# Anemia and its Associated Factors among Adult HIV Patients on Highly Active Anti-Retroviral Therapy at Woreta Health Center, North Central Ethiopia: A Cross-Sectional Study

Sisay Getu[1]*, Tegenaw Tiruneh[1], Henok Andualem[2], Wasihun Hailemichael[2], Misganaw Gebru[3], Demeke Mesfin[4], Alemayehu Digissie[5]

[1]Department of Hematology and Immuno Hematology, Debre Tabor University, Debre Tabor, Ethiopia; [2]Department of Immunology and Molecular Biology, Debre Tabor University, Debre Tabor, Ethiopia; [3]Department of Medical Laboratory Science, Ebre Tabor University, Debre Tabor, Ethiopia; [4]Department of Pediatrics and Child Health Nursing, Debre Tabor University, Debre Tabor, Ethiopia; [5]Department of Human Nutrition, Debre Tabor University, Debre Tabor, Ethiopia

## ABSTRACT

**Background**: Anemia refers to a condition in which the hemoglobin content of the blood is lower than normal for person's age, gender and environment, resulting in the oxygen carrying capacity of blood being reduced. It is found to be highly prevailing among adult HIV/AIDS patients. This study aimed to assess the prevalence of anemia and its associated factors among adult HIV/AIDS patients attending their follow up at Woreta health center, North Central Ethiopia (NCE).

**Methods**: A cross-sectional study was conducted from October to December, 2020. A total of 230 participants were selected using simple random sampling technique. Demographic and clinical data were collected using structured questionnaire whereas, venous blood sample was collected and analyzed by Sysmex KX-21 (Sysmex corporation, Kobe, Japan), and BD FACS for hemoglobin and CD4 determination respectively. Data then entered in to EPI info version 3.5.3 and transferred to and analyzed using SPSS version 25.0. Descriptive statistics including frequencies, proportions, means and standard deviations were used to summarize the data. Logistic regression analysis was made to identify the factors associated with anemia. P-value ≤ 0.05 is considered statistically significant.

**Result**: A total of 230 participants were included in the study making the response rate 100%. Most of the respondents 120 (58.2%) were in the age group of 31 years to 45 years. The prevalence of anemia in the study area was 37.8%. Alcohol drinking, clinical stage, CD4 count and drug regimen were identified to be significantly associated with the anemia status of adult HIV/AIDS patients. The odds of having anemia were 2.1 times (AOR: 2.1, 95% CI: 1.1, 4.0) higher than those patients who drank alcohol compared to those who didn't drink alcohol. Whereas patients who had clinical stage III were 10.7 (AOR: 10.7, 95% CI: 1.8, 64.0) times more likely to have anemia than those who were on clinical stage I. The odds of anemia were 1.9 times (AOR:1.9, 95% CI:1.1,4.2) higher in those patients with CD4 count <200 was compared to those with above 500 CD4 count. Patients on AZT containing drug regimen were 11.3 times (AOR:11.3, 95% CI:2.4,54.4) more likelihood to have anemia than compared to TDF based ART regimen.

**Keywords**: Anemia; Adult HIV/AIDS patients; ART; Red blood cells; Ethiopia

# INTRODUCTION

Anemia refers to a condition in which the hemoglobin content of the blood is lower than normal for person's age, gender and environment, resulting in the oxygen carrying capacity of blood to be reduced. It is also a condition which develops when blood lacks sufficient healthy Red Blood Cells (RBC) both in quality and quantity or Hb in circulation to carry adequate oxygen to tissue [1]. It refers to a condition in which the Hb content of the blood is lower than 13 g/dL for male and lowers than 12 g/dL for female [2].

The Human Immune Deficiency Virus (HIV) which is the causative agent of Acquired Immune Deficiency syndrome (AIDS), it is one of the retroviruses that possess an enzyme reverse transcriptase that can transcribe single stranded Ribose Nucleic Acid (RNA) in to double stranded Deoxyribonucleic Acid (DNA) [3].

The etiology of anemia in HIV infection is multifactorial. Typically, the anemia may result from lower production of RBC, increased RBC destruction, infective RBC production [4]. The major cause of anemia is malnutrition associated with Iron deficiency, foliate deficiency and infections such as malaria and Helminthaisis [5]. In established HIV infection, lower hemoglobin level has been shown to correlate with decreasing Cluster of Differentiation (CD4) cell counts and many studies have shown that there is an association between anemia during established infection and a faster progression to AIDS and death [6,7].

Frequently the laboratory parameters are compatible with anemia of chronic disease with low reticulocyte count, normochromic RBC with normal iron store and cytokine mediated poor erythropoietin response. HIV/AIDS can also lead to anemia as a result of change in cytokine production and subsequent effect on the hematopoietic concentration [8,9].

If an entity used antiretroviral treatment effectively, there will be a relatively normal level of CD4 cells and Hb concentration, which in turn decrease the incidence of anemia. Although HIV infected patients on Highly Active Anti-Retroviral Therapy (HAART) showed minor prevalence of anemia. Azidothymidine (AZT) extensively used HIV reverse transcriptase inhibitor and one of the first line antiretroviral drugs suggested by World Health Organization (WHO) for treating HIV infected adults in resource limited courtiers, AZT is an eminent cause of drug induced hepatotoxicity. Several studies in developed countries have shown that AZT alone and AZT based HAART regimen is linked with major reduction of Hb level and neutrophil number [10]. On the other Hand Zidovudine (ZDV) related anemia usually occurs after three months of initiation of therapy. Risk factors include high AZT dosage, increased treatment duration, low CD4 count and pre-existing anemia [11]. Routine screening of Hb level, proper treatment of respondents on Zidovudine-based ART regimen and increasing productivity to improve dietary diversity are essential to prevent anemia [12].

The majority of global distribution of disease burden of anemia is carried by developing world with high prevalence in Africa and south East Asia. Anemia is major public health problem that affect all age groups of the population [13,14]. The overall prevalence of anemia among PLWHA on ART is increases as the disease progress. It ranges from 10% asymptomatic population to 80% among PLWHA [15].

The hematological manifestations of HIV infection are complications of the disease which may be clinically important in patients. An evident cause of anemia in patients with HIV infection is blood loss. Other than blood loss, HIV associated anemia may cause: Decreased RBC production, increased RBC destruction and ineffective RBC production [16,17]. Although HIV associated anemia is multifactorial, the principal factors are permeation of the bone marrow by neoplasm or infection, Myelo-suppressive medications such as ZDV, HIV infection itself, drop off production of endogenous erythropoietin, hemolytic anemia that may result from RBC auto-antibodies or may also develop as a result of the use of a range of medications [18].

In sub saharan Africa where the prevalence of HIV/AIDS and underfeeding are high, anemia is major clinical cases to a considerable burden of morbidity and mortality. The problem of anemia in much poor resource setting area, made worse by the fact those population characteristics such as genetic disorder, infection and malnutrition [19]. Parasitic diseases, including helminthes infections and falciparum, have long been recognized as important contributors of anemia in endemic countries [20]. Hook worm causes Iron Deficiency Anemia (IDA) through the process intestinal blood loss and through Nitric Oxide (NO) release [21]. Associated factors include age, low socio-economic status, nutritional status and illiteracy causes anemia. Infection with Hook worm and intestinal helminthes causes gastro-intestinal blood loss resulting in depletion of iron stores and consequently impaired erythropoiesis. They also lead to mal-absorption and inhibition of appetite, there by worsening micronutrient deficiency anemia.

## Study objective

**General objective**: To assess the prevalence and associated factors of anemia among adult HIV/AIDS patients who were on ART follow up at Woreta health center, South Gondar zone, Northwest Ethiopia, 2020.

**Specific objectives**: To determine the prevalence of anemia among adult HIV/AIDS patients who are attending Woreta health center for ART follow up, South gondar zone, Northwest Ethiopia, 2020.

To identify the factors associated with anemia among adult HIV/AIDS patients who are attending Woreta health center for ART follow up South Gondar Zone, Northwest Ethiopia, 2020 [20].

# MATERIALS AND METHODS

## Study area

This study was conducted at Woreta health center which is located in Woreta Town. Woreta town is located in the south Gondar zone of Amhara Region, east of lake Tana and south of

Addis Zemen, 62 Km east away from Bahir Dar city, the capital of the Amhara regional state and 605 km far from Addis Ababa, the capital of Ethiopia. This town has a latitude and longitude of 11°55′N 37°42′E with an elevation of 1828 meters (5997.375328ft) above sea level [22].

## Study design and period

An institutional based cross-sectional study was conducted from October 02 to December 28, 2020.

Population

**Source population**: All adult HIV/AIDS patients on HAART and who were attending Woreta Health Center for follow up.

**Study population**: All sampled HIV/AIDS patients who were attending Woreta health center for follow up during the study period.

## Eligibility criteria

**Inclusion criteria**: Adults HIV/AIDS patients 18 years or above attending the ART clinic at Woreta health center were included in the study.

**Exclusion criteria**: Pregnant women, patients with any mental or physical illness were excluded from the study.

## Sample size determination and sampling procedure

**Sample size determination**: The sample size was determined by using single population proportion formula by considering the prevalence of anemia among adult HIV patients 16.2% reported from Jimma university specialized hospital [23].

$$n = \frac{\left(Z_{1-\alpha/2}\right)^2 P(1-P)}{d^2}$$

Where n is minimum sample size required; $Z_{1-\alpha/2}$ is the standard normal variable at $(1^{\alpha})$ % confidence level and at $\alpha$ level of significance. 95% confidence level is used=1.96; P is estimate of the prevalence rate of anemia in the population; d is the margin of sampling error tolerated, assumed 0.05. Therefore, the calculated sample size (n) was 209. After adding of 10% non-response rate the final sample size (N) was calculated to be 230.

## Sampling procedure

Simple random sampling technique was used to select the eligible study participants by using the documented list of adult HIV/AIDS patients in Woreta health center as a sampling frame.

## Study variables

**Dependent variable**: Anemia status.

**Independent variable**: Socio demographic variables (age, sex, marital status, religion, educational status, residence, occupation) and nutritional statue Behavioral history (smoking, alcohol, Khat chewing).

Clinical variables (clinical stages, Cotrimoxazole treatment, CD4 count ART drugs and duration of treatment, BMI).

## Operational definitions

**Hemoglobin**: is a red substance in the blood that carries oxygen and contains iron. Normal if Hb>13 g/dl (for male) and>12 g/dL.

**Anemia**: is a condition in which the amount of hemoglobin concentration in individual is reduced (according to WHO classification below 11.5 g/dL. To classify severity of anemia we used WHO classification criteria anemia could be mild anemia if Hb is between 11 g/dL-11.9 g/dL (for female) and 11.0 g/dL -12.9 g/dL (for male); moderate anemia; if Hb is 8.0 g/dL-10.9 g/dL (for both male and female); severe anemia; if <8.0 g/dL (for both male and for female).

## Data collection and measurement

**Data collection procedure**: A structured questionnaire related to the socio demographic, nutritional and clinical data of the adult HIV/AIDS patient was used. Data was collected by the trained data collectors and laboratory investigations were done by professional laboratory technologist and the results were recorded using appropriate laboratory format.

**Blood specimen collection, preparation and analysis**: In this step, blood sample collection and laboratory analysis were done for measuring hemoglobin and CD4 count. After obtaining informed consent, 5 ml of venous blood from each selected participant was drawn by venipuncture and collected into EDTA tube. Then EDTA anti-coagulated whole blood collected from HIV/AIDS patients was loaded to Sysmex KX-21 and BDFACS count to determine Hb and CD4$^+$ T cell respectively.

**Data processing and statistical analysis**: After data collected and coded, then it was checked for completeness and entered to EPI info version 3.5.3 and transferred to and statistically analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. The data was presented using table, graphs and charts. Important proportions and summary statistics were calculated for quantitative variables. Simple and multivariate logistic regression analyses were performed to examine the predictive variables and odds ratio. The variables that are found with P<0.2 at bivariate regression analysis were entered to multivariate regression model. Adjusted Odds Ratio (AOR) with 95% Confidence Interval (CI) was used to show the strength of association. Those variables with a two-sided P-value of less than or equal to 0.05 was considered as statistically significant.

**Data quality control and management**: The data quality management starts during questionnaire development by translating the questionnaires prepared in English into the local Amharic language. Prior to actual data collection, pretest was undertaken in 5% of the study population to check for accuracy of responses, to assess the integrity of questioner and necessary

modification were made accordingly before being applied on the actual study participants. Training was also given for data collectors prior to data collection and supervisors regarding to the objective of the study, eligibility criteria, procedure of blood sample drawing. Data quality was also assured during blood sample collection by training blood sample collectors and strictly following the standard aseptic operational procedure. Laboratory analysis was done by following the appropriate procedures based on the manufacturer's instruction. All the laboratory procedures were handled with professional laboratory technologists. Then the filled questionnaires were checked for completeness by the supervisors to maintain the overall quality of data. Furthermore, during data entry and analysis using computer software, due attention was given to keep the data quality.

**Ethical consideration**: Ethical clearance letter was obtained from Debre Tabor university, Community Based Education (CBE) office. Formal support letter for data collection was also being taken from Woreta health center head. The purpose and objective of the study was explained briefly and written informed consent was taken from each selected study participant before data collection. Participants were also informed verbally that participation is on voluntary basis and they were assured on the right to refuse data collection at any time. Confidentiality of the information taken from study participants was assured by making the data collection procedure anonymous and was told that the information gathered is only used for purposes of problem-solving research purpose. Confidentiality of the blood sample results was kept secret and code numbers was used during sample collection. Hence, the results of this study were shared only with the relevant stakeholders.

# RESULTS

## Sociodemographic characteristics

A total of 230 participants were included in the study making the response rate 100%. Most of the respondents 120 (58.2%) were in the age group of 31 years to 45 years. Around 104 (45.2%) and 181 (78.7%) were married and urban dwellers respectively. Educational status of respondents showed that 121 (52.6%) were not able to read and write. Majority 221 (96.1%) of the study participants were Orthodox Christian and while all of them were Amhara in ethnicity. Th greater proportion 63 (27.4%) of respondents were farmers as shown in Table 1.

**Table 1:** Sociodemographic characteristics of adult HIV/AIDS patients on ART follow up at Woreta health center, South gondar zone, 2020.

| Variable | Category | Frequency | Percent (%) |
|---|---|---|---|
| Gender | Male | 72 | 31.3 |
| | Female | 158 | 68.7 |
| Age | 18-30 | 65 | 28.3 |
| | 31-45 | 120 | 58.2 |
| | 46-60 | 42 | 18.3 |
| | >60 | 3 | 1.3 |
| Marital status | Single | 41 | 17.8 |
| | Married | 104 | 45.2 |
| | Divorced | 48 | 20.9 |
| | Widowed | 37 | 16.1 |
| Residence | Urban | 181 | 78.7 |
| | Rural | 49 | 21.3 |
| Educational status | Unable to read and write | 121 | 52.6 |
| | Able to read and write | 8 | 3.5 |
| | Primary school | 53 | 23 |
| | Secondary school | 28 | 12.2 |

| | Diploma and above | 20 | 8.7 |
|---|---|---|---|
| Religion | Orthodox | 221 | 96.1 |
| | Muslim | 9 | 3.9 |
| Occupation | Government employee | 39 | 17 |
| | Farmer | 63 | 27.4 |
| | Merchant | 48 | 20.9 |

**Nutritional history**: Regarding the nutritional history of respondents, Injera was found to be the staple diet in the study area. More than two third (70.9%) of participants were having a habit of eating three meals per day and the remaining were having a habit of taking meal twice, above three times and once a day, accounted for 55 (23,9%), 8 (3.5%) and 4 (1.7%) respectively (Figure 1). Of the total respondents, majority 183 (79.6%) of them ate either flesh or organ meat at least once in a week. Nevertheless, the remaining 47 (20.4%) never ate meat even a day per week.
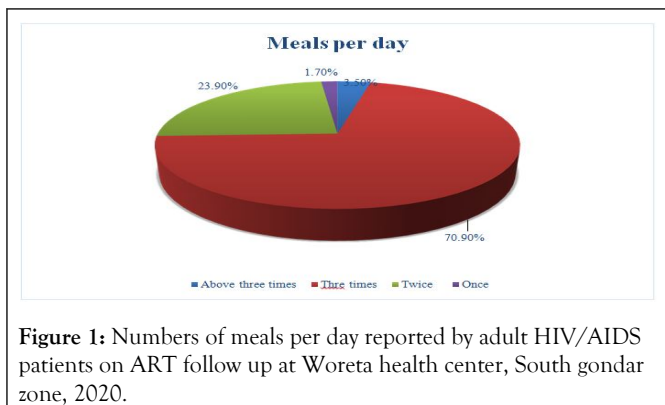


**Figure 1:** Numbers of meals per day reported by adult HIV/AIDS patients on ART follow up at Woreta health center, South gondar zone, 2020.

## Behavioral characteristics

Almost all (99.1%) of the participants were non cigarette smokers whereas 148 (64.3%) and 226 (98.1%) of them were neither alcohol drinker nor khat chewer respectively. Besides, the major proportion 204 (88.7%) of the study participants didn't have shoe wearing habit (Table 2).

Table 2: Behavioral characteristics of adult HIV/AIDS patients on ART follow up at Woreta health center, South gondar zone, 2020.

| Variables | | Frequency | Percent |
|---|---|---|---|
| Smoking status | Smoker | 2 | 0.9 |
| | Non-smoker | 228 | 99.1 |
| Alcohol drinking | Yes | 82 | 35.7 |
| | No | 148 | 64.3 |
| Khat chewing | Yes | 4 | 1.7 |
| | No | 226 | 98.3 |
| Shoe wearing habit | Yes | 204 | 88.7 |
| | No | 26 | 11.3 |

## Clinical characteristics

Among the total Adult HIV/AIDS patients, greatest proportion 99 (43.0%) were in stage III, while the least 14 (6.1%) were in Stage IV (Figure 2).
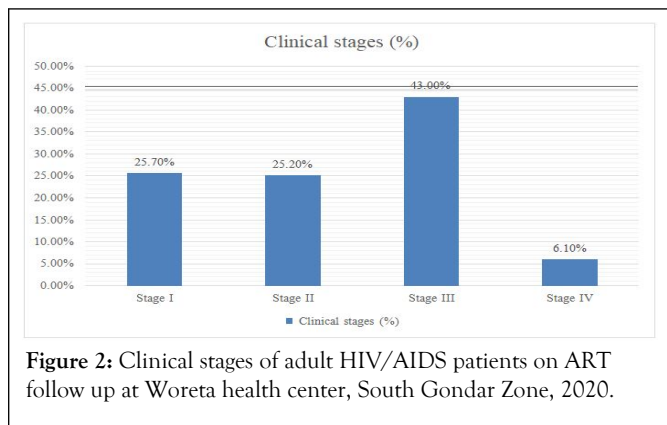


**Figure 2:** Clinical stages of adult HIV/AIDS patients on ART follow up at Woreta health center, South Gondar Zone, 2020.

As described in Table 3, majority 128 (55.7%) of patients had normal BMI (18.5-24.9 kg/m$^2$). The TDF+3TC+EFV combination was the frequently taken type of HAART drug regimen among the participants. Nearly two in five (40.4%) of patients were on HAART for more than 120 months. Two hundred one (87.4%) of respondents were on Cotrimoxazole treatment. Hb level was used to determine the magnitude of anemia among HIV/AIDS patients on ART. Hence the prevalence of anemia in the study area was 37.8%. Of which, mild anemia and moderate anemia took the large proportion, accounted for 21.7% and 13.0%. One hundred two (44.3%) of participants had above 500 CD4 count.

**Table 3:** Clinical characteristics of Adult HIV/AIDS patients on ART follow up at Woreta health center, South gondar zone, 2020.

| Variables | | | Frequency (N) | Percent (%) |
|---|---|---|---|---|
| BMI (kg/m$^2$) | <18.5 | | 90ss | 39.1 |
| | 18.5-24.9 | | 128 | 55.7 |
| | >25.0 | | 12 | 5.2 |
| Duration of HAART | 3-30 months | | 8 | 3.5 |
| | 31-60 months | | 4 | 1.7 |
| | 61-90 months | | 53 | 23 |
| | 91-120 months | | 72 | 31.3 |
| | >120 month | | 93 | 40.4 |
| Type of drug regimen | D4T+3TC+NVP | | 59 | 25.7 |
| | D4T+3TC+EFV | | 19 | 8.3 |
| | AZT+3TC+NVP | | 51 | 22.2 |
| | AZT+3TC+EFV | | 15 | 6.5 |
| | TDF+3TC+EFV | | 74 | 32.2 |
| | TDF+3TC +NVP | | 12 | 5.2 |
| Cotrimoxazole treatment | Yes | | 201 | 87.4 |
| | No | | 29 | 12.6 |
| Anemia status | Non anemic | | 143 | 62.2 |
| | Anemic | Mild | 50 | 21.7 |
| | | Moderate | 32 | 13.9 |
| | | Severe | 5 | 2.2 |

| CD4 count | <200 | | | 46 | 20 |
|-----------|------|---|---|-----|------|
| | 200-350 | | | 52 | 22.6 |
| | 351-500 | | | 30 | 13.6 |
| | >500 | | | 102 | 44.3 |

## Factors associated with anemia status of adult HIV/AIDS patients

The bivariate analysis reveals that sex, residence, educational status, occupation, alcohol drinking habit, clinical stage, CD4 count and drug regimen were associated with the anemia status of adult HIV/AIDS patients. However, after adjusting for covariates, multivariate analysis indicates that alcohol drinking habit, clinical stage, CD4 count and drug regimen were identified to be significantly associated with the anemia status of adult HIV/AIDS patients.

The odds of having anemia was 2.1times (AOR: 2.1, 95% CI: 1.1, 4.0) higher than those patients who drank alcohol compared to those who didn't drink alcohol. Whereas patients

in the clinical stage III were 10.7 (AOR: 10.7, 95% CI: 1.8, 64.0) times more likely to have anemia than those who were on clinical stage I. The odds of anemia were 1.9 times (AOR: 1.9, 95% CI: 1.1, 4.2) higher in those patients with CD4 count less than 200 were compared to those with above 500 CD4 count. Patients on Zidovudine (AZT) containing drug regimen were 11.3 times (AOR: 11.3, 95% CI: 2.4, 54.4) more likelihood to have anemia than compared to TDF based ART regimen (Table 4).

**Table 4:** Bivariate and multivariate binary logistic regression analysis for factors associated with anemia status of adult HIV/AIDS patients on ART follow up at Woreta health center, South gondar zone, 2020.

| Variables | | Anemia status | | Odds ratio | P- value | |
|-----------|---|---------------|---|------------|----------|---|
| | | Anemic | Non anemic | COR (95% CI) | AOR (95% CI) | |
| Age | 18-30 | 15 (-17.2) | 50 (35.0) | 1 | 1 | |
| | 31-45 | 47 (54.0) | 73 (51.0) | 6.7 (0.6,78.7)* | 10.5 (0.7,163.6) | 0.094 |
| | 46-60 | 23 (26.4) | 19 (13.3) | 3.1 (0.3,35.2) | 4.1 (0.3,57.7) | 0.302 |
| | > 60 | 2 (2.3) | 1 (0.7) | 1.7 (0.4,19.7) | 1.4 (0.1,22.2) | 0.799 |
| Gender | Male | 33 (37.9) | 39 (27.3) | 1 | 1 | |
| | Female | 54 (62.1) | 104 (72.7) | 0.6 (0.4,1.1)* | 0.6(0.2,1.5) | 0.247 |
| Marital status | Married | 33 (37.9) | 71 (49.7) | 1.9 (0.8,4.6) | IS | |
| | Unmarried | 54 (-62.1) | 72 (50.3) | 1 | | |
| Residence | Urban | 70 (-80.5) | 111 (77.6) | 1 | 1 | |
| | Rural | 17 (19.5) | 32 (22.4) | 0.8 (0.4,1.6)* | 0.5 (0.1,3.1) | 0.428 |
| Educational status | Unable to read and write | 40 (46.0) | 81 (56.6) | 0.9 (0.3,2.5)* | 1.0 (0.2, 5.7) | 0.971 |
| | Able to read and write | 3 (3.4) | 5 (3.5) | 0.7 (0.1, 4.0) | 1.0 (0.1,11.0) | 0.971 |
| | Primary school | 22 (25.3) | 31 (21.7) | 0.6 (0.2,1.8) | 0.6 (0.1,3.2) | 0.486 |
| | Secondary school | 16 (18.4) | 12 (8.4) | 0.3 (0.1, 1.1)* | 0.3 (0.1,1.8) | 0.182 |
| | Diploma and above | 6 (6.9) | 14 (9.8) | 1 | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| Occupation | Gov't employee | 16 (18.4) | 23 (16.1) | 1 | 1 | |
| | Farmer | 20 (23.0) | 43 (30.1) | 0.8 (0.3,1.9) | 0.2 (0.01,1.4) | 0.094 |
| | Merchant | 23 (26.4) | 25 (17.5) | 1.2 (0.5,2.6) | 0.6 (0.2,2.0) | 0.428 |
| | House wife | 11 (12.6) | 21 (14.7) | 0.6 (0.3,1.4)* | 0.8 (0.2,2.5) | 0.7 |
| | Others | 17 (19.5) | 31 (21.7) | 1.1 (0.4,2.7) | 1.7 (0.2,6.1) | 0.854 |
| Shoe wearing habit | Yes | 79 (90.8) | 125 (87.4) | 1 | IS | |
| | No | 8 (9.2) | 18 (12.6) | 1.4 (0.6,3.4) | | |
| Alcohol drinking | Yes | 35 (40.2) | 47 (32.9) | 1.4 (0.8, 2.4)* | 2.1 (1.1,4.0)** | 0.037 |
| | No | 52 (59.8) | 96 (67.1) | 1 | 1 | |
| Chewing khat | Yes | 1 (1.1) | 3 (2.1) | 0.543 (0.056,5.300) | IS | |
| | No | 86 (98.9) | 140 (97.9) | 1 | | |
| Meals per day | Once | 1 (1.1) | 3 (2.1) | 0.333 (0.023, 4.736) | IS | |
| | Twice | 23 (26.4) | 32 (22.4) | 0.588 (0.060,5.777) | | |
| | Three times | 59 (67.8) | 104 (72.7) | 0.464 (0.045, 4.746) | | |
| | Above 3 times | 4 (4.6) | 2(2.8) | 1 | | |
| Eat meat | Yes | 67 (77.0) | 116 (81.1) | 1 | IS | |
| | No | 20 (23.0) | 27 (18.9) | 0.780 (0.4, 1.5) | | |
| BMI (kg/m$^2$) | <18.5 | 41 (47.1) | 49 (34.3) | 0.9 (0.3, 2.9) | IS | |
| | 18.5-24.9 | 41 (47.1) | 87 (60.8) | 1.5 (0.5, 5.1) | | |
| | >25.0 | 5 (5.7) | 7 (4.9) | 1 | | |
| Clinical stage | Stage I | 25 (28.7) | 34 (23.8) | 1 | 1 | |
| | Stage II | 15 (17.2) | 43 (30.1) | 1.020 (0.314,3.312) | 4.1 (0.7,23.6) | 0.115 |
| | Stage III | 41 (47.1) | 58 (40.6) | 2.2 (0.641,7.215)* | 10.7 (1.8,64.0)** | 0.009 |
| | Stage IV | 6 (6.9) | 8 (5.6) | 1.061 (0.342, 3.289) | 3.9 (0.7,21.0) | 0.112 |
| CD4 count | <200 | 19 (21.8) | 27 (18.9) | 1.8 (1.1,2.7)* | 1.9 (1.1,4.2)** | 0.024 |
| | 200-350 | 22 (25.3) | 30 (21.0) | 0.8 (0.4, 1.5) | 0.9 (0.3,2.3) | 0.084 |
| | 351-500 | 9 (10.3) | 21 (14.7) | 1.3 (0.6, 3.2) | 1.4 (0.4,4.8) | 0.078 |
| | >500 | 37 (42.5) | 65 (45.5) | 1 | 1 | - |
| Drug regimen | D4T+3TC+NVP | 9 (10.3) | 50 (35.0) | 1 | 1 | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | D4T+3TC+EFV | 6 (6.9) | 13 (9.1) | 1.845 (0.516,6.601) | 6.0 (0.8,43.5) | 0.692 |
| | AZT+3TC+NVP | 22 (25.3) | 29 (20.3) | 7.8 (2.0,30.0)* | 11.3 (2.4,54.4)** | 0.002 |
| | AZT+3TC+EFV | 10 (11.5) | 5 (3.5) | 3.0(0.7,13.6)* | 1.4 (0.3,7.2) | 0.075 |
| | TDF+3TC+ EFV | 33(37.9) | 41(28.7) | 0.700(0.145, 3.370) | 0.9 (0.1,6.6) | 0.911 |
| | TDF+3TC +NVP | 7 (8.0) | 5 (3.5) | 1.739 (0.505,5.985) | 1.3 (0.3,6.9) | 0.723 |
| Cotrimoxazole treatment | Yes | 76 (87.4) | 125 (87.4) | 0.995 (0.446,2.220) | IS | |
| | No | 11 (12.6) | 18 (12.6) | 1 | | |

**Note:** *COR written in bold indicates bivariate analysis with p<0.25; **indicates significant at P<0.05 in multivariate analysis; IS=Insignificant.

# DISCUSSION

Anemia is a frequent complication of people living with HIV/AIDS who are taking ART drug and associated with an increased risk of death. Many studies have reported that anemia is major global public health issue among adult HIV/AIDS patients. The burden of anemia is highly pronounced in developing countries, particularly in Sub-Saharan African, including Ethiopia. Therefore, this study was aimed to assess the prevalence and associated factors of anemia among adult HIV/AIDS patients who are on ART follow up at Woreta health center, Northwest Ethiopia.

Based on this study, the overall prevalence of anemia was 37.8% which was in line with findings from Minilik II Hospital, Addis Ababa (37.4%), Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia (34.6%) and northwest Ethiopia (35%). This figure was however higher than that of studies done in Eastern India (16.2%), Jimma (23.1%), Ghana (23.8%), North Eastern Nigeria (24.3%) and Rwanda (29%). In contrast, this finding was lower than that of studies conducted in China (51.9%), Arba Minch (52.3%) and Tanzania (77.4%). This variation in the burden of anemia could be explained by the difference in study settings as well as disparities in socio-demographic characteristics, types of diet, drug regimen and CD4 count.

Besides, the present study demonstrated that 57.5%, 36.9% and 5.7% of anemic patients had mild, moderate, and severe types of anemia respectively. This report is nearly parallel with the study done in Jimma University specialized hospital in which 72.2%, 25.9%, and 1.9% of anemic HIV/AIDS patients had mild, moderate, and severe anemia respectively. The figure is however comparably higher than the finding of a study conducted in Arba Minch hospital and health center, which indicated that about 28.1%, 22.9% and 1.3% of patients were mild, moderate and severe anemia, respectively.

This study also determined factors associated with anemia among adult HIV/AIDS patients and demonstrated that alcohol drinking, advanced clinical stage HIV/AIDS, low CD4 count and AZT based ART drug regimen were identified to be major risk factors associated with the anemia in adult HIV/AIDS patients.

This study noted that patients who drink alcohol were more likely to be anemic compared to those who didn't drink alcohol. This finding is inconsistent with a cross sectional study conducted at the university of Calabar teaching hospital, Calabar, Nigeria, in which alcohol drinking is not significantly associated with the anemia status of HIV/AIDS patients.

Besides, those patients who had clinical stage III HIV/AIDS have more likelihood to be anemia than those who had clinical stage I HIV/AIDS. This is consistent with the study by Camocho, et al. that reported the risk of developing anemia as well as its prevalence increase as the disease advances. This could be due to as the disease severity the risk of inflammation and opportunistic infection increase and pose the patient to anemia. In contrary, the study by Zerihun, et al., showed that the clinical stage III of HIV/AIDS patients are not significantly associated with the anemia status.

Furthermore, this study indicated that CD4 count is one of the major risk factors for anemia. The odds of anemia were higher in those patients with CD4<200 when compared to those with CD4>500. This result is consistent with the study done in done in Dire Dawa, Ethiopia, and Zewuditu memorial hospital, Addis Ababa, Ethiopia, Debre Tabor Town, Ethiopia, Nigeria and Willig, et al. This result was also supported by a study of Camocho et al who confirmed that the presence and severity of anemia varies due to the immune status or CD4 cell levels [14,15].

Patients who were on Zidovudine (AZT) based drug regimen were more likely to be anemic than those who were on Tenofovir (TDF) based ART regimen. This finding is supported by studies done in Ethiopia, Rwanda, and Iran. Several studies in developed countries have also shown that AZT alone and AZT based HAART regimen is linked with major reduction of Hb level and neutrophil number. This is due to AZT suppresses the bone marrow, which is erythropoietic and hemopoietic site, and leads to a low erythrocyte and other blood cells production in the bone marrow [16,17]. A study done by Willig et al., reported that AZT related anemia usually occurs within three months after initiation of therapy, which is consistent with the lifespan of erythrocytes and the replenishing time by the bone marrow. The same study also added that high dosage and increased

treatment duration of AZT were the risk factors for developing anemia though the current study not found duration of HAART treatment as risk factor [18]. However, the current study finding is consistent with in the study conducted in Nigeria, which found HAART duration was not risk factors for anemia.

Unlike the previous studies conducted in Ethiopia, the current study assessed behavioral characteristics such as smoking status, alcohol drinking, and khat chewing effects on anemia. In addition, shoe wearing habits and Cotrimoxazole treatment were also considered. This study demonstrated that alcohol drinking and the advanced clinical stage of the disease were identified as significant risk factors for anemia in HIV/AIDS patients compared to other studies conducted in Ethiopia.

## CONCLUSION

The prevalence of anemia in the study area was high and it has a public health importance among adult HIV/AIDS patients on ART at Woreta Health center. Thus, we recommend serious follow up considering the anemia in HIV patients.

### Limitation of the study

Since it was a cross sectional study design, it couldn't show temporal relation between cause and effect.

The study might not be representative to the whole HIV positive population or sufficient to generalization as it was conducted in the institution.

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