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Prevalence and Predictors of Malaria Among HIV Infected Subjects Attending an Antiretroviral Therapy (ART) Clinic in a Tertiary Healthcare Facility in Central Nigeria

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Abstract

Malaria is still considered globally as a leading cause of morbidity with Nigeria carrying the highest burden of 19%. Coinfection of malaria and Human Immunodeficiency Virus (HIV) accelerate disease progression of HIV/AIDS subjects. This study investigated the prevalence and predictors of malaria among HIV infected subjects attending the antiretroviral therapy Clinic at Federal the Medical Centre, Keffi, Nigeria. After ethical clearance, 200 whole blood specimens were collected from patients who gave informed consent and completed a self-structured questionnaire. The specimens were examined for malarial parasite using rapid kits and microscopy. The overall prevalence of the infection was 78/200 (39.0%). The prevalence was higher in male (44.7%) than female (34.0%) subjects. Those subjects aged < 20 years (54.5), male gender (44.7%), non-formal education holders (61.5%), farmers (62.5%), stream water users (48.1%), those that lives in rural setting (43.6%), those that do not use Insecticides Treated Nets (ITNs) (39.4%) and swampy environment dwellers (41.7%) were identified predictors for malaria infection in the area. All the predictors studied did not show any statistically significant difference with the infection but some arithmetic difference exists (P > 0.05). The 39.0% prevalence of malaria in HIV infected subjects is a public health concern. Therefore, Public health surveillance and health education among HIV population should be advocated to help eradicate malaria comes 2030. Further study that will characterize the genes of the parasite should be carried out.

Keywords: Malaria; *Plasmodium* species; HIV; Prevalence; Subjects; Central Nigeria.

1. Introduction

Malarial and Human Immunodeficiency Virus (HIV) infections are public health issues facing Africa in recent years and coinfection of these two infections has scantly been studied [1-3]. Our current understanding of human immune response to malaria and HIV leads us to expect of the other [4]. Many other types of infections have been documented to cause at least a transient increase in HIV viral load [5, 6]. There were 435, 000 deaths from malaria globally in 2017 compared with 451, 000 estimated deaths in 2016 [7], 88% of such deaths occurring in WHO African region [7]. Currently, there are almost 37.9 million people living with HIV, and tens of millions mortality have been reported due to AIDS-related causes since the beginning of the epidemic [8]. Those who are at high risk are young children, pregnant women and immunocompromised people (PLWHIV) [7, 9].

In Nigeria, where the malaria situation has improved, almost 60 million people (about 50% of the population) experience one episode of malaria or the other during the year and the disease causes death of over 200,000 people annually [10, 11]. Hence, it is logical to expect malaria to do the same; and thus accelerate HIV disease progression. Malaria is a mosquito-borne infectious disease of humans and other animals caused by *Plasmodium* species [11]. The disease arises from the division of *Plasmodium* parasites in the red blood cells, causing symptoms which headache and fever, in severe cases progressing to coma and/or death. It is widespread in tropical and subtropical regions, including much of Sub-Saharan Africa, Asia, and the Americas [11-13]. Five species of malarial parasite causes infection in humans exists [14]. Severe disease is largely caused by *Plasmodium falciparum* while the disease caused by *Plasmodium vivax, Plasmodium ovale and Plasmodium malariae* is generally mild and seldom fatal [14, 15]. This infection still remains a life threatening vector borne concern and has a significant role on the economic development of most endemic countries [13, 16, 17].

Malaria transmission can be mitigated by preventing mosquito bites by distribution of insecticidal treated net (ITN) insect repellants, or by mosquito-control measures such as spraying insecticides and draining stagnant water [5]. There is no vaccine that offers a high level of protection in existence but efforts in developing such are ongoing. Although number of medications are available as prophylaxis especially among travelers to malaria-endemic regions [3].

Co-infection of malaria with HIV is very common in Sub-Saharan Africa [1, 5, 6, 10, 14, 18-20]. The overlapping features of malaria and HIV/AIDS has established the fact that people living with HIV/AIDS are at high risk of clinical malaria and HIV infection can reduce the protection offered by anti-malarial drugs [4, 21]. Malaria contributes to a temporary increase in viral load among HIV- infected people which may lead to increased clinical disease and enhances mother to child transmission [22, 23]. This study examined the prevalence and predictors of malaria among HIV infected subjects attending ART clinic in a tertiary healthcare facility in Central Nigeria.

2. Materials and Methods

2.1. Study Area

This study was carried out in Keffi. Keffi is 68 Km from Abuja, the Federal Capital Territory and 128 Km from Lafia, Nasarawa State. It lies in latitude eight 5'N of the equator and longitude seven 8'E, it also situates on altitude of 850 M above sea level [24]. The average annual rainfall in Keffi is ±2,000 millimeters (79 in), and is often heavier during the rainy months having its peak around July through September [25]. Most of the people living here are dominantly traders, farmers, civil servants, and students.

2.2. Study Population

A prospective cross sectional study was carried out among 200 HIV infected subjects attending the facility who agreed to participate in the study from a period of June through August, 2018. Structured questionnaire was administered to the parents/guardians of the children; information on age, gender and risk factors such as; source of drinking water and use of insecticidal treated nets was obtained from each participant. Participants who could not read or write in the English Language were interviewed orally in Hausa. Representative sample size was determined using the formula propounded by Swinscow and Campbell [26].

2.3. Sample Collection

Blood sample was collected from each participant by venipuncture. A tourniquet was used to tie in the upper region of the arm for the veins to be visible and also increase the pressure of blood into the veins. The area in which needle was inserted was cleaned with a spirit cotton wool after which the needle was introduced into the vein, and 5ml of blood was collected. The tourniquet was loosed before the needle was pulled out from the vein and the blood transferred to an EDTA (Ethylenediamine Tetra Acetic Acid) container after which it was labeled accordingly using unique identifier codes to ensure confidentiality of participants [13].

2.4. Laboratory Analysis

2.4.1. Rapid Diagnosis of Malaria Parasite

All the subjects were screened for malarial parasite using the Care Start ™ malaria HRP2 (Pf) rapid test for *Plasmodium falciparum* malaria ML no: 338 (Orchid Biomedical System, India) following the manufacturer's specifications prior to microscopy.

2.4.2. Microscopic Examination of the Malaria Parasite

Thin and thick smears were prepared to determine the malaria parasitemia in the target population of HIV subjects. The both smears were stained using 3% Giemsa technique as described by Cheesbrough [27]. This is considered as the gold standard and it was used to confirm the initial screening with the rapid kit.

2.5. Ethical Clearance

In line with the Helsinki Declaration which specifies the code of ethics for biomedical research involving human samples, clearance for the study was obtained from the Ethical Committee on Health Research of Federal Medical Centre, Keffi, Nigeria. Formal consents were retrieved from all participating subjects using a consent form.

2.6. Statistical Analysis

The information obtained were analyzed statistically using Smith's Statistical Package (SSP version 2.80, Claremont, California-USA). Chi-square statistical test was used to determine association and values obtained were considered statistically significant at $p \leq 0.05$.

3. Results and Discussion

Out of 200 HIV subjects examined for the parasitic infection, 78 (39.0%) were infected with malarial parasite. Table 1 shows the prevalence of malaria among HIV infected subjects with respect to possible predictors. The prevalence of malaria in this study was higher among those < 20 years of age (54.5%), male gender (44.7%), non-formal education holders (61.5%), farmers (62.5%), stream water users (48.1%), those that lives in rural setting (43.6%), those that do not use ITNs (39.4%) and swampy environment dwellers (41.7%). All of the studied predictors showed no statistically significant association with malaria but some arithmetic differences were observed ($p > 0.05$).

Table-1. Prevalence of malaria among HIV infected subjects attending Federal Medical Centre Keffi, Nigeria with respect to possible predictors

Parameters	No. Examined	No. Positive	Prevalence (%)	χ^2	*P*
Age (Years)					
< 20	22	12	54.5		
21-30	54	20	37.0	1.3334	0.7212
31-40	86	34	39.5		
>40	38	12	31.6		
Gender					
Male	94	42	44.7		
Female	106	36	34.0	1.0525	0.3049
Educational Status					
Non-formal education	26	16	61.5		
Primary	34	18	52.9	4.7868	0.1880
Secondary	62	20	32.3		
Tertiary	78	24	30.8		
Occupation					
Artisans	36	16	44.4	4.8347	0.1842
Students	54	20	37.0		
Civil servants	78	22	28.2		
Farmers	32	20	62.5		
Locality					
Rural	78	34	43.6	0.4914	0.4833
Urban	122	44	36.1		
Sources of Drinking Water					
Tap	84	24	28.6		
Well	62	28	45.2	3.0198	0.2208
Stream	54	26	48.1		
Use of ITNs					
Yes	134	52	38.8	0.0028	0.9577
No	66	26	39.4		
Nature of Environment					
Swampy	24	10	41.7		
Dry	176	68	38.6	0.0352	0.8512

Human immunodeficiency virus infected individuals are at higher risk of malaria and other opportunistic infections because of their compromised immune systems. Sub-Saharan Africa carries a high burden of coinfection with malaria and HIV [2, 7, 16].

An overall prevalence rate of 39.0% was recorded among the HIV subjects attending the Federal Medical Centre, Keffi, Nigeria in this study which is in agreement with the reports in other parts of the country. It was 65% among people living with HIV/AIDS in Keffi Bello and Ishaleku [1], 56.8% among patients in Keffi Yohanna, *et al.* [13], 24% among HIV patients in Jos Iroezindu, *et al.* [28], 14.2% among HIV patients in Uyo Amadi, *et al.* [29], 16.2% among HIV-infected individuals in North Central Nigeria Inyama, *et al.* [15], 59.2% among HIV patients in Kaduna Abioye, *et al.* [5] and 18.5% among HIV positive individuals in Osogbo Olusola, *et al.* [3]. Findings from other countries have been reported such as 14% among HIV seropositive patients in Cameroon Sandie, *et al.* [19], 61.7% among HIV patients in Mozambiqu Saracino, *et al.* [20], 36% in South Africa Cohen, *et al.* [18], 83.8% among HIV infected and uninfected population in Uganda Katrak, *et al.* [6] and a high malaria parasite density among HIV/AIDS subjects in Kenya Kirinyet [30]. Differences in sample size, study population, sensitivity and specificity of tests used, weather and climate conditions may account for these differences in the prevalence rates.

In this study, there was no statistically significant association between the age groups and malaria ($p > 0.05$). The infection was highest among subjects aged < 20 years (54.5%) and least prevalence among those aged greater than 40 years old (31.6%). This correlates with the findings of Bello and Ishaleku [1] in Keffi, Amadi, *et al.* [29] and Kirinyet [30] reported that age was not significant to malaria acquisition in their studies. The less than 20 years subjects are active with developing immune system and have less knowledge on how to prevent the infection which enhance their vulnerability to the infection.

With respect to gender, malaria was not associated with gender of the subjects ($p > 0.05$). The infection was higher in male (44.7%) than the female (34.0%) counterparts. Similar studies in Nigeria and beyond also report same outcome [9, 11, 30] but contradicts the reports of Sandie, *et al.* [19] in Cameroun, Bello and Ishaleku [1] in Keffi, and Amadi, *et al.* [29] in Uyo, Nigeria. Male gender tends to have severe immunosuppression than the female counterparts. This finding might be because males often stayed out lately at night most times and thus exposes themselves to mosquito bites.

There was no statistically significant association between educational status and the prevalence of malaria ($p > 0.05$). Those subjects without any formal education reported the highest prevalence of 61.5% while those with a tertiary education had the least prevalence of 30.8%. This outcome is obvious because education has long been

embraced to be of great advantage in our society. Therefore, more improved preventive measures and prophylaxis is intertwined with higher levels of education.

This study reports showed that the prevalence of malaria is highest among farmers (62.5%) and lowest among the civil servants (28.2%). There was no statistical association between the parasitic infection and occupation of the subjects in the area ($P > 0.05$). Malaria is understood to be both a disease of poverty and a cause of poverty [5]. The high prevalence rate among farmers might be because of low income rate, lack of proper preventive means and treatment and also lack of proper feeding which make their body system vulnerable to opportunistic infections including malaria.

In this study, no significant association statistically was observed between malaria and the locality of the subjects ($p > 0.05$). The prevalence of the infection was higher among subjects from the rural areas (43.6%) than those in the urban settings (36.1%). This report is in consonance with Iroezindu, *et al.* [28] findings in Jos, Nigeria. Rural dwellers are more likely to indulge in practices that create favorable breeding environment for the vector. Furthermore, malaria prevention and control programs are less commonly done in rural settings in Nigeria.

In this study, no significant association statistically was observed among malaria and use of ITNs ($p > 0.05$). The prevalence of the infection was higher among those subjects that do not use ITNs (39.4%) than those who use ITNs (38.8%). Findings in this study was also recorded in related researches in Nigeria and other countries [13, 31-33]. The protective effect of ITNs usage shown in this study adds to the body of evidence supporting the effectiveness of ITNs for protection against malaria and other vector-borne diseases [7]. This finding is a wake-up call to all healthcare providers to provide and continue distributing the long lasting ITNs to HIV population in Nigeria

Source of drinking water and nature of environment are not statistically associated with malaria infection among the population ($P > 0.05$). Amadi, *et al.* [29] and Iroezindu, *et al.* [28] reported similar findings in their studies. Those that use stream water and live in swampy environment are at high risk of malaria from this study. This high rate of stream water users and those in swampy environment is interrelated. HIV individuals living in riverine areas are at high risk of malaria infection.

4. Conclusion

This study successfully revealed a high prevalence of malaria among HIV infected subjects in the area. None of the predictors studied showed any statistically significant association with the infection ($p > 0.05$). This study has contributed to the understanding of malaria among HIV subjects in Nigeria. Thus, continuous screening of malaria parasites in HIV patients and public health awareness should be priorities in eliminating the infection in Nasarawa State, Nigeria.

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