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PREVALENCE AND RISK FACTORS ASSOCIATED WITH MALARIA AND HIV CO-INFECTION AMONG ADULT PERSONS LIVING WITH HIV ATTENDING MARGRET MARQUART CATHOLIC HOSPITAL, KPANDO

BY

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DECLARATION

I declare that apart from specific references which have been duly acknowledged, this work is the result of my own original research, and that this thesis either whole or in part has not been presented elsewhere for another degree.

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DEDICATION

I dedicate this work to God and my family

ACKNOWLEDGEMENTS

I am most grateful to God almighty for making it possible for this work to be done. I am also grateful to my family for their unflinching support and prayers throughout this period. I am grateful to my supervisor for helping me identify this research problem and also for his directions and critique throughout the period. I say thank you to all my teachers for contributing in diverse ways to this work. And to the staff and patients of the ART clinic of Margret Marquart Catholic Hospital, I am grateful.

ABSTRACT

Background:

Malaria and HIV represent the two most important public health problems of sub-Saharan Africa due to geographical overlap. Together, they are responsible for more than 4 million deaths a year. However, when HIV and malaria co-infect an individual, they drastically worsen the morbidity outcome for the person, increasing the odds of mortality than as single infections. In Ghana, there is paucity of data on the prevalence of this co-infection.

This study determined the prevalence of HIV-Malaria co-infection and its associated factors among adult persons living with HIV (PLHIV) attending Margret Marquart Catholic Hospital (MMCH), Kpando.

Methods:

This is a cross sectional study design involving 200 participants drawn from the ART clinic of MMCH. Closed-ended interview questionnaire was used to obtain information from participants. The interview data were analysed using various statistical methods including cross tabulations and simple and multiple logistic regression.

Results:

There were 200 participants in the study. Forty-four (22%) of them were males and 156 (78%) were females. Two (1.00%) of the participants were pregnant at the time of the study. Ages of participants ranged between 20 to 65 years. Seventeen (8.50%) participants were between 20 to 30 years of age. Sixty-five (32.50%) participants were between 31 to 40 years of age. Eighty-one (40.50%) were between 41 to 50 years and 37 (18.50%) were above 50 years. The mean age of participants was 42.725 (SD= $\pm$9.01).

Thirty-one (15.50%) participants were single while 67 (33.50%) were married. Fifty-nine (29.50%), 26 (13.00%) and 17 (8.50%) participants were divorced, separated or widowed respectively.

Forty-seven (23.50%) participants had no formal education. One hundred and twenty-four (62.00%) of participants attained primary level education while 23 (11.50%) had secondary level education. Only 6 (3.00%) of participants had tertiary level education.

Twenty-four (12.00%) of participants were either unemployed or housewives. Forty-seven (23.50%) were employed in various positions in the public service. One hundred and twenty-seven (63.50%) of participants were self-employed whiles only 2 (1.00%) were employed in the private sector.

Participants resided in various localities in the Kpando Municipality of the Volta region of Ghana with the highest number of 51 (25.50%) resident in Nkonya. Others were resident in Ho, Hohoe, Trevi among others.

The prevalence of HIV-Malaria co-infections at MMCH was found to be 41.00%. PLHIV who visit hospital more often, with intervals less than a month, have statistically significant lower odds (OR= 0.29, 95% CI= 0.14-0.59, p=0.001) of the co-infection compared to PLHIV who visit hospital less often with intervals longer than one month.

Conclusion:

There is a high prevalence of 41.00% HIV-malaria co-infection among PLHIV attending MMCH. The findings suggest that there is reduced odds of malaria infection among PLHIV who visit hospital regularly. Thus, PLHIV must visit hospital regularly so as to be educated on preventing the co-infection.

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LIST OF ABBREVIATIONS

ACT	-	Artemisinin Combination Therapy
AIDS	-	Acquired Immune Deficiency Syndrome
ART	-	Antiretroviral Therapy
DALYs	-	Disability Adjusted Life Years
HIV	-	Human Immuno-deficiency Virus
IRS	-	Indoor residual spraying
ITN	-	Insecticide Treated Nets
MMCH	-	Margret Marquart Catholic Hospital
NMCP	-	National Malaria Control Programme
PLHIV	-	People/Person Living With HIV
RDT	-	Rapid Diagnostic Test
SSA	-	Sub-Saharan Africa
UNAIDS	-	Joint United Nations Programme on HIV/AIDS
WHO	-	World Health Organisation

DEFINITION OF TERMS

Co-Infection: A simultaneous infection of a single host by more than one pathogenic agent

Co-Morbidity: The presence of two or more disorders or diseases that is co-occurring in a host. It is associated with changes in the prognosis and course of the diseases, worse health outcomes, and more complex clinical management.

CD4 Count: A test that measures the number of CD4 T lymphocytes (CD4 cells) in a cubic millimetre of blood. A normal count ranges between 500 – 1500 cells per cubic millimetre of blood.

Parasitaemia: The quantitative content of parasites in the blood, and is an indication of the degree of an active parasitic infection.

Malaria: A life-threatening infectious disease caused by *plasmodium spp*, and transmitted to people through the bites of infected female *Anopheles* mosquitoes.

AIDS: A spectrum of conditions caused by infection with human Immunodeficiency Virus, and characterised by the breakdown of the immune system.

Risk factors: Any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or an injury.

Prevalence: The number of cases of a disease or condition that are present in a particular population at a given time.

Viral load: The amount or quantity of HIV particles in a given volume of blood.

CHAPTER ONE

INTRODUCTION

Background

The Human Immuno-deficiency Virus (HIV) is a disease-causing retrovirus that infects cells which are responsible for immunity in humans (primarily $CD4^+$ T cells, but also macrophages, monocytes, thymocytes and dendritic cells), and leaves its host susceptible to opportunistic infections (Fanales-Belasio, Raimondo, Suligoi, & Buttò, (2010); Nizet & Esko, (2009)). This condition of decreased immunity is known as acquired immune deficiency syndrome (AIDS), a condition as yet without cure.

Although there are two sub-types of HIV – HIV 1 and HIV 2, HIV-1 has higher infectivity and global relevance (Butler, Pandrea, Marx, & Apetrei, 2007). HIV-1, apart from decimating an individual's immunity also activates immune cells and elevates inflammatory-triggering cytokines and chemokines in the plasma and lymph nodes (Appay & Sauce, 2008). These actions of immune suppression and activation are responsible for the observable effects of its infection.

HIV is transmitted primarily through sexual contact (including vaginal, oral and anal sex), sharing of blood fluids (through contaminated blood transfusions, hypodermic needles), and from mother to child (during pregnancy, delivery, and/or breastfeeding) (De Cock, Jaffe, & Curran, 2012). The infection is often accompanied by typical presentations such as significant weight loss, recurrent unexplained diarrhoea, carcinomas, opportunistic infections such as tuberculosis and several other conditions.

Despite the global health significance of HIV, it is especially important in sub-Saharan Africa (SSA) because it is the region that has been hardest hit by the HIV pandemic (Mosam & Dlova, 2006). Also, HIV in SSA is associated with critical co-morbidities (i.e. occurrence of combination of disease conditions in the same person at the same

time) of which some are due to the presence of endemic infectious diseases (Alemu, Shiferaw, Addis, Mathewos, & Birhan, 2013; Mutevedzi & Newell, 2011; Narayan et al., 2014). One of such parasitic co-morbidities is malaria.

Malaria, is one of the leading causes of morbidity and mortality globally especially in tropical and sub-tropical regions of the world where about 3.2 billion people are at risk (World Health Organisation [WHO], 2015). Malaria is a disease caused by protozoa of the *plasmodium* spp. (*P. falciparum, P. vivax, P. ovale, P. malariae and P. knowlesi*) (Zambrano-Villa, Rosales-Borjas, Carrero, & Ortiz-Ortiz, 2002).

Although 6.2 million deaths due to malaria have been prevented around the world between 2000 to 2015, in 2014, 584,000 deaths were caused by malaria, and 90% of those deaths occurred in sub-Saharan Africa most of which were due to *P. falciparum* infection –the most virulent and infective plasmodium species (Nadjm & Behrens, 2012); World Health Organisation [WHO], 2015). This has been credited to the fact that climatic conditions favour transmission, the long lifespan and strong human-biting habit of the African vector species and the large number of people with low immunity including pregnant women, children and people living with HIV/AIDS (Alemu et al., 2013; De Silva & Marshall, 2012).

As a co-morbidity of HIV, malaria represents a substantial danger to those living with HIV as malaria not only enables the transmission of HIV, it also hastens progression from asymptomatic HIV infection to full-blown AIDS (Uneke & Ogbonna, 2009). In sub-Saharan Africa, this is significant as increased HIV transmission due to malaria, as well as its worsening of HIV condition ensures that HIV mortality remains high. Considering their infectiousness, it is not surprising to find that Malaria and HIV are the two most prevalent infections in sub-Saharan Africa (Uneke & Ogbonna, 2009).

In Ghana, recent estimates show that HIV prevalence stands at 1.8% of the total population (National AIDS/STI Control Programme, 2015), while there were about 11.3 million hospital-treated cases of Malaria in 2013 (National Malaria Control Programme -Ghana [NMCP], 2014; Tay, Badu, Mensah, & Gbedema, 2015). This high prevalence of malaria has resulted in economic losses as well as significant disability adjusted life years (DALYs) and mortalities (Asante & Asenso-Okyere, 2003). Research has shown that between 2002 and 2005, at least 0.40% of the country's GDP was eroded by malaria morbidity (Okorosobo, Okorosobo, Mwabu, Orem, & Kirigia, 2011).

When malaria infects people living with HIV (PLHIV), it increases the risk of concurrent HIV infection at the population level (Sanyaolu et al., 2013). There is evidence that the mean malaria parasite density in malaria-infected PLHIV is 12 times that found in HIV-negative patients (Birku, Mekonnen, Björkman, & Wolday, 2002). Furthermore, it increases HIV replication in vitro and in vivo, increases the risk of severe malaria in adults, increases risk of congenital infection and helps propagate the spread of both disease (Sanyaolu et al., 2013). In SSA, the burden of HIV/AIDS and malaria may be as high as 30 percent among HIV-positive populations (Ezeamama et al. 2012).

The risk of different groups of opportunistic infections typically increases at different stages of HIV infection in relation to $CD4^+$ count. In children, it was found that HIV infection especially at low CD4 counts, increased children's risk of developing malaria, and amplifies the frequency of the disease (Ezeamama et al., 2012). Also, a study has shown that there is a higher risk of malaria mortality among HIV-infected compared to HIV-uninfected children with severe malaria (Malamba et al., 2007).

In HIV-infected pregnant women, there was higher incidence of peripheral and placental malaria, higher parasite densities, and more febrile illnesses, severe anaemia, and adverse birth outcomes than HIV-uninfected women, particularly in multi-gravidae (Ter Kuile et al., 2004). There was also an increase of malaria during pregnancy attributable to HIV.

In adult populations generally, the HIV and Malaria co-infection causes more frequent episodes of symptomatic malaria, increases HIV plasma viral load and decreases CD4+ T cells; together, they synergistically dysregulate production of cytokines and antibodies (Hochman & Kim, 2009).

Considering the effects of this co-infection, there is a need to investigate how prevalent it is in Ghana and what risk factors predispose adults to it.

Problem statement

The threat that co-infection of HIV and Malaria poses is a substantial one considering how it disproportionately affects socially vulnerable populations including women, children, and HIV MARPS (most at risk population including female sex workers, men having sex with men, people who inject drugs and prisoners) (Blair, 2015).

Statistics show that in sub-Saharan Africa, the co-infection of malaria and HIV occurs among 9% of those with HIV (amounting to more than 2 million people) (World Health Organization - WHO, 2005). In Ghana currently, there is limited studies that have assessed this prevalence in the adult Pl.HIV population. A facility based study in Ghana by Tay et al. (2015) represents an exception, as it pegs the prevalence of HIV-Malaria co-infection among the adult sero-positive attendants of a private hospital at 11.75%. However, among pregnant women several studies on the co-infection have been done.

This co-infection has been said to be responsible for a significant proportion of the more than 300,000 HIV AIDS related deaths in 2013, and adds to the 12 billion cost due to lost productivity, that sub-Saharan Africa experiences every year (WHO, 2005; 2015).

HIV-malaria co-infection in Ghana therefore needs great attention. HIV and malaria are both generally treated as separate diseases, with any interactions between them often seen as coincidental. Also, previous population-based studies did not show the existence of any significant difference in clinical outcomes between HIV-positive and HIV-negative individuals with malaria.

As such there is paucity of data on the prevalence and risk factors of malaria infection in HIV-positive patients in Ghana.

Conceptual Framework

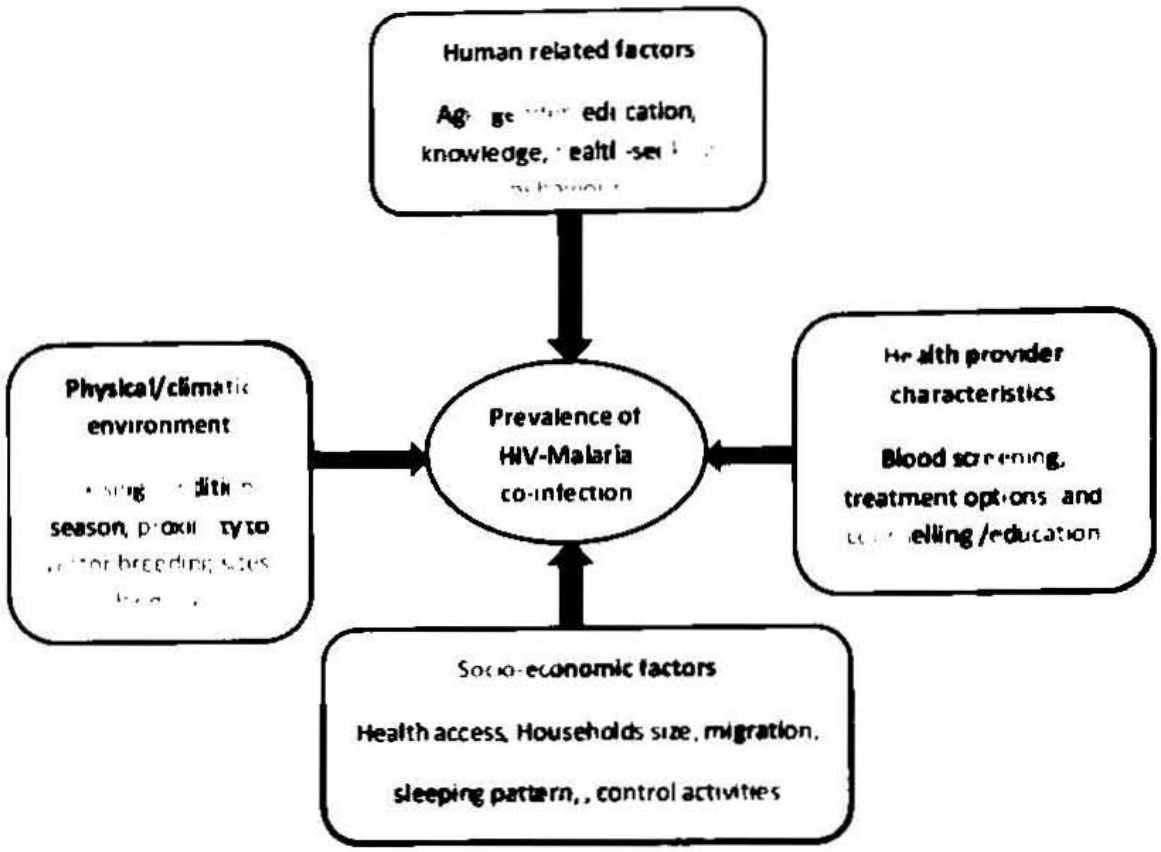

Figure 1: Conceptual Framework (Author's model)

The conceptual framework for this study is demonstrated in Figure 1. According to the framework, the prevalence of HIV-Malaria co-infections is determined by different factors. These factors include human related factors which encompasses socio-demographic characteristics such as age, gender and education, as well as knowledge of HIV and malaria and the health seeking behaviour adopted by the individual –whether they seek medical help or not, use drugs as prescribed, engage in risky behaviours that increase the likelihood of the co-infections. The physical environment also matters - this includes where the person resides, the housing condition of such a place, its climates, the

season (considering there is a seasonal pattern to malaria infection) and whether it has vector breeding sites in proximity that increases the chances of getting co-infected.

Socio-economic factors also influence the prevalence of HIV-Malaria co-infection, as the sleeping patterns (which is predicted by occupation), household size (with larger households being more susceptible to co-infection), access to health care (to both prevent and manage co-infection), control activities engaged in (such as ITN use, IRS which is more prevalent in wealthy homes/communities) and migration (due to economic desires, such as rural-urban migration). The health providers also have a role in determining the prevalence of the HIV-Malaria co-infection, as their blood maintenance practices might cause infections, their screening might be flawed and fail to detect co-infections early. Their management of co-infections also matters in the prevalence levels in the general population.

Justification of the problem

Despite the availability of the measures and intervention to control both HIV and malaria separately, the enhanced risk of mortality due to HIV-malaria co-infection among the general adult population has not been thoroughly investigated in Ghana. This study is thus, designed to provide epidemiological data of malaria among PLHIV.

The collected data will provide an understanding of the factors that influence the prevalence of HIV-malaria co-infection among the adult attendants of MMCH. The information that will be collected will be an essential component in the assessment of the effectiveness of both malaria and HIV control and elimination interventions, and encourage synergised efforts between these programs; and in so doing, recalibrate their efficiency in effectively reducing HIV-malaria co-infection burden. Furthermore, as

malaria is not the only tropical infection that interacts with HIV, information obtained from this study may be useful for understanding how HIV interacts with other co-infections be it parasitic, bacterial or viral.

Objectives of the study

General Objective

The general objective of this study is to determine the prevalence of HIV-malaria co-infection and its associated factors among adult PLHIV attending Margret Marquart Catholic Hospital, Kpando.

Specific Objectives

1. To assess the prevalence of HIV-malaria co-infection among the adult PLHIV attendants of MMCH.
2. To determine factors associated with HIV-malaria co-infection in the participants.

CHAPTER TWO

LITERATURE REVIEW

Epidemiology of HIV-Malaria co-infection

The Joint United Nations Programme on HIV/AIDS (UNAIDS) estimates that in 2014, 36.9 million people were living with HIV infections around the world; of this, 2 million were said to be new infections (Joint United Nations Programme on HIV/AIDS - UNAIDS, 2014). Also the report stated that while HIV infections have fallen by 35% since 2000, 25.3 million people have died of AIDS-related illnesses in that same period.

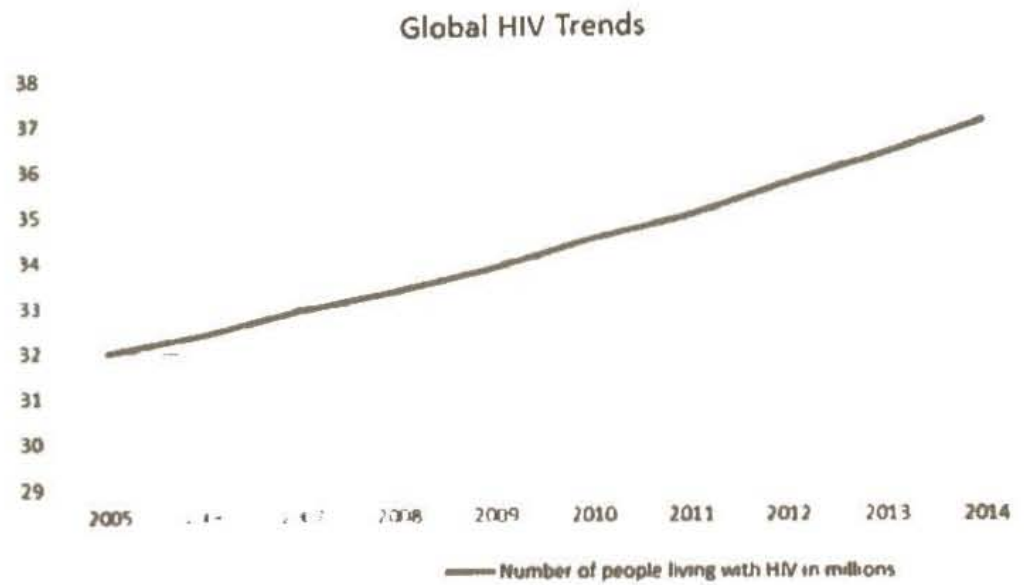

Figure 2: Global HIV Trends (Source: UNAIDS, 2014)

Since the HIV pandemic became recognised as more concentrated in the developing world, especially sub-Saharan Africa, concerns have been raised over the potential of clinical and epidemiological interactions between HIV and tropical diseases, the most important of which was Malaria (Holmes et al, 2003). Since then, malaria has been

identified as the third most important source of HIV-related morbidity in Africa (Saracino et al., 2012).

The figures below show the global distribution of HIV and malaria. This shows that most countries that are endemic for malaria also have HIV as a public health issue. This has often been described as the "geographic overlap between HIV and malaria".

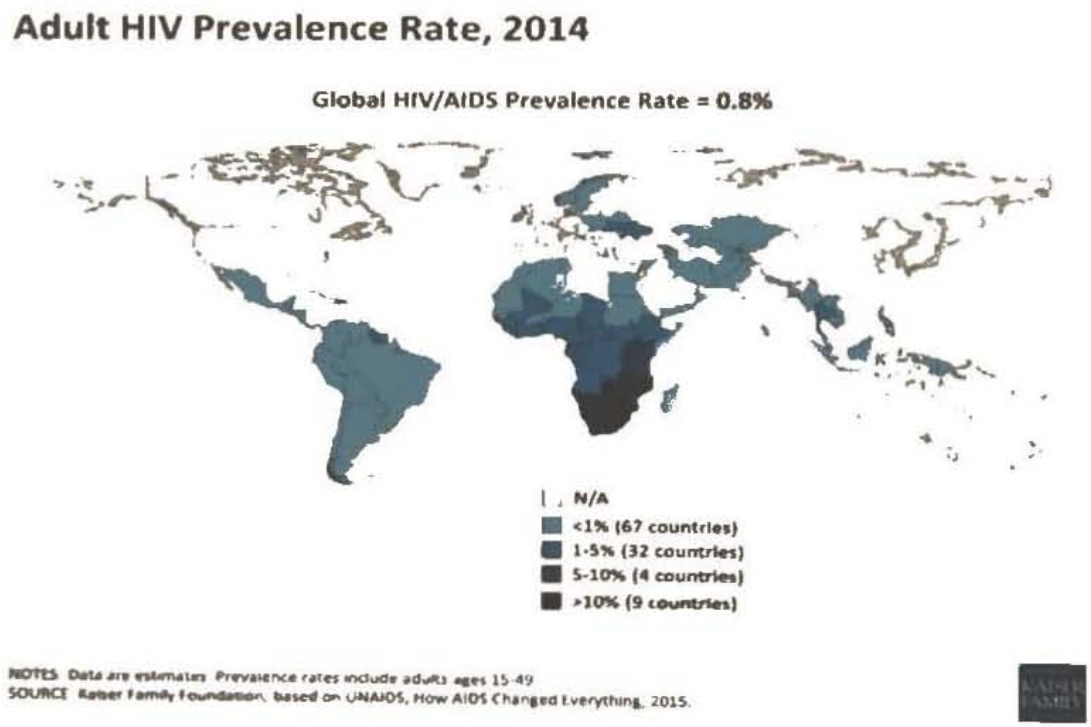

Figure 3: Adult HIV Prevalence Rate (Source: Kaiser Family Foundation, based on UNAIDS, How AIDS Changed Everything; 2015)

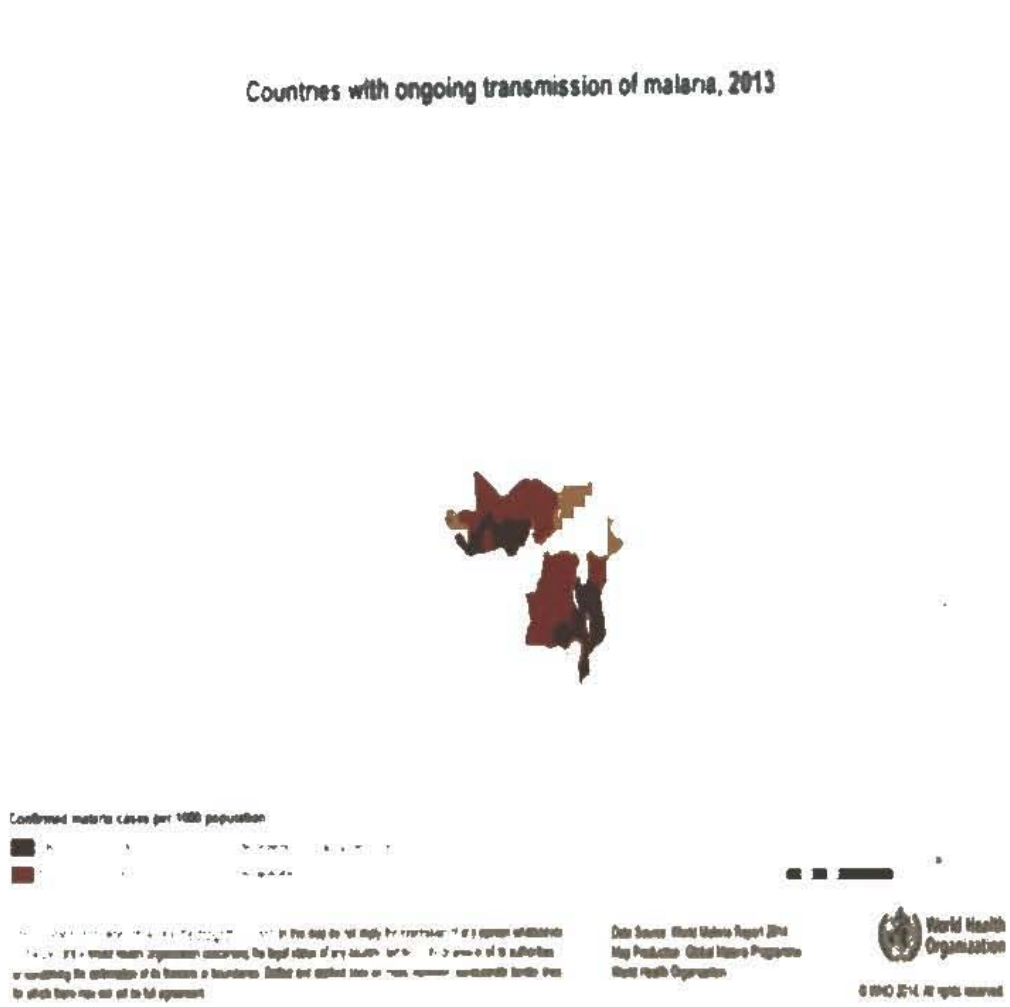

Figure 4: Countries with ongoing transmission of malaria in 2013 (Source: WHO World Malaria Report, 2014)

Malaria is transmitted through the saliva from the bite of the female anopheles mosquito infected by the *plasmodium* and thus, acts as a vector (Donovan et al., 2007). After the parasitic protozoa is introduced into the body, it enters the blood stream, multiplies in the liver before re-infecting red blood cells (Prudêncio, Rodriguez, & Mota, 2006).

While the individual epidemiology of malaria and HIV have been well explored, doing same for HIV-malaria co-infection is a recent endeavour (Van Geertruyden, 2014). This may be due to the fact that there are similarities in diagnostic and treatment of malaria and other HIV co-morbidities (Brentlinger, Behrens, & Micek, 2006). It was only in

2009 that global recognition of malaria as an AIDS-related opportunistic infection occurred (Saracino et al., 2012). However, a better understanding of HIV and malaria interaction has emerged.

Recent studies have outlined the mechanistic relationship between HIV and malaria by describing not just the epidemiology but the disease-causing mechanism (Hawley & Altizer, 2011; Knobler, O'Connor, Lemon, Najafi, & Lal, 2004). HIV results in the loss of pathogen-specific CD4 cell immunity by the lysis of those cells. When this happens, it was expected that malarial infections would not be affected by the impaired immunity, as the immunity was thought to be antibody-mediated and the cytokines adapted to provide a differently mediated immunity (Artavanis-Tsakonas, Tongren, & Riley, 2003). More so, earlier works asserted that total immunoglobulin concentrations, including antimalarial antibodies, in HIV infected patients was similar and not markedly different from that found in HIV-free patients (Knobler et al., 2004).

However findings from several studies have revealed that things work differently (Pisell et al., 2002; Renia & Potter, 2006). It is now known that the destruction of the CD4 cells by HIV virus cripples the body's response to malaria, while the enhanced activation of T-cells worsens the immune response to both diseases (Kasirye et al., 2010; Kublin & Steketee, 2006). Malaria infection results in increased CD4 cell activation, destruction of CD4 cells and upregulation of pro-inflammatory cytokines; this allows for the spread of the virus among the CD4 cells and for higher HIV viral load from viruses released from the lysed CD4 cells (Cohen et al., 2005; Focà, Odolini, Brianese, & Carosi, 2012; Lawn, Butera, & Folks, 2001) . This is especially important in HIV positive pregnant women, who can transfer the virus to their children as malaria-infected pregnant women have an increased viral load and hence a higher risk of transmission to the child,

although their viral load is lower than that observed in non-pregnant adults (Ter Kuile et al., 2004).

Furthermore, there is a two-way interaction that affects the transmission of both infections in adults. Malaria causes heightened immune activation which aids HIV transmission and disease advancement (Van Geertruyden, 2014). This is because malaria increases the viral load in a fleeting but regular manner, and as this happens, it results in an increase in the risk of heterosexual HIV transmission, which is the major route of HIV transmission in Ghana and sub-Saharan Africa generally (Abu-Raddad, Patnaik, & Kublin, 2006; Lawn et al., 2001). PLHIVs have an increased risk of clinical malaria, a risk which increases as their immunity weakens with lower CD4 cells count (Slutsker & Marston, 2007). Further evidence of this is provided by a population-based study in Uganda which found that families co-habiting with a PLHIV have more frequent cases of malaria among HIV-negative children than families without a PLHIV in the home (Mermin et al., 2005).

In PLHIVs the infection of malaria causes an increase in viral load, and also elevated parasite load ensuring that HIV-malaria co-infection would produce a larger amount of pathogenic agents with greater biodiversity, considering the influence of their interaction on the pathogens genetic makeup (Korenromp & D'Alessandro, 2008).

However, the relationship between malaria and HIV immune suppression is more complex than expected. Studies conducted in Malawi showed that although recurrent malaria is not associated with a low CD4 cell count, low CD4 cell count was associated with increased parasitaemia in those with clinical malaria, with clinical and severe malarial presentations likelier among those with lower CD4 cell count (Laufer et al., 2006; Patnaik et al., 2005). Also, antimalarial treatment failure may be more common in

HIV-infected adults with low CD4-cell counts (about ≥400 cells/mL) (World Health Organization - WHO, 2005).

A study in Zambia found that as much as a seven times increase in mortality due to HIV-malaria co-infection occurs in places with endemic malaria due to the epidemiological overlap between both infections, particularly in eastern and southern Africa where co-infection is common (Chalwe, 2009). This is somewhat corroborated by Berg et al. 2014, who found that, malaria patients co-infected with HIV had significantly more severe malaria and higher mortality compared with patients with malaria alone (Berg et al., 2014). Another study done among children and adults found that patients with HIV-Malaria co-infections had higher parasite burden, more complications, and higher case fatality rate (Hendriksen et al., 2012).

Another point of commonality found by van Ejik et al. (2002) in Kenya is that while anaemia is observed in both individuals with malaria and in those with HIV infection, co-infection leads to lower haemoglobin levels than that observed among PLHIV who had no malaria (van Eijk et al., 2002). Also, PLHIVs infected with malaria have a sharper haemoglobin decline shortly after successful malaria treatment, and experience slow haematological recovery, due to the impairments of erythropoiesis and iron mobilization (Mulenga et al., 2009).

Pregnant women are also very vulnerable to this co-infection, as there is an increased risk of malaria in those with HIV infection (Ter Kuile et al., 2004). The risk increment is more pronounced in multigravida than in primigravida, and the risk of anaemia among them is greater than that seen with malaria or HIV alone, suggesting a synergistic interaction between HIV and malaria (Ter Kuile et al., 2004). A study done in the Democratic Republic of Congo found higher prevalence of malaria infections and

clinical malaria among HIV infected pregnant women; it also found that the consequences of such infections are steep, as it is associated with low birth weight and higher postnatal mortality for the mother (Wumba et al., 2015). However, it stated that epidemiological studies assessing the impact of placental malaria on mother-to-child transmission of HIV have thus far been inconsistent.

Among the general adult population, a study has found that the CD4 cell activation effect of malaria and the selective infection of CD4 memory cells by HIV leads to the lysis of protective malaria-specific CD4 cells during each malaria attack, hastening the progression to full-blown AIDS (Mermin, Lule, & Ekwaru, 2006).

Determinants of HIV-Malaria co-infection

The occurrence of HIV-malaria co-infection has been identified with some risk factors by various studies. However, to understand exactly how they predispose people to the co-infection, a review of relevant literature is deemed necessary.

Human Related factors

Tay et al. (2015), in their study of HIV-malaria co-infection in Brong Ahafo region of Ghana, found the most co-infection among those aged 30–34 years, followed by those in the age ranges of 25–29 years and 35–39 years. They also found that the prevalence of the co-infection was higher among females (12.10%) than males (10.20%) (Tay et al., 2015). Findings from a study conducted over 8 years along the Thai-Myanmar border, where prevalence of HIV-malaria co-infection was an average of 1.85%, with the highest prevalence among those aged 19-40 years (0.80%), which intersects with the findings in Ghana (Rattanapunya, Kuesap, Chaijaroenkul, Rueangweerayut, & Na-Bangchang, 2015). Goselle et al. (2009), in a study in North-central Nigeria, found

gender and age differences in the prevalence of HIV-malaria co-infection, as 41 (37.96%) women compared to 23 (25.00%) men had the co-infection (Goselle, Onwuliri, & Onwuliri, 2009). They also showed that co-infection was higher in the age groups 21-30 and 31-40 years with 35 (17.50%) and 12 (6.00%) participants respectively having the co-infection. The co-infection was also higher among farmers, 30 (15.00%) and civil servants 17 (8.50%).

A study conducted in the East African countries of Kenya, Malawi and Tanzania showed that co-infection was equally likely among men and women and it was more likely in formerly married individuals, and women with secondary level education (Cuadros, Branscum, & Crowley, 2011).

Among women, being pregnant also constituted a risk factor for co-infection, as infections which occurs during pregnancy is very common with 25 million women at risk each year (Desai et al., 2007; Skinner-Adams, McCarthy, Gardiner, & Andrews, 2008). A study done in western Kenya found the prevalence of malaria to be significantly higher in HIV positive than negative women (15/50; 30% vs. 12/145; 8.3%, OR = 4.75, 95% CI: 2.039 - 11.063, $p < 0.001$) (Kakai, Odongo, Ofulla & Wachana, 2014). Among HIV sero-positive women, pregnant women were more likely to have malaria than their non-pregnant counterparts, and such malaria-infected HIV-positive pregnant women were more anaemic, had babies with lower birth weight and are at higher risk of complications and placental malaria infection (Hochman & Kim, 2009; World Health Organization - WHO, 2015).

A study in Ghana showed that knowledge of possible co-infection was high among HIV sero-positive patients, but this did not translate into viable health seeking behaviour (Tay et al., 2015). In a study done in Tanzania, more women (30, forming 60% of participants

with the co-infection) than men had HIV-Malaria co-infection (Idindili et al., 2011). Health seeking behaviour such as abstinence from risk factors, use of facilities that will ensure health, compliance to drug regimen can also play a role in stemming the co-infection (World Health Organization - WHO, 2005). A study in Malawi showed that almost half of the young women with new infections in the study sample sought care for malaria in the 4-month period before their seroconversion was documented, three times the level of malaria-related healthcare visits at other times, which resulted in prevention of severe infections and prompt treatment of the malarial infection (Yeatman et al., 2015). This is supported by Drake et al. (2014) who found that while HIV-positive women sought good medical care both before and after HIV diagnosis, men often patronised traditional healers until their HIV diagnosis (Drake et al., 2015). In Tanzania, available information indicates that health education and information communication provided to the community have had limited impact on health seeking behaviour hampering efforts at disease prevention and control (Mboera, 2004).

Physical or environmental Factors

Cuadros et al. (2011) in their East African study found a relationship between place of residence and HIV-malaria co-infection. They found that those who live in areas with high malaria endemicity (attributable to *P. falciparum*) were nearly twice as likely to be HIV positive as those who live in areas with lower levels of malaria prevalence, just as rural dwellers were less likely to have the co-infection (Cuadros et al., 2011). Seasonal and climatic factors also affect the prevalence of HIV-Malaria co-infections. In SSA's tropical climate, the incidence of malaria is high, as the plasmodium species have the necessary conditions to thrive (WHO, 2005). However, due to the seasonal patterns of rainfall and dry season, the risk of being infected is higher in the rainy season, and especially in rainforest-savannah regions (Njunda, Kamga, Nsagha, Assob, & Kwenti,

2012). This climatic condition thus differentiates areas by endemicity, making the prevalence of HIV-malaria co-infections in malaria holoendemic areas greater as such areas are usually proximal to vector breeding sites (Ter Kuile et al., 2004).

Socio-economic and Health provider factors

Socioeconomic conditions of the community and the individual have significant bearing on the prevalence of HIV-malaria co-infection. Ignorance and poverty contribute to the transmission of the co-infection and hinder disease control strategy (WHO, 2005). This was evidenced by de Vries et al. (2013) that high costs of malaria treatment may lead to delays in treatment seeking behaviour, forcing the poorest not to seek care or limit their options of care (de Vries, van de Klundert, & Wagelmans, 2013).

Economic inequities in areas such as the control of household resources also affect access to ITNs. In one study among HIV-positive women in Benin, many women excused their inability to purchase an ITN for themselves and their children on their economic dependence and unless their husbands prioritized the use of bednets, they couldn't own one (Asante, 2007).

The study also revealed that when women did earn an income and had control over this income, they were more likely than men to purchase an ITN for their household (Asante, 2007). It has been noted that HIV-malaria co-infection afflicts primarily the poor, who tend to live in dwellings that offer little or no protection against mosquitoes (Hochman & Kim, 2009).

Cuadros et al. (2011) report showed that the burden of HIV-malaria co-infection is greatest among poor people, imposing significant direct and indirect costs on individuals and households and pushing households into a vicious cycle of disease and poverty (Cuadros et al., 2011). This depletes household resources, leading to increased food

shortages, debts, and poverty for the poorest households (Kumarasamy, Venkatesh, Mayer, & Freedberg, 2007).

In Ghana, both direct and indirect costs associated with HIV-malaria episode represent a substantial burden on poorer households. It was found that in Malawi, the choice of malaria prevention measures (bednets, insecticides, mosquito coils, other insect repellents, burning leaves, etc) was income dependent. In households where the head earned a larger than average income, use of commercial methods (mosquito coils, insecticide spray, bednets) was more common. Use of inexpensive, and less effective, natural methods (burning leaves, dung, or wood) was associated with lower income (Worrall, Basu, & Hanson, 2005).

However, a study by Mulumba et al. (2012) showed that the prevalence of HIV-malaria co-infection was relatively comparable between high and low socioeconomic status individuals, and the proportion of fatalities associated with it was also fairly comparable between the two groups (Mulumba et al., 2012).

Occupational and cultural differences related to undertaking activities likely to lead to HIV-malaria co-infection, and when malaria is acquired, access to health services is more mixed and varies considerably across different cultural settings.

Many African countries, particularly where *P falciparum* malaria is endemic and HIV/AIDS is a major health issue, cannot maintain an adequate blood supply, and fail to screen all their donated blood (Alemu et al., 2013). Even screened blood can be infectious, with a risk that depends on the background sero-prevalence among the blood donors and on the quality of the screening. Also the provision of prompt, professional service is critical to reducing prevalence (Alemu et al., 2013).

CHAPTER THREE

RESEARCH METHODOLOGY

Study Design

This is a cross-sectional study design.

Study Area

The study was conducted at the Margret Marquart Catholic Hospital located in the Kpando municipality of the Volta Region of Ghana.

The following information was taken from the municipal profile of the Kpando municipality, available on its website (http://www.districtsinghana.gov.gh/districts/?news&r=7&_=123).

It is one of the oldest municipalities in the region and lies within Latitudes 6° 20' N and 7° 05' N, and Longitude 0° 17' E. The municipality is one of twenty-five municipalities and districts in the Volta Region and is bounded to the East by the Afadjato South District, to the West by the Volta Lake, to the North by Biakoye District and the North Dayi District to the South. The municipal capital, Kpando is about 70km from the Regional capital Ho.

The land expanse of the municipality is about 820 square kilometers representing 4.5% of the Volta Region. An estimated 30% of the land is submerged by the Volta Lake.

The population of Kpando according to the National Census in 2010 was 93,649 with 49,096 of them being females. This forms 4.4% of the regional population. 53,652 of them are above 18years of age and 64,091 are rural dwellers. The growth rate is estimated to be 0.9% between 1984 and 2000.

About 62% of the working population is engaged in agriculture, animal husbandry, fishing and hunting. About 11.4% are engaged in trading, others are engaged in

professional and technical related fields and the telecommunications and transport related industries.

The municipality boasts of 58 kindergartens, 59 Primary Schools, 39 Junior High Schools, 2 Senior High Schools, one Technical Institute and one Vocational School. The municipality also has 13 health facilities providing various categories of care.

Variables

Outcome/dependent variable

The outcome variable for the study is the presence of HIV-Malaria co-infection as presented in the conceptual framework. It was measured by assessing each participant for the presence of the co-infection and prevalence determined by the proportion of those with the condition relative to the total study participant number.

Explanatory/Independent variables

The explanatory variables were;

- Human factors
    - Socio-demographics such as age, gender, education and occupation
    - Health seeking behaviour
    - Knowledge of HIV and Malaria
    - Malaria and HIV case history

- Physical and environmental factors
    - Current Residence (urban-rural)
    - Closeness of residence to malaria vector sites
    - Housing condition

- Seasonal patterns in flooding and drainage around residence

- Socio-economic factors
  - Access to health care
  - Household size
  - Sleeping patterns
  - Use of malaria controls
- Health provider factors
  - HIV treatment received
  - Malaria treatment received
  - Counselling and information received
  - Interaction level with provider
  - Service satisfaction

Privacy/confidentiality

All interviews were conducted in a manner that ensured the privacy of participants. Thus participants were interviewed with no other person within earshot. Data were reported in a way that reduced the possibility of tracing the information gathered back to any of the participants. This ensured the anonymity of respondents. Finally, no information/response of participants was made public, or accessed by anyone except the researcher and his assistants during data collection and the researcher after data collection.

Data storage and usage

Questionnaires were coded and locked in a shelf-drawer and the key kept by the researcher. For the duration of data collection, data collected daily were immediately coded at the end of the day, and entered within 24 hours of collection into a Microsoft

Excel 2013 spreadsheet. This was then imported into STATA version 13.0 at the completion of data collection. Data entered were saved under a password known only to the researcher. A digital copy of the dataset was stored on a secure cloud drive. All data collected will be kept by the researcher for 5 years, after which questionnaires will be destroyed by shredding.

Voluntary consent

Written consent was sought from all respondents before data were collected from them. Participation was fully voluntary. Respondents were given the opportunity to refuse answering any question they deemed uncomfortable, end the interview any time they wanted, or opt out of the study if they so desired.

Conflict of interest

Apart from the academic and public health importance of the study, the researcher declares no other personal interest in the study.

Study tool

The study used a questionnaire in collecting data among PLHIV aged 18 years and over who attend MMCH. Respondents were interviewed by either the researcher or trained research assistants. The questionnaire contained closed-ended questions. Pre-testing of 30 questionnaires was done at the St. Patrick Hospital, Kpando. However, the responses from this pretesting was not included in the study. The pre-test was to help the researcher modify questions which will not contribute to achieving the research objectives, and it will also allow for a smooth administration of the questionnaire in the study area.

Target population

The study's target population was PLHIV aged 18 years and over attending MMCH.

Inclusion Criteria

PLHIV aged 18 years and over attending MMCH, who freely consent to participate in the study.

Exclusion Criteria

1. PLHIV aged below 18 years attending MMCH.
2. PLHIV aged above 18 years attending MMCH but who did not freely give consent.
3. Patients who are too weak or sick to respond to questions.

Sample Size and Sampling Technique

Sampling size determination

Considering that the prevalence of HIV-malaria co-morbidity was determined in a study done by Tay et al (2015) to be 11.75%, this prevalence rate of was used to calculate the sample size. A confidence interval of 95% and a significance level of 5% were used. The Cochran's (1977) formula below was used to calculate the sample size.

$$n = \frac{z^2pq}{d^2}$$

Where n= sample size

p= probability of the event occurring, which is 50% (0.5)

q= 1-p= probability of the event not occurring, in this case 1-0.5= 0.5

d =margin of error (0.05)

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d=margin of error (0.05)

Z= 1.96 normal deviate representing a 95% confidence interval

Hence, a minimum sample size of 159 is calculated for this study. Adjusting for anticipated non-response, a total of 220 participants were targeted for this study. However, 200 individuals participated in the study.

Sampling Technique

Adult HIV sero-positive patients attending ART Clinic at the hospital were approached as they exited the clinic. They were invited to participate in the study and their consent sought. This study used an exit-interview method to recruit participants. HIV status was verified by requesting for ART clinic treatment folder.

Determining HIV-Malaria Co-infection

Individuals who answered yes to having had an episode of fever in the last six months which was successfully treated with antimalarial were classified as cases of co-infection.

Data collection and quality control

The researcher employed three research assistants who helped in the data collection process. To ensure reliability of data, the research assistants were trained for two days on principles, ethical considerations, procedures and meanings of the questions included in the questionnaire and how data should be collected. The researcher also supervised the data collection process as the research assistants carried it out. Data were checked daily for completeness, accuracy and correctness by the researcher, and problems detected were immediately addressed. The raw data was entered into a Microsoft Excel 2013 spreadsheet by the principal researcher, and it was validated and cleaned after

entry (by matching each observation to the appropriate questionnaire response) to ensure accuracy and consistency of data.

Data Handling

Questionnaires were coded, validated, cleaned and manually entered into Microsoft Excel 2013 spreadsheet. After which it was imported into STATA version 13.0 for analyses.

Data Analyses

The outcome of interest, which is the outcome/dependent variable was measured as a binary outcome, thus, presence or absence of HIV-Malaria co-infection. Independent variables included; socio-demographic characteristics (age, sex, education, occupational status, religion), Socio-economic characteristics and environmental characteristics.

The variables were described using frequencies and cross tabulations. Categorical independent variables were analysed using chi square (and Fisher's exact test where needed) to measure associations with the dependent variable. Those that attained statistical significance were further analysed using binary logistic regression. Crude and adjusted odds ratios (ORs) were calculated with a 95% confidence interval (CI 95%). All reported p-values were two-tailed and considered statistical significant at a level of $p<0.05$. A multiple logistic analysis was carried out to determine the total effect of selected independent variables on the dependent variable. A binary logistic regression was used because the dependent variable of the study was treated as a categorical variable with two categories (presence or absence of HIV-Malaria co-infection). Data was analysed using STATA version 13.

Ethical Consideration

Ghana Health Service Ethical Approval

Before data collection, ethical approval (GHS-ERC: 80/12/15) was obtained from the Ghana Health Service Ethical Review Committee of the Research and Development Division of the Ghana Health Services.

Approval from study area

Permission and approval was also sought from the health facility, Margret Marquart Catholic Hospital, located in the Kpando Municipality of the Volta region of Ghana where the study was conducted.

Potential risks/benefits

Both the target population and the society stand to benefit from the study. The target population gain appreciable knowledge about the existence of HIV-Malaria co-infection. Also, identification of the risk factors that influence the prevalence of the co-infection can serve as a platform to address previously ignored morbidity and mortality due to the co-infection. The research poses no risks to the target population or society.

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CHAPTER FOUR

RESULTS

Socio-demographic characteristics of participants

Prevalence of HIV-malaria co-infection was determined to be 41.00% (82/200).

There were 200 participants in the study. Forty-four (22%) of them were males and 156 (78%) were females. Two (1.00%) of the participants were pregnant at the time of the study. Ages of participants ranged between 20 to 65 years. Seventeen (8.50%) participants were between 20 to 30 years of age. Sixty-five (32.50%) participants were between 31 to 40 years of age. Eighty-one (40.50%) were between 41 to 50 years and 37 (18.50%) were above 50 years. The mean age of participants was 42.725 (SD= + 9.01).

Thirty-one (15.50%) participants were single while 67 (33.50%) were married. Fifty-one (29.50%), 26 (13.00%) and 17 (8.50%) of participants were divorced, separated or widowed respectively.

Forty-seven (23.50%) participants had no formal education. One hundred and twenty-four (62.00%) of participants attained primary level education while 23 (11.50%) had secondary level education. Only 6 (3.00%) of participants had tertiary level education.

Twenty-four (12.00%) participants were either unemployed or housewives. Forty-seven (23.50%) were employed in various positions in the public service. One hundred and twenty-seven (63.50%) participants were self-employed whiles only 2 (1.00%) were employed in the private sector.

Participants resided in various localities within the Kpando Municipality and its immediate environs with the highest number of 51 (25.50%) resident in Nkonya. Others were resident in Ho, Hohoe, Trevi among others.

Table 1: Socio-demographic characteristics of participants

Variables	Frequency(N=200)	Percentage (%)
Age category (years)		
20-30	17	8.50
31-40	65	32.50
41-50	81	40.50
51-60	30	15.00
61-70	7	3.50
Sex		
Male	44	22.00
Female	156	78.00
Marital status		
Single	31	15.50
Married	67	33.50
Divorced/Separated/Widowed	102	51.00
Highest educational level		
No formal education	47	23.50
Primary	124	62.00
Secondary	23	11.50
Tertiary	6	3.00
Employment status		
Unemployed/Housewife	24	12.00
Self-employed	127	63.50
Private	2	1.00
Public Service	47	23.50

Health Seeking Behaviour

All participants, except 1 (0.50%) newly diagnosed person, in the study were on anti-retroviral therapy. This was expected as they were attendants at the HIV clinic of the hospital and were being managed for the condition. One hundred and fifty-one (75.50%) of the participants were compliant on their medications. 41 (20.50%) of the participants keep to their medications most times and 8 (4.00%) take their medications occasionally.

One hundred and forty-three (71.50%) participants visit hospital over intervals longer than one month for their reviews. Forty-seven (23.50%) visit hospital every month while 4 (2.00%), 1 (0.50%) and 5 (2.50%) visit hospital every two weeks, weekly and two or three times a week respectively.

Table 2: Health seeking behavior of participants

Variable	Frequency (N=200)	Percentage (%)
Participants on ART		
ART	199	99.50
No ART	1	0.50
Compliance to treatment		
Comply without fail	151	75.50
Comply most times	41	20.50
Comply occasionally	8	4.00
Frequency of hospital visit		
>1 monthly	143	71.50
Monthly	47	23.50
Two weeks	4	2.00
Weekly	1	0.50
>1 weekly	5	2.50

Prior to being diagnosed with HIV, 169 (84.50%) of the participants visited public hospitals or clinics for healthcare. Twenty-four (12.00%) of the participants visited

private health facilities. One (0.50%) participant visited a CHPS zone whiles 3 (1.50%) visited chemists and traditional healers respectively. Sixty-one (30.50%) participants also visited other places for healthcare aside the regular facility they visit.

Table 3: Health facility of choice before diagnosis

Health facility	Frequency (N=200)	Percentage (%)
Public hospitals or clinics	169	84.50
Private hospitals or clinics	24	12.00
CHPS zone	1	0.50
Chemist/Traditional Healer	3	1.50

One hundred and six (53.00%) of the participants had an episode of fever in the past six months (January to June 2016). Of this number, 63(59.43%) reported to hospital for healthcare. Of those who didn't go to hospital, 29 (67.44%) visited the chemist while 12 (27.91%) and 2 (4.65%) self-medicated and visited the traditional healer respectively. They assigned several reasons for not visiting the hospital such as lack of funds, long distance to health facility and the illness not being serious amongst others.

Of the 200 participants in the study, 82 (77.36%) had fever and were treated with anti-malarials such as artesunate-amodiaquine and artemether-lumefantrine. This represents the number of cases identified over the period (January to June 2016) and hence forms the numerator for the determination of prevalence of the co-infection.

Table 4: Episode of fever in the last six months (January to June 2016)

Response	Frequency (N=200)	Percentage (%)
Yes	106	53.00
No	94	47.00

Table 5: Anti-Malarial treatment of participants in the past six months

Status	Frequency (N=200)	Percentage (%)
Treated	82	41.00
Not treated	118	59.00

Table 6: Participants' reasons for not attending hospital

Reason	Frequency (N=200)	Percentage (%)
Long distance	1	2.33
Inconvenience	3	6.98
Know the problem and can manage it	3	6.98
Lack of funds	11	25.58
Low efficacy of medications prescribed at the hospital	1	2.33
Fear of interaction with ARVs	1	2.33
Illness not serious enough to visit the hospital	22	51.16
Work will not allow a hospital visit	1	2.33

Knowledge of malaria

172 (86.00%) of participants correctly described malaria as an illness that affects the whole body and is characterized mainly by fever. Twenty-eight (14%) incorrectly described it as a boil on the leg. 3 (1.50%) as stomach problem and 24 (12.00%) didn't know what it is.

Table 7: Knowledge of malaria

Response	Frequency (N=200)	Percentage (%)
Boil on the leg	1	0.50
Sickness that affects the whole body characterized by fever	172	86.00
Stomach problem that causes stooling	3	1.50
I don't know	24	12.00

Mode of transmission

One hundred and twenty-six (63.00%) of the respondents correctly chose mosquito bites as the mode of transmission of malaria. Seventy-four (37.00%) respondents incorrectly chose other options such as through sex and exchange of bodily fluids, eating and drinking unclean food and water or did not know how it is transmitted.

Table 8: Knowledge on mode of transmission

Mode	Frequency (N=200)	Percentage (%)
Sex and exchange of bodily fluids	9	4.50
Mosquito bites	126	63.00
Unclean food and water	31	15.50
I don't know	34	17.00

Considering their sero-status, 106 (53.00%) of respondents said they were at a higher risk of the co-infection. Forty-four (22.00%) said they were at a lower risk whiles 50 (25.00%) did not know whether they were at a higher or lower risk of the co-infection.

One hundred and twenty-four (62.00%) of respondents indicated that the co-infection presents a worse prognosis compared to being infected with only HIV. Seventy-six (38.00%) indicated that the co-infection presents a better prognosis or does not affect their health in any way.

Respondents indicated that prevention of the co-infection would be advantageous as pain and suffering will be reduced. Money and time would also be saved for other purposes.

Table 9: Knowledge on benefits of preventing co-infection

Response	Frequency (N=200)	Percentage (%)
Reduce pain and suffering	187	93.50
Save money for other purposes	100	50.00
Save time from visiting the hospital	60	30.00

Respondents showed a good knowledge of the preventive measures of malaria. High numbers of respondents correctly chose preventive measures to combat malaria as shown in the table below.

Table 10: Knowledge of preventive measures

Preventive Measure	Frequency (N=200)	Percentage (%)
ITN use	167	83.50
Environmental cleanliness	125	62.50
Destroying breeding sites	59	29.50
Use of anti-malarial	17	8.50
Traditional remedies	9	4.50
Fumigants/IRS	9	4.50
Insecticide sprays	89	44.50
Repellants	60	30.00

Preventive Measures' Use

Respondents also showed a high level of use of the preventive measures. One hundred and one (73.72%) used one preventive measure everyday whiles 10 (7.30%) engaged in at least one preventive measure once every three months.

Table 11: Participants' use of protective measures

Protective measure	Frequency (N=200)	Percentage (%)
ITN	107	56.32
Environmental cleanliness	82	41.00
Destroying the breeding sites	37	18.50
Use of anti-malarial	6	3.00
Use of traditional remedies	5	2.50
Fumigants	3	1.50
Insecticide sprays	62	31.00
Use of repellents	49	24.50

Table 12: Frequency of participants' use of preventive measures

Preventive measures	Frequency (N=200)	Percentage (%)
Everyday	101	73.72
2-4 times a week	22	16.06
Once weekly	4	2.92
1-3 times in a month	10	7.30

Majority of respondents did not have to pay for the preventive measures. Eighty-six (62.77%) acquire or get the means to prevent malaria for free whiles 42 (30.66%) had to pay for it directly. Five (3.65%) and 4 (2.92%) of the respondents paid for preventive measures from government sources and through community efforts respectively. Sixty-three (31.50%) of the respondents did not engage in any preventive measures. Several reasons were assigned for this. Fifty-one (80.95%) said they couldn't afford it whiles 13 (20.63%) said preventive measures were not available to them.

Table 13: Source of funding preventive measures

Source	Frequency (N-=137)	Percentage (%)
Free	186	93.47
Direct from pocket	42	30.66
From government	5	3.65
Community efforts	4	2.92

Table 14: Participants' reasons for not using preventive measures

Response	Frequency (n=63)	Percentage (%)
Not available	13	20.63
Cost/Affordability	51	80.95
Lost	0	0.00
Used for other purposes	2	3.17
Old/ Thrown away	0	0.00
Housing structure doesn't allow net use	3	4.76
Absence of a bed	3	4.76
Measures do not work	1	1.59
Afraid of side effects/ Toxicity	0	0.00
Weather does not allow use	33	52.38

Eighty-five (42.50%) of respondents said they could afford the preventive measures if they were not for free.

Ninety-two (46.00%) of respondents said malaria occurs more in the rainy season whiles 57 (28.50%) said the disease occurs uniformly throughout the year. Six (3.00%) said it occurs more in the dry season and 45 (22.50%) did not know if the occurrence varied with the seasons. Only 5 (2.50%) of the respondents took further preventive action against malaria during periods of increased occurrence.

Thirteen (6.50%) of the respondents have had indoor residual spraying done in their homes at least once.

Housing Environment

Respondents answered questions on their housing environment. One hundred and fifty-five (77.50%) of the respondents had three or more people constituting their household. Ten (5.00%) and 35 (17.50%) had one and two members of household respectively.

Thirty-four (17.00%) had their homes close to breeding sites such as stagnant water whiles 29 (14.50%) had homes close to farms. One hundred and sixty-two (81.00%) kept clean homes and environments. One hundred and fourteen (57.00%) had homes with windows screened with intact wire gauze and 123 (61.50%) had a separate bedroom. With respect to the structure of the bedroom, 178 (89.00%) were such that bottoms can be put up for hanging mosquito nets.

Health Provider

Respondents were asked if they are given information on preventing malaria when they visit health facilities. One hundred and fifty-eight (79.00%) were given information on

preventive measures. None of the respondents clearly remembered how they became sero-positive and thus could not say for certain whether it was related to any hospital procedure. One hundred and ninety-one (95.59%) of respondents said health workers, on the average, were approachable with 186 (93.00%) being able to discuss their health problems always with health providers. One hundred and ninety-one (95.50%) of respondents said they receive good care from health providers.

One hundred and seventy-five (87.50%) of respondents live farther than five minutes-drive from the hospital.

Univariate Analysis

The data was analysed to show which variables had significant association with the outcome. Several categories of variables were analysed using chi square.

None of the socio-demography variables had a significant association with the outcome. Sex, age, marital status, level of education, employment status and place of residence all had p-value greater than 0.05. Other variables such as frequency of hospital visits, knowledge of malaria and preventive efforts all showed significant association with the outcome variable. Below is a table showing the results of the univariate analysis.

Table 15 i: Univariate Analysis of predictions with HIV-Malaria Co-infection

Variable	Participants (N=200) N	%	HIV-Malaria Co-infection (N=82) Prevalence	%	C.I.	Chi2 value	p-value
Age						8.6578	0.2780
20-25	6	3	0	0	0.0090-0.8139		
26-30	11	5.5	4	36.4	0.1167-0.7120		
31-35	26	13	10	38.5	0.2114-0.5931		
36-40	39	19.5	16	41.0	0.2630-0.5756		
41-45	55	27.5	29	52.7	0.3924-0.6583		
46-50	26	13	11	42.3	0.2416-0.6280		
51-55	17	8.5	5	29.4	0.1925-0.6726		
56-60	13	6.5	5	38.5	0.0632-0.5717		
61-65	7	3.5	2	28.6	0.0420-0.7850		
Sex						0.1110	0.7390
Male	44	22.0	19	43.2	0.1675-0.2833		
Female	156	78.0	63	40.4	0.7167-0.8325		
Marital Status						6.0071	0.1990
Single	31	15.5	7	22.6	0.1108-0.2125		
Married	67	33.5	30	44.8	0.2725-0.4038		
Divorced	59	29.5	28	47.5	0.2354-0.3625		
Separated	26	13	11	42.3	0.0898-0.1846		
Widow/Widower	17	8.5	6	35.3	0.0533-0.1330		
Educational Status						2.2640	0.5190
No education	47	23.5	23	48.9	0.1809-0.2993		
Primary level	124	62.0	46	37.1	0.5502-0.6852		

Secondary level	23	11.5	10	43.5	0.0774-0.1676		
Tertiary level	6	3.0	3	50	0.0134-0.0656		
Employment Status						3.9619	0.2660
No employment/ Housewife	24	12.0	9	37.5	0.0815-0.1733		
Public service	47	23.5	22	46.8	0.1809-0.2993		
Self-employed	127	63.5	49	38.6	0.5655-0.6993		
Private sector	2	1.0	2	100.0	0.0025-0.0395		
Compliance to therapy						1.4384	0.4870
Fully Compliant	151	75.5	65	43.0	0.6901-0..8101		
Most times	41	20.5	15	36.6	0.1543-0.2672		
Occasional	8	4	2	25.0	0.0200-0.0784		
Frequency of hospital visits						21.1882	0.0000
2-3 times a week	5	2.5	5	100.0	0.0104-0.0591		
Weekly	1	0.5	1	100.0	0.0007-0.0352		
2 times a month	4	2.0	4	100.0	0.0075-0.0525		
Monthly	47	23.5	25	53.2	0.1809-0.2993		
Only when sick	143	71.5	47	32.9	0.6480-0.7737		

Table 15(ii): Univariate Analysis of predictions with HIV-Malaria Co-infection

Variable						Chi2 value	p-value
Knowledge of malaria						9.3381	0.0250
Febrile illness	172	86.0	74	43.0	0.8041-0.9019		
Stomach sickness	3	1.5	3	100.0	0.0048-0.0459		
Don't know	25	12.5	5	20	0.0856-0.1790		
Choice of healthcare facility						19.1822	0.0010
Public hospital/clinic	169	84.5	64	37.9	0.7709-0.8763		
CHPS centre	1	0.5	1	100.0	0.0234-0.0846		
Private hospital/clinic	24	12.0	12	50.0	0.0270-0.0909		
Chemist/drug store	3	1.5	3	100.0	0.0379-0.1092		
Traditional healer	3	1.5	2	66.7	0.0025-0.0395		
Preventive efforts						7.4689	0.0060
Use a preventive method	137	68.5	65	47.4	0.6168-0.7461		
Does not use a preventive method	63	31.5	17	27.0	0.2539-0.3832		
Affordability of preventive measures						10.5154	0.0010
Can afford preventive method	85	42.5	46	54.1	0.3578-0.4951		
Can't afford preventive method	115	57.5	36	31.3	0.5049-0.6422		
Number of members of household						4.1770	0.1240
One	10	5.0	4	40.0	0.0270-0.0909		
Two	35	17.5	9	25.7	0.1280-0.2346		
Three or more	155	77.5	69	44.5	0.7114-0.8280		
Knowledge of season of high transmission						3.7814	0.2860

Rainy season	92	46.0	42	43.8	0.3915-0.5300
Dry season	6	3.0	3	50.0	0.0134-0.0656
Throughout seasons	57	28.5	24	42.1	0.2263-0.3520
Don't know	45	22.5	13	28.9	0.1720-0.2886

Table 15(iii): Univariate Analysis of predictions with HIV-Malaria Co-infection

Variable						Chi2 value	p-value
Distance of facility from residence						6.7260	0.0350
Less than 5min walk	8	4.0	3	37.5	0.0200-0.0784		
Less than 5min drive	17	8.5	12	70.6	0.0533-0.1330		
Farther than 5min drive	175	87.5	67	38.3	0.8210-0.9144		

Univariate analysis showed several variables have a significant association, $p<0.005$, with the outcome.

Some variables that had a significant association with the outcome, with p-values less than 0.005, and have been shown to have a significant association by literature were selected for multivariate analysis.

A simple logistic regression showed a significant association between knowledge of malaria and the co-infection. Respondents who could not describe what malaria is have 0.3311 odds (95% CI= 0.1187, 0.9231) of the co-infection compared to respondents who

know what malaria is. The choice of place of treatment for malaria did not show significant association with the outcome. How other variables are independently associated with the outcome are shown in the table below.

Table 16: Univariate Analysis of potential risk factors for malaria infection among PLHIV attending MMCH

Variable	Crude Odds Ratio	95% CI	p-value
Frequency of hospital visit			
One month or less interval	1		
More than one month	0.3077	0.1627-0.5820	0.000
Knowledge of malaria			
Knows what malaria is	1		
Does not know what malaria is	0.3311	0.1187-0.9231	0.035
Preventive efforts			
Uses preventive method	1		
Does not use preventive method	0.4094	0.2138-0.7838	0.007
Distance from health facility			
Less than 5 minutes' walk	1		
≤ 5min drive from health facility	4.0000	0.6805-23.5119	0.125
: 5min drive from health facility	1.034	0.2393-4.4675	0.964

Multivariate analysis

The variables that showed significant association, p<0.005, with the outcome, in the univariate analysis of the crude odds ratio were analyzed in a multivariate analysis. The only factor that showed significant association with the outcome in the multivariate analysis is the frequency of hospital visits (OR=0.4575, 95% CI= 0.2184-0.9582), indicating that PLHIV who visit hospital regularly with intervals of less than one month have reduced odds of having the co-infection compared to PLHIV who visit hospital less often with intervals longer than one month . All other factors did not show a significant association with p-value >0.05. Results are shown in a table below.

Table 17: Multivariate analysis of risk factors for malaria infection among PLHIV attending MMCH

Variable	Adjusted Odds Ratio	CI	p-value
Frequency of hospital visit			
One month or less interval	1		
More than one month interval	0.4575	0.2184-0.9582	0.038
Knowledge of malaria			
Knows what malaria is	1		
Does not know what malaria is	0.4885	0.1592-1.4988	0.210
Choice of facility for treatment			
Public Hospital/Clinic	1		
CHPS zone	1.4545	0.3330-6.3524	0.618
Chemist/ Drug store	0.3194	0.0628-1.6237	0.169
Traditional Healer	2.0856	0.1185-36.7151	0.615
Preventive efforts			
Uses preventive method	1		
Does not use preventive method	0.8014	0.3488-1.8413	0.602
Affordability of preventive measures			
Can afford preventive method	1		
Can't afford preventive method	0.5528	0.2613-1.1695	0.121
Distance from health facility			
Less than 5 minutes' walk	1		
5 minutes-drive	2.3807	0.3648-15.5381	0.365
Farther than 5 minutes-drive	0.8304	0.1791-3.8506	0.812

CHAPTER FIVE

DISCUSSION

The prevalence of HIV-Malaria co-infection was determined in this study to be 41.00%. This includes all cases of fever treated with antimalarial among PLHIV who are attendants at the hospital. This prevalence is higher compared with the prevalence of clinically diagnosed malaria of 38.10% established by Adu-Gyasi et al (2013) in a study involving some selected hospitals in Ghana. Sanyaolu et al (2013) also found a prevalence of 2.90% (31/1080) in a study done in Lagos, Nigeria.

Fana et al (2015) also reported a malaria prevalence of 41.60% among pregnant women who are another sub-population with impaired immunity, in a study done in the semi-urban area of Argungu, Kebbi State Nigeria. Johnbull et al (2014) also determined a prevalence of 49.83% in a study among HIV positive pregnant women on anti-retroviral therapy in a study done in the Enugu state of Nigeria.

Though the prevalence of the co-infection is high in this present study, it is expected in this sub-population as they have an impaired immune system and are unable to mount a full immune response to the infection.

Forty-seven (23.50%) of participants had no formal education. Education had no significant association with the outcome in this study. This contrasts with findings from Guthmann et al (2001) who found in a study done in northern Peru among the general population, that a high level of education was protective against malaria.

There was a high level of knowledge on the aetiology and spread of malaria among participants in the study. One hundred and seventy-two (86.00%) participants knew what malaria is whiles 126 (63.00%) knew the mode of transmission of the disease. This is comparable to 87.00% of participants having knowledge of malaria, 65.90% of

participants knowing the disease is transmissible and 91.20% of these knowing the mode of transmission established by Tay et al (2015). This is an indication that malaria is endemic in Kpando municipality. It also indicates that patients are receiving education on the disease at the hospital and from other sources. More education is needed however, as 24 (12.00%) of participants did not know what malaria is whiles 34 (17.00%) did not know how it is transmitted. Though this study found that respondents who did not know what malaria is had some protective association from the co-infection (OR=0.3311, 95% CI=0.1187, 0.9231) in the univariate analysis, the multivariate analysis did not support this assertion (OR=0.4885, 95% CI=0.1592, 1.4988). This finding was supported by Mendez et al (2000) who found that knowledge of the disease and knowledge of prevention by elimination of breeding sites had a protective effect for malaria (OR=0.49, 95% CI=0.26-0.95).

One hundred and sixty-seven (93.82%) of participants identified use of ITNs as a preventive measure for malaria with 107 (56.32%) using the method. The percentage of participants who identified use of ITNs as a preventive measure for malaria in this study (93.82%) is higher than the 75.00% of participants who identified taking tablets and use of bednets as preventive measure in a study conducted by Tay et al (2015). Tay et al (2015) also found that 8.50% use bednets as a preventive measure. This high level of ITN use can be attributed to various interventions such as the distribution of free ITNs by various agencies of the ministry of health. Discomfort from heat and lack of space were some of the reasons mentioned for the non-use of bednets as a preventive measure.

One hundred and eighty-five (92.50%) of the respondents go to hospital for treatment when they contract malaria. 13 (6.50%) visit the chemist whiles 2 (1.00%) go to a traditional healer. The greater majority visit the hospital and thus are more likely to benefit from education on prevention of the illness. Early reporting to hospital also helps

prevent severe infections and allow prompt treatment of the malarial infection (Yeatman et al., 2015).

One hundred and thirty-seven (63.00%) of respondents engage in some preventive measure against malaria. Use of ITNs was the most popular method of prevention. Environmental cleanliness, use of repellents and destroying breeding sites then follow. The study by Tay et al (2015) found that the most frequently mentioned method of prevention was environmental sanitation, 286 (94.10%), followed by taking antimalarial tablets, 238 (78.30%), bed nets 231 (76.00%) and mosquito repellent, 196 (64.50%). Asante et al (2011) found ITN use as the most popular preventive method in a study in the Ahafo area in Ghana. The use of ITNs is encouraging as they have been found to be highly effective in reducing childhood mortality and morbidity from malaria (Lengeler, 2014). This success can be replicated among PLHIV.

Of the respondents who do not use any preventive measure, 51 (25.50%) gave reasons of cost as why they weren't doing so. This is similarly reported by Chirebvu et al (2014). Thirty-three (16.50%) attributed it to the weather and heat from the ITNs whiles 13 (6.53%) said the preventive measures were not available to them.

Several factors were found to have a significant association with the outcome of interest after testing with chi square analysis ($p< 0.05$). These factors were then analysed with simple logistic regression after which frequency of hospital visit, knowledge of malaria, engagement in preventive efforts, sleeping in a separate bedroom, distance of residence from health facility and good care provision from healthcare workers all showed significant association with the outcome ($p< 0.05$). However, after multiple logistic regression adjusting for other variables such as knowledge of malaria, choice of facility for treatment, use of preventive efforts, affordability of preventive efforts and distance

from health facility, only frequency of hospital visit reached significance (OR= 0.4575, 95% CI= 0.2184-0.9582, p= 0.038) indicating that PLHIV who visit hospital regularly are at a lower risk of the co-infection compared to PLHIV who do not visit hospital regularly. This agrees with findings in a study done in Ethiopia by Alemayehu et al, (2015) that HIV-seropositive patients who come for routine follow up were less likely to be infected by malaria (OR = 0.23, 95% CI = 0.09-0.74).

Limitations

Though the study revealed some insightful findings, it has some limitations.

It was a cross-sectional study and hence the prevalence may be different if the study was done over a different period.

The diagnosis of malaria was subjective as it was dependent on respondent's recall of having had fever treated with anti-malarials and not laboratory investigations such as a blood film test or a rapid diagnostic test for malaria.

Recommendations

A more reliable study type such as a cohort study can be used to improve on the findings of the study. The cohort study design follows up disease free persons, in this case PLHIV who do not have malaria, over a period during which some develop the HIV-malaria co-infection. It can therefore identify and correctly diagnose persons with the co-infection as they develop symptoms compared to the subjective method used in this study. It can also determine the incidence of the co-infection as well as discover interactions between the two diseases.

Efforts at preventing malaria among this vulnerable group must be increased to reduce the prevalence of the co-infection. This should be spearheaded by the Malaria Control Program and public health officials.

Education of PLHIV on malaria and its preventive measures should continue so they can prevent the co-infection. All health workers must contribute their quota in this endeavor.

Interventions such as provision of free ITNs should be extended to this vulnerable group to enable them prevent malaria. A similar effort among pregnant women is being done by the Malaria Control Program and this can be extended to PLHIV so as to help decrease the prevalence of the co-infection.

Collaboration between the Malaria Control Program and the National AIDS/STI Control Program should be improved as the co-infection is becoming more and more relevant. Improved collaboration will help address the co-infection better and reduce its prevalence.

Prophylaxis should be considered for this group as they are an at-risk group. This should be considered by the control programs aforementioned in a collaborative effort.

Conclusions

The prevalence of HIV-Malaria co-infection was 41%. The study revealed a high prevalence of the co-infection among PLHIV attending MMCH, thus malaria is a major public health problem among this susceptible group. The frequency of hospital visit was found to be significantly associated with HIV-malaria co-infection with PLHIV who visit hospital regularly with intervals of one month or less having lower odds of the co-infection compared with PLHIV who do not visit hospital often with intervals longer than one month.

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APPENDICES

Appendix I

Informed consent

Title: Prevalence and risk factors associated with malaria and HIV co-infection among adults attending Margret Marquart Catholic Hospital.

Principal Investigator: Mark Zigah

Address: University of Ghana, School of Public Health, P.O. Box 43, Legon.

ID NO:_____

Dear Participant,

My name is Mark Zigah, and I would like to invite you to participate in a research with the above stated title. The research will help the principal investigator to write a dissertation which is in partial fulfilment of the Master of Public Health for academic year 2015/2016. You are entreated to read the information below very careful before you agree to take part in this study.

General Information about Research

The purpose of the study is to determine the prevalence of HIV-malaria co-infection and its associated factors among the adult attendants of Margret Marquart Catholic Hospital.

The study will address these three objectives:

1. To estimate the prevalence of HIV-malaria co-infection among the adult attendants of the hospital.

2. To find out the demographic characteristics of those with HIV-malaria co-infection among the adult attendants of the hospital.

3. To determine the factors associated with prevalence of HIV-malaria co-infection among the adult attendants of the hospital.

You will be required to answer interview questions which will take you between 45 to 60 minutes to go through the interview at a convenient place. Do not hesitate because in this interview there are no RIGHT or WRONG answers. The findings will be analysed and then compared to other related researches and conclusions will be drawn.

Possible Risks and Discomforts

You will not be exposed to any risk during the research.

Possible Benefits

You will not receive any direct benefit for participating but the findings of the study will be used to complete my dissertation. It will also inform HIV-Malaria co-infection prevention and management efforts.

Confidentiality

All the information you will provide will be known exclusively to the researcher and his supervisors. Your name will not be included in any of the information you give me. The interview will be done at a place where nobody will be able to identify you. The information you provide will be kept under lock for five years and if the need to use it again arises permission will be sought from you.

Compensation

You will receive the investigator's gratitude and be given refreshments after the interview if available.

Voluntary Participation and Right to Leave the Research

Please be assured that your participation in this study is solely voluntary. You have the right to participate or refuse to participate and this will not result in any penalty in the service you are entitled to. You have the right to drop out of the research at any time you desire.

Contacts for Additional Information

If you have any questions now or at any point during the course of the study, please feel free to ask. For further information please contact the principal investigator, Mark Zigah, Department of Epidemiology, School of Public Health, University of Ghana, Legon. Telephone: 0244987082 or email: p4real07@yahoo.ca. Contact can also be made with the supervising lecturer, Dr. Bismark Sarfo of the same department.

Participant Agreement

The above document describing the benefits, risks and procedures for the research titled "prevalence and risk factors associated with malaria and HIV co-infection among adults attending a district hospital" has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction.

By ticking this box, ☐ voluntarily agree to participate in the research.

Date

Signature or thumbprint of parent or guardian

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

Date

Signature or thumbprint of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual

Date

Name & Signature of Person Who Obtained Consent

Appendix 2

Questionnaire

Information sheet

Dear participant,

I am Mark Zigah from School of Public Health, University of Ghana. I'm interested in learning more about HIV-malaria co-infection and its risk factors. I will ask you several questions about yourself, your health-seeking behaviour and your HIV-malaria prevention efforts. I am requesting you to answer these questions truthfully to the best of your ability. Whatever information you provide will be kept confidential.

ID NO: _

Section A: Socio-demographic factors

1. Sex: Male Female

2. Age at last birthday: _____

3. Marital status: single married divorced separated widow/widower Other (Please, specify)

4. Level of education: No education Primary school Secondary school [ ] Tertiary [ ] others (Please, specify)____ _____

5. Employment status: No employment/housewife public service self-employed private sector

others_____

6. Place of residence:___

Section B: Health seeking behaviour

7 Are you on any medication regimen? Yes [ ] No [ ]

8. How well do you keep to the regimen?

I keep to it without fail [ ] I keep to it most times [ ]

Only take it sometimes [ ] I never remember to take it [ ]

9. How often do you visit a health-facility?

Every-day [ ] 2-3 times a week [ ] Once a week [ ] Twice a month [ ] Monthly [ ]

others, please specify_____

10. Before your diagnosis, where did you mainly visit for health care? (Tick only one)

Public Hospital/Clinic [ ] CHPS centre [ ] Private hospital/ clinic [ ]

Chemist/Drug store [ ] Traditional Healer [ ]

11. Did you visit any other place for health care then? Yes [ ] No [ ]

Where?

Public Hospital/Clinic [ ] CHPS centre [ ] Private hospital clinic [ ]

Chemist/Drug store [ ] Traditional Healer [ ]

12. Within the past six month did you have episodes of fever? Yes [ ] No [ ]

13. Did you go to the hospital? Yes [ ] No [ ] **(If yes, skip to 16)**

14. If the answer is no, explain why _____

15 Where did you go to for treatment?

Chemist/Drug store [ ] Traditional Healer [ ] Self-medicated [ ]

16. Were you given anti-malaria drugs? Yes [ ] No [ ]

17. If the answer is yes, mention the name of the drugs that was given

Section C: Knowledge of HIV-Malaria co-infection

18. What is malaria? (Tick only one)

A boil on the leg [ ]

A serious sickness that affect the whole body and is characterised by fever, muscle aches [ ]

A stomach problem that causes stooling [ ]

A place in America [ ]

I don't know [ ]

19. Do you know how it is transmitted?

Through sex and exchange of bodily fluids [ ]

A serious sickness that affect the whole body and is characterised by fever, muscle aches [ ]

Through Mosquito bites [ ]

Through eating dirty food and drinking unclean water [ ]

I don't know [ ]

20. Considering your sero-status, do you think your risk of contracting malaria is higher or lower?

Risk is higher [ ] Risk is lower [ ]

21. What do you think are the consequences of having a HIV-Malaria co-infection?

_____

22. What do you think are the advantages of preventing HIV-malaria co-infections? *(You can tick more than one*

Reduce pain and suffering [ ]

Help save money for other purposes [ ]

Saves time from visiting the hospital [ ]

23. What are the main preventive measures of malaria? *(You can tick more than one)*

Use ITN [ ]

Environmental cleanliness [ ]

Destroying the breeding sites [ ]

Use of Antimalarials/ALU [ ]

Use traditional remedies [ ]

Fumigants /IRS [ ]

Use insecticide sprays [ ]

Using repellents [ ]

Other_____ [ ] Don't Know [ ]

24. When you contract malaria, where do you go for treatment? (Tick one only)

Public Hospital/Clinic [ ] CHPS centre [ ] Private hospital/ clinic [ ]

Chemist/Drug store [ ] Traditional Healer [ ]

Section D: Control measures

25. Do you take any efforts to prevent malaria? Yes [ ] No [ ]

26. If yes, what efforts? *(You can tick more than one)*

Use ITN [ ]

Environmental cleanliness [ ]

Destroying the breeding sites [ ]

Use of Anti-malarials/ALU [ ]

Use traditional remedies [ ]

Fumigants /IRS [ ]

Use insecticide sprays [ ]

Using repellents [ ]

Other_____ [ ] None [ ] **(If none, skip to 29)**

27. What is the frequency of malaria preventive effort you take?

Everyday [ ] 2-4 times a week [ ] once weekly [ ] 1-3 times monthly [ ] Others, specify_____

28. Who pays for the preventive effort usually? *(Tick only one)*

Free [ ] self-paid [ ] from government source,[ ] voucher system, [ ] community effort [ ]

others specify _ **(Skip to 30 after answer)**

29. Reasons for not using any preventive efforts *(You can tick more than one)*

Not available [ ]

Cost/affordability [ ]

Lost/stolen [ ]

Used for other purposes [ ]

Old; then thrown away/finished [ ]

Housing structure affects net use [ ]

Absence of bed [ ]

They do not prevent malaria [ ]

Afraid of toxicity [ ]

Weather [ ]

Other (specify)_____

30. In case you did not get preventive measures free or from other sources, can you afford one?

Yes [ ] No [ ]

Section E: Housing environment

31. How many people do you have in the household?

One [ ] Two [ ] Three and above [ ] none [ ]

32. Is your residence

Proximal to breeding sites: old tires, containers, ponds [ ]

A clean environment [ ]

Proximal to farming activities, [ ]

33. Are the windows screened with the mosquito wire gauze .Yes [ ] no [ ]

34. Does the house have separate bed room? Yes [ ] No [ ]

35. What is the structure of the room?

Such that bottoms can be put up for hanging ITNs [ ]

Such that there is no space for putting up ITNs [ ]

Such that the rooms are so small there is hardly any space [ ]

Cost/affordability [ ]

Lost/stolen [ ]

Used for other purposes [ ]

Old; then thrown away/finished [ ]

Housing structure affects net use [ ]

Absence of bed [ ]

They do not prevent malaria [ ]

Afraid of toxicity [ ]

Weather [ ]

Other (specify) _____

30. In case you did not get preventive measures free or from other sources, can you afford one?

Yes [ ] No [ ]

Section E: Housing environment

31. How many people do you have in the household?

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Proximal to breeding sites: old tires, containers, ponds [ ]

A clean environment [ ]

Proximal to farming activities. [ ]

33. Are the windows screened with the mosquito wire gauze .Yes [ ] no [ ]

34. Does the house have separate bed room? Yes [ ] No [ ]

35. What is the structure of the room?

Such that bottoms can be put up for hanging ITNs [ ]

Such that there is no space for putting up ITNs [ ]

Such that the rooms are so small there is hardly any space [ ]

Such that it has unintentional cracks and holes all over [ ]

Such that it is made of slates, boards or planks [ ]

36. In which season of the year do you often have malaria infection? *(Tick only one)*

a) Rain

b) Dry

c) Throughout

d) Don't know

e) Others (specify)_____

37. Do you take any special preventive efforts in the above mentioned season?

If yes, what?

_____ _____

38. Has your house been sprayed with IRS? Yes [ ] No [ ]

Section F: Health Provider questions

39. Are you given information on preventing HIV-Malaria co-infection by health workers? Yes [ ] No [ ]

40. Do you know how you became sero-positive? **(If no, skip to 42)**

41. Was it related to any hospital procedure?_____ _____ _____

42. On average, are the health providers approachable? Yes [ ] No [ ]

43. How close is this facility to your residence?

≤5 mins walk [ ] ≥5 mins drive [ ] Farther [ ]

44. Can you always tell the health-worker your health problems?

Always, no matter how personal [ ]

Not all, I keep somethings personal [ ]

I only tell them the essentials [ ]

45. Do the providers always give you good care?

Always [ ] Most-times [ ] Sometimes [ ] Never [ ]

(If sex is male, end interview)

Section G: For only female participants

46. Are you currently pregnant? Yes [ ] No [ ] **(If no, end interview)**

47. If yes, for how long? ___ _____

END OF INTERVIEW