Nutritional status and associated factors among adult on Antiretro-viral therapy in Gamo zone public health facilities, southern Ethiopia

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Abstract

Introduction:
Nutritional status is continuing a major public health concern in low income countries. Now a day, sub-Saharan African countries are facing double burden of malnutrition. There are evidences on underweight among general population, but limited evidences on overweight/obesity among people living with HIV. Thus, this study is designed to assess nutritional status and associated factors among adult on antiretroviral therapy.

Objective:
To assess nutritional status and associated factors among adults on antiretroviral therapy in Gamo zone public health facilities, Southern Ethiopia.

Methods:
Institution-based cross-sectional study was conducted from March 10 to April 10, 2022, among systematically selected 414 adults on antiretroviral therapy. The data were collected by using a structured interviewer-administered questionnaire, patient record review, and physical measurements. Multinomial logistic regression model was used to assess the association between dependent and independent variables. A p-value < 0.05 with its 95% CI was considered as a statistically significant and interpreted accordingly.

Results:
The magnitude of Underweight and Overweight/Obese were 28.3% (95% CI: 24.0-32.9)) and 13.3% (95% CI: 10.2–17.0)) respectively. Divorced (AOR = 3.71(1.345–7.496)), not finishing CPT (AOR = 2.96(1.41–6.231)), taking < 5 food groups (AOR = 2.87(1.574–5.266)), food insecure (AOR = 2.69(1.163–6.234)), and chewing khat (AOR = 2.78(1.09–7.114)) were significantly associated with underweight as compared to normal. Whereas, drinking alcohol (AOR = 1.61(1.09–3.61)), and monthly income of < 2000 ETB (AOR = 0.33(0.115–0.954)) were significantly associated with overweight/obese as compared to normal among adults on antiretroviral therapy.

Conclusion:
The magnitude of underweight among adult on Antiretro viral therapy is higher and magnitude of overweight/obese among adult on Antiretro viral therapy is lower as compared from most of the previous studies. Divorce, taking < 5 food groups, food insecure and chewing khat were factors for underweight, and income and alcohol drinking were factors for overweight/obese. Therefore, this finding shows the need to implement nutritional supplement and health education to improve the nutritional status of adults living with HIV in the study area.
Introduction

According to the World Health Organization (WHO), more than 33 million people have died of HIV-related illnesses including malnutrition, since the occurrence of the pandemic. In 2020 around 680 000 (480 000 – 1.0 million) people died of HIV-related illnesses worldwide(1).

Food and nutrition are fundamental elements for the continuity of life and normal health, growth, and development. But it is a prolonged problem for African and some Asian country’s to serve and provide adequate and safe food(1).

Malnutrition refers to both undernutrition and overnutrition. It attracts global interest which affects 33.3% of people living in the world (2). Human immune virus (HIV) infection and malnutrition are interrelated entities and one exacerbates the other. Asymptomatic HIV positive person requires 10% more energy and symptomatic HIV positive person requires 20–30% more energy compared to HIV negative individuals of the same age sex and physical activity level. HIV infection increases the risk of undernutrition by reducing food intake and impairing nutrient absorption and metabolism due to diarrhea and cytokine activity. It also changes body utilization and storage of nutrients(3).

The side effect of Anti-Retroviral Therapy (ART) drugs may make patients reduce food intake and develop depression and may have a loss of appetite, nausea, vomiting, diarrhea that can change the nutritional status(4). Malnutrition may cause immunity reduction, which aggravates the effect of HIV, and leads to more rapid progression to acquired immune deficiency syndrome (AIDS), and this is the reason why malnutrition is considered as both a contributor and the effect of HIV (5).

On the other hand, Obesity is becoming a problem for HIV-infected people in developed countries due to progressive economic development which leads to nutrition transition and several people are adopting a modern lifestyle, less physical inactivity, and consuming high-dense food(6). Weight gain among ART patient are common and considered as a side effect of regimens (7), while for others, it was considered to be an immunological response (8).

Globally, nearly 795 million people had undernutrition and around 462 million adults were underweight and mostly occur in low income and developing countries(9). Sub-Saharan Africa (SSA) has also higher prevalence of undernutrition in the world, in which 23.2% of its population were affected (10). A meta-analysis done in SSA countries reported the pooled prevalence of HIV-related undernutrition was 10.3% (10). Studies done in developing countries also showed that the prevalence of undernutrition among HIV-infected adults ranges from 8.9% in South Africa to 42.9% Ethiopia (11, 12).

Among the United States of America HIV patients who were on ART, 22% were affected with Overweight and 5% were affected with obesity(9). Sub Saharan African (SSA) is a state of malnutrition and characterized by a double burden of malnutrition with a high prevalence of undernutrition and increasing obesity along with diet-related non-communicable diseases (13).

Demographic Health Survey study of 32 SSA countries stated that the pooled prevalence of overweight was 15.9%, with the least value in Madagascar 5.6% and the highest in Swaziland 27.7%, likewise, the prevalence
of obesity was also lower in Madagascar 1.1% and higher in Swaziland 23.0%(14). In our country Ethiopia, the pooled prevalence of overweight/obesity was found was 3.58%(15).

Weight loss that ends with the wasting syndrome have a significant impact HIV-related infections and diseases (16). Unintentional weight loss and wasting can contribute to morbidity and mortality in HIV infected population. A study showed that loss of five to ten percent of initial body weight can quadruple the risk of death in HIV-infected people(17).

Study showed that nearly 52% Undernourished HIV patient had opportunistic infections (OI), and nearly one-third of participants had severe immunodeficiency(18). Around 25% of deaths among HIV-infected peoples taking ART are due to AIDS and undernutrition, while up to 50% are secondary to non-communicable causes (19).

A meta-analysis of cohort studies showed that undernutrition significantly increased the risk of mortality among adults living with HIV, while severely undernourished adults living with HIV were at higher risk of death as compared to mildly undernourished adults living with HIV. Furthermore, the pooled estimates of cohort studies revealed that undernutrition significantly increased the risk of developing tuberculosis among adults living with HIV (20).

Low Body Mass Index (BMI) score was also significantly related to death in HIV infected population. Malnutrition and HIV/AIDS together affect the immune system of many Ethiopians. In 2020 our country Ethiopia was one of the 20 countries which have the highest mortality due to HIV/AIDS-related illness(21).

Overweight and obesity are risk factors for diabetes, hypertension, cardiovascular disease, and cancer in the general population that increasingly affect HIV-infected people(22). Moreover, obesity seems to have a detrimental effect on immune recovery after ART initiation(23). Among non-obese individuals during the initiating ART, around 18.3% were developing obesity within an average of 2 years of ART initiation. 1.9 years from ART initiation. The greatest risk factor for developing such a condition was having an Integrase Strand Transfer Inhibitor (INSTI) as the most-used ART core drug class (24).

National multisectoral policies are trying to implement the Lancet framework of nutrition-specific and nutrition-sensitive interventions with a major focus on reducing undernutrition at the beginning and later emphasizing to obesity in Africa is growing (25). Ethiopian Ministry of Health has also started to implement National Guidelines for HIV/AIDS and Nutrition since 2007. Ethiopian ministry of health also acknowledge and include nutritional management in HIV treatment guideline(26).

Even though treatment protocol was improved, malnutrition can affect the effectiveness of the drug, the survival status of the patient, and increase the risk of non-communicable disease(27). And also different intervention and proclamation were implemented to improve the nutritional status of HIV/AIDS patients, the problem is still evident and it is a major public health problem. In addition to this, the emergence of obesity/overweight among HIV/AIDS patients in many developing countries is also an emerging public health problem.

There is also a shortage of data in the context of Ethiopia and specifically in the southern parts of the country. Moreover, important variables like a history of OI, regime type, comorbid disease, drug adherence, presence of
food supplement at facility level and some behavioral (smoking, khat chewing, physical activities and alcohol consumption) and were not well studied so far.

The aim of this study was, therefore, to assess nutritional status and determine its associated factor among adults on Antiretro-viral therapy in Gamo zone public health facilities.

Methods And Materials

Study design, area and period

Institution based cross-sectional study design was employed in public health facilities of Gamo zones. It is one of the 15 zonal administrations of south nation nationality and people region. It has a total area of 7, 581, 4 square kilometers. This consists of 15 Woredas and one city administration. The administrative center of the Gamo zone is Arba Minch town. Arba Minch is located about 454km south of Addis Ababa, and 275km far from Hawassa. Gamo zone has six public hospitals and 57 Health centers. Out of those 11 health facilities are providing ART service (three hospital and eight health centers). The total population of the zone is around 2,019687 from this there are around 3339 adult ART patients under follow-up (Gamo zone health administration report). The data was collected from March 10 to April 10, 2022.

Populations

All adult patients on ART in public health facilities of Gamo zones, southern Ethiopia were Source population. All adult patients on ART who had regular follow up in the health facilities and visit the health facilities during the data collection period were Study population. Pregnant and lactating women (six month of postpartum) were excluded since our anthropometric measurement is BMI and it is not applicable for those population groups. And incomplete medical records which miss more than 20% of the independent variables.

Sample size determination and sampling techniques

Sample size was determined by using a single population proportion with 95% level of confidence and 5% margin of error.

\[
 n_0 = \frac{\left(\frac{Z^2}{2}\right)p(1-p)}{d^2}
\]

Where; \( n_0 \) = Minimum sample size
Z = 1.96, Normal deviant at the portion of 95% confidence interval two-tailed test
P = proportion of outcome variable.

\( d = \) margin of error acceptable is taken as \( 5\% = 0.05 \)
• **For undernutrition:** The magnitude of undernutrition among patients on ART is 42.9% from a study conducted in the eastern zone of Tigray, Northern Ethiopia (12).

\[ z = (1.96), z^2 = 3.8416, n = (3.84) (0.429) (1-0.429) / (0.05)^2 = 376, n = 376 \]

For overnutrition/obese: The magnitude of overnutrition/obese among patients on ART is 22.1% from a study conducted in Addis Ababa (28).

\[ n = (3.8416) (0.21) (0.79)/0.0025 = 265, n = 265 \]

Therefore, the maximum sample size for this study is taken. Finally by adding 10% none response rate the total sample size is 414.

**Sampling Techniques**

Gamo zone has eleven health facilities which are providing ART service. All health facilities were included in the study because currently all health facilities are using appointment spacing model to which clients can return to the health facility after six months that can reduce patient flow and difficult to get optimal study population in one month study period.

The total sample size was proportionally allocated to the selected health facilities. The last one month registration was used to see patient flow and to predict the source population. Finally, a systematic random sampling technique was used to select the study participants. Per each health facilities, three Ks was calculated by dividing the number of the population (N) by their respective number of the sample (n) based on a one-month report.

**Data collection instruments and procedures**

Data were collected by health care providers who are working in ART clinic. Structured interviewer-administered questionnaire; patient record review and anthropometric measurement were used. The questionnaire has four parts: socio-demographic and economic factors, clinical characteristics, anthropometric measurements, behavioral related characteristics’ and data related to dietary factors. The data was collected by using kobo collect (smartphone for data collection) through face-to-face interviews. Check list was developed to assess clinical related factors from patient records.

Physical activity level was assessed by using Global Physical Activity Questionnaire Analysis Guide. Physical activity (or inactivity) was described to estimate a population's mean or median physical activity using continuous indicators by metabolic equivalent (MET) minutes per week or time spent in physical activity. It was measured by WHO recommendations on physical activity for health, Throughout a week, including activity for work, during transport and leisure time, adults should do at least 150 minutes of moderate-intensity physical activity OR 75 minutes of vigorous-intensity physical activity OR an equivalent combination of moderate- and vigorous-intensity physical activity achieving at least 600 MET-minutes(28).
The household food insecurity status of participants was assessed by using Household Food Insecurity Access Scale (HFIAS), the tool developed by Food and Nutrition Technical Assistance (FANTA) project and adapted to individual level. Each question is within a recall period of 30 days. The respondents were first asked an occurrence question that is, whether the condition in the question happened at all in the past 4 weeks (yes/no). If the respondent answer was “yes” to an occurrence question, a frequency-of-occurrence was asked to determine whether the condition happened rarely (once or twice), sometimes (3–10 times), or often (more than 10 times) (29, 30).

Dietary Diversity Score (DDS) was determined by asking the respondents to list all the food items consumed in the previous 24 hours preceding the assessment date, starting with the first food consumed the previous morning. If a mixed dish was eaten, participants were asked about all the ingredients of the dish. Once the recall was finished, participant was probed for food groups to ask for food that was not mentioned. The reported food items were categorized into fourteen food groups: starchy staples, dark green leafy vegetables, white tubers and roots, vitamin A-rich fruits and vegetables, other fruits and vegetables, organ meat, meat and fish, flesh meats, fishes, eggs, legumes, nuts and seeds, milk and milk product and oils and fats. The DDS was calculated as the sum of the food groups consumed over 24 hours (31).

Cigarette smoking, khat chewing, and alcohol consumption were assessed using a structured questionnaire adopted from a STEPS survey on non-communicable diseases risk factors in Ethiopia and WHO STEPwise approach to chronic disease risk factor surveillance (32).

**Anthropometric measurements**

Height and weight were measured according to the WHO steps procedure. A stadiometer (Seca Germany) was used to measure the height of the study participants to the nearest 0.1 cm with the subjects positioned at the Frankfurt Plane and the four points (heel, calf, buttocks, and shoulder) touching the vertical stand of the stadiometer and their shoes taken off. Before starting the measurement, the stadiometer was checked using calibration rods. It was measured three times and the average was taken.

An electric-powered digital scale (Seca Germany) was used to measure the weight to the nearest 0.1 kg with the subjects wearing light clothes and without shoes. Before starting the measurements, the tools were calibrated. A stone of weight 15 kg was used to check the validity of the scale every morning. The weight was measured three times and the average was taken. The coefficient of variation within data collectors was calculated at the time of training and it was below 3%. BMI was calculated as the ratio of weight in kilograms (kg) to the square of height in meters (m\(^2\)).

**Study Variable**

**Dependent Variable**

Nutritional status (Underweight, Normal weight, Overweight/Obese)

**Independent Variables**
**Socio-demographic and economic variables:** Age, Sex, Religion, Marital status, Occupational status, Educational status, place of residence and monthly income.

**Clinically related factors:** Duration on ART, Recent viral load, Recent CD4, History of OI in the last six month, Regime type, drug adherence, WHO clinical staging, comorbidity, IPT and CPT.

**Dietary related factors:** Household food insecurity, Dietary diversity score and Food supplementation.

**Behavioral related factors:** Alcohol consumption, Cigarette smoking, Khat chewing, and Physical activity.

**Operational Definitions**

**Regular follow:** patients who are taking medication and registered in the ART cohort chart of the health facilities.

**Poor drug adherence:** taking less than 85% of doses per month (≥9 dose missed per month for those who are taking twice per day and ≥5 doses per month for those who are taking once per day)(26).

**Fair drug adherence:** taking 85-94% of dose per month (4-9 doses missed per month for those who are taking twice per day and 3-4 dose per month for those who are taking once per day)(26).

**Good drug adherence:** taking greater than or equal to 95% of doses per month (<3 dose missed per month for those who are taking twice per day and <2 doses per month for those who are taking once per day)(26)

**Alcohol Consumption:** An individual will be taken as a “current drinker” if he/she drink more than 21 standard drinks/week for men and more than 14 standard drinks/week for women in the past 30 days(33).

One standard drink of alcohol is equivalent to “Tella” (one glass “borde” or “cheka” or “korefe”) or “Tej” (1/2 “Berele”) or “Areke”(one “melkiya”) or regular Beer (330 mL beer or one bottle) or Draft (one “single”), or Spirits (30 mL of Whisky or Gin or Uzo or Vodka), or one glass of wine (120 mL), which is generally defined as the net alcohol content of a standard drink is approximately 10 g of ethanol(34).

**Cigarette Smoking:** An individual will be taken as a “current cigarette smoker” if she/he had smoked a minimum of one cigarette (the manufactured type like Nyala, Rothman, etc.) per week within the last 30 days (27).

**Khat Chewer:** An individual will be taken as “current khat chewer” if he/she had chewed at least one bundle of khat per week within the last 30 days (27).

**Dietary diversity:** Good dietary diversity is considered when an individual consuming more than five food groups out of nine food groups(35).

**Physically activity:** Good physically activity is considered when and individual have An equivalent combination of moderate- and vigorous-intensity physical activity achieving at least 600 MET-minutes per week(28).

**Food security:** Food insecurity is considered when the individual HFIAS score is >1(29).
High health risk: Individual whose waist to hip ratio value is $\geq 1.0$ for men and $\geq 0.85$ for women (36).

Low health risk: Individual whose waist to hip ratio value is $< 0.9$ for men and $< 0.80$ for women (36).

Nutritional status: underweight when BMI is less than $18.5 \text{ kg/m}^2$, Overweight when BMI is between $25.0 \text{ kg/m}^2$ to $30.0 \text{ kg/m}^2$, Obese when BMI is above $30.0 \text{ kg/m}^2$, overweight or obese (BMI $\geq 25 \text{ kg/m}^2$) and normal BMI between $18.5 \text{ kg/m}^2$ to $24.9 \text{ kg/m}^2$ (37).

Data Quality Assurance

Before data collection, the questionnaire was first prepared in English and translated to the local language, and then translated back to English to ensure its consistency. Five percent of questionnaire was pretested at sawula general hospital. The data collectors and supervisors (three health officers) took two days of training about the objective, procedure, tool, and ethics of the study. During the data collection period, the Principal investigator and supervisor made ongoing supervision and review all the completed questionnaires to ensure completeness and consistency of the information collected. After data collection, all the questionnaires were revised, cleaned, and checked its completeness.

Data Processing and Analysis

Data were recorded in the mobile KOBO tool box application and exported to the SPSS version 25 software package for further management and analysis. DDS was calculated based on the number of food groups consumed by an individual over the past 24 hours (31, 38). Using HFIAS, food security was categorized into two categories (29).

Descriptive statistics were used to describe the distribution of independent variables. Before running the multinomial logistic analysis chi-square assumption were checked for all variables. Variance inflation factor was calculated to check the collinearity between independent variables. The data were checked for outliers for age, weight, height, monthly income, viral load, CD4 count, waist circumference and hip circumference by drawing boxplot then there were no outliers. The presence of a relationship between the dependent variable and combination of independent variables is checked based on the statistical significance of the final model chi-square in the "Model Fitting Information". Goodness of fit of the statistical model was checked by Pearson chi-square based on a p-value greater than 0.05. The association between each independent variable and the dependent variable was checked using Bivariable multinomial logistic regression analysis. After that Independent variables which showed association at the Bivariable level with p-values of less than 0.25 were considered using multivariable multinomial logistic regression analysis. Finally, statistical significant association was declared at a p-value of $< 0.05$. The results were presented in odds ratios and 95% confidence intervals.

Data Dissemination

The result of this study will be submitted to Arba Minch University, Collage of Medicine and Health Sciences, School of Public Health. Furthermore, we will submit a copy of the research finding to the zones health department, to the study area hospitals, present at different seminars, and will be published in reputable journals and also available at libraries of Arba Minch University, Nechisar campus.
Result

Socio demographic and Economic characteristics of adult on ART in Gamo zone public health facilities

A total of 414 adults who are on ART were included and making a response rate of 100% and 214 (51.7%) of them were males. Out of the total respondent 333 (80.4%) of the respondent were from hospital and the rest were from health center. And also 218 (52.7%) of the respondent were belong to the age groups of 30–44 years, while 80 (19.3%) were between 18 and 29 years.

Out of those who responded, 201 (48.6%) of the respondents belong to orthodox Christians, while 45(10.9%) of the respondents represent Muslim. In this study, 235 (56.80%) were married and 56 (13.5%) were divorced. Regarding to the educational status of respondents, 182 (44%) were able to read and write; on the other hand, 68 (16.4%) were not able to read and write. The occupational status of respondents in this study was 132 (31.9%) daily labor and only 39 (9.4%) non-governmental employee. On the other hand 298 (72%) of the respondent were from urban residence and 269 (65%) of the respondent had an average monthly income of more than 2000ETB (Table 1).
Table 1
Socio demographic and Economic characteristics of adult on ART in Gamo zone public health facilities, Southern Ethiopia 2022.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18–29</td>
<td>80</td>
<td>19.3%</td>
</tr>
<tr>
<td></td>
<td>30–44</td>
<td>218</td>
<td>52.7%</td>
</tr>
<tr>
<td></td>
<td>≥ 45</td>
<td>116</td>
<td>28%</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>214</td>
<td>51.7%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>200</td>
<td>48.3%</td>
</tr>
<tr>
<td>Religion</td>
<td>Orthodox</td>
<td>201</td>
<td>48.5%</td>
</tr>
<tr>
<td></td>
<td>Protestant</td>
<td>168</td>
<td>40.6%</td>
</tr>
<tr>
<td></td>
<td>Muslim</td>
<td>45</td>
<td>10.9%</td>
</tr>
<tr>
<td>Occupational status</td>
<td>Daily labor</td>
<td>132</td>
<td>31.9%</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>42</td>
<td>10.1%</td>
</tr>
<tr>
<td></td>
<td>Government employee</td>
<td>88</td>
<td>21.3%</td>
</tr>
<tr>
<td></td>
<td>Housewife</td>
<td>61</td>
<td>14.7%</td>
</tr>
<tr>
<td></td>
<td>Merchant</td>
<td>52</td>
<td>12.6%</td>
</tr>
<tr>
<td></td>
<td>Non-governmental employee</td>
<td>39</td>
<td>9.4%</td>
</tr>
<tr>
<td>Marital status</td>
<td>Married</td>
<td>235</td>
<td>56.7%</td>
</tr>
<tr>
<td></td>
<td>Widowed</td>
<td>64</td>
<td>15.5%</td>
</tr>
<tr>
<td></td>
<td>Divorced</td>
<td>56</td>
<td>13.5%</td>
</tr>
<tr>
<td></td>
<td>Never married</td>
<td>59</td>
<td>14.3%</td>
</tr>
<tr>
<td>Educational status</td>
<td>Not read and write</td>
<td>68</td>
<td>16.4%</td>
</tr>
<tr>
<td></td>
<td>Read and write only</td>
<td>182</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td>Formal education</td>
<td>164</td>
<td>39.6%</td>
</tr>
<tr>
<td>Place of residence</td>
<td>Urban</td>
<td>298</td>
<td>72%</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>116</td>
<td>28%</td>
</tr>
<tr>
<td>Average monthly income</td>
<td>&lt; 2000 ETB</td>
<td>145</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>≥ 2000 ETB</td>
<td>269</td>
<td>65%</td>
</tr>
</tbody>
</table>

Note: ETB = Ethiopian birr;
Clinical characteristics of adult on ART in Gamo zone public health facilities

Out of the total respondent 237 (57.2%) were taking ART medication for more than five years. While 281 (67.9%) had good drug adherence and 55 (13.3%) had fair drug adherence. In this study, 328 (79.2%) were belongs to at WHO clinical stage I, and 24 (5.8%) were stage II, 139 (33.6%) were diagnosed with opportunistic infection within the last six months, out of those 79 (56.8%) were diagnosed as TB and 4 (2.9%) were other OI. and, 313 (75.6%), had CD4 count of $\geq 350$ cells/mm$^3$ and 178 (43.0%) of the participant had viral load count $\leq 50$ copies/mm$^3$ of blood and 102 (24.6%) had $\geq 1000$ copies/mm$^3$ of blood.

This study also showed that 349 (84.3%) of the respondent were on $1j$ (TDF + 3TC + DTG) drug regimen type and 13 (3.1%) were on other regimen type. And 321 (77.5%) were finished CPT, 15 (03.6%) were not taking CPT. Similarly 326 (78.7%) were finished IPT and 39 (9.4%) were no took IPT. Regarding to other comorbid diseases 38 (9.2%) had other comorbidity and out of those 16 (42%) had diabetes militias and 4 (10.35%) had kidney disease (Table 2).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration on ART</td>
<td>&lt; 5 years</td>
<td>177</td>
<td>42.8%</td>
</tr>
<tr>
<td></td>
<td>≥ 5 years</td>
<td>237</td>
<td>57.2%</td>
</tr>
<tr>
<td>WHO clinical staging</td>
<td></td>
<td>328</td>
<td>79.2%</td>
</tr>
<tr>
<td></td>
<td>/</td>
<td>62</td>
<td>15.0%</td>
</tr>
<tr>
<td>Recent CD4 count</td>
<td>&lt; 350</td>
<td>101</td>
<td>24.4%</td>
</tr>
<tr>
<td></td>
<td>≥ 350</td>
<td>313</td>
<td>75.6%</td>
</tr>
<tr>
<td>Recent viral load</td>
<td>≤ 50</td>
<td>178</td>
<td>43.0%</td>
</tr>
<tr>
<td></td>
<td>50-1000</td>
<td>134</td>
<td>32.4%</td>
</tr>
<tr>
<td></td>
<td>≥ 1000</td>
<td>102</td>
<td>24.6%</td>
</tr>
<tr>
<td>History of OI in the last six month</td>
<td>Yes</td>
<td>139</td>
<td>33.6%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>275</td>
<td>66.4%</td>
</tr>
<tr>
<td>Current regimen type</td>
<td>TDF + 3TC + DGT (1j)</td>
<td>349</td>
<td>84.3%</td>
</tr>
<tr>
<td></td>
<td>TDF + 3TC + EFV (1f)</td>
<td>52</td>
<td>12.6%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>13</td>
<td>3.1%</td>
</tr>
<tr>
<td>Drug adherence level</td>
<td>Good</td>
<td>281</td>
<td>67.9%</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>55</td>
<td>13.3%</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>78</td>
<td>18.8%</td>
</tr>
<tr>
<td>Isoniazid preventive therapy</td>
<td>Finished</td>
<td>326</td>
<td>78.8%</td>
</tr>
<tr>
<td></td>
<td>Taking</td>
<td>49</td>
<td>11.8%</td>
</tr>
<tr>
<td></td>
<td>Not taking</td>
<td>39</td>
<td>9.4%</td>
</tr>
<tr>
<td>Cotrimoxazole preventive therapy</td>
<td>Finished</td>
<td>321</td>
<td>77.5%</td>
</tr>
<tr>
<td></td>
<td>Taking</td>
<td>78</td>
<td>18.9%</td>
</tr>
<tr>
<td></td>
<td>Not taking</td>
<td>15</td>
<td>3.6%</td>
</tr>
<tr>
<td>Other comorbidity</td>
<td>Yes</td>
<td>38</td>
<td>9.2%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>376</td>
<td>90.8%</td>
</tr>
</tbody>
</table>

Note: ART = Antiretro viral therapy, WHO = World health organization, OI = Opportunistic infection, CD4 = cluster of differentiation 4;
Behavioral factors of adult on ART in Gamo zone public health facilities

Regarding to the behavioral characteristics of the respondent 70 (16.9%) were alcohol drinker, whereas, 24 (5.8%) and 43 (10.3%) were smoker and khat chewer respectively. Only 89 (21.3%) of the respondent were achieving WHO recommendations on physical activity for health (Table 3).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol drinking status</td>
<td>Yes</td>
<td>70</td>
<td>16.9%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>344</td>
<td>83.1%</td>
</tr>
<tr>
<td>Smoking status</td>
<td>Yes</td>
<td>24</td>
<td>5.8%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>390</td>
<td>94.2%</td>
</tr>
<tr>
<td>Khat chewing status</td>
<td>Yes</td>
<td>43</td>
<td>10.4%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>371</td>
<td>89.6%</td>
</tr>
<tr>
<td>Physical activity status</td>
<td>&lt; 600 MET</td>
<td>326</td>
<td>78.7%</td>
</tr>
<tr>
<td></td>
<td>≥ 600MET</td>
<td>88</td>
<td>21.3%</td>
</tr>
</tbody>
</table>

Note: MET = metabolic equivalent

Dietary factors of adult on ART in Gamo zone public health facilities

This study also showed that 272 (65.7%) of adult ART patient were food in secured and 283 (68.4%) of the respondent consumed more than five food group within 24 hours. On the other hand only 6 respondent took food supplement from the health facilities (Fig. 1&2).

Nutritional status of adults on ART in Gamo zone public health facilities

Among 414 adult ART respondents, 117 (28.3%), 95% CI : ( 24.0- 32.9)) were underweight (BMI < 18.5Kg/m²), 55 (13.3%), 95% CI: (10.2–17.0)) were overweight/obese (BMI ≥ 25kg/m²). On the other hand 36 (8.7%) of the respondent had high health risk, 98 (23.70%) had moderate health risk and 280 (67.6%) had low health risk based on their waist to hip ratio.

Factors Associated with Nutritional Status of Adult ART Patients
In this study sex, marital status, monthly income, duration on ART, history of OI in the last six month, Cotrimoxazole preventive therapy, drug adherence, comorbidity, dietary diversity, household food security, physical activity status, khat chewing status and alcohol drinking status were candidate variables for multivariable multinomial logistic regression. In multivariable multinomial logistic regression Marital status, Cotrimoxazole preventive therapy, Average monthly income, Individual dietary diversity, Household food security, Khat chewing status and Alcohol drinking status were significantly associated with nutritional status of adult on antiretroviral therapy.

As compared to normal, the odds of underweight were 3.17 times more common among adult ART patients those who were divorced as compared to married (AOR: 3.17 (1.34–7.49)). Similarly, As compared to normal, the odds of underweight were also 2.96 times more common among adult HIV patients who had not finished Cotrimoxazole preventive therapy as compared to those who had finished their Cotrimoxazole preventive therapy (AOR: 2.96 (1.41–6.23)).

As compared to normal, the odds of underweight were also 2.69 times more common among adult ART patients those who were food insecured as compared to food secure (AOR: 2.69(1.16–6.23)), and the odds of underweight were 2.87 times more common among adult ART patients who were taking less than five food group more common as compared with their counter parts (AOR: 2.87 (1.57–5.26)). As compared to normal, the odds of Underweight were also 2.78 times more common among khat chewers when compared with non khat chewers (AOR: 2.78(1.09–7.11)).

Adult ART patients with average monthly income < 2000 ETB were nearly 67% less common to had Overweight/Obese as compared to those who had ≥ 2000 ETB average monthly income (AOR: 0.33(0.11–0.95)) in comparison to normal. And, the odds of overweight/obese were also 1.61 times more common among adults ART patients who were alcohol drinker as compared to their counter parts (AOR = 1.61(1.09–3.61)) in comparison to normal (Table 4).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Underweight</th>
<th></th>
<th>Overweight/Obese</th>
<th></th>
<th>Normal weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>COR (95%CI)</td>
<td>AOR (95%CI)</td>
<td>N</td>
<td>COR (95%CI)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>39</td>
<td>0.39 (0.25–0.62)</td>
<td>0.69 (0.37–1.27)</td>
<td>40</td>
<td>2.11 (1.10–4.03)</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>27</td>
<td>2.89 (1.53–5.47)</td>
<td><strong>3.17 (1.34–7.49)</strong></td>
<td>6</td>
<td>0.87 (0.33–2.30)</td>
</tr>
<tr>
<td>Widowed</td>
<td>26</td>
<td>1.73 (0.96–3.12)</td>
<td>1.36 (0.64–2.88)</td>
<td>12</td>
<td>1.55 (0.1–2.68)</td>
</tr>
<tr>
<td>Single</td>
<td>8</td>
<td>0.44 (0.19–1.01)</td>
<td>0.36 (0.13–1.03)</td>
<td>7</td>
<td>0.53 (0.22–1.27)</td>
</tr>
<tr>
<td>Married</td>
<td>56</td>
<td>1</td>
<td>1</td>
<td>41</td>
<td>1</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2000 ETB</td>
<td>55</td>
<td>1.63 (1.04–2.56)</td>
<td>1.17 (0.64–2.14)</td>
<td>5</td>
<td>0.18 (0.07–0.04)</td>
</tr>
<tr>
<td>≥ 2000 ETB</td>
<td>62</td>
<td>1</td>
<td>1</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>On ART</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5 years</td>
<td>54</td>
<td>1.10 (0.70–1.71)</td>
<td>1.19 (0.66–2.12)</td>
<td>17</td>
<td>0.57 (0.30–1.70)</td>
</tr>
<tr>
<td>≥ 5 years</td>
<td>63</td>
<td>1</td>
<td>1</td>
<td>38</td>
<td>1</td>
</tr>
<tr>
<td>OI (last 6 mos.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>53</td>
<td>2.03 (1.28–3.21)</td>
<td>1.69 (0.79–3.59)</td>
<td>16</td>
<td>1.00 (0.52–1.92)</td>
</tr>
<tr>
<td>No</td>
<td>64</td>
<td>1</td>
<td>1</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>CPT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not taking</td>
<td>5</td>
<td>1.58 (0.51–4.89)</td>
<td>0.71 (0.13–3.83)</td>
<td>4</td>
<td>1.97 (0.5–3.51)</td>
</tr>
<tr>
<td>Not finished</td>
<td>42</td>
<td>3.63 (2.13–6.18)</td>
<td><strong>2.96 (1.41–6.23)</strong></td>
<td>6</td>
<td>0.80 (0.10–1.20)</td>
</tr>
<tr>
<td>Finished</td>
<td>70</td>
<td>1</td>
<td>1</td>
<td>45</td>
<td>1</td>
</tr>
<tr>
<td>Drug</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>50</td>
<td>5.73</td>
<td>1.92 (0.8–4.48)</td>
<td>12</td>
<td>2.86 (0.6–5.2)</td>
</tr>
<tr>
<td>adherence</td>
<td>(3.28–10.02)</td>
<td>4.61)</td>
<td>3.28)</td>
<td>(0.09–2.58)</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>-------</td>
<td>-------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>8</td>
<td>0.59 (0.26–1.34)</td>
<td>0.47 (0.16–1.34)</td>
<td>7</td>
<td>0.66 (2.82–1.59)</td>
</tr>
<tr>
<td>Good</td>
<td>59</td>
<td>1</td>
<td>1</td>
<td>46</td>
<td>1</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>Yes</td>
<td>7</td>
<td>0.79 (0.32–1.95)</td>
<td>0.83 (0.21–3.28)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>110</td>
<td>1</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td>IDD</td>
<td>&lt; 5 Food group</td>
<td>70</td>
<td>4.51 (2.82–7.23)</td>
<td>2.87 (1.57–5.26)*</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>≥ 5 Food group</td>
<td>47</td>
<td>1</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>HHFS</td>
<td>Food insecure</td>
<td>107</td>
<td>6.56 (3.26–13.19)</td>
<td>2.69 (1.16–6.23)*</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Food secure</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>Physical activity status</td>
<td>&lt;600 MET</td>
<td>99</td>
<td>1.89 (1.06–3.38)</td>
<td>1.66 (0.79–3.49)</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>≥ 600 MET</td>
<td>18</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Khat chewing status</td>
<td>Yes</td>
<td>16</td>
<td>1.85 (0.91–3.76)</td>
<td>2.78 (1.09–7.11)*</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>101</td>
<td>1</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Alcohol drinking status</td>
<td>Yes</td>
<td>3</td>
<td>0.10 (0.018–1.56)</td>
<td>0.42 (0.02–1.39)</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>114</td>
<td>1</td>
<td>1</td>
<td>37</td>
</tr>
</tbody>
</table>

*Statistically significant at p-value < 0.05, ETB = Ethiopian birr, mos. = month, ART = Anti-retroviral therapy, OI = opportunistic infection, CPT = Cotrimoxazole preventive therapy, IDD = individual dietary diversity, HHFS = household food security

**Discussion**

This study was set out with the aim of assessing magnitude of nutritional status and its associated factors among adult on ART in Gamo zone public hospitals. The magnitude of underweight and overweight/obese
was 28.3% and 13.3% respectively. And also marital status, Cotrimoxazole preventive therapy, individual dietary diversity, household food security and khat chewing were positively associated to underweight. On the other way alcohol drinking was positively and average monthly income was negatively associated with overweight/obese.

The magnitude of underweight in this study is consistent to the study from east Harerge zone (30%) (39), Ethiopia a systematic review and meta-analysis (27.4%) (40), Arba Minch town public health facilities (24%) (41), and Bench Shako zone (29.2%) (42).

However it is lower as compared to the study in eastern zone of Tigray (42.9%) (12). The difference may be attributable to difference in the feeding style. Study from northern part of Ethiopia showed that food prepared from cereals (sorghum, barley, white, maize, teff,) are the common food eaten by the population (43). On the other hand wild fruit, vegetables and animal source food are common food type in southern and south west Ethiopia(44). Besides, it might be due to the difference and improvements in healthcare services. Or it might be as a result of the patients reporting with advanced stage of HIV infection to medical facilities.

When compared with the result from Iran (11.08%), the magnitude of underweight is much higher. The discrepancy may be difference in year of study and setting of the study since the study was conducted in 2015 at community level (45). Similarly the magnitude of underweight is also higher as compared with the study from Nepal (18.3%). It seems possible that these results are due to difference in socio economic deference observed from the population and time of study. Another possible explanation for this is that difference in health care service and food supplement program might had difference in the magnitude of underweight (46).

The magnitude of underweight in this study is also much higher than the study from Cameron 8.5% and Gahanna 13.8%. The inconsistence might be due to difference in the sample size and nature of study. The study done in Cameroon was a pilot study that was conducted in 82 individual (47).While the study from Gahanna was done on 152 individuals (48). As compared to the study done in south Africa 2020 (8.9%)(49), Zimbabwe (13%) (50), and Uganda (10.28%) (51),the magnitude of underweight is also higher. This may be due to population difference and year of study. The evidence from this study also suggests that the magnitude of underweight is also higher than the findings reported from different parts of Ethiopia; 18.3% in Asela town(52),18.8% in LegaTafo and surrounding (41),15.1% HIV-infected adults in Addis Ababa (53),19.1% at Selected Health Facilities of Addis Ababa (54),18.23% in Arba Minch town and Arba Minch Zuria (35). This differs from the findings presented here may be difference in health care awareness of the community, socio demographic difference and year of study.

On the other way the most interesting finding is that the magnitude of overweight/obese is 13.3%( 95% CI: 10.2–17.0). The yields in this investigation is higher compared to those of other studies conducted in bench Sheko zone 9.6%(42). The potential difference might be due to difference in study period and the studies also include only hospitals that may miss population at health center level.

The magnitude of overweight/obese observed in this investigation is far below those observed by the study in Nepal (46.4%). The difference may be difference in BMI cut off point to which the study categorized nutritional status as underweight (BMI < 18.5 kg/m²), normal (BMI 18.5–22.9 kg/m²), overweight (BMI 23.0–27.4 kg/m²) and obese (BMI ≥ 27.5 kg/m²) (46), The overall magnitude of overweight/obese is also lower than that of
previous study conducted in south Africa 39% (49) and Gahanna 28.3% (48). Socio demographic and economic difference between the populations may be attributable for the variation.

This finding is also lower to previous studies done in Addis Ababa (22.1%) (53). The existence of different socio-economic status of population could be the reason for the discrepancy. There is also difference in the year of study. Another possible explanation for this is that different in sample size that may add or reduce the target population. Another important finding was that magnitude of overweight/obese was lower than the study from Jimma (21%) (55). This can be explained by most of the participant were follower of orthodox Christianity and the data was collected during fasting month as compare to the study from Jimma. The sample size of this study is also higher and includes all health facilities (hospitals & health centers), but the study from Jimma zone was conducted only at hospital level on 252 participants.

Results of this study showed that divorced respondent were 3.71 times more likely to be underweight as compared to married in comparison to normal. This finding is not supported by the study from Nepal which stated that being married was positively associated with undernutrition (46). The potential discrepancy may be population difference and difference in the reference population since married is the reference group in this study. This might be explained by psychological disorder and stress after divorce may affect food intake.

The results of this study indicated that the odd of underweight was 2.96 times more common among respondents who finished CPT as compared to those who were not finished CPT in comparison to normal. These findings is concurred with the study from Arba Minch town public health facilities (56), and the study from eastern zone of Tigray region (12). More over Cotrimoxazole preventive therapy have antimicrobial effect of on some bacterial diseases such as pneumonia, diarrhea, malaria, and other opportunistic infections that may help to improve the overall status of the patients (57).

The present study also stated that adults who were taking less than five food groups in the past 24 hours were 2.87 times more likely to be underweight as compared to those who were consuming more than five food groups in comparison to normal. This might be explained by poor dietary diversity has direct effect to the nutritional status of the population. Healthy nutrition plays a central role in the management of HIV/AIDS, especially those symptoms such as diarrhea, anorexia, sore mouth, fever, and muscle wasting – directly associated with the disease. Adequate dietary intake enhances the therapeutic effect of medicines, boosts the immune system (thus helping to fight against the disease and to maintain body weight), prolongs the progression of HIV infection to AIDS, prolonging life and promotes healthy living (39). This finding is supported by the study done Arba Minch town, Asela town public health facilities and Arba Minch Zuria public health facilities (35, 52, 56).

The finding of this study also reviled that food insecured respondents were 2.69 times more likely to be underweight as compared to those who were food secured in comparison to normal. This finding is in line with other studies done in bale Goba, LegaTafo and surrounding, bench shako zone, east Hareige zone and west Shewa zone which stated that household food insecurity was significantly independently associated with undernutrition (27, 39, 41, 42, 58). This was obviously due to lack access to sufficient food to meet dietary needs for productive and health life and it leads to deficiency of macro and micronutrient.
Finding of this study also showed that khat chewer respondents were 2.78 times more likely to be underweight as compared to non-khat chewer in comparison to normal. This finding is not in line with study conducted in east Harerge zone which stated that khat chewing HIV positive adults were half times less likely to be undernourished(39). The possible explanation for this finding may be analysis difference. But This study is supported by other study which was conducted on other population group that stated that khat chewing was significantly associated with underweight(59). This can be explained by khat can have loss of appetite, gas trio intestinal disorder, stomatitis, and esophagitis. The tannins and cathinone from the khat contributes to constipation which is the common medical complain in khat chewer(60).

On the other hand finding of present study showed that respondents whose monthly income less than 2000 ETB were 67% less common to had overweight/obese as compared to those who had more than 2000 ETB monthly income in comparison to normal. This finding is supported by the study in Asela town (52). This can be explained by good income increase the chance of getting junk and high energy food is increased. But low income restricts an individual from getting adequate food and nutrients that may affect the nutritional status of the person.

Present study also showed that the odd of overweight/obese among adult on ART were 1.61 times more common in alcohol drinker as compared to non-drinker in comparison to normal. This can be explained by alcohol can cause weight gain in different ways. It can stop our body from burning fat, alcohol by itself has high kilojoules, and it can increase feeling of hungry that leads to poor food choice(61). This finding was not supported by a study from bale Goba that stated that alcohol consumption was significantly associated with undernutrition among PLHIV. The potential difference might be difference in the study design.

**LIMITATION OF THE STUDY**

Even if we are giving enough time to remember what they did or the data collector were probing the respondents, we may introduce recall bias when measuring household food security, physical activities and dietary diversity. The data was collected in Abiy Fasting month and Ramadan that can affect daily dietary diversity score. All of the respondents were not the head of the house hold or care giver for the member of the house hold and HFIAS may be affected. Social desirability bias was also the limitation when collecting data regarding alcohol consumption, cigarette smoking and khat chewing, since the data collector was health care providers.

**RECOMMENDATIONS**

Therefore, based on the finding of this study the following recommendation is forwarded to the concerned bodies.

Federal ministry of health and other nutritional programmer would

- Strength nutritional supplementations to improve the nutritional status of adults living with HIV in the study area.
Health care providers and office administrators would

- Focus on achieving routine patient-centered nutritional assessment and providing supplementation, counseling, care, and support.
- Providing health education to bring behavioral change on the health risks of khat chewing and alcohol drinking associated with benefits of eating fruits and/or vegetables, physical exercise.

Future researcher would

Address factors not assessed in this study like environmental related factors and focus on follow up study especially on those modifiable and clinically important variables.

**Conclusion**

In this study, the magnitude of underweight among adult on Antiretro viral therapy were higher and magnitude of overweight/obese among adult on ART were lower as compare from most of the study. Furthermore marital status, CPT, monthly income, IDD, HHFS, khat chewing, and alcohol drinking were found significantly associated with nutritional status of adults on ART.

**Abbreviations**

AIDS: Acquired Immune Deficiency Syndrome, ART: Anti-Retroviral Therapy, ARV: Anti-Retro Viral, BMI, Body Mass Index, CD4: Cluster of Differentiation 4, CI: Confidence Interval, CPT: Cotrimoxazole Preventive Therapy, DDS: Dietary Diversity Score, ETB: Ethiopian Birr, FANTA: Food and Nutrition Technical Assistance, FAO; Food and Agricultural Organization, HFIAS; Household Food Insecurity Access Scale, HIV; Human Immune Viruses, IPT; Isoniazid Preventive Therapy, MET; Metabolic Equivalent, OI; Opportunistic Infection, PLHIV; People Living with Human Immune Viruses, SSA; Sub-Sahara Africa, TB; Tuberculosis, UNAIDS; United Nation Program on Acquired Immune deficiency syndromes, WHO; World Health Organization

**Declarations**

**Ethics approval and consent to participate**

All the methods and procedures in this study were carried out by the Declaration of Helsinki and ethical clearance was obtained from the Arba Minch University, College of Medicine and Health Sciences, institutional ethical review board (ref.no IRB/1229/2022). Informed written consent were obtained from each study participants. Verbal consent was obtained from illiterate study participants and then informed written consent was obtained from their partners. The name or any other identifying information was not recorded on the questionnaire. All information taken from the participant was kept strictly confidential and in a safe place. The information retrieved was used only for the study purpose.

**Consent for publication**
Availability of data and materials

The datasets generated and/or analyzed during this study are not publicly available due to participant anonymity, but they are available from the corresponding author upon reasonable request.

Competing interests

Every author declares that they have no competing interests.

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Arba Minch University provided funds for the data collection and stationary materials of this research work. The website of the university is www.amu.edu.et. "The funders had no role in study design, data collection, and analysis, decision to publish, or preparation of the manuscript."

Authors' contributions

NK designed the study, was involved in data collection, analysis, and interpretation of the findings, drafted the paper, and participated in the preparation of all manuscript versions. EZ, TF, EK, MY and DT contributed to the design and development of the proposal, monitored data collection, assisted with analysis, and revised subsequent draughts of the paper. The final manuscript was read and approved by all authors.

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Guarantor

Nigus Kabtu

Provenance and peer review

Not commissioned, externally peer-reviewed.
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Figures
**Individual Dietary Diversity**

- <5 food groups: 31.6%
- ≥5 food groups: 68.4%

*Figure 1*

Individual dietary diversity of adult on ART in Gamo zone public health facilities southern Ethiopia, 2022.

**Household Food Security Status**

- Food insecure: 65.5%
- Food secured: 34.5%

*Figure 2*

Household food security status of adult on ART in Gamo zone public health facilities southern Ethiopia, 2022.