

Prevalence of Human Immunodeficiency Virus and Malaria Co-Infection in Nigeria: A Review of Published Literature

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Abstract

Background: Human immunodeficiency virus and malaria are significant global health challenges. Both diseases contribute to the global burden of disease and poverty notable amongst low-income countries, including sub-Saharan Africa and Nigeria. There are little or no available review articles on the prevailing epidemiological data on human immunodeficiency virus and malaria interaction in Nigeria.

Aim: This literature review aims to update knowledge on human immunodeficiency virus and malaria co-infection and determine the prevalence of human immunodeficiency virus and malaria from published literature.

Method: This work reviewed published articles on human immunodeficiency virus/malaria co-infection published in English in PubMed, Google Scholar, and ScienceDirect. An internet search on Google Scholar was also conducted for studies that were conducted between 2007 and 2017 in Nigeria.

Result: The literature review indicated that the highest prevalence of human immunodeficiency virus and malaria co-infection in Nigeria is 86.2%. The mean \pm SD among the HIV-malaria co-infected group and the negative malaria group in all of Nigeria's geo-political zones are 36.6 ± 25.5 and 19.5 ± 15.3 , respectively. The highest mean prevalence of 64.5% was reported in human immunodeficiency virus patients co-infected with malaria in the northwest zone. The use of highly active antiretroviral therapy is also associated with a reduced mean positive prevalence of 31.26%.

Conclusion: Human immunodeficiency virus-positive individuals across all the geopolitical zones in Nigeria are at high risk of malaria. Findings from this review of literature will provide additional information on HIV-malaria co-infection prevalence and guide public health prevention, control and management practice.

Keywords: HIV, malaria, co-infection, prevalence, adults, treatment, Nigeria

1. Introduction

Human Immunodeficiency Virus (HIV) and malaria are a significant health challenge (World Health Organization, 2005). Globally, there is a rapid increase in the population of HIV seropositive individuals from 31.0 million in 2002 to an estimated 35.3 million in 2012 (UNAIDS, 2013) with an approximately 36.7 million including 2.1 million (1.8–2.4) newly reported cases worldwide at the end of 2016 (WHO, 2016a).

The prevalence of global malaria cases fell by 18% from approximately 262 million to 212 million cases between the years 2000 and 2015 (WHO, 2016b). About 216 million malaria cases were reported at the end of 2016 (95% Confidence Interval (CI): 196–263 million), in contrast to approximately 237 million cases documented in 2010 (95% CI: 218–278 million) (WHO, 2017). Approximately half of the global population (3.2 billion people) are still at risk of malaria (WHO, 2016b), largely in the tropics and South East Asia, a region where both diseases overlap (Hochman Sarah & Kim Kami, 2009).

Over the years, positive progress has been made to speed up HIV and malaria control and preventive programme. Remarkable decrease in Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (HIV/AIDS) morbidity and mortality has been reported since the initiation of Highly Active Antiretroviral

Therapy (HAART). However, severe and repeated malaria cases were documented among HIV positive patients on HAART and Artemisinin-based Combination Therapy (ACT) (Nakanjako, Kiragga, Castelnuovo, Kyabayinze, & Kanya, 2011). Co-infection interaction between malaria and HIV encourages the proliferation of both infectious diseases, coupled with an increased risk of HIV transmission and multiple episodes of severe malaria (Cuadros & Garca-Ramos, 2012). Furthermore, it was believed that interaction between HIV and malaria is expected to have a significant impact on prevention and management practices and further leads to decreased control efforts (WHO, 2016c).

The prevalence of HIV-malaria co-infection is based on the pattern of malaria transmission, which differs in developed and developing countries. Therefore, data on prevalence from high-income countries cannot be generalized to low-income countries, especially in the sub-Saharan African (SSA) region, including Nigeria. Findings from studies on the prevalence of HIV-malaria co-infection conducted in SSA, as well as in Nigeria, revealed several differences due to geographical variation. The prevalence reported from selected studies conducted in SSA ranges from 0.7% to 72% and 2.11% to 86.2% among studies conducted in Nigeria.

1.1 Purpose of the Literature Review

The purpose of this review of the published article is to update the knowledge of HIV-malaria co-infection and determine the prevalence of HIV-malaria co-infection in Nigeria.

2. Method

2.1 The Search Strategy of the Literature Review/Data Collection

This literature review involves an extensive search of databases such as PubMed, Google Scholar, ScienceDirect, and a general internet search for related studies that were conducted for over ten years. Reference sections in journal articles and studies that reported HIV-malaria co-infection prevalence (and vice versa) were also reviewed to find other relevant studies. Studies included in this review are those conducted in Nigeria.

2.2 HIV and Malaria Co-Infection

A high level of co-infection interaction occurs mainly in sub-Saharan Africa, where the immune deficiency posed by HIV supports malaria disease and transmission, which may affect malaria control efforts (Whitworth et al., 2000). Malaria on the other hand, increases HIV replication, progression, and transmission (Foca Odolini, Brianese, & Carosi, 2012; Van geertruyden, 2014), and the severity of malaria cases in HIV positive individuals usually depends on malaria prevalence in the general population. HIV-malaria co-infection is highly influenced by the local HIV prevalence, malaria endemicity, and transmission. This is responsible for the heterogeneous distribution of co-infections in regions where both disease overlap (UNAIDS).

2.3 HIV-Malaria Co-Infection Interaction Among Adults

HIV-malaria co-infection interaction is responsible for an increase in clinical cases of severe malaria among adults, including children and pregnant women (Hochman Sarah & Kim Kami, 2009). The combined effect increases the viral load and decreases CD4+ T-cell counts, together with a decrease in the production of antibodies and cytokines (Hochman Sarah & Kim Kami, 2009). Previous studies have documented that the resulting viral load is higher among women with placental malaria. Infants of co-infected mothers are at high risk of premature birth, decreased birth weight, and death, compared to infants born of mothers who are only HIV seropositive. Malaria in pregnant adults is also responsible for increased blood viral load, breast milk, and decreased CD4 T-cell count, which increases the risk of transmitting the virus to the children (Laufer & Plowe, 2007). The efficacy of malaria chemotherapy is lower in non-pregnant HIV positive adults than in those who are HIV seronegative (Khoo, Back, & Winstanley, 2005). Higher malaria density is common among male HIV seropositive individuals than their female counterparts, which may be associated with more severe immunosuppression in infected male individuals (Iroezindu et al., 2012).

2.4 Prevalence of HIV and Malaria Co-Infection in Nigeria

According to the Joint United Nations Programme on HIV and AIDS (UNAIDS) 2014, Nigeria accounted for more than 9% of global HIV positive individuals (Unaid Facts Sheet 2014, Global Statistics), which is the nation with the second-largest global HIV epidemic. Despite having an adult HIV prevalence of approximately 2.9% at the end of 2017 (NACA, 2017), and a 15% decrease in new HIV cases since 2005 (UNAIDS, 2017). Approximately two-thirds of all HIV cases in the central and west African regions occur in Nigeria (UNAIDS, 2017). It currently accounts for more than 3.6 million global HIV positive individuals and one of the highest rates of new HIV cases in the SSA region (NACA, 2017). According to the 2017 UNAIDS report, an estimated 3.2 million people lived with HIV and Acquired Immune Deficiency Syndrome (AIDS) in Nigeria, with more than

220 000 new cases annually (UNAIDS, 2017). Nigeria has an estimated 3.1% adult's prevalence of HIV-1 between 15–49 years (NACA, 2015), with an estimated 3.5 million adults being HIV seropositive (UNAIDS, 2016).

Over 100 million individuals are at high risk of malaria in Nigeria (WHO, 2012). Approximately half of the adult population experiences at least one malaria infection, while under-five children are at risk of multiple annual malaria episodes (WHO, 2012). Similarly, malaria is responsible for approximately 51 million hospital admissions and 207,000 mortalities every year, higher than any other country where there is a high prevalence of malaria (WHO, 2012). The country also accounts for 25% of all malaria cases in the Africa sub-region (WHO, 2012). Malaria is not only an important public health problem but also constitutes a serious community and financial burden in affected countries (Carnivale & Mouchet, 2011). In Nigeria, malaria is endemic across all ecological zones, and the peak transmission period is during the rainy season, usually between July and December (Salako & Obi, 1997).

Studies conducted in Nigeria have shown diversity in the spread and distribution of HIV malaria co-infection. There is variation in co-infection prevalence documented in studies conducted in Nigeria, according to groups, populations, and regions. The prevalence of HIV-malaria co-infection among HIV seropositive individuals in Nigeria ranges from 2.11% to 86.2%, 2% to 44.67% among HIV negative individuals, and 3.53% to 68.6% among pregnant individuals. Similarly, a significant association has been documented between CD4 T-cell count less than 200, and a high risk of anaemia in HIV-malaria co-infected patients. *P. falciparum* malaria is associated with the majority of malaria cases among HIV positive individuals (Jegade et al., 2017).

2.5 Effect of HIV-Malaria Co-Infection in Nigeria

The separate physiological and public health impact of malaria among HIV positive patients cannot be underestimated. The combined effects of HIV and malaria co-infection contributes to more than two million deaths worldwide annually (Mukandavire, Gumel, Garira, & Tchuente, 2009; WHO, 2016a). Abu-Raddad et al. (2006) observed that approximately 980,000 new malaria cases and 8,500 excess HIV infections were attributed to co-infection between the 1980s and 2006 in Kenya (Abu-Raddad, Patnaik, & Kublin, 2006). In Nigeria, the indirect impact of malaria, such as cost of transportation to the health facility, cost of health care, loss of working hours, absenteeism from work accounted for more than 132 billion Naira loss annually and posed a great danger to the economy (Federal Republic of Nigeria, 2005). In a study conducted among HIV positive outpatients, Akinbo et al. (2009) reported that there was an increased risk of anaemia and malaria among HIV positive individuals (Akinbo, Okaka, Omoregie, Mordi, & Igbinuwen, 2009). A significant association was also reported between HIV-malaria co-infection and rapid reduction in the Packed Cell Volume (PCV) compared to HIV-positive individuals alone, with a mean PCV of 24.81% in co-infected patient and 34.81% in malaria negative HIV patients (Goselle, Onwuliri, & Onwuliri, 2009).

An important marker to evaluate the effect of malaria parasitaemia among HIV-malaria co-infected individuals is serum iron concentration (Onyenekwe et al., 2008). Findings from previous studies demonstrated that serum iron reduction among HIV-malaria co-infected patients compared to HIV-seropositive malaria negative individuals, similar to what was observed among asymptomatic HIV-malaria co-infected patients, and unlike among symptomatic HIV-malaria co-infected individuals (Onyenekwe et al., 2008). A relatively lower albumin concentration was reported by Gossele et al. 2007 among HIV positive patients (Gossele, Onwuliri, & Onwuliri, 2007), while congenital malaria was observed among new-borns of co-infected mothers (Eki-Udoko, Sadoh, Ibadin, & Omoigberale, 2017). Notable impacts of malaria on biochemical indicators were observed among HIV positive patients with a rapid reduction of serum iron (Onyenekwe et al., 2007).

2.6 Methods of Disease Diagnosis

2.6.1 HIV Diagnosis

The Methods of HIV diagnosis and testing that was used in all the literature reviewed are identical to each other. The HIV diagnostic and testing were carried out according to the standards of the World Health Organization (WHO) and recommendations (The Global Fund, 2016). Two major methods used in detecting the HIV antibody are - the Abbott determine HIV-1/2 test Kits (Abbott Laboratories, USA), and Stat Pak HIV 1–2, Rapid HIV Test kit (Premier Medical Corporation Limited, India).

2.6.2 Malaria Diagnosis

As observed from the reviewed literature focusing on the studies that were conducted in Nigeria. Microscopic examination and Rapid Diagnostic Test (RDT) are the most widely used methods for malaria diagnosis. However, the most commonly used method for malaria diagnosis is the microscopic examination. The blood smears were performed by the method described by Warhurst (Warhurst & Williams, 1996) and were analyzed by making thin

and thick smear to check for malaria parasites. A drop of blood was added to the RDT malaria kit as a confirmatory test. Although both methods were useful, the thin film was used for the identification of the malaria parasites (Berg et al., 2014).

2.7 Analysis

Data were extracted from selected published articles that reported the prevalence of HIV-malaria co-infection (Table 1). Statistical analysis was done with Statistical Package for Social Science (SPSS) version 25.0, and the p-value of < 0.05 was considered significant. The difference between the means of the HIV-malaria co-infected groups and HIV-malaria negative groups was tested using one-way Analysis of Variance (ANOVA).

Table 1. Overview of selected research studies reporting the prevalence of HIV and malaria co-infection in Nigeria

Author	Study settings	Study design	Study population	Sample size	Gender of participants	HIV-Malaria prevalence	HIV/Negative	Other findings	Treatment procedure
Akinbo (Akinbo FO et al., 2013) Benin City, Nigeria	Tertiary hospital	Not stated	HIV positive patients	317	Both gender/Adults	9.8%	Nil	Reduced prevalence of HIV-malaria co-infection was observed among patients on HAART.	HAART /ACT
Akinbo (Akinbo FO et al., 2016) Kogi State, Nigeria NCZ	Secondary hospital	Case-control study	HIV positive patients	411	Both gender/Adults	7.8%	2%	Higher prevalence of HIV-malaria co-infection was observed among patient on HAART	HAART
Akinbo (Akinbo FO et al., 2009) Benin City, Nigeria	Tertiary hospital	Case-control prospective study	HIV positive patients	350	Both gender/Adults	46.0%	4.9%	A higher prevalence of co-infection was reported among females.	Nil
Akinbo (Akinbo FO & Omoregie R, 2012) Benin City, Nigeria	Tertiary hospital	Cross-sectional study	HIV positive patients	285	Both gender/Adults	2.11%	Nil	There is an association between CD4 T-cells, anaemia, and malaria among HIV patients.	HAART
Ako-Nai (Ako-Nai AK et al., 2013) Akure, Nigeria	Secondary hospital	Prospective cross-sectional study	Pregnant women ANC	3225	Pregnant Adults	3.53%	Nil	There is a decreasing mean of CD4 T-cell counts among HIV seropositive participants.	Nil
Dada (Dada EO, 2015) Ondo State, Nigeria	Secondary hospital	Not stated	HIV positive patients	150	Both gender/Adults	54.5%	Nil	High co-infection rate among females.	Nil
Edit (Edet UO, Ebana RUB, Etok CA, & Nwamuo LC, 2016) Kaduna Nigeria	Secondary hospital	Not stated	HIV positive patients	150	Both gender (all age group)	63.8%	44.67%	The prevalence of HIV-malaria co-infection was high, but not significant.	Nil

Iroezindu (Iroezindu et al., 2012) Jos, Nigeria NCZ	Tertiary hospital	Cross-sectional study	HIV positive patients	100	Both gender/Adults	24%	9%	High prevalence of malaria among HIV positive patients than their HIV negative counterpart.	Nil
Izuka (Izuka EO et al., 2017) Enugu, Nigeria	Tertiary hospital	Longitudinal cohort study	Pregnant women ANC	204	Pregnant adults	68.6%	35.3%	Higher prevalence of placental malaria and anaemia were observed among HIV positive women than the negative control.	HAART
Jegede (Jegede et al., 2017) Kano, Nigeria	Tertiary hospital	Cross-sectional study	HIV positive patients	761	Both gender/Adults	27.7%	Nil	A lower prevalence of co-infection was documented among patients on cotrimoxazole.	ART
Onifade (Onifade AK, Akanni EO, & Mewoyeka OO, 2007) Ondo State, Nigeria	Secondary hospital	Not stated	HIV positive patients	1410	Both gender (all age group)	33.50%	Nil	There is an association between co-infection and gender, with higher prevalence among the male.	Nil
Ojurongbe (Ojurongbe et al., 2014) Osogbo Nigeria	Tertiary hospital	Not stated	HIV positive patients	200	Both gender/Adults	18.5%	Nil	Reduced PCV was recorded among HIV/co-infected areas.	Nil
Olaniran (Olaniran O et al., 2012) Ile-Ife, Nigeria	Tertiary hospital	Not stated	HIV positive patients	93	Both gender (all age group)	86.2%	Nil	There is no association between increasing or decreasing CD4 T-count and parasitaemia.	HAART
Omoti (Omoti CE, Ojide CK, Lofor PV, Eze E, & Eze JC, 2013) Benin City, Nigeria	Tertiary hospital	Not stated	HIV positive patients	342	Both gender/Adults	74.3%	Nil	New cases of malaria parasitaemia progress with HIV clinical stage.	Nil
Onyenekwe (Onyenekwe CC et al., 2007) Nnewi, Nigeria	Tertiary hospital	Prospective cohort study	HIV positive patients	196	Both gender (all age group)	18.9%	10.6%	High co-infection prevalence was reported among symptomatic HIV positive individuals three times higher than in the asymptomatic.	Nil
Sanyaolu (Sanyaolu AO et al., 2013)	Secondary hospital	Cross-sectional	HIV positive patients	1080	Both gender	47.7%	25.8%	High cases of malaria and anaemia were reported among HIV seropositive patients.	Nil

Lagos, Nigeria									
Unata (Unata IM, Bunza NM, Ashcroft OF, Abubakar A, & Faruk N, 2015) Sokoto, Nigeria	Tertiary hospital	Not stated	HIV positive patients	159	Both gender	45.4%	Nil	A high prevalence of malaria was reported among females and married individuals.	Antimalaria/cotrimoxazole
Wariso (Wariso KT & Nwauche CA, 2011) Port Harcourt, Nigeria	Tertiary hospital	Not stated	HIV positive patients	300	Both gender/Adults	26.5%	Nil	A slightly higher prevalence of malaria was reported among males.	Nil

3. Results

Data obtained from the reviewed literature selected from all the geopolitical zone was shown in (Table 1) above. The variables were coded and analysed using SPSS version 25.0. The data analysis indicated that the mean ±SD among the HIV-malaria co-infected group and the study participants who were HIV positive alone in all the geo-political zone are 36.6 ± 25.5 and 19.5 ± 15.3, respectively. The overall mean prevalence of HIV-malaria co-infection was 36.6% (Table 2). The reviewed literature also reported the use of Highly Active Antiretroviral Therapy (HAART), which is associated with a reduced mean positive prevalence of 31.26%.

Table 2. Descriptive statistics for HIV-malaria co-infected group and the HIV-malaria negative group in Nigeria, as reported in the literature

	N (studies)	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
HIV-malaria co-infected.	SSZ	5	31.7420	29.16102	13.04120	-4.4662	67.9502	2.11	74.30
	NCZ	2	15.9000	11.45513	8.10000	-87.0203	118.8203	7.80	24.00
	SWZ	6	40.6550	29.10659	11.88271	10.1095	71.2005	3.53	86.20
	NWZ	1	63.8000	.	.	.	.	63.80	63.80
	SEZ	2	43.7500	35.14321	24.85000	-271.9992	359.4992	18.90	68.60
	NEZ	2	36.5500	12.51579	8.85000	-75.8999	148.9999	27.70	45.40
	Total	18	36.6022	25.52515	6.01634	23.9089	49.2956	2.11	86.20
HIV-malaria negative.	SSZ	2	14.4500	13.50574	9.55000	-106.8943	135.7943	4.90	24.00
	NCZ	2	5.5000	4.94975	3.50000	-38.9717	49.9717	2.00	9.00
	SWZ	1	25.8000	.	.	.	.	25.80	25.80
	NWZ	1	44.6700	.	.	.	.	44.67	44.67
	SEZ	2	22.9500	17.46554	12.35000	-133.9716	179.8716	10.60	35.30
	NEZ	0	.	.	.	.	.	.	.
	Total	8	19.5338	15.36215	5.43134	6.6907	32.3768	2.00	44.67

Key: SSZ: South-South Zone. NCZ: North Central Zone. SWZ: South West Zone. NWZ: North West Zone. SEZ: South East Zone. NEZ: North East Zone.

The highest mean prevalence of 63.7% was reported among HIV patients co-infected with malaria in the north-west zone (NWZ) compared to 44.67% reported among HIV-malaria negative patients in the same region. However, the lowest mean prevalence of 16% and 5.5% were found in a similar group in the north-central zone (NCZ) Nigeria, respectively. This may be because only a small proportion of the study selected for review, 11.1% were conducted in the NCZ. Interestingly there is a strong correlation of 1.0 and 0.794 between the two groups recruited in the study in association with the HIV prevalence, although the association is not statistically significant (Table 2).

The mean prevalence of HIV-malaria co-infection is the highest 86.2% among patients on antimalarial treatment (Olaniran et al., 2012). A proportion of the reviewed literature also reported the use of HAART, which is associated with reduced mean positive prevalence of 31.26%, far higher than 2.1% that was reported by (Akinbo et al., 2009) and lower than the 86.2% documented by (Olaniran et al., 2012) in 2012. However, a relatively higher mean prevalence of 37.88% was observed among patients that were not using any treatment procedure, as reported in the studies selected for this literature review (Figure 1). Among HIV seropositive individuals, the use of HAART has shown to improve host immunity (Willemot & Klein, 2004), which might be responsible for the reduced prevalence reported among patients on HAART compared to patients without any treatment procedure in this literature review.

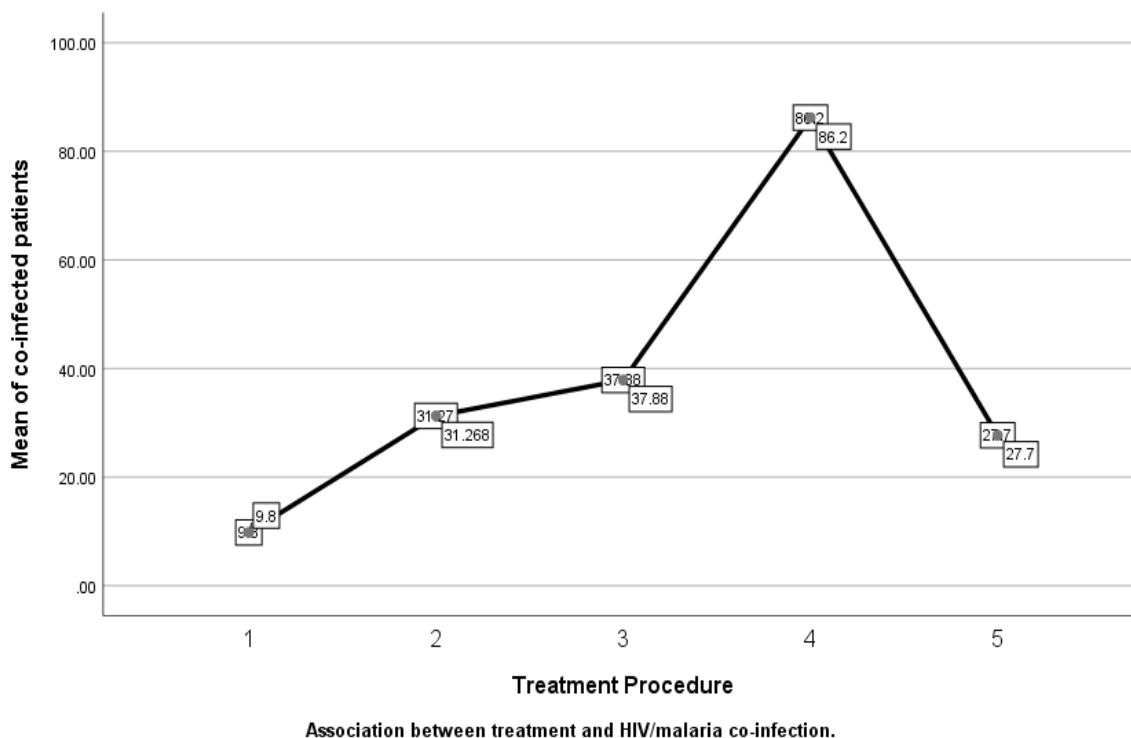


Figure 1. Shows an association between treatment and HIV-malaria co-infection

The test for the homogeneity of variance revealed that there is no significant association between both HIV patients that were co-infected with malaria and the HIV-malaria negative group and the mean, median, and adjusted degree of freedom (Figure 1). The analysis of variance between the two groups and the mean prevalence of HIV co-infected patients indicated no significant association, 0.769 and 0.351 for HIV-malaria co-infected group and the participants that were only HIV positive.

4. Discussion

Annually, HIV and malaria are responsible for over four million deaths globally (Akinbo FO et al., 2009). There is also a high risk of public health concern of HIV-malaria co-infection interaction in Nigeria, a region where both diseases overlap. Findings from this review of the literature revealed that studies conducted on HIV malaria co-infection in Nigeria hardly document the study design used in the research study and the research settings where the studies were conducted. This review also established that semi-urban regions where primary and secondary

hospital settings were situated with the possibility of high HIV-malaria co-infection interaction have been repeatedly neglected, as previously reported (Berg, Patel, Langeland, & Blomberg, 2008), (Nakanjako et al., 2011). Similarly, some of the study design employed are either not suitable or inappropriate (Iroezindu et al., 2012), (Sanyaolu et al., 2013).

5. Conclusion

This review of the literature utilized 18 studies selected in Nigeria between ten years. The literature showed a relatively high mean prevalence of 36.6% HIV-malaria co-infection among HIV seropositive patients in Nigeria. This indicates that HIV positive individuals in the NCZ, as a result of a suppressed immune system, are at higher risk of malaria co-infection. This review highlights the urgent need for regular malaria screening and testing among PLWHA to prevent mortality in HIV-malaria co-infected patients.

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Availability of Data and Materials

Not applicable.

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Authors Contributions

Relevant literature was reviewed by O. S. Alaofin, who wrote the manuscript. K. Naidoo helped in drafting the manuscript. The manuscript was edited and approved by the authors O.S. Alaofin and K. Naidoo.

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Limitations

An equal proportion of the research study were not reviewed across the zones, together with a small sample size in almost all the reviewed literature are limitations that weaken the internal validity of this literature review.

Competing Interests Statement

The authors declare that they have no conflict of interest regarding the publication of this literature review.

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