

## Original Research Article

# Anaemia in HIV positive mothers on antiretroviral therapy for prevention of mother-to-child transmission HIV in a tertiary health institution in North Central Nigeria

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## ABSTRACT

**Background:** Anaemia in pregnancy and HIV infection are two common public health issues in sub-Saharan African with Nigeria bearing the greatest burden. The duo occurring together poses a higher risk of morbidity and mortality for both the foetus and the mother. We therefore conducted this study to determine the burden of anaemia and other haematological abnormalities among HIV positive pregnant mothers on antiretroviral therapy who attended antenatal clinical services in our health institution.

**Methods:** A 10-year retrospective review from January 2010 to December 2019 of medical records of HIV positive mothers on highly anti-retroviral therapy in attendance for antenatal clinical services in our health institution was carried out for the above objectives. Information extracted were, age, HIV status, gestational age at delivery, type of antiretroviral drugs used, duration of use, haemoglobin level, platelet, and complete blood count at booking of the positive mothers.

**Results:** Of a total of 330 HIV positive mothers seen during the review period, 82.7% were from rural communities, 88.8% were from middle socio-economic class, 80.0% were Christians, and 80.3% started their highly active antiretroviral therapy before their index pregnancy. Most, 51.5% and 42.7% were on zidovudine, lamivudine and nevirapine, and tenofovir with lamivudine and lopinavir boosted ritonavir combinations, while 94.2% were on 1<sup>st</sup> line antiretroviral medication. Their mean age, gestational age at delivery, and parity were 31.11±4.7 years, 38.57±3.1 weeks, and 2.0±1.6 respectively. The prevalence of anaemia, thrombocytopenia and leucopenia were 36.1%, 4.8%, and 6.7% respectively while their mean CD4 cell count and viral loads at the point of booking were 543.63±283.7 cells/μl, and 2953.02±1619.9 copies/ml. The two maternal variables that showed significant relationship with haemoglobin concentration of <10 gm/dl was mother's level of education  $\chi^2=6.29$ ,  $p=0.043$ , and her socio-economic class,  $\chi^2=10.162$ ,  $p=0.006$ .

**Conclusions:** There is high burden of anaemia among HIV positive mothers on antiretroviral therapy in our environment. The prevalence of thrombocytopenia and leucopenia was much lower. The burden of maternal anaemia was associated with maternal level of education and her socio-economic class.

**Keywords:** HIV positive, Pregnant mothers, Anaemia, Thrombocytopenia, Leukopenia

## INTRODUCTION

Human immunodeficiency virus (HIV) infection and maternal anaemia are major public health problem in developing countries with extremely high prevalence in the sub Saharan Africa (SSA).<sup>1,2</sup> The duo occurring in pregnancy is associated with increased risk of foeto-maternal morbidity and mortality.<sup>3,4</sup> Anaemia is said to occur when the oxygen-carrying capacity of red blood cells is insufficient and fails to satisfy the physiologic demands of the body, and defined as haemoglobin concentration of <11.0 g/dl by WHO remains a big health challenges to safe motherhood in developing parts of Africa despite the considerable improvement in health-care-delivery services.<sup>4-6</sup> Globally, about 41.8% of pregnant women are said to be anaemic, SSA recorded the highest rate of >57.0%, with over 40.0% occurring in Nigeria. and 11% maternal deaths from anaemia in the country.<sup>7,8</sup> SSA also has the highest proportion of people living with of HIV across the globe, Nigeria being second to South Africa in this global burden and having over 1.8million of her people living with HIV (PLWH).<sup>9</sup> Women of reproductive age make up almost 57% of adults living with HIV, and responsible for 80% of HIV-infected women in the world, with HIV-prevalence rates exceeding 40% among the pregnant women in some areas.<sup>10</sup>

Pregnant women with HIV are at higher risk of anaemia compared with their counterpart that are not infected. Anaemia in positive pregnant women is multifactorial, and include factors such as: nutritional iron deficiency from increased demands up to sevenfold in early to late pregnancy, inadequate iron stores in the body, and low dietary intake before and during pregnancy.<sup>11</sup> Other nutritional causes of anaemia include deficiencies in vitamin B12, folate, vitamin A, and zinc.<sup>12</sup> The association of zidovudine (AZT) with increased anaemia is well established.<sup>13,14</sup> AZT suppresses erythropoiesis by inhibiting the proliferation of red cell progenitors.<sup>15,16</sup> This is commonly seen within 4 to 6 weeks of its commencement, and dependent on dosage, bone marrow reserve, duration of usage, and stage of HIV infection.<sup>15,16</sup> The drug trimethoprim plus sulphamethoxazole are two drug combination in co-trimoxazole for the treatment of opportunistic infections in HIV infected individuals. Both acts at the two levels of bio-synthesis of tetra-hydro folate, a precursor in the synthesis of folic acid and purine. While sulphamethoxazole inhibits the incorporation of para-amino benzoic acid (PABA) into folic acid, trimethoprim blocks the reduction of dihydrofolic acid to tetra-hydrofolic acid.<sup>16,17</sup> HIV infection itself can also suppress erythropoiesis in the bone marrow cells indirectly from increased apoptosis of the marrow cells thus predisposing infected individuals to anaemia.<sup>18</sup> Parasitic infections are also strongly associated with anaemia in pregnancy, especially malaria, which is a major problem in SSA.<sup>19</sup> Dual infection of HIV and malaria in pregnancy doubles the risk of developing moderate-to-severe anaemia.<sup>12</sup> Helminth infections also

causes anaemia in resource-limited settings, notably hookworm infestation. Greater than a third of pregnant women in such areas are infected.<sup>12,20</sup> Hookworms feeds on human blood, and with inadequate iron and other nutrient intake, together with high physiological demand of pregnancy, such women are prone to the development of anaemia which can further exacerbate anaemia in HIV infection.<sup>21</sup>

Over the years there have being changes in antiretroviral therapy (ART) regimen by WHO and in Nigerian guidelines.<sup>21</sup> Initially, all HIV pregnant women are on nevirapine (NVP) only, after some years, zidovudine (AZT), lamivudine (3TC) and nevirapine (NVP); was introduced from 2005 to 2010.<sup>21</sup> For the past ten (10) years, our centre has also changed highly active antiretroviral therapy (HAART) regimen according to WHO and national guideline.<sup>22</sup> Currently pregnant women are on two nucleoside reverse transcriptase inhibitors (NRTI), tenofovir (TDF), lamivudine (3TC) and one non-nucleoside reverse transcriptase inhibitor (NNRTI), efavirenz (EFV), or one protease inhibitor (PI) lopinavir boosted ritonavir (LPV/r. Integrase inhibitors, dolutegravir (DGT), has just been added to the regimen in 2020 after the year under review year.<sup>22</sup> A boosted PI plus two NRTIs are recommended for the second-line ART.<sup>22</sup>

Other haematological abnormalities associated with HIV infection are thrombocytopenia, and leucopenia, both of which are prognostic markers for HIV disease progression and have not been given much attention in the sub region. Considering the burden of HIV and anaemia in pregnancy in Nigeria where over half of pregnant women are anaemic, and HIV prevalence of 1.5% in federal capital territory (FCT), we embarked on this study not only to determine the burden of anaemia in HIV pregnant women on HAART in our health facility but also record associated thrombocytopenia, and leukopenia in such women since no such study has been carried out in the area from the inception of HIV free treatment services in the institution in 2005.<sup>23,24</sup>

## METHODS

This 10-year retrospective study (January 2010 to December 2019) was carried at the prevention of mother-to-child transmission (PMTCT) unit of the antenatal clinic of university of Abuja teaching hospital (UATH), Gwagwalada to determine the burden of anaemia in HIV positive women assessing antenatal care in the hospital at time of booking and the other associated haematological abnormalities. The unit provides routine antenatal clinical services, pre and post HIV counselling, rapid HIV testing, adherence counselling and distribution of routine antenatal drugs, and Highly active antiretroviral therapy (HAART) to the positive mothers. It has consulting rooms for the doctors, the nurses, and adherence counsellors. Record clerks, pharmacists, laboratory technicians, and scientist are also available for them on

week days (Monday to Friday, from 7.30 am to 4 pm.). UATH is a 350-bed capacity referral hospital, subserving the people of federal capital territory (FCT) Abuja, and four neighbouring states of Nasarawa, Kogi, Kaduna and Niger. This is one of the first centres to start offering free HIV/AIDS services in the country, courtesy of federal government of Nigeria (FGN), and United States of America (USA) president emergency plan for AIDs relief (PEPFAR) since 2005.

Data for the subjects were collected from the data base of the PMTCT unit, antenatal clinic, and delivery records. Parameters collected were: maternal age, place of residence (whether urban or rural), religion, parity, her gestational age at delivery, type of antiretroviral therapy (ART) used, duration of its use, time ART was started, whether before pregnancy, early, mid, or late pregnancy, or at delivery, whether it was 1st line or 2nd line medication. Other variables collected were her haematological profile at booking [packed cell volume (PCV), platelet, complete blood cell count (CBC), CD4 cell count, and her viral load (VL) at the antenatal booking. Also collected was her weight, her level of education, the husband's occupation, whether she was married or single, her mode of delivery, and whether she was alive or dead.

Anaemia in pregnancy by the WHO classification is haemoglobin (Hb) concentration of  $<11 \text{ g/dl}$ .<sup>6</sup> Thrombocytopenia, is defined as low platelet count of  $<100 \times 10^9/l$ , with a count  $<50 \times 10^9/l$  considered severe, and  $<10 \times 10^9/l$  considered very severe, while leucopenia was defined as FBC of  $<3,000 \times 10^9/l$  in adult.<sup>25</sup> However, a lower Hb level of  $<10 \text{ g/dl}$  is used by many African clinicians as indication of anaemia in pregnancy in most healthy African women thus falling below the WHO cut-off for anaemia.<sup>26,27</sup> All HIV pregnant women in the study received prophylactic iron therapy (oral ferrous sulphate, 200 mg daily), folic acid, 5 mg daily as part of their routine antenatal drugs in addition to HARRT, and malaria prophylactic drugs. The PCV (%) values were converted to Hb (g/dl) by applying the constant factor of 0.3.<sup>27</sup> The Hb concentration, platelet, and CBC levels was divided into two groups:  $<10 \text{ g/dl}$ , and  $>10 \text{ g/dl}$  for Hb,  $<100 \times 10^9/l$ , and  $>100 \times 10^9/l$  for the platelet, and  $<3,000 \times 10^9/l$ , and  $>3,000 \times 10^9/l$  for the purposes of the study.

HIV testing was done using determine TM and uni-gold TM test kits, CD4 cell count was measured using automated Partec Cyflow easy count kit (Partec code no. 05-8401 Western Germany), VL was measured with (Roche Smp/prep/cobs Taqman 96, USA), while adult Seca beam weighing scale accurate to the nearest 0.01 kg was used for measuring the weight. PCV was done using (Hawskley Haematocrit centrifuge), while full blood count with differentials was done using (Sysmex, Mythic 18). Olusanya et al two-factor index, husband's occupation, and mother's level of education was used to assign classification socio-economic class (SEC) of each mother.<sup>29</sup>

### Data analysis

It was done using SPSS version 22 for the generation of frequency tables, mean, and standard deviation. Student t test was used to compare group means, while chi-square was used to analyse categorical data. Same tests were used for test of association, and  $p < 0.05$  was considered statistically significant.

### Ethical issues

Ethics approval was obtained from the health research and ethics committee of the hospital before the commencement of the study, and principles of research ethics was meticulously adhered.

### RESULTS

Table 1 shows the characteristics of 330 HIV positive mothers reviewed. Majority of the mothers 273 (82.7%) were from rural environment, most 175 (53.0%) and 120 (36.4%) had secondary and tertiary level of education, 264 (80.0%) were Christians, all 330 (100.0%) were married, 293 (88.8%) were from middle socio-economic class, and 265 (80.3%) started their HARRT before the index pregnancy. Majority 170 (51.5%) and 141 (42.7%) were on AZT/3TC/NVP, and TDF/3TC/EFV HARRT combination, most 311 (94.2%) and 173 (50.9%) were on 1<sup>st</sup> line and AZT HARRT regimen.

Table 2 depicts maternal haematological and clinical parameters. While 119 (36.1%) had Hb concentration of  $<10 \text{ g/dl}$ , 16 (4.8%) had platelet of  $<100 \times 10^9/l$ , and (6.7%) had WBC of  $<3.0 \times 10^9/l$ . Only 27 (8.2%), and 23 (9.2%) had VL and CD4 cell count of  $>1000$  (copies/ml), and  $<200$  (cells/ $\mu$ l). Most mothers 303 (91.8%) weighed  $<90 \text{ kg}$ , and very few 6 (1.8%) had HIV related morbidity. Their mean age, parity and gestational age at delivery were  $31.11 \pm 4.7$  years,  $2.0 \pm 1.6$ , and  $38.57 \pm 3.1$  weeks respectively, while  $10.9 \pm 2.1 \text{ gm/dl}$ ,  $5.77 \pm 2.86 \times 10^9/l$ ,  $240.65 \pm 69.7 \times 10^9/l$ ,  $543.63 \pm 283.7$  (cell/ $\mu$ l), and  $2953.02 \pm 1619.9$  (copies/ml) recorded as their mean Hb, WBC, platelet, CD4 cell count, and VL.

Table 3 shows the relationship between pack cell volume and types of HARRT regimen. There was no statistically significant relationship between the level of Hb and type of HARRT, or regimen of HARRT (1<sup>st</sup> or 2<sup>nd</sup> line), their  $p > 0.05$

Table 4 depicts the relationship between maternal variables and packed cell volume. The only two maternal variables that showed significant relationship with Hb were maternal level of education (MLE), and SEC,  $\chi^2 = 6.29$ ,  $p = 0.043$  for MLE, and  $\chi^2 = 10.162$ ,  $p = 0.006$  for SEC.

**Table 1: Characteristics of the 330 HIV positive pregnant mothers.**

<b>Maternal variables</b>	<b>Frequency (%)</b>
<b>Residence</b>	
Rural	273 (82.7)
Urban	57 (17.3)
<b>Level of education</b>	
No formal and primary	35 (10.6)
Secondary	175 (53.0)
Tertiary	120 (36.4)
<b>Religion</b>	
Christianity	264 (80.0)
Islam	66 (20.0)
<b>Marital status</b>	
Married	330 (100.0)
<b>Socio-economic status</b>	
Low	31 (9.4)
Middle	293 (88.8)
High	6 (1.8)
<b>Time of commencing HARRT</b>	
Before pregnancy	265 (80.3)
During first trimester	24 (7.3)
During mid trimester	28 (8.5)
During last trimester	11 (3.3)
At delivery	2 (0.6)
<b>Type of HAART</b>	
ABC/3TC/LPV/r	3 (0.9)
AZT/3TC/NVP	170 (51.5)
AZT/3TC/LPV/r	3 (0.9)
TDF/3TC/EFV	141 (42.7)
TDF/3TC/LPV/r	13 (4.0)
<b>Type of regimen</b>	
First line	311 (94.2)
Second line	19 (5.8)
<b>Regimen base</b>	
AZT based	173 (50.9)
TDF based	154 (47.1)
<b>Mother's weight (kg)</b>	
<90	303 (91.8)
≥90	27 (8.2)
<b>Mode of delivery</b>	
Caesarean section	43 (13.0)
Spontaneous vertex delivery	287 (86.9)
<b>Maternal outcome</b>	
Alive	322 (97.6)
Dead	8 (2.4)

**Table 2: Maternal haematological and clinical parameters.**

<b>Maternal variable</b>	<b>Frequency (%)</b>	<b>Mean±SD</b>
<b>Platelet (10<sup>9</sup>/l)</b>		
<100	16 (4.8)	-
≥100	314 (95.2)	-
<b>Hbg/dl</b>		
<10	119 (36.1)	-
≥10	211 (63.9)	-

Continued.

Maternal variable	Frequency (%)	Mean±SD
<b>Full blood count (10<sup>9</sup>/l)</b>		
<3.000	32 (9.6)	
≥3.000	298 (90.3)	
<b>Viral load (copies/ml)</b>		
<20	82 (24.8)	-
20-1000	221 (67.0)	-
>1000	27 (8.2)	-
<b>CD4 cell count (cells/μl)</b>		
<200	23 (9.2)	-
200-500	179 (39.8)	-
>500	128 (51.0)	-
<b>Mother's weight (kg)</b>		
<90	303 (91.8)	
>90	27 (8.2)	
<b>Mother's HIV related morbidity</b>		
Yes	6 (1.8)	-
No	324 (98.2)	-
<b>Age (years)</b>	-	31.11±4.7
<b>Parity</b>	-	2.0±1.6
<b>Gestational age at delivery (weeks)</b>	-	38.57±3.1
<b>Hb mg/l</b>	-	10.9±2.1
<b>Full blood count (10<sup>9</sup>/l)</b>	-	5.77±2.86
<b>Platelet (10<sup>9</sup>/l)</b>	-	240.65±69.7
<b>CD4 cell count (cells/μl)</b>	-	543.63±283.7
<b>Viral load (copies/ml)</b>	-	2953.02±1619.9

**Table 3: Relationship between pack cell volume and types of HARRT regimen.**

Types of HARRT	Total, n=330 (%)	Hb<10 gm/dl, n=119 (%)	Hb>10 gm/dl, n=211 (%)	X <sup>2</sup>	P value
ABC/3TC/LPV/r	3 (0.9)	2 (66.7)	1 (33.3)	4.08	0.396
AZT/3TC/NVP	170 (51.5)	61 (35.9)	109 (64.1)		
AZT/3TC/LPV/r	3 (0.9)	1 (33.3)	2 (66.7)		
TDF/3TC/EFV	141 (42.7)	53 (37.6)	88 (62.4)		
TDF/3TC/LPV/r	13 (4.0)	2 (15.4)	11 (84.6)		
<b>Type of regimen</b>				0.509	0.476
First line	311 (94.2)	113 (36.3)	198 (63.7)		
Second line	19 (5.8)	6 (31.6)	13 (68.4)		

**Table 4: Relationship between maternal variables and packed cell volume.**

Maternal variable	Packed cell volume (%)		X <sup>2</sup>	P value
	<30%, n=119 (%)	≥30, n=211 (%)		
<b>Residence</b>			0.183	0.669
Rural	107 (39.2)	166 (60.8)		
Urban	12 (21.1)	45 (78.9)		
<b>Maternal level of education</b>			6.29	0.043
No formal/primary	14 (11.8)	21 (10.0)		
Secondary	70 (58.8)	105 (49.8)		
Tertiary	35 (29.4)	85 (40.2)		
<b>Religion</b>			0.164	0.686
Christianity	66 (55.5)	198 (93.8)		
Islam	53 (44.5)	13 (6.2)		
<b>Socio-economic class</b>			10.162	0.006
Low	17 (14.3)	14 (6.6)		
Middle	100 (84.0)	193 (91.5)		
High	2 (1.7)	4 (1.9)		

Continued.

Maternal variable	Packed cell volume (%)		X <sup>2</sup>	P value
	<30%, n=119 (%)	≥30, n=211 (%)		
<b>Time of commencement on HART</b>				
Before pregnancy	90 (75.6)	175 (82.9)	3.5	0.478
During first trimester	10 (8.4)	14 (6.6)		
During mid trimester	14 (11.8)	14 (6.6)		
During last trimester	4 (3.4)	7 (3.3)		
At delivery	1 (0.8)	1 (0.5)		
<b>Mother's weight (kg)</b>				
<90	105 (88.2)	198 (79.88)	0.403	0.526
≥90	14 (11.8)	13 (6.2)		
<b>Platelet (10<sup>9</sup>/l)</b>				
<100	3 (2.5)	13 (5.2)	0.976	0.325
≥100	116 (97.4)	198 (93.8)		
<b>Viral load (copies/ml)</b>				
<20	20 (16.8)	62 (29.4)	0.583	0.747
20-1000	89 (74.8)	132 (62.6)		
>1000	10 (8.4)	26 (8.0)		
<b>CD4 cell count (cells/μl)</b>				
<200	9 (7.6)	14 (6.6)	5.31	0.07
200-500	75 (63.0)	104 (49.3)		
>500	35 (29.4)	93 (44.1)		
<b>Maternal HIV related morbidity</b>				
Yes	2 (1.7)	4 (1.9)	0.419	0.517
No	117 (98.3)	207 (98.1)		
<b>Full blood count (10<sup>9</sup>/l)</b>				
<3,000	18 (15.1)	4 (1.9)	0.763	0.651
≥3,000	101 (84.9)	207 (98.1)		

## DISCUSSION

The burden of anaemia in HIV positive women on HART in this study was high (36.1%). This was comparable to 33.7% among same group of women from Jos, 44.6% from another study from Owerri, both in Nigeria, and 34.5% using Hb<10 g/dl cut-off from South Africa study.<sup>30-32</sup> The finding was however much lower than 62.6% prevalence found from Port Harcourt, 75.5% from Orlu, and 88.5% prevalence in Uyo, all from Nigeria, as well as 64.5% from South Africa, and 83.0% from Tanzania.<sup>33-36</sup> The high prevalence of anaemia in HIV positive pregnant women in this study could not be unconnected with multifactorial causes earlier mentioned: Direct retroviral infection of bone marrow stroma, and haematopoietic stem cells, changes in the regulation/suppression of erythropoiesis from cytokine production, and decrease in erythropoietin concentration, and indirectly from increase in apoptosis of the marrow cells in response to chronic opportunistic infections with autoimmune destruction of cells.<sup>18,38</sup> Suppression of erythropoiesis by ART especially AZT, ineffective erythropoiesis from co-trimoxazole used against opportunistic infections, hemolytic anemia induced by oxidant drugs, and thrombotic microangiopathy one of the significant causes of anaemia in HIV patients could all be contributory causes. Other possible multifactorial causes include nutritional deficiencies of iron, vitamin B12, folic acid, dual infections with malaria,

schistosomiasis, hookworm and tuberculosis which are all endemic in study area. In addition to the multifactorial causes of anaemia, the use of lower cut off value for anemia of <10 g/dl in this study as previously advocated<sup>26,27</sup> as against WHO recommended <11 g/dl may have contributed to high prevalence rate in present study.

HIV infection is an illness with protean manifestations including hematological abnormalities. The role for platelets in the pathogenesis of HIV has been postulated due to the recognition of platelet decline as a symptom of the disease. Platelets are small, anucleate blood cells that originate as evaginations from bone marrow megakaryocytes, and regarded as the cellular coordinators of hemostasis. Its participation in the immune response to invading organisms is increasingly being recognized. In a recent meta-analysis, thrombocytopenia in HIV-infected individuals prior to ART gave a prevalence of 5-30%, this figure has improved with the advent of ART.<sup>39</sup> In the present study, the prevalence of thrombocytopenia was put at 4.8%. This was similar to 3.2% by Mark et al, and 8.6% by Munyazesa et al.<sup>40,41</sup> This documented thrombocytopenia may be as a result of HIV associated morbidity seen in 1.8% of patients in this study which is a marker of disease progression from opportunistic infections.

Leucopenia, defined as WBC of less than 3,000x10<sup>9</sup>/l in adult was documented in 6.7% of patients in this study.

This is frequently seen in advanced HIV infection, and could have resulted from poor ART-treatment outcome, or failure to 1<sup>st</sup> line or 2<sup>nd</sup> line ART medication which are both strong predictors of mortality. The finding of 6.7% leukocytopenia in this study was similar to 4.2% recorded among HIV positive Rwandan women, even though Rwanda study used a lower cut off value of  $<2000 \times 10^3$  cells/mm<sup>3</sup> for their WBC. Leukopenia seen in 6.7% of PWHA's seen in this study was a negative prognostic marker with outcomes represented by 1.8% morbidity and 2.4% mortality recorded.

The prevalence of anaemia in HIV positive women on HARTT in this study was higher than that of thrombocytopenia, and leucopenia. The three are prognostic markers of HIV disease progression. However, the lower prevalence of thrombocytopenia and leukocytopenia in this study might be as result of stability of patients in the study evidence by lower number 27 (8.2%), 9 (7.6%) having high VL and low CD4 cell both are good markers HIV disease progression.

Socioeconomic status (SES) has direct implications on nutrition and hence Hb level of the populace. Women's education and job status has been identified by many researchers to be statistically significantly associated with anaemia in pregnancy.<sup>42,43</sup> In a given population, culture, norms, and religion are important factors affecting nutritional level, which can cause a group of population to be more at risk of anaemia than others. Nwizu et al in their study on socio-demographic and maternal factors in anemia in pregnancy at booking in Kano, from Northern Nigeria observed prevalence of anemia to be inversely related to educational and SES of the mothers in their study.<sup>44</sup> Anaemia they said was seen in 64.7% of their subjects from low SES when compared to those from higher socioeconomic class. This was equally reported from Malawian study, where a greater percentage of the population from poor and uneducated were reported to have anaemia in pregnancy as high as 90%, and attributed this high prevalence to lack of education, and finance for good maternal health services making them prone deleterious effects of poor nutrition, malaria, diarrheal diseases and chronic infections.<sup>45</sup> Similar findings were also seen in this study where maternal level of education and SES had statistical relationship with maternal anaemia.

## CONCLUSION

The burden of anaemia in HIV positive women on HARTT in this study was high when compared to the level of thrombocytopenia, and leucopenia from same group of women. This burden was related to the maternal level of education and her socio-economic status.

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