

Anemia and Associated Risk Factors among People Living with Hiv in Dodoma Region, Central Tanzania

Yulitha Barnabas^{1,2}, Pilly Machivya², Sixbert I. Mkumbaye^{2,3,*}

¹ Milembe Referral Mental Hospital-Dodoma Regional Hospital. P. O. Box 910, Dodoma, Tanzania

²Faculty of Medicine, Kilimanjaro Christian Medical University College of Tumaini University, Makumira, Tanzania

³Kilimanjaro Christian Medical Centre, Moshi, Tanzania

*Corresponding author: Yulitha Barnabas (s.mkumbaye@kcri.ac.tz)

Research Article

Open Access

How to cite this article: Barnabas, Y., Machivya, P., & Mkumbaye, S. (2019). Anemia and Associated Risk Factors among People Living with Hiv in Dodoma Region, Central Tanzania. *Trends Journal Of Sciences Research*, 4(2), 80-87.

Received: November 17, 2018

Accepted: January 21, 2019

Published: February 01, 2019

Copyright © 2019 by authors and Trends in Scientific Research Publishing.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Abstract Background: Anemia is the most frequent hematologic abnormality of HIV disease and one of the most common manifestations of nutritional deficiency disorders in the world. In sub-Saharan Africa, about 70% of the world's people living with HIV/AIDS, where the prevalence of anemia is higher than in developed countries. The aim of this study was to determine the prevalence and factors associated with anemia among people living with HIV at Dodoma regional hospital during 2013-2014. **Methodology:** A retrospective cross-section study conducted among PLWHIV at Dodoma Regional Hospital between 2015 and 2016. A total of 869 PLWHIV were enrolled. Data extraction sheet were used to collect Socio- demographics, immune-hematological data and ARV status from existing patient's files (CTC 2 card). Double entry of data in Microsoft excel were done and transferred for analyzing using SPSS v.16. **Results:** Majority of them were females 648(74.6%) and 508(58.2%) were between 19-45 years with mean age of 38.84(±14.09). 824(94.8%) were on ARV; where 640(73.6%) are from urban. The overall prevalence of anaemia among PLHIV was 59.5% of which 56.6% of these were on ARV, and 2.9% were not on ARV. Age, sex and CD4+ counts < 200cell/µl were among factors associated with anemia among PLWHIV. **Conclusion:** Moderate anaemia was common in the study population. Screening and management of anemia along with the proper use Anti-retroviral therapy may decrease risk of anemia and the effect ARV on red blood cells. Haemoglobin measurements should be taken before initiation of ARV and routinely followed among ARV users.

Keywords: Prevalence, Anaemia, PLWHIV, ARV

1. Introduction

Anemia is a condition in which there is a decrease in the red blood cell count, hemoglobin and/or hematocrit values as compared to normal reference range for age, sex, race and altitude which decreases oxygen-carrying capacity of red blood cells to tissues [1]. Anemia was defined as a hemoglobin level of <12 g/dl for women and <13 g/dl for [1-5]. Also anemia was classified as mild (11–11.9 g/dl for women and 11– 12.9 g/dl for men), moderate (8–10.9 g/dl) and severe (<8 g/dl) [1]. Similarly this definition is in agreement with WHO (2006) classification of anemia(WHO 2006).

Anemia is the most frequent hematologic abnormality of Human Immunodeficiency Virus (HIV) disease and one of the most common manifestations of nutritional deficiency disorders in the world. Among HIV-infected individuals from the United States and Europe, anemia has been independently associated with mortality, progression to Acquired Immune Deficiency Virus (AIDS), and decreased quality of life [6]. Although comparing rates of anemia among People Living with HIV (PLHIV) from different studies is complicated by variations in a number of factors including stage of HIV disease,

use of Antiretroviral Therapy (ART), and definition of anemia. Results from a review of the literature suggest that rates of anemia in PLHIV in a number of subpopulations tend to be higher in developing countries than in developed countries [7].

In sub-Saharan Africa, the prevalence of anemia among PLHIV are higher than in developed countries, and anemia is commonly caused by nutrient deficiencies, sickle cell disease, AIDS, malaria, hookworm infection, and other infections. Prevalence of anemia is generally higher in women than men [7]. The prevalence of anemia was higher in the HIV-positive cohort than in the HIV-negative cohort 28.1% and 15.1%, respectively [8]. In the study done by Brien and colleagues about 70%–80% among those with HIV infection are anemic [6].

The symptoms of Anemia in HIV- infected patients are Fatigue, Diarrhea, nausea, or vomiting, Dizziness, headaches, Insomnia, Pain and nerve problems, skin rash, Injection site reactions, Dry mouth, Weight loss, Vivid dreams and infiltration of the bone marrow by neoplasm. This is caused by various factors such as Blood loss may be associated with such conditions as neoplastic disease (e.g., Kaposi sarcoma in the gastrointestinal tract) or gastrointestinal lesions that accompany opportunistic cytomegalovirus infection. Other than blood loss, the path physiology of HIV-associated anemia may involve 3 basic mechanisms: decreased RBC production, increased RBC destruction, and defective RBC production [9]. However HIV associated anemia is multifactorial and the principal factors are infection, use of myelosuppressive medications such as zidovudine, HIV infection itself ,a decreased production of endogenous erythropoietin, hemolytic anemia that may result from RBC autoantibodies, or may also develop as a consequence of the use of various medications [10]. Moreover anemia can result from thrombotic microangiopathy, disseminated intravascular coagulation, folic acid and vitamin B12 deficiencies, nutritional deficiencies such as vitamin and iron deficiencies are common in developing countries [11].

Anemia can have severe consequences for PLHIV. Anemia can cause fatigue, shortness of breath, renal failure and increased heart rate, all of which substantially worsen a patient's quality of life. Moreover, anemia can impact HIV disease progression, treatment options, and mortality. Several studies have indicated that among individuals with HIV, anemia is associated with HIV progression to AIDS. Furthermore, HIV patients with anemia are at a greater risk of mortality compared to their non-anemic counterparts, even after controlling for CD4+ cell count and viral load [6].

Based on previous studies done in United State of America did not show any association between zidovudine and anaemia among HIV patient but reported that patients who experienced anemia after initiating zidovudine were promptly switched to a different ART regimen [6]. However the study conducted in South America , the prevalence of anaemia was high in patients starting with non-AZT containing cART than patients initiating AZT-containing cART [12]. More interestingly is the study done in China by Shen et al, reported the prevalence of anaemia was high among newly diagnosed HIV infected patients on zidovudine based ART regimen [13].

Also a study done in Iran reported the prevalence of anaemia among HIV patients receiving no HAART were 39.7 % (1721) and receiving HAART were 35.5 % (7252) [14]. However the study from Eastern India, the prevalence of anaemia was 16.2% among patients receiving ART and the mean decline of haemoglobin was 6.3 ± 1.4 g/dl [15]. All these studies markedly showed significantly different findings.

The study from Nigeria shows HIV infected patients on HAART had a significantly lower prevalence of anaemia compared with their HAART naive counterparts 51.15% and 69.17% respectively [16]. Furthermore, study conducted in south west Ethiopia shows the prevalence of anemia was high in HIV infected patients who are not under HAART [17]. Alem et al, from North west Ethiopia found that there was no statistically significant difference in prevalence of anemia between HAART users and non- users [3]. However another study conducted in the same country shows the prevalence of anaemia were 21.2% and 11.5% before HAART initiation and after HAART initiation respectively [1]. Moreover the study conducted from rural Tanzania reported that, HIV infected patients after receiving ART hemoglobin level were increased [18].

In 2014 in the United State of America and China, reported that CD4+ cell count of less than 200 cells/mL are associated with an increased prevalence of anemia ,but according to their studies it was found that, no any an association between ART regimen and anemia , where the prevalence of anemia among female was high as compared to males with the age ranging between 20-34years [5,6,12,13].

No significant association was reported when looking at anaemia and lower CD4+ cells count as well as zidovudine use [14], however, Agarwal and his colleagues reported that, there were no significant association between CD4+ cell count

with anemia, but antiretroviral medication was associated with risk of developing anaemia among females than males [15,19].

Anemia was reported to be a common manifestation in the Mexican population without antiretroviral therapy, in HIV naïve patients, a CD4+ Cell Count <200 cells/mm³ was associated with an increased risk of anemia [10]. Significant and positive correlation was found between anaemia and lower CD4+ cell count [20]. The prevalence of anaemia was highest among patients who had a CD4 lymphocyte count of 100–199 cells/μL, the increase in prevalence of anaemia with decreased CD4+ cell count was statistically significant and 62% of females were anemic [4]. Similarly, the study from North west Ethiopia reported CD4+ cell count was not statistically significant association with risk of anemia [3,18].

Thus, anaemia is the most problems of HIV disease and one of the most common manifestations of nutritional deficiency disorders in the world [7]. Anemia can have severe consequences for PLHIV that can cause life threatened conditions like HIV disease progression, treatment options, and mortality. The effort done previously was to treat anaemia with EPO or a blood transfusion with ZDV [21]. Other effort was to treat patients with HAART which does not contain Zidovudine.

Therefore, anemia is a major problem among HIV patients. There is a need updating data on anaemia prevalence in people living with HIV patients in each region since it helps in reflecting the magnitude of the problem. Therefore, this study is intended to assess the prevalence and factors associated with anaemia among People living with HIV at Dodoma referral hospital as there is no evidence based study conducted based on prevalence of anemia among PLWHIV.

2. Materials and Method

2.1. Study design and study population

A retrospective cross-sectional study which included data from records/files to patients who attended the clinic from 2015-2016. This study was conducted at Dodoma Regional Hospital during the month of March and April 2015 and included all HIV-infected patients who visited CTC at Dodoma regional hospital from 2015-2016.

2.2. Data collection methods

Data were collected using information available in the patients file from CTC department at Dodoma Regional Hospital. These files are kept at CTC department special medical records room and securely maintained. From these files data were extracted by accessing each file one by one, were all HIV infected patients (male and female) attended CTC were included; excluding only Pregnant women with HIV infection since pregnant was thought to confound the results.

2.3. Ethical consideration

This study was conducted under the permission of Dean of Faculty of Medicine of Kilimanjaro Christian Medical University college, Research Course coordinator and the permission obtained from the Medical Officer in charge of Dodoma Regional Hospital, by considering that the anonymity and confidentiality was observed.

2.4. Data handling and analysis

Data were coded and double entry of data were done using Microsoft excel and analyzed using the Statistical Package for Social Science (SPSS) version 16. Descriptive statistics was used to summarize data, where; in continuous data, mean with standard deviation (SD) was used to describe the spread of data around the mean, frequencies and percentages was used in categorical variables. Also Chi-square test was used to analyze categorical data and variables were compared. The crude (unadjusted) and multivariate (adjusted) logistic regression analysis of factors associated with anaemia among PLHIV were examined. A p-value <0.05 at 95%CI was considered statistically significant.

3. Results

3.1. General characteristics of the study patients

A total of 869 people living with HIV were collected from CTC files. Majority of them were females 648(74.6%). Almost 508(58.2%) were found to be in age group between 19-45. Where the mean age (\pm SD) of participants at enrollment was 38.84(\pm 14.09). Majority of them were ARV users 824(94.8%). Most of them were Christian 479(55.1%) followed by Islamic 318(36.6%). Where majority was from urban 640 (73.6%) (Table 1).

Table 1. Characteristics of the study participants (N=869)

| Variables | N | % |
|-------------------|---------------------|------|
| <i>Age</i> | | |
| 1-18 | 78 | 9.0 |
| 19-45 | 508 | 58.2 |
| 46+ | 285 | 32.8 |
| Mean(\pm SD) | 38.84(\pm 14.09) | |
| <i>Sex</i> | | |
| Female | 648 | 74.6 |
| Male | 221 | 25.4 |
| <i>Residence</i> | | |
| Urban | 640 | 73.6 |
| Rural | 229 | 26.4 |
| <i>Religion</i> | | |
| Christian | 479 | 55.1 |
| Islamic | 318 | 36.6 |
| Others | 72 | 8.3 |
| <i>ARV status</i> | | |
| Yes | 824 | 94.8 |
| No | 45 | 5.2 |

3.2. Prevalence of anaemia among people living with HIV

A total of 869 PLHIV were enrolled in the study. The overall prevalence of anemia was 517(59.9%), (Figure 1). Also in this study moderate anaemia were found to be higher 313(36%) followed by mild anaemia 110(12.7%), (Figure 2).

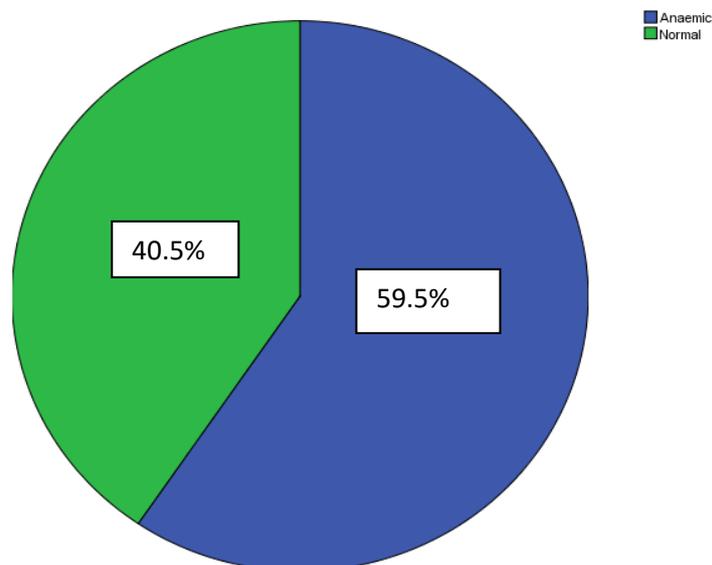


Figure 1. Overall prevalence of anaemia among PLHIV

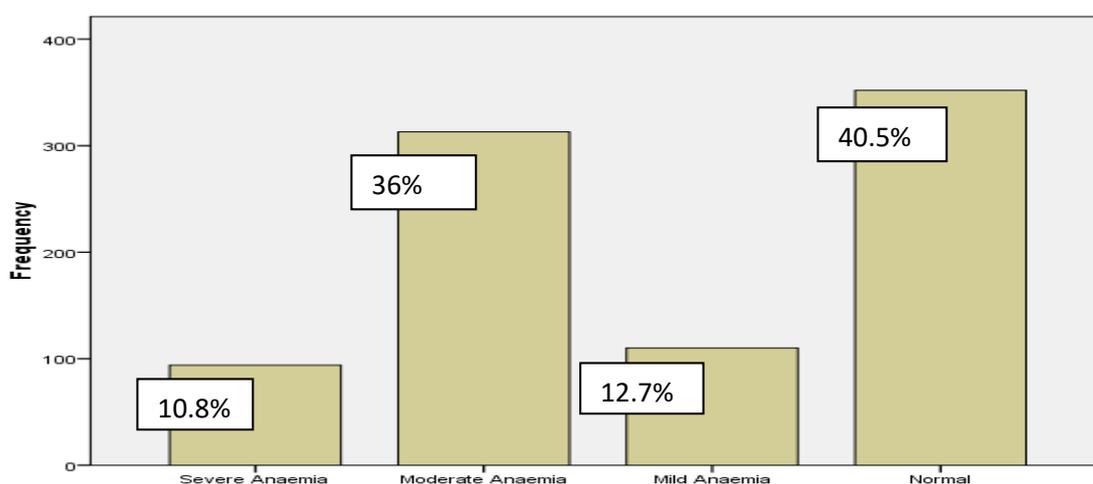


Figure 2. Severity of anaemia classification among PLHIV

3.3. Prevalence of anaemia among PLHIV by ARV status

A total of 869 PLHIV were enrolled in the study with their ARV status. The overall prevalence on patients not on ARV were 2.9%, where, 0.8% were found with severe anaemia, 1.4% was found with moderate anaemia and 0.7% was found with mild anaemia. Moreover, patients who were on ARV the overall prevalence were 56.6%, where 10.0% were found with severe anaemia, 34.6% with moderate anaemia and 12.0% were found with mild anaemia (Table 2).

Table 2. Prevalence of anaemia among PLHIV by ARV status n=517

| ARV status | Anaemia | | | Total n(%) |
|------------|------------------------|-----------------------------|----------------------|---------------|
| | Severe anaemia n(%) | Moderate Anaemia n(%) | Mild anaemia n(%) | |
| Not on ARV | 7(0.8%) | 12(1.4) | 6(0.7) | 25(2.9) |
| On ARV | 87(10.0) | 301(34.6) | 104(12.0) | 492(56.6) |

3.4. Factors associated with anaemia among PLHIV

In Univariate analysis sex, age ≤ 30 and CD4+ counts < 200 cell/ μ l were statistically associated to anaemia. Therefore, being females is as having 55% chance of being anemic as compared to males (OR 0.58 (0.42-0.80) $P = 0.001$). The odds being anemic among people with CD4 counts < 200 cell/ μ l is 55% compared to other above this range. The odds of anaemia among age 46+ years old is 47% (OR 0.53, 95% CI=0.73-0.76) though statistically not significant (Table 3).

In Multivariate logistic regression analysis, it is still reported that, Females, CD4 counts of < 200 cell/ul and age of < 30 years are among factors associated with anemia among ARV users (Table 4).

4. Discussion

Anaemia among PLHIV patients is among the problem that faces these patients; and it is much more serious to those on ARV compared to those not on ARV; despite the fact that ARV is needed to support the life of the people living with HIV.

This study was mainly conducted to the assessment of the prevalence and factors associated with anemia among people living with HIV who both on and not on ARV for the purpose of assessing the anemia burden among the HIV population

patients and also to assess whether or not ARV, age, sex and CD4+ cells count has any association to the anemic patients with HIV.

Table 3. Univariate logistic regression analysis associated of anaemia among PLHIV. N=869

| Variables | Anaemia n(%) | Normal n(%) | Crude | |
|-------------------|--------------|-------------|-----------------|---------|
| | | | OR(95%CI) | P-Value |
| <i>Sex</i> | | | | |
| Male | 82(37.1) | 139(62.9) | 1 | |
| Female | 325(50.2) | 323(49.8) | 0.58(0.42-0.80) | 0.001 |
| <i>Age</i> | | | | |
| 1-30 | 115(55.6) | 92(44.4) | 0.53(0.73-0.76) | 0.001 |
| 31-45 | 178(47.2) | 199(43.5) | 0.74(0.54-1.01) | 0.064 |
| 46+ | 114(40.1) | 171(60.0) | 1 | |
| <i>CD4 count</i> | | | | |
| <200 | 144(56.5) | 111(43.5) | 0.55(0.38-0.81) | 0.002 |
| 200-500 | 179(43.2) | 235(56.8) | 0.94(0.67-1.33) | 0.758 |
| >500 | 83(41.9) | 115(58.1) | 1 | |
| <i>ARV status</i> | | | | |
| No | 19(2.1) | 27(3.1) | 1 | |
| Yes | 387(44.6) | 436(50.2) | 0.82(0.44-1.50) | 0.313 |

Table 4. Multivariate logistic regression analysis of factors associated with anaemia among PLHIV. N=869

| Variables | Anaemia n(%) | Normal n(%) | Adjusted | |
|------------------|--------------|-------------|------------------|---------|
| | | | OR(95%CI) | P-Value |
| <i>Age</i> | | | | |
| 1-30 | 115(55.6) | 92(44.4) | 0.54(0.37-0.78) | 0.001 |
| 46+ | 114(40.1) | 171(60.0) | 1 | |
| <i>CD4 count</i> | | | | |
| <200 | 144(56.5) | 111(43.5) | 2.06(0.21-20.23) | 0.053 |
| >500 | 83(41.9) | 115(58.1) | 1 | |

This study shows the overall prevalence of anaemia among PLHIV was 59.5%, where 2.9% patients were not on ARV, however, the overall prevalence of anaemia on patients who were on ARV was 56.6%, of them 10.0% were found with severe anaemia, 34.6% with moderate anaemia and 12.0% were found with mild anaemia. This is contrarily to the study conducted at Northwest Ethiopia, where the prevalence of anemia was high to the patients on ARV 86%, of them, 1.6%,

14.8%, 53.6% had severe, moderate and mild anemia respectively [3]. On other hand lower prevalence of anaemia was reported in Uganda 16% , 0.4% had severe anemia , 6.2% had moderate anemia and 9.4% had mild anemia [22], but slightly higher from Northern Tanzania 40% [18]. Differences in findings might have been attributed by time frame (duration) of the study, sample size, geographical area, study population and study design as well as ethnicity as all these factor can contribute to differences in findings.

After multivariate logistic regression analysis, it was demonstrated that, levels of CD4 + T cell <200cell/ μ l, was not statistical significant associated with anemia with marginal p-value. This was in the same line with the report from Eastern India and Northwest Ethiopia where they did not find any significant association with CD4+ T cells count with anaemia [3,15,19]. However other studies reported the statistical significance of CD4+Tcell <200cell/ μ l to be associated with anaemia in USA [21], China [13], Hispanic [5], Iran [14], Ghana [20], Uganda [22]. Differences in finding might be due to healthcare policies, HIV subtype and antiretroviral regimen types that could have contributed for the differences in findings between developed countries and resource- limited settings.

Age among females with \leq 30years was a positive predictor of anaemia among PLWHIV, which is in agreement with findings from Iran [14], Northwest Ethiopia [3,4], Uganda [22], Tanzania [18] and USA but there were observed slightly differences in age group of 31-45 [21], Similarly to the study from Northwest Ethiopia which reported that sex and age were not associated with anemia [1]. Menstrual blood loss and multiple deliveries was among the reasons given in due course of the difference in findings.

This study reported also that, patients on ARV were associated with anemia. This is in agreement with studies from USA [6], Northwest Ethiopia [3], rural Tanzania [18], but different to other studies done in India, where ARV was significant associated with anaemia [15]. However the study from Nigeria reported patients who on ARV have significantly higher prevalence of anaemia than those not on ARV [16]. These differences are attributed by HIV sero-prevalence and ethnicity.

In conclusion, anemia was prevalent in PLWHIV patients. The prevalence of anemia was higher in patients who were on ARVs than those who were not on ARVs. However, females on ARV were much more prevalent in anemia than not on ARV. HIV sero-prevalence, ethnicity and geographical location are said to contribute to the difference in findings. Therefore, early screening, diagnosis and management of anaemia is essential in PLWHIV for proper health recovery and monitoring.

References

- [1] Tesfaye Z and Enawgaw B (2014) Prevalence of anemia before and after initiation of highly active antiretroviral therapy among HIV positive patients in Northwest Ethiopia : a retrospective study. 7(1): 1-5.
- [2] Johannessen A, Naman E, Ngowi BJ, Sandvik L, Matee MI, Aglen HE, Gundersen SG and Bruun JN (2008) Predictors of mortality in HIV-infected patients starting antiretroviral therapy in a rural hospital in Tanzania. 10: 1-10.
- [3] Alem M, Kena T, Baye N, Ahmed R and Tilahun S (2013) Patients at the Anti-Retroviral Therapy Clinic at the University of Gondar. 2(3).
- [4] Ferede G and Wondimeneh Y (2013) Prevalence and related factors of anemia in HAART-naive HIV positive patients at Gondar University Hospital , Northwest Ethiopia. BMC Blood Disorders. BMC Blood Disorders 13(1): 1. Available at: BMC Blood Disorders.
- [5] Santiago-rodríguez EJ, Mayor AM, Fernández-santos DM, Ruiz-candelaria Y and Hunter-mellado RF (2014) Anemia in a cohort of HIV-infected Hispanics : prevalence , associated factors and impact on one-year mortality. 1-8.
- [6] Martin C, Poudel-tandukar K and Poudel KC (2014) HIV Symptom Burden and Anemia among HIV-Positive Individuals : Cross-Sectional Results of a Community-Based Positive Living with HIV (POLH) Study in Nepal. 1-16.
- [7] Brien MEO, Kupka R, Msamanga GI, Saathoff E, Hunter DJ and Fawzi WW (2005) Anemia Is an Independent Predictor of Mortality and Immunologic Progression of Disease Among Women With HIV in Tanzania. 40(2): 219-225.
- [8] Belperio PS and Rhew DC (2004) Prevalence and Outcomes of Anemia in Individuals with Human Immunodeficiency Virus : A Systematic Review of the Literature. 27-43.

- [9] Volberding PA, Levine AM, Dieterich D, Mildvan D, Mitsuyasu R, Saag M and Working HI V (2004) Anemia in HIV Infection : Clinical Impact and Evidence-Based Management Strategies. 94121.
- [10] Mata-mar ń JA, Gayt ń-mart ńez JE, Mart ńez-mart ńez RE, Arroyo-anduiza CI, Fuentes-allen JL and Casarrubias-ramirez M (2010) Risk factors and correlates for anemia in HIV treatment-naïve infected patients : a cross-sectional analytical study. 3–7.
- [11] Cunha G, Santis D, Menezes D, Crivelenti F, Branda RA, Zomer R, Muniz DA, Momo G, Lima N De, Amorellichacel ME, Tadeu D and Artioli A (2011) International Journal of Infectious Diseases Hematological abnormalities in HIV-infected patients. 15: 808-811.
- [12] Zhou J, Jaquet A, Bissagnene E, Musick B, Wools-kaloustian K, Maxwell N, Boule A, Wehbe F, Masys D, Iriondoperez J, Hemingway-foday J and Law M (2012) Short-term risk of anaemia following initiation of combination antiretroviral treatment in HIV- infected patients in countries in sub-Saharan Africa , Asia-Pacific , and central and South America. Journal of the International AIDS Society. BioMed Central Ltd 15(1): 5. Available at: <http://www.jiasociety.org/content/15/1/5>.
- [13] Shen Y, Wang Z, Lu H, Wang J, Chen J, Liu L and Zhang R (2013) Prevalence of Anemia among Adults with Newly Diagnosed HIV / AIDS in China. 8(9): 1-6.
- [14] Amitis Ramezani, Arezoo Aghakhani, Mohammad Reza Sharif, Mohammad Banifazl, Ali Eslamifar, Ali Akbar Velayati (2008). Anemia Prevalence And Related Factors In HIV-Infected Patients: A Cohort Study. Iranian Journal of Pathology. 3(3), 125-128.
- [15] Agarwal D, Chakravarty J, Chaube L, Rai M, Agrawal NR and Sundar S (2010) High incidence of zidovudine induced anaemia in HIV infected patients in eastern India. (October): 386-389.
- [16] Omoregie R, Omokaro EU, Palmer O, Ogefere HO and Egbeobauwaye A (2009) Prevalence of anaemia among HIV-infected patients in Benin City, Nigeria. 11(1).
- [17] Lealem G, Tilehum Y, Zewdineh S, Daniel Y (2013). Anemia and Risk Factors in HAART Naïve and HAART Experienced HIV Positive Persons in South West Ethiopia: A Comparative Study. PLOS ONE. 8:8 | e72202.
- [18] Johannessen A, Naman E, Gundersen SG and Bruun JN (2011) Antiretroviral treatment reverses HIV-associated anemia in rural Tanzania. BMC Infectious Diseases. BioMed Central Ltd 11(1): 190. Available at: <http://www.biomedcentral.com/1471-2334/11/190>.
- [19] Denué BA, Bello HS and Abja AU (2013) Changes in blood profile of human immunodeficiency virus (HIV) -infected patients on highly active antiretroviral therapy (HAART) in North Eastern Nigeria. 5(8): 284-291.
- [20] Obirikorang C and Yeboah FA (2009) Blood haemoglobin measurement as a predictive indicator for the progression of HIV / AIDS in resource-limited setting. 7: 1–7.
- [21] Curkendall SM, Richardson JT, Emons MF, Fisher AE and Everhard F (2007) Incidence of anaemia among HIV-infected patients treated with highly active antiretroviral therapy *. 483-490.
- [22] Mugisha JO, Shafer LA, Paal L Van Der, Mayanja BN, Eotu H, Hughes P, Whitworth JAG and Grosskurth H (2008) Anaemia in a rural Ugandan HIV cohort : prevalence at enrolment , incidence , diagnosis and associated factors. 13(6): 788–794.