people were using an artemisinin-based combined therapy in their last malaria episode; the majority of patients still preferred sulphadoxine-pyrimethamine and chloroquine.³⁶ This could increase the development of resistant parasite strains, especially in the case of chloroquine.

Although there was no significant difference in the prevalence of malaria among different population groups, parasitemia varied significantly, with the older population carrying the higher burden of the disease. It is usually expected that children, especially infants, would bear the greatest burden of malaria, because acquired immunity may still be not well developed. However, advocacy for malaria prevention in children and pregnant women has been strong recently in Nigeria. This may yield a better adherence to malaria control in these groups. Even with limited resources, children (0–5 years) and pregnant women are given priority in malaria control programs in every state

of Nigeria. These programs may have an impact by reducing the extent of exposure to mosquitoes and subsequently lowering the intensity of malaria parasites infection in these groups. Nevertheless, the mean parasitemia recorded in children was very high in our study, and efforts towards abating transmission should be further strengthened, not only in children, but also in the adult population (age 18–59 years) that has a significant number of pregnant women.

In our study, the prevalence of HIV was lower than in many studies reported elsewhere in Nigeria. A prevalence of 4.9% was reported in Osogbo,³⁷ 6.2% in Abeokuta,³⁸ 24.1% in Borno,³⁹ 10% in Benin, and 16% in Zaria.⁴⁰ The low prevalence we found in Lagos could represent the positive impact of the various HIV/AIDS prevention programs in the state. Of importance is the possible contribution of HIV infection to increasing susceptibility to malaria parasites infection. This was demonstrated by the increased prevalence and intensity of malaria parasites infection in HIV-positive subjects compared to HIV-negative individuals. While earlier studies have shown no relationship between HIV and the severity of malaria in children and adults, 41,42 our results seem to confirm the findings of studies that have linked HIV infection to a predisposition to more frequent episodes of symptomatic and severe malaria. 43 It is possible that by suppressing the immune system, HIV favors the multiplication and proliferation of malaria parasites.

CONCLUSION

This study has shown that malaria was hyperendemic among febrile patients, while HIV had a low incidence in Ikeja, Lagos. Due to the possible interactions between malaria and HIV/AIDS, the presence of one can influence the morbidity associated with the other. HIV increases susceptibility to malaria parasites and could therefore aggravate the burden associated with malaria in infected individuals, with more serious consequences in pregnant women and infants. In order to minimize the impact of HIV on malaria, malaria and HIV control programs should be integrated into one another. The distribution of LLIN and promotion of their usage should be incorporated into voluntary counselling and testing programs in malaria endemic areas. Prompt treatment of malaria confirmed febrile patients is also highly recommended, especially in HIV/AIDS endemic areas.

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STATEMENT OF ETHICS

Informed consent was obtained from the participants. Ethical approval with approval number OOUTH/DA.326/899 was obtained from Olabisi Onabanjo University Teaching Hospital, Ogun State, Nigeria.

CONFLICT OF INTEREST

None declared.

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