

## SHORT COMMUNICATION

# High prevalence of *Plasmodium falciparum* malaria among Human Immunodeficiency Virus seropositive population in the Lake Victoria zone, Tanzania

DOMENICA MORONA<sup>1\*</sup>, MARIA ZINGA<sup>1</sup>, MARIAM M. MIRAMBO<sup>2</sup>, SAID MTAWAZI<sup>2</sup>, VITUS SILAGO<sup>2</sup> and STEPHEN E. MSHANA<sup>2</sup>

<sup>1</sup>Department of Medical Parasitology and Entomology, Weill Bugando School of Medicine, Catholic University of Health and Allied Sciences, P.O. Box 1464, Mwanza, Tanzania

<sup>2</sup>Department of Microbiology and Immunology, Weill Bugando School of Medicine, Catholic University of Health and Allied Sciences, P.O. Box 1464, Mwanza, Tanzania

### Abstract

Malaria and Human Immunodeficiency Virus (HIV) infections are major public health problems in Sub-Saharan Africa. Their overlapping geographical distribution and co-existence often result into high morbidity and mortality. This study was designed to establish the prevalence of *Plasmodium falciparum* malaria among HIV infected populations. A cross-sectional hospital-based study involving 250 plasma samples from HIV seropositive individuals was conducted in July 2017 at the Bugando Medical Centre, Mwanza, Tanzania. Socio-demographic and other relevant information were extracted from a pre-existing database. Detection of malaria antigens was carried out using the immune-chromatographic test. The mean age of the study participants was 40.0±13.5 years. The prevalence of *P. falciparum* was 22.4% (95% CI: 17-27%). None of the factors under study was found to be associated with *P. falciparum* infection among HIV infected individuals. The prevalence of *P. falciparum* was high among HIV seropositive individuals in the Lake Victoria Zone, which calls for additional control interventions targeting this group.

**Keywords:** malaria, Human immunodeficiency virus, Lake Victoria zone, Tanzania

Human immunodeficiency virus (HIV) infection and malaria are among the diseases causing high morbidity and mortality in many parts of the world with a high prevalence in sub-Saharan Africa (Abu-Raddad *et al.*, 2006). Many parts of the world with a heavy HIV burden also have a high malaria prevalence. This overlapping geographical distribution and increasing rates of co-infection has been a public concern. A high prevalence of both infections and the fact that they all depend on cell-mediated immunity would indicate an interaction between these diseases which might have an impact of their individual progression.

In areas where the HIV prevalence is high, HIV infection may facilitate the infection with malaria parasites due to the impaired cell-mediated immunity in HIV positive individuals (French *et al.*, 2001; Patnaik *et al.*, 2005; Mermin *et al.*, 2006a). HIV infection is known to impair T-cell mediated immunity resulting into the depletion of CD4 T cells and antibody responses which are necessary for an effective antimalarial response (Delves & Roitt, 2000; Ezeamama *et al.*, 2012). HIV has also been found to cause an abnormal activation of immune cells which results into dysregulated massive production of cytokines. On the other side, malaria infected individuals have been shown to massively produce anti-inflammatory cytokines such as TGFβ and IL-10 to counteract inflammatory effects elicited by Th1 cells. This response is important in preventing the onset of severe malaria. It may however, results into the impairment of cell-mediated immunity which is central to the control of both diseases (Clerici & Shearer, 1993). The interactions may lead to an increase of HIV plasma level, a

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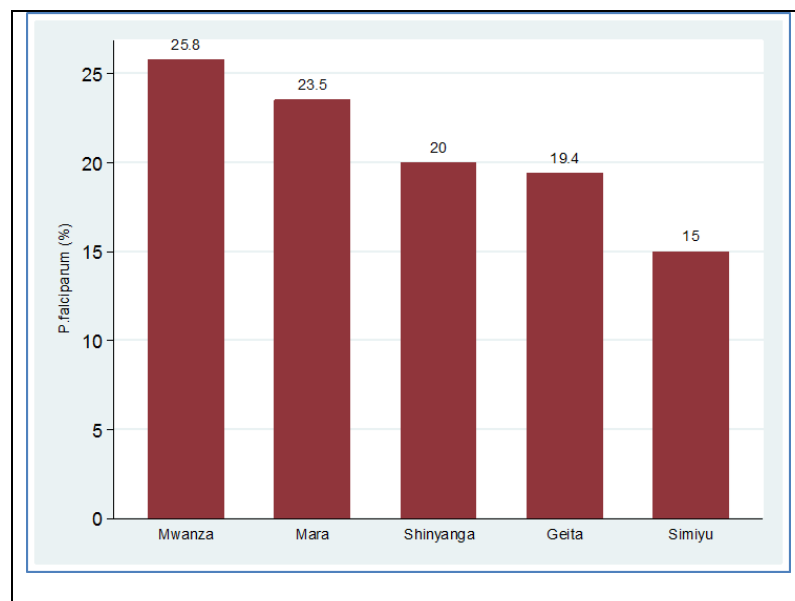
\* Correspondence E-mail: [dmorona@gmail.com](mailto:dmorona@gmail.com)

decrease of haemoglobin level, a decrease of CD4 T cell counts and, occasionally, an increase in the frequency and onset of episodes of malaria fever (Mermin *et al.*, 2006a).

Despite the known geographical overlapping of malaria and HIV and their possible immunological interactions, there are limited studies in Tanzania, and no single study in the Lake Victoria Zone, investigating the burden of the co-morbidity. This study aimed at providing baseline data on the prevalence of malaria among the HIV infected population. The findings might be relevant to the ongoing malaria control programme and highlight gaps for future research.

A cross-sectional hospital-based study was conducted in July 2017 at the Bugando Medical Centre (BMC) involving a total of 250 plasma samples. The samples were collected from children and adults, both males and females, from different regions around Lake Victoria in Tanzania. BMC is a consultant and teaching hospital with a 900-bed capacity located in north-western Tanzania and serving the Lake Zone regions of: Mwanza, Mara, Kagera, Shinyanga, Tabora, Simiyu and Kigoma, with an estimated population size of 13 million people. The centre receives approximately 168 plasma and whole blood samples per day from different regions of the Lake Victoria Zone. The sample size was calculated using the Kish formula (1965) with a prevalence of 7.76% (Cohen *et al.*, 2005). The minimum sample size was 110; however, a total of 250 plasma samples were serially collected. All samples submitted for HIV viral load testing were eligible and were included in the study. Samples with incomplete information were excluded.

Detection of *P. falciparum* antigens was carried out by malaria Rapid Diagnostic Test (MRDT) as per manufacturer's instructions (Care Start Malaria Test, USA). Data were analysed by STATA version 13 whereby continuous variables were summarized as median with interquartile ranges while categorical variables were summarized as proportions. Chi-square test was used to show the association between variables. A p-value of <0.05 at 95% confidence interval was considered as statistically significant. The protocol for the study was approved by the joint Catholic University of Health and Allied Sciences/Bugando Medical Centre Research Ethics and Review Committee (No. CREC/369/2017).



**Figure 1: Proportion of the study participants from different regions of the Lake Victoria zone**

The mean age of the study participants was 40.0±13.5 years. More than two thirds of the participants were from Mwanza (25.8%), Mara (23.5%) and Shinyanga (20%) (Figure1). Most of the participants, 153

(61.2%), were females while the majority had a good adherence to highly active antiretroviral therapy (HAART) (Table1). The prevalence of *P. falciparum* was found to be 22.4% (95% CI: 17-27%). On two sample *t*-test, there was no significant difference in mean age between individuals infected with *P. falciparum* and uninfected ones ( $40.4 \pm 13.4$  versus  $38.6 \pm 14.1$ ,  $P=0.183$ ). None of the factors (age, sex, residence, adherence to HAART) were found to be associated with *P. falciparum* infection among HIV infected individuals.

**Table 1: Demographic and Clinical characteristics of 250 HIV seropositive individuals in Lake Victoria zone**

Variable		Number	Percent/Mean
Age (years)		250	40±13.5
Sex	Male	97	38.8
	Female	153	61.2
<i>P. falciparum</i>	Negative	194	77.6
	Positive	56	22.4
Adherence	Good	150	60.0
	Poor	100	40.0

This is the first study to establish the prevalence of *falciparum* malaria among HIV infected individuals in the Lake Victoria Zone, Tanzania. In the current study, the prevalence of *P. falciparum* among HIV infected individuals was higher than that previously reported in South Africa (Grimwade *et al.*, 2004). However, the prevalence in this study is lower than that reported in Malawi, South Africa, and Uganda with a prevalence of 34.5%, 29.4% and 35.6%, respectively (Grimwade *et al.*, 2004; Mermin *et al.*, 2006b) but significantly higher compared to other studies in sub-Saharan Africa (Nguyen-Dinh *et al.*, 1987; Abu-Raddad *et al.*, 2006). The high prevalence of *P. falciparum* in this study may be caused by geographical and climatic conditions (Martens *et al.*, 1999; Gubler *et al.*, 2001) and could be further explained by the fact that, the samples were collected between May and June, soon after the rainy season, the peak of malaria transmission in the region. Another possible explanation could be found in the immunological changes associated with the HIV status, which has been associated with high malaria prevalence elsewhere (French *et al.*, 2001).

Among the few factors explored in this study, none was found to be associated with *P. falciparum* positivity. This could be explained by the limited information regarding the study participants such as CD4 counts, haemoglobin levels and other factors that could be associated with malaria transmission. However, after this initial exploration of the association, further longitudinal studies on the factors associated with *falciparum* malaria in this setting are highly warranted as the prevalence of *P. falciparum* among HIV seropositive individuals around the Lake Victoria zone remains high.

### Competing interest

None declared

### Author's contributions

DM, MMM, SEM participated in the design of the study. SM, VS and MMM did data collection and laboratory work. SEM and MZ performed statistical analysis and interpretation of the data. MMM wrote the first draft of the manuscript. SEM and DM provided critical revision of the manuscript. All authors read and approved the final version of the manuscript.

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