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Dual Infection of HIV and Malaria among HIV-Infected Individuals in Port Harcourt, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author IOO designed the study and wrote the protocol. Authors TIC, OEA, INCN and KO managed the laboratory analyses and performed the statistical analysis of the study. Authors IOO and KO managed the literature searches and wrote the first draft of the manuscript. Author IOO supervised the whole study which, Miss. Sandra N. Azoroh (SNA) used as part of her B.Sc. Project in the Department of Microbiology, University of Port Harcourt, Nigeria. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Malaria and HIV, two of the world's most deadly diseases are wild spread, especially in sub-Saharan Africa. This study was carried out to detect circulating malaria *P. falciparum* among HIV-infected individuals in Port Harcourt, Nigeria.
Study Design: Cross-sectional study.
Place and Duration of Study: University of Port Harcourt Teaching Hospital (UPTH) in Port Harcourt, Nigeria, between August 2012 and July 2015.
Methods: A total of 100 blood samples confirmed to be HIV positive were collected and subjected to

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detection of circulating *P. falciparum* malaria using malaria *P. falciparum* Rapid test devices and ELISA kit (Dia. Pro) following the respective manufacturer's instructions.
Results: Overall prevalence of *P. falciparum* was 5.0%. The result showed a higher HIV and malaria co-infection among age groups 20-24 years indicating that a higher portion of subjects with malaria parasitemia was from this age groups (5.7%) compared to other age groups (16-19 years, 5.0% and 25 years & above, 3.5%). Sex-specific co-infection indicated that prevalence of HIV/malaria co-infection was only present among females (11.9%).
Conclusion: This study further confirms the presence of HIV and malaria co-infection among the population studied. Routine screening of malaria among HIV-positive patients is therefore advocated.

Keywords: Co-infection; HIV, malaria; P. falciparum; prevalence.

1. INTRODUCTION

Malaria and HIV, the two most widespread infectious diseases of our time are still a major public health menace in sub-Saharan Africa (SSA). These infections are endemic especially in rural populations taking the lives of almost one million people a year [1]. Malaria, a protozoan parasite disease accounted for 216 million cases and 445,000 deaths in 2016 occurring in SSA, while HIV, a viral disease accounted for 36.7 million cases and about I million deaths in 2016 in SSA [2]. Both diseases affect the poorest segment of a population made vulnerable by the lack of access to quality education, information and state services. Malaria and HIV-1 are 2 of the most common infection in sub-Saharan Africa and to a lesser extent, in other developing countries. It is estimated that 38 million African are infected with HIV-1, whereas 300 million to 500 million suffer from malaria each year [3], therefore, any interaction between these infections will have a significant public health effect, even if the statistical effect is modest.

On a population basis, an increased prevalence of malaria and increased parasite density in HIV-infected individual could lead to an increase in malaria transmission affecting both HIV-positive and-negative individuals [4].

Human malaria is commonly caused by *Plasmodium falciparum, P. vivax, P. malaria* and *P. ovale*. Malaria parasites are usually transmitted to man via the bite of a female anopheles' mosquito and the parasite lifecycle pass through two parts, one in the mosquito and one in its human victim [5]. The human immunodeficiency (HIV) is a single-stranded enveloped RNA virus belonging to the lentivirus genus of retroviruses which causes slowly progressing disease often with long incubation period by processing the enzymes reverse transcriptase and integrase. It causes progressive impairment of the body cellular immune system leading to increased susceptibility to infection, tumours and acquired immunodeficiency syndrome (AIDS) [6].

Co-infection with malaria and HIV has led to several deaths especially in sub-Saharan Africa. Therefore, the present work was undertaken to determine the risk of co-infection with malaria and HIV among patient attending the University of Port Harcourt Teaching Hospital (UPTH). Also, screening for HIV and malaria was carried out to determine the prevalence level of these infections as biological markers of risk, modes and time functions of their transmissions.

Despite the popularity and widespread of these diseases, very limited research studies have been carried out in hospital settings in Rivers State, Nigeria, thus, the present study was carried out to detect malaria *P. falciparum* specific antibodies in sera of blood donors and patients, identifying some risk factions associated with *P. falciparum* co-infection with HIV transmission and create data which may be useful for appropriate authorities.

2. MATERIALS AND METHODS

2.1 Study Area

This study was performed using HIV positive patients attending the University of Port Harcourt Teaching Hospital (UPTH) located at Alakahia along East-West road, Obi-Akpo Local Government Area of Rivers State, Nigeria. Port Harcourt, is found along the Bonny River in the Niger Delta region of Nigeria with its Coordinates: 4°53'23"N and 6°54'18"E. Port Harcourt metropolis consists of Obio/Akpor Local Government Area and Port Harcourt Local

Government Area [7], which encompass largely of Ikwere ethnic with several other ethnic groups from all around Nigeria. According to census 2006 report, Port Harcourt city local government area and Obio/Akpor local government area have populations of 1,382,592 and 878,890 respectively [8] and a landmass of 360 km^2 and 260 km^2 respectively.

2.2 Study Design

This is a cross-sectional study involving a cohort of 100 HIV positive patients attending the University of Port Harcourt Teaching Hospital (UPTH) in Port Harcourt, Nigeria. The method for this study consists of informed consent, blood withdrawal by venipuncture, screening for malaria and recording of demographic information such as the age and sex of the participants.

2.3 Determination of Sample Size for the Study

The sample size for this study was determined using the established formula [9,10]: $N= [Z^2 (PQ)]/d^2$. Where N is the desired sample size. Z = standard normal deviation at a 95% confidence interval (which was 1.96). p = proportion of target population (prevalence estimated at 6.0%, reported for Rivers State as at HIV Sentinel Survey of 2010); this implies 6.0/100 = 0.06. q = alternate proportion (1-p), which was calculated as: 1 – 0.06 = 0.94. d = desired level of precision (degree of precision/significance). This was taken as 0.05. Then, the desired sample size (N) = 87. Hence, the estimated sample size was 87 individuals with an additional 10.0% sample (which is 8.7) to take care of study participants that may be lost to follow-up [9,10], providing a total sample size of 96 approximated to 100 from each of hospital.

2.4 Study Population

After obtaining verbally informed consent, a total of 100 samples (42 males and 58 females, ages from 16 to 25 years) were collected from patients attending University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Nigeria.

2.5 Inclusion and Exclusion Criteria

All HIV-infected patients were eligible for the study. HIV-infected patients who were duly registered in the registration book were included, whereas HIV-infected patients who had incomplete data like age, sex and duplicate records were exempted from the study. Those on any form of anti-malaria drugs were also exempted from the study.

2.6 Specimen Selection, Collection, and Preparation

The method of sample collection employed was venipuncture technique [6]. About 3 ml of venipuncture blood was collected in EDTA BA Vacutainer TM anti-coagulant tubes (BD, Franklin Lakes, USA). Plasma specimens were separated by centrifugation at 300 rpm (revolution per minute) for 5 min. The plasma was stored at -20°C and used for the laboratory analyses. Specimens were brought to room temperature before testing. The frozen specimen was thawed completely and mixed well before testing. Specimens were not frozen and thawed repeatedly.

2.7 Serological Analysis

Blood samples of HIV positive individuals screened for the presence of *Plasmodium falciparum* using rapid detection techniques (RDT) strips and ELISA kit. Plasma was tested at the Virus Research Unit, Department of Microbiology, University of Port Harcourt, for the presence of *P. falciparum* antibodies following the respective manufacturer's instructions. The test result was read and tested within 20mins. Plasma samples were also analyzed for the presence of Malaria *Plasmodium falciparum* using the ELISA kit manufactured by DIA.PRO Diagnostic Bioprobes Srl (Milano) – Italy, according to manufacturer’s specifications.

2.8 Data Analysis

The prevalence for malaria *P. falciparum* and possible co-infection with HIV was calculated by using patient with the positive sample as the numerator and the total number of patients enrolled in this study as the denominator. The data generated from this study were presented using descriptive statistical method. Significance level was set at $P \leq 0.05$.

3. RESULTS AND DISCUSSION

3.1 Results

A total number of 100 HIV positive patients were tested for malaria co-infection of which 5.0% was

positive for malaria. Table 1 shows the frequency and distribution of malaria and HIV co-infection in relation to age. The result showed the higher HIV and malaria co-infection was observed among age groups 20-24 years indicating that a higher portion of subjects with malaria parasitemia was from this age groups (5.7%) compared to other age groups (16-19 years, 5.0% and 25 years & above, 3.5%).

Table 1. The prevalence rate of HIV and malaria co-infection in relation to age

Age groups (years)	No. tested	No. positive (%)
16-19	20	1 (5.0)
20-24	52	3 (5.7)
5 & above	28	1 (3.5)
Total	100	5 (5.0)

Table 2 shows the prevalence of malaria and HIV co-infection relation by sex, indicating the prevalence of HIV/malaria co-infection was present only among females (11.9%).

Table 2. The prevalence rate of HIV and malaria co-infection in relation to sex

Sex	No. tested	No. positive (%)
Males	42	0 (0.0)
Females	58	5 (11.9)
Total	100	5 (5.0)

3.2 Discussion

In sub-Saharan Africa, malaria and HIV co-infection is a major public health menace. Also, the level of transmission in the rural area is high, high population densities and possible low immunity can also accelerate disease spread, hence, this work focuses on the occurrence of malaria parasitemia among HIV patients within the University of Port Harcourt Teaching Hospital which is an endemic area.

In this study, the overall prevalence of malaria and HIV co-infection in the study population was 5.0%. This is similar to report in a study by Njunda et al. [11] who reported 7.0%. Furthermore, the prevalence observed in this study is lower compared to similar studies performed in other countries in sub-Saharan Africa like; 11.75% in Ghana, 34.0% in Cameroon [12], and 18.5 % in other parts of Nigeria [13]. The difference between the prevalence observed in these studies and ours could be due to the geographical differences in the study populations and the differences in the level of malaria endemicity. The low prevalence of malaria in this group could be attributed to the health-seeking attitude of HIV patients. Studies have shown that malaria in HIV is more severe and patients infected with malaria will quickly go down with the disease and seek medical attention faster [14].

In the current study, there was no significant association observed between the prevalence of malaria and co-infection with HIV and age. Though the highest prevalence occurred more in ages 24 years and below than in 25 years and above. This is in agreement with findings reported by Njunda et al. [11] and Ojurongbe et al. [13].

In this study, women 5(11.9%) had a significantly higher risk of being infected with malaria than men (0.0%). This is comparable with the studies carried out by Onyekwere et al. [15]. Though a predominance of malaria infection in the male patient has been documented [16,17], there is no scientific evidence to prove the high prevalence being related to gender as susceptibility to malaria infection is not influenced by gender [17].

HIV-increase the burden of malaria by increasing susceptibility to infection and decreasing the response to malaria treatment [18]. HIV has also been found to suppress the immune system and predispose to severe forms of malaria in adults [19]. Consequently, the risk of HIV transmission, thus increasing HIV incidence [19]. Co-infection may increase HIV viral load in a population where they are prevalent, thereby facilitating HIV transmission [19]. Malaria can affect all ages of human groups (male and female genders).

4. CONCLUSION

The findings of the present study have revealed the presence of malaria and HIV co-infection between ages and gender in University of Port Harcourt Teaching Hospital (UPTH), Rivers State. The effects of malaria on HIV patients are now well documented. Malaria infection and fever rates are increased in the area of stable transmission, especially for individuals with low CD4 counts or high viral loads. In areas of unstable transmission, HIV is associated with more severe disease and death. Anti-malaria therapy appears to be less effective in HIV-infection than in uninfected adults because of more rapid reinfection. Several questions still need to be answered, such as how HIV affects

malaria in children, whether the current HIV epidemic is affecting malaria control programs in Africa, and whether improved clinical management of malaria in HIV-1-infected subject (e.g. avoidance of mosquito bites or chemoprophylaxis) slows the progression of HIV disease. We also need to establish whether acute malaria episodes accelerate clinical HIV disease progression and increase transmission. The effects of ART and cotrimoxazole on susceptibility to malaria parasitemia and fever should be studied in a range of academic settings. We also need more information about pharmacokinetic interaction between anti-malaria and anti-retroviral and about the implications of widespread cotrimoxazole use in areas of high malaria prevalence.

CONSENT

All authors declare that written informed consent was obtained from the patient for publication of this study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the Hospital Research Ethics Committee of University of Port Harcourt Teaching Hospital (UPTH) And University Research Ethics committee of University of Port Harcourt, Nigeria and have, therefore, been performed following the ethical standards laid down in the 1964 Declaration of Helsinki.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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