International Journal of TROPICAL DISEASE & Health
15(4): 1-11, 2016, Article no.IJTDH.25022
ISSN: 2278–1005, NLM ID: 101632866

SCIENCEDOMAIN *international*
www.sciencedomain.org

Malaria Parasite and Anaemia Prevalence in Adult HIV-patients Attending Care and Treatment Centre in Baptist Hospital Mutengene, Cameroon

Emmaculate Lum[1,2*], Helen K. Kimbi[1,3], Elias F. Onyoh[4,5], Bate Ayukenchengaba[1], Godlove B. Wempnje[1], Conica M. Njabi[1] and Leopold G. Lehman[6]

[1]Department of Zoology and Animal Physiology, Faculty of Science, University of Buea, P.O.Box 63, Buea, S.W.R., Cameroon.
[2]Department of Biological Sciences, Higher Teachers' Training College, University of Yaounde 1, P.O.Box 47, Central Region, Cameroon.
[3]Department of Medical Laboratory Science, Faculty of Health Sciences, University of Bamenda, Bamenda, P.O.Box 39, Bambili, N.W.R., Cameroon.
[4]AIDS Care and Prevention Program, Cameroon Baptist Convention Health Services, Cameroon.
[5]Institute of Epidemiology and Preventive Medicine, College of Public Health, National Taiwan University, Taiwan.
[6]Department of Animal Biology, Faculty of Science, University of Douala, P.O.Box 2701, Littoral Region, Cameroon.

Authors' contributions

This work was carried out in collaboration between all authors. Authors EL and HKK did the study design and wrote the protocol. Author EL did the literature searches. Authors EL, HKK, EFO, BA, GBW and CMN assisted in data collection. Authors EL, HKK, LGL, BA, GBW and CMN carried out laboratory analyses. Author EL wrote the article. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2016/25022
Editor(s):
(1) Giuseppe Murdaca, Clinical Immunology Unit, Department of Internal Medicine, University of Genoa, Italy.
Reviewers:
(1) Kadima Ntokamunda Justin, University of Rwanda, Rwanda.
(2) Rina Girard Kaminsky, Institute for Infectious Diseases and Parasitology Antonio Vidal, Tegucigalpa, Honduras.
Complete Peer review History: http://sciencedomain.org/review-history/14111

Original Research Article

Received 14th February 2016
Accepted 21st March 2016
Published 11th April 2016

ABSTRACT

Aim: This study was aimed at investigating malaria parasite and anaemia prevalence, the impact of co-infection on immune-haematological parameters, clinical/treatment profiles and how malaria preventive measure associate with malaria and anaemia in adult HIV-patients attending care and

**Corresponding author: Email: ngongpanemma@yahoo.co.uk;*

treatment centre in Baptist Hospital Mutengene.
Study Design: Cross-sectional study.
Place and Duration of Study: This study was carried out in Mutengene from June to August, 2012.
Methodology: A semi-structured questionnaire was used to record information on demographic factors and use of preventive measures from adult HIV-patients. Venous blood was collected; blood films were prepared and Giemsa-stained for malaria parasite detection. Haemoglobin concentration was determined. A total of 470 adults HIV-patients aged 20 - 68 years were studied.
Results: There was an overall malaria parasite prevalence of 36.38% but there was no significant difference in malaria parasite prevalence between the various categories examined. The overall anaemia prevalence in the study was 24.89% with a significant difference ($p=0.02$) between males and females. There was a highly significant difference ($p<0.001$) in anaemia prevalence between different CD4+ levels, WHO clinical stages, fever status, clinical symptoms status, HAART consumption status, NRTIs and NNRTIs classes of HAART. There was however no significant difference in anaemia prevalence between the various malaria preventive measures applied in the study.
Conclusion: This study demonstrates that malaria infection in HIV patients can lead to a reduction in CD4+ count and increase anaemia and fever. This can facilitate the HIV-patient's change from clinical stage 1 to 4 where the patients will find it difficult to manage the disease and stay healthy. HIV-patients need to implement malaria control measures such as use of ITN and keep the environment clean in order to avoid malaria-related morbidity and mortality and improve generally on their health.

Keywords: Malaria; anaemia; prevalence; HIV; adults; Mutengene.

1. INTRODUCTION

Malaria and Human Immunodeficiency Virus (HIV) constitute a significant burden on world health and are major causes of mobidity and mortality in sub-Saharan Africa [1,2]. There is widespread overlap in the distribution of the two diseases [1]. Worldwide, it is estimated that 207 million cases of malaria occurred in 2012, 80% of which were in the African Region [1]. An estimate of 627,000 malaria deaths occurred worldwide, 90% of which were in the African Region [1]. Most of these deaths were due to *P. falciparum* though it has been reported that HIV infection is the leading cause of mortality amongst adults aged 15–59 years in sub-Saharan Africa [3]. In Cameroon, malaria is a major public health problem, affects over 90% of the population and is responsible for 35% of the annual mortality [4]. In the Mount Cameroon area of the South West Region, human malaria is meso-endemic during the dry season, but becomes hyper-endemic in the rainy season, with incidence peaking in July – October and *P. falciparum* accounts for up to 96% of malaria infections in this area [5].

In HIV-patients, it has been reported that lower CD4+ counts are associated with higher frequency of clinical malaria and anaemia [6,7]. HIV infection is associated with a wide variety of haematological changes some of which are reported as HAART induced though contrasting report exists [8]. Furthermore, the implimentation of malaria preventive measures have been shown to improve health and thus quality of life in HIV infected persons [7]. Marked haematological changes will complicate health and treatment of patients hence it is important to determine the extent of HIV/malaria co-infection and anaemia in HIV patients which will lead to improved management and hence quality of life of the infected persons.

2. MATERIALS AND METHODS

2.1 Study Site

The study was carried out in the Care and Treatment Centre of the Baptist Hospital Mutengene (BHM). Mutengene is a semi-urban, road-junction town, located in the Mount Cameroon area of the South West Region. In this town the Care and Treatment Centre of the Baptist Hospital is the only health service providing antiretroviral therapy and care to HIV-patients for free, attracting them from within the town and its environs. The Mount Cameroon area has an equatorial climate with a rainy season that starts in March and ends in October and a dry season that starts in November and ends in February. Mutengene is located at Latitude 4°05'N, Longitude 9°18'E and about 220

meters above sea level, with a total population of about 47,478 inhabitants. It is characterized by mean temperatures of 27.5℃, a relative humidity of 83.1% and an annual rainfall of 4000 mm [9].

2.2 Study Design, Period and Population

This study was a cross sectional study where HIV-patients aged 20 to 68 years of both sexes who came to the Care and Treatment Centre of the Baptist Hospital Mutengene from June to August, 2012 were recruited after obtaining their informed consent. The adult was accepted for recruitment if not pregnant.

2.3 Methodology

2.3.1 HIV staging

HIV staging was done by the consulting physician according to the proposed WHO clinical staging classification based on clinical and performance criteria (stage 1, no symptoms; stage 2, minor signs of immunosuppression; stage 3, moderate immunosuppression; stage 4, AIDS) [10].

2.3.2 Microscopy for malaria parasite

About 10 µL of blood was placed on a slide free from dirt, grease and finger prints and used for the preparation of thick blood films. The drop of blood was spread out by stirring to form a smear approximately 1 cm wide. The slides were air-dried properly in order to avoid the thick blood film from washing off during the staining process. Giemsa diluted in 1:20 buffered distilled water was used for staining blood films. Blood films were flooded with Giemsa and stained for 15 minutes. The stains were washed off gently using clean water and allowed to air-dry in a slanting position on a draining rack. The Giemsa-stained smears were examined under X100 (oil immersion) objective of a Unico light microscope. Using the bench aid of Cheesbrough, slides were considered positive if asexual forms and or gametocytes of the malaria parasite were found after observing at least 100 high power fields of the microscope [11].

2.3.3 Determination of CD4+ T-lymphocyte count

This was done using a CyFlow® Counter [12]. CD4 T-cell counts were categorised as low or advanced stage (<200/µl), moderate or chronic stage (200-499/µl) and high or asymptomatic stage (≥500/µl) [13].

2.3.4 Determination of haemoglobin (Hb) concentration

Hb concentrations were determined using a Urit12 haemoglobinometer. Hb strips were inserted in to the haemoglobinometer and using a micropipette about 20 µL of blood was placed on the haemoglobinometer following the manufacturer's instructions. The haemoglobin value was displayed automatically by the haemoglobinometer and read in grams per decilitre (g/dL). Classification and severity of anaemia was done according to WHO [14] where haemoglobin values less than 11 g/dl were considered anaemic. Anaemia severity was classified as follows: Hb values between 10.0-10.9 g/dL, 7.0 - 9.9 g/dL and < 7.0 g/dL were considered as mild, moderate and severe anaemias [14].

2.3.5 Statistics

Pearson Chi-square test (X^2) was performed to measure association between the status of different parameters and the presence of malaria parasite and anaemia. For these statistical analyses, PASW Statistics 18.0 SPSS Inc. software was used.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Characteristics of the study population

The overall population of adults HIV-patients in this study was 470, 25.32% (119/470) of which were males and 78.75% (351/470) females (Fig. 1), 36.38% (171/470) were positive for malaria parasite (Fig. 2) while 24.89% (117/470) were anaemic (Fig. 3). Based on clinical and performance criteria, the patients could either be classified as stage 1, 2, 3 or 4 [10].

3.1.2 The prevalence of malaria parasite and anaemia based on gender and age

In the study, the malaria prevalence was higher (37.32%, 131/351) in females than males (33.61%, 40/119) though the difference was not significant (p=.47) in malaria prevalence between gender. Among the age groups, malaria was most prevalent in those aged ≥50 years (38.98%, 23/59) and least (34.88%, 42/121) in those aged 40-49 years but the difference was insignificant (p=.93) in malaria prevalence between the age groups (Table 1).

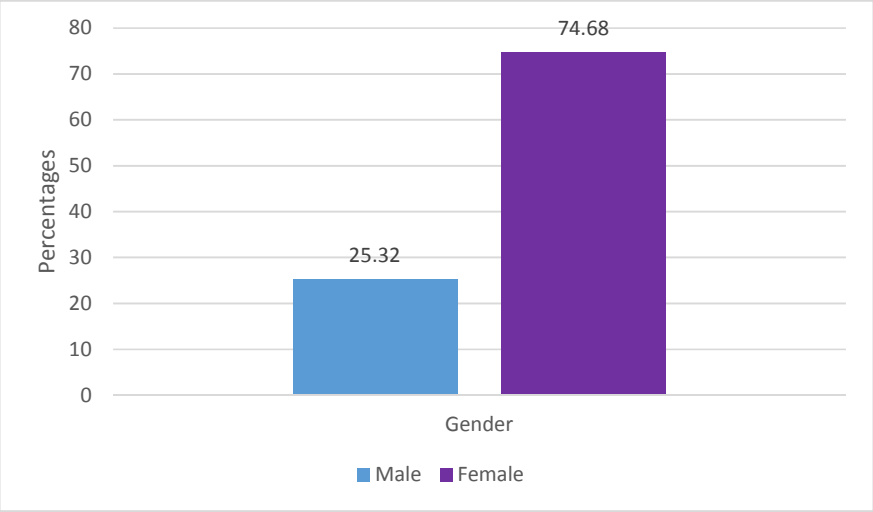

Fig. 1. The prevalence of males and females in the study population

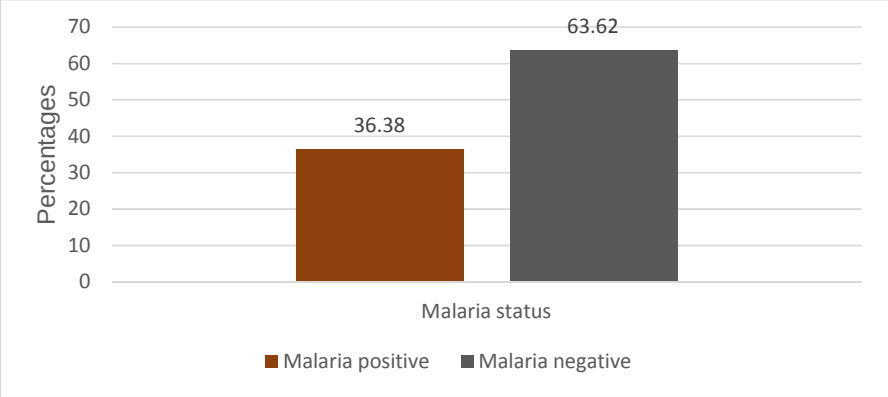

Fig. 2. The overall prevalence of malaria in the study population

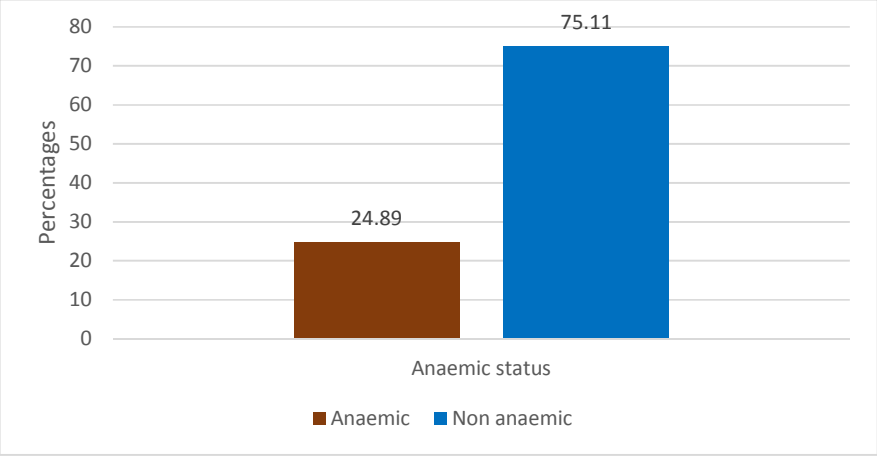

Fig. 3. The overall prevalence of anaemia in the study population

On the other hand, the overall prevalence of anaemia in the study was 24.89% (Fig. 3). Anaemia prevalence was higher in females (27.64%, 97/351) than males (16.81%, 20/119) with a significant difference (p=.02) in anaemia between gender while among the age groups, it was highest among those aged 20-29 years (26.74%, 23/86) and least in those aged ≥50 years old (18.64%, 11/59) but there was no significant difference in anaemia prevalence among age groups (p=.67) (Table 1).

3.1.3 The prevalence of malaria parasite and anaemia based on immunehaemato-logical parameters in the study

Malaria prevalence was higher among those that were anaemic (38.46%, 45/117) than those that were non anaemic (35.69%, 126/353) and highest in those with severe anaemia (57.14%, 4/7) than those with mild (40.30%, 14/43) and moderate (32.56%, 27/67) anaemia though without any significant difference (p=.55). It was also most prevalent in individuals with CD4+ between 200-499 cells/µl of blood (37.50%, 93/248) and least in those with CD4+ ≥500 cells/µl of blood (35.29%, 36/102) though without any significant difference (p=.87) in malar Mutengene ia prevalence at different CD4+ levels. Malaria prevalence was also highest among those at WHO clinical stage 3 (38.46%, 65/169) and least among those with clinical stage 1 (33.33%, 32/96) but there still was no significant difference (p=.87) recorded in malaria prevalence at the different clinical stages (Table 2).

Anaemia prevalence on the other hand was highest among individuals with CD4+ count <200 cells/µl of blood (44.17%, 53/120) and lowest among those with CD4+ count ≥500 cells/µl of blood (15.69%, 16/102) and there was a highly significant difference (p<.001) in anaemia prevalence between individuals at different CD4+ levels. Similarly, anaemia prevalence was highest among individuals at WHO clinical stage 4 (51.35%, 38/74) and least among those at WHO clinical stage 1 (15.63%, 15/96) with a highly significant difference (p<.001) (Table 2).

Table 1. The prevalence of malaria and anaemia in adults HIV-patients based on gender and age

Demographic factors	Category	Total number (N=470)	Plasmodium positive n (%)	p=value	Number anaemic n (%)	p=value
Gender	Male	119	40 (33.61)	.47	20 (16.81)	.02
	Female	351	131 (37.32)		97 (27.64)	
Age groups	20-29	86	30 (34.88)	.93	23 (26.74)	.67
	30-39	204	79 (38.73)		51(25.00)	
	40-49	121	42 (34.71)		32(26.45)	
	≥50	59	23 (38.98)		11(18.64)	

Table 2. The prevalence of malaria and anaemia in adults HIV-patients based on immune-haematological parameters

Immuno-haematological parameters	Category	Total number (N=470)	Plasmodium positive n (%)	p=value	Number anaemic n (%)	p=value
Anaemic status	Non-anaemic	353	126(35.69)	.59	NA	NA
	Anaemic	117	45(38.46)			
Anaemia severity	Severe	7	4(57.14)	.55	NA	NA
	Moderate	67	27(40.30)			
	Mild	43	14(32.56)			
CD4+ count (Cells/µl)	<200	120	42(37.00)	.87	53(44.17)	<.001
	200-499	248	93(37.50)		48(19.35)	
	≥500	102	36(35.29)		16(15.69)	
HIV Clinical stage	1	96	32(33.33)	.87	15(15.63)	<.001
	2	131	47(35.88)		25(19.08)	
	3	169	65(38.46)		39(23.08)	
	4	74	27(36.49)		38(51.35)	

Anaemic = Hb<11.0 g/dl; Non anaemic = Hb ≥ 11.0 g/dl; Severe anaemia = Hb<7.0 g/dl; Moderate anaemia = Hb: 7.0-9.9 g/dl; Mild anaemia = Hb: 10-10.9 g/dl; CD4+ count of <200 cell/µl of blood = advanced; 200-499 = chronic and ≥500 = asymptomatic stage

3.1.4 The prevalence of malaria parasite and anaemia based on clinical/treatment profiles in the study

Adults HIV-patients that had fever had a higher malaria prevalence (50.00%, 16/32) than those without fever (35.39%, 155/438) but there was no significant difference (p=.10) in malaria prevalence between febrile status. Also, individuals with clinical symptoms had a higher malaria prevalence (43.14%, 22/51) than those without any clinical symptom (35.56%, 149/419) yet there was no significant difference (p=.29) in malaria prevalence between clinical symptom status. It was also found that individuals that were consuming HAART had a higher malaria parasite prevalence (37.37%, 139/372) than those that were not on HAART (32.65%, 32/98) though the difference was not significant (p=.39). Among the individuals that were consuming HAART, those that were placed on Protease inhibitors (PIs) had a higher malaria parasite prevalence (71.43%, 5/7) with no significant difference in parasite prevalence between those that took PIs and those that were not on PIs (p=.05). There was no significant difference in malaria prevalence when an individual consumed Nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs) and Non-nucleoside reverse transcriptase inhibitors (NNRTIs) or not have consumed any drug from these two classes (Table 3).

Anaemia prevalence was higher among individuals that had fever (56.25%, 18/32) than among those that had no fever (22.60%, 99/438) and the difference was highly significant (p<.001). Anaemia prevalence was also higher among those with clinical symptoms (47.06%, 24/51), those not consuming HAART (39.80%, 39/98) and those consuming the NRTIs (20.98%, 77/367) and NNRTIs (20.40%, 71/348) class of HAART than their counterparts and the difference was highly significant (p<.001). There was however no significant difference (p=.82) in anaemia prevalence among those consuming PIs compared to those not consuming PIs (Table 3).

3.1.5 The prevalence of malaria parasite and anaemia based on malaria control measures applied in the study

It was observed that individuals that were not using ITNs had a slightly higher malaria parasite prevalence (36.60%, 56/153) as compared to those that were using ITNs (36.28%, 115/317) though there was no significant difference (p=.95). Those that were using insecticide sprays against mosquitoes rather had a slightly higher malaria parasite prevalence (36.84%, 49/133) than those that were not using insecticides (36.20%, 122/337) though without any significant difference (p=.90). Similarly, individuals that had no bushes (38.61%, 78/202) or stagnant water around their houses (37.88%, 136/359) recorded a higher malaria parasite prevalence than their counterparts but there was no significant difference in malaria prevalence in all the cases (Table 4).

There was no significant difference in malaria prevalence whether or not individuals applied any of the malaria preventive measures but anaemia prevalence was however higher among those that did not use ITN (27.45%, 42/153), used insecticides (27.82%, 37/133), had bushes around the house (25.37%, 68/268) and had no stagnant water around the house (25.63%, 92/359) than those that used ITN (23.66%, 75/317), did not use insecticides (23.74%, 80/337), had no bushes (24.26%, 49/202) and had stagnant water (22.52%, 25/111) around their houses (Table 4).

Table 3. The prevalence of malaria and anaemia in adults HIV-patients based on clinical/treatment profiles

Clinical/treatment profiles	Category	Total number (N=470)	Plasmodium positive n (%)	p=value	Number anaemic n (%)	p=value
Febrile status	Fever	32	16(50.00)	.10	18(56.25)	<.001
	No fever	438	155(35.39)		99(22.60)	
Clinical symptoms*	Yes	51	22(43.14)	.29	24(47.06)	<.001
	No	419	149(35.56)		93(22.20)	
HAART consumption	Yes	372	139(37.37)	.39	78(20.97)	<.001
	No	98	32(32.65)		39(39.80)	
Class of HAART	NRTIs	367	138(37.60)	.89	77(20.98)	<.001
	NNRTIs	348	126(36.21)	.89	71(20.40)	<.001
	PIs	7	5(71.43)	.05	2(28.57)	.82

Clinical symptoms = Headache, joint pain, nausea, vomiting, body weakness and stomach disorder*
Fever = T ≥ 37.5℃; No fever = T < 37.5℃

Table 4. The prevalence of malaria and anaemia in adults HIV-patients based on malaria preventive measures

Malaria preventive measures	Category	Total number (N=470)	Plasmodium positive n (%)	p=value	Number anaemic n (%)	p=value
Use of ITN	Yes	317	115(36.28)	.95	75(23.66)	.37
	No	153	56(36.60)		42(27.45)	
Use of insecticide	Yes	133	49(36.84)	.90	37(27.82)	.36
	No	337	122(36.20)		80(23.74)	
Presence of bushes around house	Yes	268	93(34.70)	.38	68(25.37)	.78
	No	202	78(38.61)		49(24.26)	
Presence of stagnant water around house	Yes	111	35(31.53)	.22	25(22.52)	.51
	No	359	136(37.88)		92(25.63)	

3.2 Discussion

Malaria and HIV/AIDS constitute two of the medical challenges facing Africa today and any potential for interaction between the two diseases is of medical importance. This study was aimed at determining the prevalence of malaria and anaemia, the impact of co-infection on immune-haematological parameters, clinical/treatment profiles and how malaria preventive measure associate with malaria and anaemia in adults HIV-patients attending the Care and Treatment Centre of Mutengene Baptist Hospital, Cameroon.

The overall prevalence of malaria in the study was 36.38% and this was higher than results that have been reported in other parts of the country [15,16]. The fact that the mosquito vector thrives more in warmer climates than colder climates could be one of the reasons attributed to the difference seen in this co-infection with malaria prevalence. Furthermore the prevalence of malaria also depends on intensity of transmission and the availability of competent vectors for the transmission of falciparum malaria have been reported in the southwest region of Cameroon [1,17].

Malaria prevalence was higher in females than males though the difference was not significant. This is similar to the report of other studies and a higher proportion for co-infected females could probably be due to the fact that females spend more time outdoors at dusk and dawn than males and as such are more exposed to mosquito bites [18].

The highest malaria parasite prevalence was recorded in individuals aged ≥50 years and least in those aged 40-49 years but the difference was not significant. Being HIV positive at an older age might contribute to a weaker immune system hence increase in malaria parasite prevalence. Generally, immunity to malaria is not sterile and builds up with age due to continuous exposure to the same antigen.

On the other hand, the overall prevalence of anaemia in the study was 24.89% and was higher in females than males with a significant difference. This is similar to results of Ferede and Wondimeneh were more HIV positive females than males were anaemic in a study [19]. Generally, females are usually reported to have lower haemoglobin values than males. This could be because premenopausal women have a higher incidence of iron deficiency anaemia (IDA) because of heavy menstrual blood losses [20].

Anaemia was highest among those aged 20-29 years and least in those aged ≥50 years old but there was no significant difference in anaemia prevalence among age groups. There are many causes of anaemia including nutritional deficiencies where poor feeding can lead to prevalence of anaemia in addition to the immune-compromised states of HIV positive persons [21].

Malaria prevalence was higher among those that had anaemia than those that were non anaemic; highest in those with severe anaemia than those with mild and moderate anaemia though without any significant difference. Malaria parasites normally feed on haemoglobin of infected red blood cells (RBCs) and thus greater number of its victims can easily get anaemic [22]. Moreover, HIV on its own can predispose one to anaemia. This suggests that a higher prevalence of HIV/malaria co-infection will cause more individuals to be anaemic and this is in line with

reports from other studies [23,24]. The fact that those with severe anaemia had a higher malaria parasite prevalence strenghtens the fact that HIV positive individuals infected with malaria usually have low haemoglobin values [19,23]. High parasitaemia and the virulence of the infecting species could also contribute to severe anaemia [18,25].

Malaria parasite prevalence was also highest in individuals with CD4+ between 200-499 cells/µl of blood and least in those with CD4+ ≥500 cells/µl of blood though without any significant difference. It has been reported that malaria infection is associated with strong CD4+ cell activation and up-regulation of pro-inflammatory cytokines, providing an ideal micro-environment for the spread of the virus among CD4+ cells and thus for rapid HIV replication where malaria clinical episodes will increase as CD4+ decreases [6]. Malaria prevalence was also highest among those at WHO clinical stage 3 and least among those with clinical stage 1 but there still was no significant difference recorded in malaria prevalence at the different clinical stages. Normally, the immune deficiency caused by HIV infection should reduce the immune response to malaria parasitaemia and therefore increase the frequency of clinical attacks of malaria [26].

When looking at the anaemia prevalence, we realized that it was highest among individuals with CD4+ count <200 cells/µl of blood and lowest among those with CD4+ count ≥500 cells/µl of blood and there was a highly significant difference in anaemia prevalence between individuals at different CD4+ levels. Similarly, anaemia prevalence was highest among individuals at WHO clinical stage 4 and least among those at WHO clinical stage 1 with a highly significant difference. This is similar to reports of other studies where anaemia and CD4+ count has an inverse relationship. In established HIV infection, lower haemoglobin levels have been shown to correlate with decreasing CD4+ cell count (i.e from ≥500 to <200 cells/µl of blood) and increase clinical stage (from 1 to 4) [27].

Adults HIV-patients that had fever had a higher malaria prevalence than those without fever. Similarly, individuals with clinical symptoms had a higher malaria prevalence than those without any clinical symptom. This is consistent with studies of Neil et al. [28] where data revealed an increasing risk of malarial fever in HIV-patients. The causes of fever are multifactorial. However, the characteristic feature of malaria has been fever which is associated with the periodic release of merozoites, metabolic waste products and toxins causing paroxysms [29].

It was also found that individuals that were consuming HAART had a higher malaria parasite prevalence than those that were not on HAART. Some other study has given a contrary report where individuals consuming HAART had a low malaria parasite prevalence in HIV infected adults [7]. Among the individuals that were consuming HAART, those that were placed on PIs had a higher malaria parasite prevalence with a significant difference in parasite prevalence between those that took PIs and those that were not on PIs. On the contrary, researchers measuring the effect of antiretroviral agents on malaria have suggested a direct effect by protease inhibitors on the frequency of malaria by improving immune function [30,31]. There was no significant difference in malaria prevalence when an individual consumed NRTIs and NNRTIs or not have consumed any drug from these two classes. It has been reported that antiretroviral therapy that contains non-nucleoside reverse transcriptase inhibitor (NNRT) when combined with cotrimoxazole decreases the prevalence of malaria [7,31].

Anaemia prevalence on the other hand was higher among individuals that had fever than among those that had no fever and the difference was highly significant. Fever is a common complaint among patients with HIV infection and may occur at any point during viral infection, with numerous potential causes and history of fever reported as a risk factor for anaemia [8,32].

Anaemia prevalence was also higher among those with clinical symptoms than those without clinical symptoms. It's been suggested that individuals with a higher burden of clinical symptoms may have a higher prevalence of anaemia because increased symptom burden may represent more opportunistic infections and increased inflammation, both of which are connected with anemia [33].

Anaemia prevalence was also higher among those not consuming HAART than those consuming HAART and those consuming the NRTIs and NNRTIs class of HAART than their corresponding counterparts and the difference was highly significant. This is consistent with findings which have reported that the prevalence

of anaemia was significantly higher among HAART naive patients than in HIV patients on HAART [34]. Zidovudine which is a NRTI is reported to increase risk of anaemia [35]. However, there was no significant difference in anaemia prevalence among those consuming PIs compared to those not consuming PIs. All PIs have been associated with metabolic abnormalities and not anaemia but may increase the risk of bleeding in haemophiliacs [36].

It was also observed that individuals that were not using ITNs had a higher malaria parasite prevalence as compared to those that were using ITNs. Studies have supported the fact that the use of bednets have reduced the rate of malaria among adults with HIV infection [7].

Those that were using insecticide sprays against mosquitoes rather had a slightly higher malaria parasite prevalence than those that were not using insecticides. Similarly, individuals that had no bushes or stagnant water around their houses recorded a higher malaria parasite prevalence than their counterparts. The reason for this disparity is yet to be discovered since it is normally expected that clean environmental conditions and the use of insecticides should reduce the mosquito vector hence reduction in malaria prevalence compared to dirty environments [37]. May be the particular group of patients studied and the size coincidentally played a role in not giving results that reflect generally accepted concepts.

Anaemia prevalence was higher among those that did not use ITN than those that used ITN implying that the use if ITN might reduce morbidity due to malaria in adults HIV-patients. Anaemia prevalence was also higher among those that did not use insecticides and had bushes around their houses than those that did not use insecticides and had no bushes around their houses. This suggests that keeping the environment clean will reduce human-vectors contact hence reduction in anaemia burden.

4. CONCLUSION

This study demonstrates that malaria infection in HIV patients can lead to a reduction in CD4+ count and increase anaemia and fever. This can facilitate the HIV-patient's change from clinical stage 1 to 4 where the patients will find it difficult to manage the disease and stay healthy. Patients on HAART medication had more malaria but less anaemia. Therefore the type of HAART medication should be looked into carefully before prescription since PIs could predispose patients to malaria and increase anaemia as shown in the study. The use of ITN and keeping the environment clean as malaria preventive measures should be encouraged among HIV-patients since this reduces malaria infection and anaemia and will generally lead to an improved state of health of HIV-patients.

CONSENT

After giving a health talk on malaria and purpose of study, informed consent forms were given to all adults who came to the treatment centre to ask for their participation in the study. The form explained the purpose of the study, procedures to be used and the advantages, and any potential risk in participating in the study. Retractable vacutainers were used on the subjects after which they were properly discarded. For the purpose of confidentiality, participants were given codes that were used on their sample collection tubes and results and only members of the research team and supporting health personnel had assess to participants information. Upon presentation of the codes to the laboratory staff, participants had access to their results for subsequent follow-up by the physician or care giver. The use of name was not accepted in this study and only participants who accepted and signed the consent forms were included in the study. Pregnant women were excluded in the study. Participation was voluntary.

ETHICAL APPROVAL

An ethical clearance for this work was obtained from the Cameroon Baptist Convention Health Board (CBCHB) Institutional Review Board, Cameroon.

ACKNOWLEDGEMENTS

We thank the PARTEC Laboratory, Douala for assistance in doing CD4+ counts for the study and Mr Tchakunte Simeon for statistical analysis.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. WHO. World Malaria Report, Geneva, Switzerland; 2013.

Available:http://www.who.int/malaria/world_malaria_report_2013/en/
(Accessed on April 3, 2014)
2. Global report: UNAIDS report on the global AIDS epidemic; 2013.
Available:http://www.unaids.org/sites/default/files/media_asset/UNAIDS_Global_Report_2013_en_1.pdf
(Accessed 7 July 2015)
3. Mathers CD, Boerma T, Ma Fat D. Global and regional causes of death. Br Med Bull. 2009;92:7–32. Epub. Review.
DOI: 10.1093/bmb/ldp028
PMID:19776034
4. Ministry of Public Health of the Republic of Cameroon. Guidelines for the management of malaria in Cameroon. Ministry of Public Health, Yaounde; 2008.
5. Bigoga JD, Manga L, Titanji VPK, Coetzee M, Leke RGF. Malaria vectors and Transmission dynamics in coastal south-western Cameroon. Malaria Journal. 2007;6:5.
6. Whitworth J, Morgan D, Quigley M, Smith A, Mayanja B, Eotu H, et al. Effect of HIV-1 and increasing immunosuppression on malaria parasitaemia and clinical episodes in adults in rural Uganda: A cohort study. Lancet. 2000;356:1051-056.
7. Mermin J, Lule R, Ekwaru JP. Association between malaria and CD4 cell count decline among persons with HIV. J Acquir Immun Def Syn. 2006;41(1):129–130.
8. Meidani M, Rezaei F, Maracy MR, Avijgan M, Tayeri K. Prevalence, severity, and related factors of anemia in HIV/AIDS patients. J Res Med Sci. 2012;17(2):138–142.
9. Cameroon Development Corporation (CDC) weather records; 2004.
10. WHO case definitions of HIV for surveillance and revised clinical staging and immunological classification of HIV-related disease in adults and children; 2007.
11. Cheesbrough M. Parasitological tests in District Laboratory Practice in Tropical Countries. Part 1. Cambridge Low-Price Editions, Cambridge University Press; 2005.
12. Partec Gmbh. Protocol for CD4+ T-cell counting with the Partec CD4 easy count Kit. (Partec Code No. 05-8401). Partec Gmbh, Otto-Hahn-Str. 32, D-48161 Munster, Germany; 2006.
13. Obonyo CO, Shah SN, Smith E, Bloland PB, Slutsker L, Hamel M. The impact of HIV-infection on response to antimalaria treatment: Preliminary results of an antimalarial efficacy trial in HIV-infected and HIV-uninfected adults in Siaya District, Kenya. Global forum for Health Research, Forum 8, Mexico City; 2004.
14. WHO. Worldwide prevalence of anaemia 1993–2005. WHO Global database on anaemia; 2008.
Available:http://apps.who.int/iris/bitstream/10665/43894/1/9789241596657_eng.pdf
(Accessed 10 February 2016)
15. Nkuo-Akenji T, Tevoufouet EM, Nzang F, Ngufor N, Fon E. High prevalence of HIV and malaria co-infection in urban Douala, Cameroon. Afr J AIDS Res. 2008;7(2): 229-32.
16. Njunda AL, Kamga FH, Nsagha SD, Assob NJ, Kwenti ET. Low malaria prevalence in HIV-positive patients in Bamenda, Cameroon. J Microb Res. 2012;2(3):56-59.
17. Wanji S, Tanke T, Atanga SN, Ajonina CT, Tendongfor N, Fontenille D. Anopheles species of the Mount Cameroon Region: Biting habits, feeding behaviour and entomological inoculation rates. Trop Med Int Health. 2003;8(7):643-649.
18. Kimbi HK, Lum E, Wanji S, Mbuh JV, Nyanga JLN, Eyong EEJ, et al. Co-infections of asymptomatic malaria and soil-transmitted helminths in school children in localities with different levels of urbanization in the Mount Cameroon Region. J Bacteriol Parasitol. 2012;3:134.
DOI: 10.4172/2155-9597.1000134
19. Ferede D, Wondimeneh Y. Prevalence and related factors of anemia in HAART-naive HIV positive patients at Gondar University Hospital, Northwest Ethiopia. BMC Hematology. 2013;13:8.
DOI: 10.1186/2052-1839-13-8
20. WHO. Worldwide prevalence of anaemia 1993–2005. WHO Global database on anaemia; 2008.
21. Gonzalez L, Seley C, Martorano J, Garcia-Moreno I, Troncoso A. Infections and inequalities: Anemia in AIDS, the disadvantages of poverty. Asian Pacific Journal of Tropical Biomedicine. 2012; 1691(12):60081–1.
DOI: 10.1016/S2221
22. Flateau C, Le Loup G, Pialoux GG. Consequences of HIV infection on malaria and therapeutic implications: A systematic review. Lan Infect Dis. 2011;11:541-56.
23. Tagoe DNA, Boachie JJ. Assessment of the impact of malaria on CD4+ T cells and

haemoglobin levels of HIV –malaria co-infected patients. Journal of Infection in Developing Countries. 2012;6(9):660-663.

24. Tay SCK, Badu K, Mensah AA, Gbedema SY. The prevalence of malaria among HIV seropositive individuals and the impact of the co- infection on their hemoglobin levels. Annals of Clinical Microbiology and Antimicrobials. 2015;14:10.
DOI: 10.1186/s12941-015-0064-6
25. de Roode JC, Pansini R, Cheesman SJ, Helinski MEH, Huijben S, Wargo AR, et al. Virulence and competitive ability in genetically diverse malaria infections. PNAS. 2005;102(21):7624–7628.
Available:www.pnas.orgcgidoi10.1073pnas.0500078102
26. Hochman S, Kim K. The impact of HIV and malaria coinfection: What is known and suggested venues for further study. Interdisciplinary Perspectives on Infectious Diseases. 2009;8. Article ID 617954.
DOI: 10.1155/2009/617954
27. Lau B, Gange SJ, Phair JP, Riddler SA, Detels R. Use of total lymphocyte count and hemoglobin concentration for monitoring progression of HIV infection. Journal of Acquired Immune Deficiency Syndrome. 2005;39:620–625.
28. Neil F, Nakiyingi J, Lugada E, Watera C, Whitworth JAG, Gilks CF. Increasing rates of malarial fever with deteriorating immune status in HIV-1-infected Ugandan adults. AIDS. 2001;15(7):899–906.
29. Autino B, Corbett Y, Castelli F, Donatella TO. Pathogenesis of malaria in tissues and blood. Miditerinean Journal of Haematology and Infectious Diseases, 2012;4(1):E2012061.
30. Parikh S, Gut J, Istvan E, Goldberg DE, Havlir DV, Rosenthal PJ. Antimalarial activity of human immunodeficiency virus type 1 protease inhibitors. Antimicrobial Agents and Chemotherapy. 2005;49: 2983−85.
31. Porter KA, Cole SR, Eron, Jr JJ, Zheng Y, Hughes MD, Lockman S, et al. HIV-1 protease inhibitors and clinical malaria: A secondary analysis of the AIDS clinical trials group A5208 study. Antimicrob Agents Chemother. 2012;56(2):995–1000.
DOI: 10.1128/AAC.05322-11
PMCID: PMC3264273
32. Barat LM, Gunn JE, Steger KA, Perkins CJ, Craven DE. Causes of fever in patients infected with human immunodeficiency virus who were admitted to Boston City Hospital. Clinical Infectious Disease. 1996;23:320-328.
33. Thein M, Ershler WB. Inflammation and anemia. Anti-Inflammatory & anti-allergy agents in medicinal chemistry. 2011;10:299–314.
DOI: 10.2174/187152311797928135
34. Omoregie R, Omokaro EU, Palmer O, Ogefere HO, Egbeobauwaye A, Adeghe JE, et al. Prevalence of anaemia among HIV-infected patients in Benin City, Nigeria. Tanzanian Journal of Health Resources. 2009;11(1):1-4.
PMID: 19445097
35. Agarwal D, Chakravarty J, Chaube L, Rai M, Agrawal NR, Sundar S. High incidence of zidovudine induced anaemia in HIV infected patients in eastern India. Indian J Med Res. 2010;132:386-389.
36. Hollmig KA, Beck SB, Doll DC. Severe bleeding complications in HIV-positive haemophiliac patients treated with protease inhibitors. European Journal of Medical Resource. 2001;6(3):112-4.
37. Visser G, Dale P, Dowe D, Ndoen E, Dale M, Sipe N. A novel approach for modeling malaria incidence using complex categorical household data: The minimum message length (MML) method applied to Indonesian data. Computational Ecology and Software. 2012;2(3):140-159.
Available:www.iaees.org

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/14111