

## Under nutrition and Associated Factors among Adult Individuals Receiving Highly Active Antiretroviral Therapy in Health Facilities of Nekemte Town, Eastern Ethiopia

Abdi Edosa Abenezer Teklu Rediet Takele Ahmed Reshid Abriham Engida  
Department of Public Health, College of Medical and Health Sciences, Wollega University, P.O. Box 395,  
Nekemte, Ethiopia

### Abstract

HIV/AIDS is a major public health problem affecting both developed and developing countries. As HIV progressively damages immune system cells, the body becomes more vulnerable to infections, resulting in difficulty in fighting off HIV, infection. Malnutrition and infection are interlinked and exacerbate one another effect in a vicious cycle. Institutional based cross-sectional study was conducted from April, to May, 2017 in Nekemte Referral Hospital and Health Centers. A total of 295 adults receiving Highly Active Antiretroviral Therapy (HAART) were selected by using systematic random sampling technique. The data was entered by Epi-Info version 3.5.1 and analyzed by using SPSS version 20. Weight and Height measurements were taken to determine *BMI*. Odds ratio (AOR) along with 95%CI was estimated to measure the strength of association at P value  $\leq 0.05$ . A total of 295 participants (64.7% female and 35.3% male) were included in the study. The mean ( $\pm$ s.d) age was 33.9 + 8.2 years. The overall prevalence of underweight was 24% (95% CI: 21.2- 29.7%) of which 15% 6% and 3% were mildly, moderately, and severely malnourished, respectively. Multivariate logistic regression analysis revealed that the odds of under nutrition was higher among females (AOR=2.4, 95 % CI: 1.73, 5.18), among those who had eating difficulties, (AOR=3.2, 95 % CI: 1.24, 6.41) on ARV drugs < 12months (AOR = 2.7, 95 % CI: 1.26, 3.57), and WHO stage III and IV (AOR = 2.47, 95 % CI: 1.22, 4.88). Prevalence of under nutrition among HIV positive adults was higher. Furthermore, Sex of respondent, eating difficulty, duration of ART, and clinical stage three and four were the significant predictors to under nutrition. HIV related symptoms and eating difficulty should be prevented and treated as early as possible. There is a need to routinely screen PLWHA for the risk of developing under nutrition to facilitate early detection and intervention.

**Keywords:** Adult, ART, HIV, Malnutrition, Nutritional Status.

### Background

HIV/AIDS is a major public health problem affecting both developed and developing countries. As HIV progressively damages immune system cells, the body becomes more vulnerable to infections, resulting in difficulty in fighting off HIV infection. Malnutrition and infection are interlinked and exacerbate one another effect in a vicious cycle (1).

HIV infection can lead to under-nutrition through loss of appetite, eating difficulty, poor nutrient absorption, prevents the body from using the nutrients provided by foods and adversely affecting nutrient absorption and metabolism. Insufficient food intake, may lead to decreased immunity and increased susceptibility to opportunistic infections (OIs) resulting in further progression of HIV-disease, and the subsequent Acquired Immune Deficiency Syndrome (AIDS) related morbidity and mortality(1, 2).

Morbidity and mortality of HIV infected patients in the developing world remain unacceptably high, despite major advances in HIV therapy and increased international support, People with HIV infection face not just sickness, but also impaired productivity, decline income, and increasingly difficult choices among essential needs due to competitive expenses such as food versus health care (3, 4).

At the end of 2010, globally an estimated 34 million people were living with HIV/AIDS and in SSA, an estimated 1.9 million people become infected with HIV in 2011. Ethiopia is one of the seriously affected countries in SSA with a large number of people (approximately 800,000) living with HIV/AIDS and 44,751 AIDS-related deaths. According to the 2011 Ethiopian demographic and health survey (EDHS), over all prevalence HIV prevalence is 1.5% with 1.9% and 1.0% prevalence for women and for men respectively(5).

Introduction of Highly Active Anti-retroviral (HAART) drug treatments improves immunity, has extended the lives of many people and greatly reduced morbidity and mortality due to AIDS (6). However, HAART medications can cause loss of appetite, vomiting, diarrhea and can also further affects nutrient utilization by affecting nutrient absorption, metabolism, distribution, or excretion, which adversely affects the nutritional status of people living with HIV/AIDS (PLWHA) (7, 8).

Therefore since measuring nutritional status of PLWHA is an essential part of the ART program, this study aims to assess prevalence of under nutrition and associated factors among adults those who are on ART at public health facilities of Nekemte town. The finding will be helpful for local health planners and other stake

holders to consider during their planning.

## **Methods and Materials**

### **Study area and period**

Facility based cross-sectional study was conducted from April to May 2017 in Nekemte Referral hospital and Nekemte Health center of East Wollega Zone, Oromia Regional state, Ethiopia.

Nekemte town is located 328 km west of Addis Ababa. The ART service in Nekemte health center was initiated in 1999 E.C while the ART service for Nekemte Referral hospital was initiated in 1998 E.C. Currently, there are about 2915 HIV/AIDS patients attending ART in both Nekemte Referral Hospital and Nekemte health centers.

### **Sample Size Determination and Sampling Procedure.**

The sample size was estimated using a single population proportion formula considering 27% (9) proportion of malnutrition among adults with HIV/AIDS on ART, with 95% confidence level and 5% margin of error. Correcting for finite population and 10% for possible none response rate, 301 randomly selected cases of HIV/AIDS patients on ART were included in the study.

All HIV positive adults who had at least one prior follow-up in ART clinic were eligible for the study.

Systematic random sampling technique was employed to select the study participants. A sampling fraction ( $K_{th} = N/n = 2915/301 = 10$ ) was calculated by dividing total clients on ART at Nekemte referral hospital and Nekemte health center by the calculated sample size. The first study participant was selected using lottery method from the first ten client charts at the day-one visit. Finally, the study subjects were selected at every tenth of the first client in official working days.

### **The Study Variables**

The dependent variable of the study is nutritional status (BMI) of PLHIV on ART. The independent variables of the study are: Socio demographic variables (educational level economic status and marital status), clinical stage of HIV disease, current clinical condition, duration and regimen of ART, presence of opportunistic infections and etc.

### **Data collection instruments**

Data were collected using a pre-tested interviewer administered questionnaire by clinical nurses working in the clinic. Clinical diagnosis for opportunistic infection (OI) s and staging was made by physicians using WHO staging criteria.

### **The household economic status**

The household economic status was assessed by using the principal components analysis. The principal components analysis of household durable assets retained one factor and assigned factor score to each household. In the principal component analysis, the power of the variables to explain wealth status was determined step by step using the communalities values.

Accordingly, variables with a communality value of greater than or equal to 0.5 were used in the final step to estimate the household wealth status. The higher the score the higher was the number of household assets, indicating better the long-term economic status of the household. The factor score was used for dividing the households into quintiles from the lowest 20% to the highest 20%. The higher household asset quintile reflects higher economic status of the household (10).

### **Food intake**

Food intake was assessed by using dietary diversity score (DDS) adopted from the Food and Nutrition Technical Assistance Project (FANTA) guidelines for measuring dietary diversity and household food insecurity access scale(11, 12) Participants were qualitatively asked their intake based on nine food groups comprised of starch (cereals, and roots), vegetables, fruits, fish and tubers, meat (including organ meat), milk, egg and legumes consumed in twenty four hours using recall method.

Each food group was then counted only once resulting in a possible score of 0 to 9. Then the reported food items were categorized as low DDS, medium DDS and high DDS when the food consumed were less than or equal to 3, 4–6 and above 6 food groups, respectively(13).

Data on opportunistic disease in the past 6 months,WHO clinical stages of disease, drug adherence, and chronic diseases were obtained from patient charts and ART follow-up forms. The anemia status of the study participants was ascertained using the standard criteria for female and male adults. Accordingly, if the hemoglobin level of the female study participants was less than 12.0 gm/dl, she was considered as anemic while if it was less than 13.0gm/dl for males they were defined as anemic.

**Weight:** Weight was measured using a standard beam balance to the nearest 0.1kg with minimum clothing and no footwear. The scale was checked at zero before taking every measurement to avoid variability; the same measurer was assigned among the nurses to do all the anthropometric measurements.

**Height:** Measurement of height was measured using a using the standard scale to the nearest 0.1cm following standard procedure in Frankfurt plane without shoes. Body Mass Index (BMI): is the ratio of weight to height in meters square and subjects nutritional status was classified as

<18.5 = Underweight

18.5-24.9 = Normal weight

25-29.9 = Overweight

30 and above=Obese(14).

### **Data Quality Control**

Data quality was insured by training data collectors as well by providing day to day supervision during the entire data collection period. Prior to data collection, 5% of the tool was pre-tested on patients receiving ART.

The collected data were checked for their completeness, clarity and consistency by the principal author on daily basis. Reliability and precision of the anthropometric scales was also checked against the standard regularly.

### **Data Analysis and Statistical Test.**

Data was checked for completeness, and entered into EPI-info version 3.5.1; then, cleaned, coded and analyzed by Statistical Package for Social Science(SPSS )version 20. Anthropometric data were entered and analyzed using WHO Anthro-plus version 1.0.4.software.Bivariate & multivariate logistic regression analysis were used to assess the association of nutritional status with socio-demographic, dietary and other important factors. Multi-co-linearity was checked by using VIF/tolerance and statistically significant was determined at P value  $\leq 0.05$  at 95% CI.

### **Ethical Considerations**

Ethical approval was obtained from Ethical review committee of Department of Public Health, College of Health Science, Wollega University and official letter was written to Nekemte Referral Hospital and Nekemte Health Centers.

Written informed consent was obtained from each individual after the purpose of the study was explained. The participants were informed that they have the full right to participate or not to participate in the study as well as to with draw any time during the interview. The names and address of the participants were not recorded and data were collected after full informed written consent was obtained from participant. Undernourished participants were given nutritional counseling.

### **Result**

#### **Socio-demographic characteristics of study participant.**

A total of 295 adult patients on ART were enrolled in the study. Nearly two third (64.7.0%) of the respondents were females and more than half (63.4%) of them were currently married. About 112 (38%) were aged between 29 and 38 with the mean and standard deviation ( $\pm$ SD) of 33( $\pm$ 11) years. Almost half (49%) of respondents were Orthodox in religion. The majority of participants (77.3%) were from Oromo ethnicity and from primary level of education (65.6%). Nearly three fifth (58.6%) were from middle wealth quintile category (Table1).

**Table 1:** Socio-demographic characteristics of Adults receiving HAART in Health Facilities of Nekemte Town, Ethiopia 2017.

<b>Characteristics</b>	<b>Levels</b>	<b>Frequency (n)</b>	<b>Percent</b>
<b>Sex</b>	Female	191	64.7
	Male	104	35.3
<b>Age</b>	18-28	101	34.2
	29-38	112	38
	39-48	50	16.9
	>=49	32	10.8
<b>Residence</b>	Urban	171	58
	Rural	124	42
<b>Marital status</b>	Single	64	21.7
	Ever married	231	78.3
<b>Religion</b>	Orthodox	145	49
	Protestant	121	41
	Muslim	22	7.5
	Catholic	7	2.4
<b>Ethnicity</b>	Oromo	228	77.3
	Amhara	67	22.7
<b>Educational level</b>	Un able to read and write	29	9.8
	Primary	124	42
	Diploma	98	33.2
	Degree	44	14.9
<b>Occupational status</b>	house wife	131	44.4
	Government employee	76	25.8
	Merchant	50	16.9
	Daily laborer	29	9.8
	Farmer	9	3.1
<b>Wealth quintile</b>	Poor	46	15.6
	Middle	173	58.6
	Rich	76	25.8

#### **Clinical profiles and ART status of the study participants**

The HIV status of patients showed that most (68%) of the respondents were on WHO clinical stage I and more than half (55.3%) of the respondents were on ART treatment regimen 1e (TDF + 3TC + NVP), followed by sixty one patients (20.7) were on 1f (TDF+3TC+NVP) regimen. One hundred twenty seven patients (43%) had current or past history of opportunistic infections and of which eighty three (18%) had chronic diarrhea. Quite a number of patients (30.8%) had changed the ART regimen and the major (59.3%) reason for regimen change was for TB treatment.

**Table 2.** Clinical profile of Adults receiving HAART in Health Facilities of Nekemte Town, Ethiopia, 2017.

Characteristics	Levels	Frequency (n)	Percent
<b>WHO clinical stage</b>	Stage I	190	64.4
	Stage II	72	24.4
	Stage III& IV	33	11.2
<b>ART duration</b>	≤ 12 months	141	47.8
	>12months	154	52.2
<b>ART regimens</b>	1b	3	1
	1c	44	15
	1d	19	6.4
	1e	163	55.3
	1f	61	20.7
<b>Regimen change</b>	No	204	69.2
	Yes	91	30.8
<b>Reasons for change</b>	TB treatment	54	58.3
	Side effect	26	28.6
	Resistant	11	12.1
<b>SI of ART/OI treatment</b>	No	195	66.1
	Yes	100	33.9
<b>Type of side effect</b>	Anemia	29	29.0
	Neuropathy	21	21.0
	Rash	20	20.0
	Vomiting	10	10.0
	Food drug interaction	8	8.0
	Hepatotoxicity	7	7.0
	Others	5	5.0
<b>Eating problems</b>	No	188	63.7
	Yes	107	36.3
<b>Types of eating problems</b>	Loss of appetite	113	60
	Swallowing difficulty	75	40
<b>Current/past OI in the past 6 months</b>	Chronic cough	23	18.1
	URTI's	8	6.3
	Oral thrush	8	6.3
	Tuberculosis	5	3.9

**Prevalence of under nutrition and dietary pattern related characteristics.**

The BMI measure taken from the respondents showed that, the mean ( $\pm$ SD) value was 20.3 ( $\pm$ 3.3). About 24% (95% CI: 21.2- 29.7%) of HIV positive adults were undernourished. The proportion of respondents who consumed cereals, vegetables and fruits within 24 hours prior to the study were 100%, 60 % and 20% respectively. The mean DDS was 3.7( $\pm$ 1.54). Over half (65.7%) of respondents had low DDS (Table 3).

**Table 3:** Dietary Diversity and Nutritional status of Adults receiving HAART in Health Facilities of Nekemte Town, Ethiopia 2017.

Types of food consumed	Food group	N	%
	Cereals	295	100
	Vegetable	178	60
	Fruit	59	20
	Tuber	41	14
	Meat	44	15
	Sugar/honey	67	22.7
	Eggs	58	19.7
	Legume, nuts and seeds	29	9.8
	Milk and milk products	38	13
<b>Dietary Diversity Score</b>	Low	194	65.7
	Medium	93	31.5
	High	8	2.7
	Mean	3.7	
<b>BMI</b>	Mild	44	62
	Moderate	18	23.4
	Severe	9	12.7

### Determinants of Nutritional status and its outcomes

The major determinants identified for underweight were sex, ART duration, eating difficulty and WHO clinical stage three & four. The odds of being underweight were 2.4 times higher for females than for male counterparts (AOR=2.4; 95% CI= 1.73 to 5.18). Eating difficulty was also positively associated with under nutrition. Participants who had one or more eating difficulty were 3.2 times more likely to be undernourished as compared to those who were free of eating difficulty (AOR = 3.2 95% CI: 1.24 to 6.41).

In addition, those adults who were on ARV drugs for less than 12 months were 2.7 times more malnourished than those who took the drug more than a year, (AOR=2.7; 95% CI= 1.26 to 3.57). Finally, WHO clinical stages had significant effect on the likelihood of under nutrition. Individuals at clinical stage three and four were 2.5 times more likely undernourished than those at stage one (AOR=2.47; 95% CI= 1.22 to 4.88).

**Table 4:** Factors associated with under nutrition among Adults receiving HAART in Health Facilities of Nekemte Town, Ethiopia 2017.

Characteristics	Under-weight		Crude OR (95% CI)	Adjusted OR (95% CI)
	Yes (%)	NO n (%)		
<b>Sex</b>				
Female	57(19)	134 (45)	2.73(1.78 5.89)	2.4(1.73 5.18)*
Male	14(5)	90(31)		
<b>Residence</b>				
Urban	46(15.6)	125(42.4)	1.46(1.02 3.57)	-
Rural	25(8.5)	99(33.6)	1	1
<b>Marital status</b>				
Single	22(7.5)	42(14.2)	1.94(0.67 6.28)	
Ever Married	49(16.6)	182(61.7)		
<b>Eating problems</b>				
Yes	59(20)	129(44)	3.62(1.98-6.85)	3.2(1.24 6.41)*
No	12(4)	95(32)	1	
<b>ART duration</b>				
<12months	48(16)	93(32)	2.93(1.40 4.74)	2.7(1.26 3.57)*
>12months	23(8)	131(44)		
<b>WHO clinical stage</b>				
Stage I	43(21.9)	147	1	-
Stage II	25(21.9)	47	0.55(0.86 11.66)	
Stage III & IV	3(21.9)	30	2.93(1.35 5.13)	2.47(1.22 4.88)*

### Discussion

The present study was undertaken to assess the nutritional status and associated factors among adults those who are on ART. Almost one in five PLHIVs was found to be undernourished (BMI <18.5 kg/m<sup>2</sup>). This finding concurs with the study reported of Dembia District(23%) (15) Bahir Dar (25%) (16) and Butajira District Southern Ethiopia (25.2%)(8).

On the other hand, current finding is higher than study reports from Meta-analysis of 11 sub-Saharan African countries(10.3%)(17) and study report from Dilla, Southern parts of Ethiopia (12.3%)(18). However Higher prevalence of malnutrition (42.3%) was reported in Tigray, northern parts of Ethiopia(7) , Hosaina(31.2%) (19) Southern parts of Ethiopia and Gondar (27.8%) Northwest Ethiopia (20). The observed discrepancy of under nutrition among different parts of the country could be attributed to the existence of variation in the socio economic and other mostly dietary habit that are practiced by these different communities(21).

Under nutrition could occur in different forms and degrees. When we consider the degree of under nutrition, it varies in different settings and circumstance. In this study, the prevalence of under nutrition among HIV positive adults was 24% of which 15%, 6% and 3% were mildly, moderately, and severely undernourished, respectively. In other studies the proportion of under nutrition was 16.1% mildly, 6.2% moderately and 3% severely(8) 20.3% mildly, 10% moderately, and 12% were severely malnourished severely(7). From the above descriptive results, we looked differences in the distribution of degree of malnutrition.

This study also tried to elicit the associated factors of undernutrition. Consequently, the proportion of undernutrition was much higher in females than males. The finding was supported by the study report from Felege Hiwot referral hospital and there are also reports that support women are biologically, socially, and economically more vulnerable to both HIV/AIDS and malnutrition(16). Women have lower muscle mass and

greater amount of total body fat than men with an equivalent BMI, which may increase the prevalence of malnutrition, since sex and muscle mass can affect the relationship between BMI and body fat.

Eating difficulty was also another significantly associated variable with undernutrition among PLWHA receiving ART. Participants who had oral thrush or other eating difficulty were more likely to be undernourished despite the availability of food as compared to those who were free of eating difficulty. This was also observed in studies conducted in Gondar and Bahir dar, northwestern Ethiopia, where the presence of under nutrition can be explained by low intake of nutrients and reduced energy due eating problems which could be main reason for loss of weight(16, 20)

The duration of ART treatment reduces the risk of malnutrition as shown by the statistically significant association between duration of treatment and reduction of the risk of developing under nutrition. In this study, those who were on ARV drugs less than 12 months were more likely to get undernourished than those who took the drug more than a year, which is supported with finding from Felege Hiwet Hospita(16). This could be explained by the fact that adherence to ARV treatment would help to improve the nutritional status of individuals. It is reflected that the longer the duration of treatment, the lesser the risk of facing malnutrition. As treatment duration increases and improved nutritional status will be maintained.

WHO clinical stage four has significant effect on the likelihood of malnutrition development this result is consistent with an earlier similar study conducted in Dilla university hospital. Similarly, study done in Uganda shows PLWHA taking ART at WHO clinical stage four characterized by severe wasting chronic fever, chronic diarrhea and weight loss greater than 10% from baseline. Malnutrition is usually encountered at the advanced phase or end of the HIV infection(18).

In terms of dietary diversity score (DDS), more than half (65.7) of them had low diversity score while high DDS was observed only in 2.7% of them. Compared with some previous study reports the present finding was lower than what has been reported from *Dembia* (88.7.0% vs. 65.7%)but lower DDS was reported from study conducted in *Humera*(53.2%) and *Jimma*(44.2%) cities (7, 15, 22). This difference could be attributed to reduction of food consumption due to loss of appetite, vomiting and nausea due to the side effects of ART drugs, and swallowing difficulty due to oral thrush or ulcer.

One of the strengths of this study was to avoid recall biases, medical charts and ART data base were triangulated with the primary data collected by structured interview administered questionnaire. However, the cross-sectional nature of the study limits the investigation to the level of the association between determinants and outcomes of interest (under nutrition). Hence it's impossible to get information about causal relationship in the majority of associated factors. Moreover, the study was institution based the results could not be generalized to those HIV positive adults who are not enrolled for chronic HIV care.

## Conclusion

This study revealed that, the prevalence of under nutrition among HIV positive adults was higher. Furthermore, Sex of respondent, eating difficulty, duration of ART, and clinical stage three and four were the significant predictors to under nutrition.

HIV related symptoms and eating difficulty should be prevented and treated as early as possible. There is a need to routinely screen PLWHA for the risk of developing under nutrition to facilitate early detection and intervention on HAART and ARV treatment should be accompanied by nutrition support.

## Conflict of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgement

We would like to forward our gratitude to all data collectors and study participants involved in this study.

**Funding:** This study received no financial support.

## References

1. WorldHealthOrganisation(WHO). Antiretroviral therapy for HIV infection in adults and adolescents: recommendations for a public health approach. 2010 revision.
2. Kudakwashe C, Tsitsi M BM, Brilliant Nkomo, Ancikaria Chigumira and, B M. Malnutrition status and associated factors among HIV-positive patients enrolled in ART clinics in Zimbabwe. *BMC Nutrition* 2017;3:15.
3. Uthman OA. Prevalence and pattern of HIV-related malnutrition among women in sub-Saharan Africa: a meta-analysis of demographic health surveys. *BMC Public Health*. 2008;8(226).
4. WorldHealthOrganisation(WHO). Consolidated Guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach. 2013.
5. Central Statistical Agency (Ethiopia) and ORC Macro. 2006. Ethiopia Demographic and Health Survey

2005. Addis Ababa EAC, Maryland, USA: Central Statistical Agency and ORC Macro.
6. Lula A TD, Yoseph H. Under nutrition and associated factors among adult on highly active antiretroviral therapy in Wolaita Sodo teaching and referral hospital, southern nation's nationalities people's region, Ethiopia. *International Journal of Nutrition and Metabolism*. 2017; 9(2):10-9.
  7. Tsegazeab H WW, Desalegn T and Hailemariam B. Undernutrition among HIV positive women in Humera hospital, Tigray, Ethiopia, 2013: antiretroviral therapy alone is not enough, cross sectional study. *BMC Public Health*. 2013, ;13:943.
  8. Dereje G BG, Dagnachew M Molla M. Prevalence of malnutrition and its associated factors among adult people living with HIV/AIDS receiving anti-retroviral therapy at Butajira Hospital, southern Ethiopia. *BMC Nutrition* 2015;1:5.
  9. Meskerem A SG, Habtamu F. Assessment of Adult Nutritional Status and Associated Factors Among ART Users in Nekemte Referral Hospital and Health Center, East Wollega Zone, Ethiopia. *Journal of Food and Nutrition Sciences* .2015;3(2): 56-63.
  10. Rutstein SO JK. The DHS wealth index. DHS comparative reports. Calverton: ORC Macro;. 2004;6.
  11. Kennedy G BT, Dop MC. . Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organization of the United Nations; . 2011.
  12. Coates J SA, Bilinsky P. . Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide. Washington, DC:. Food and Nutrition Technical Assistance Project, Academy for Educational Development. 2007.
  13. WHO. Indicators for assessing infant and young child feeding practices Part 1. Definitions Food and Nutrition technical assistance November 2007.
  14. Status WP. The use of and interpretation of anthropometry, . Report of a WHO Expert Committee 1995.
  15. Anbesaw Mitiku TA, Mekonen A, Amare T. Undernutrition and associated factors among adults living with Human Immune Deficiency Virus in Dembia District, Northwest Ethiopia: an institution based cross-sectional study. *Archives of Public Health*. 2016;74:33.
  16. Molla D FM, Dereje Birhanu. Nutritional status and associated factors among adult HIV/AIDS clients in Felege Hiwot Referral Hospital, Bahir Dar, Ethiopia. *Science Journal of Public Health*. 2013;1(1) : 24-31.
  17. AU: O. Prevalence and pattern of HIV-related malnutrition among women in sub-Saharan Africa: a meta-analysis of demographic health surveys. *BMC Public Health* 2008;8(226).
  18. Solomon H GT, Henok T. Malnutrition: Prevalence and its associated factors in People living with HIV/AIDS, in Dilla University, Referral Hospital. *Archives of Public Health*. 2013;71:13.
  19. Mekuria A CH, Habtamu J. Malnutrition and Associated Factors among Adult Individuals Receiving Highly Active Antiretroviral Therapy in Health Facilities of Hosanna Town, Southern Ethiopia. *Open Access Library Journal*, 2: e1289. 2015;2(e1289).
  20. Belaynew W YK, Anwar Y. Nutritional Status Of Adults Living With Hiv/Aids At Theuniversity Of Gondar Referral Hospital, Northwest Ethiopia. *Ethiop J Health Biomed Sci*. 2010;3(1).
  21. Ayele T TB, Fisehaye A, Sibhatu B. Food insecurity and associated factors among HIV-infected individuals receiving highly active antiretroviral therapy in Jimma zone Southwest Ethiopia. *Nutrition journal*. 2012;11(51).
  22. Ayele T TB, Fisehaye A and Sibhatu B. Food insecurity and associated factors among HIV-infected individuals receiving highly active antiretroviral therapy in Jimma zone Southwest Ethiopia. *Nutrition Journal*. 2012, ;11:51.