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Chronic energy deficiency and associated factors among adults living with HIV in Gondar University Referral Hospital northwest Ethiopia

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Abstract

Background: Human Immunodeficiency Virus (HIV) infection and chronic energy deficiency are bidirectional and multifaceted. HIV can cause or worsen chronic energy deficiency by increasing energy requirements, reducing food intake and nutrient absorption. Chronic energy deficiency weakens the immune system, increase the susceptibility to infections and worsening the disease impact. Studies on the magnitude and factors associated with chronic energy deficiency among adults living with HIV are limited. The aim of this study was to assess the prevalence of chronic energy deficiency and associated factors among adults living with HIV in Gondar University Referral Hospital, northwest Ethiopia.

Methods: An institution based cross-sectional study was conducted and systematic random sampling was used to select study subjects. A total of 317 study subjects were enrolled in the study. Structured and pretested questionnaire was used to collect socio-demographic, economic and diet related variables. Weight and height measurement were taken and medical charts were reviewed. Laboratory analysis for CD4 count and anemia was done. Bi-variable and multi-variable logistic regression analyses were used to assess the effect of different factors on chronic energy deficiency.

Results: A total of 317 patients provide complete information with response rate of 99.4%. The overall prevalence of chronic energy deficiency was 18.3% (95%CI: 14.5%–22.7%). The prevalence of mild, moderate and severe chronic energy deficiency was 11.4, 3.5 and 3.5% respectively. No formal education (AOR = 2.05,95%CI:1.01,4.21), being in the WHO clinical stage three and four (AOR = 3.84,95%CI:1.39,10.61) and history of diarrhea in the last two weeks prior to the survey (AOR = 4.43,95%CI:1.83,10.72) were significantly associated with chronic energy deficiency.

Conclusion: The prevalence of chronic energy deficiency among adults living with HIV was medium public health problem. Educational status, WHO clinical stage, and history of diarrhea in the last two weeks prior to the survey were risks for chronic energy deficiency. Integration of nutritional management with HAART, early diagnosis and treatment of diarrheal disease would be supreme important.

Keywords: Chronic energy deficiency, Malnutrition, HIV, Gondar

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Background

Globally, 36.7 million people were living with Human Immunodeficiency Virus (HIV) and an estimated 0.8% of adults were affected at the end of 2015 [1]. Although the burden of the epidemic varies between countries and regions, Sub-Saharan Africa (SSA) is the region most affected and it is a home for nearly 70% of the world people living with HIV (PLWH) with an adult prevalence rate of 4.4%. Moreover, HIV is the leading cause of adult morbidity and mortality in this region [1, 2]. Ethiopia is one of the seriously affected countries in SSA with a large number of (769,600) PLWH and 15,700 new infections annually. According to 2014 estimate, the national HIV prevalence rate was 1.14% [3].

The relationship between HIV and chronic energy deficiency (CED) represents a classic example of well recognized vicious cycle of immune dysfunction, infectious disease, and malnutrition. Any immune impairment as a result of HIV can contribute to CED. In turn CED leads to immune impairment, worsens the effects of HIV, and contributes to a more rapid progression of the disease [4]. An HIV-infected person is more at risk for CED due to reduced food intake, poor absorption, and change in metabolism, by chronic infections and other illnesses [5]. Poor nutritional status is one of the major complications of HIV and a significant factor to have full-blown AIDS. Individuals who are severely chronic energy deficient have a six times higher risk of dying in the first 3 months of starting ART than those with a normal nutritional status [6, 7]. In most developing countries chronic energy deficiency with other infectious disease aggravated the HIV pandemic and contributed for morbidity and mortality of patients [5, 8, 9].

Even though there is a major advance in antiretroviral treatment and survival outcomes, Chronic Energy Deficiency (CED) remain a significant public health concern among HIV infected groups [10]. More than 800 million people worldwide are chronically undernourished from which 200 million are living in SSA, and greater than 33 million are living with HIV infection [11]. CED, the most common form of adult malnutrition in the SSA, is associated with significant morbidity and compounds the immunosuppressive effects of HIV [12]. A reported by a meta-analysis conducted in Sub-Saharan countries the pooled prevalence of HIV related CED was 10.3% and the prevalence in Ethiopian was 13.2% [13]. According to the Studies done in Brazil and India the prevalence of chronic energy deficiency among HIV infected individuals was 43 and 28.56% respectively [14, 15]. Moreover in Botswana, Tanzania and Nigeria, it was 28.5,18.4 and 5.8% respectively [16–18]. In Ethiopia, Addis Ababa city, it was 18% [19] and in Butajira Hospital the overall prevalence of CED was 25.2% and of which 49, 19, and 9% patients had mild, moderate, and severe CED respectively [20].

Age, anemia, CD4 count below two hundred and being widowed were the determinant factors of chronic energy deficiency among adults living with HIV in Dembia district [21].

Though many advances in the fight against HIV have been made in Ethiopia, sufficient effort has not been put into promoting adequate nutrition for PLHIV.As a result the Federal Minister of Health (FMOH) of Ethiopia has launched the National Nutrition Program (NNP) to address nutrition problems in a comprehensive manner by including nutrition and HIV/AIDS as part of its complete service delivery. There is also a Guideline named' National Guidelines for HIV/AIDS and Nutrition' to provide a standardized nutrition care and support for PLHIV in diverse conditions [22].

Even though there was a previous study in the study area, it was done before the implementation of nutrition assessment, counseling and support program in the Hospital. Therefore, the aim of this study was to determine the prevalence and factors associated with chronic energy deficiency among adults living with HIV in Gondar University Referral Hospital, North West Ethiopia, Gondar.

Methods

Study area and period

The study was conducted at Gondar University Referral Hospital HIV care clinic from March to April; 2016. Gondar University Referral Hospital HIV care clinic is located in North Gondar administrative zone, Amhara National Regional state, which is about 727 km northwest of Addis Ababa, the capital city of Ethiopia. The hospital serves about five million people of the northwest Ethiopia. The HIV care service of the hospital was initiated in 2005 and has 7 outpatient rooms, one voluntary testing and counseling room, one pharmacy, and laboratory rooms. It has three adult ART clinic, one pediatric, one VCT and 2 adherence counseling clinic. Daily about 30–40 HIV positive clients visit the clinic. Since 2005, 7581 adults have enrolled in the clinic. Currently, about 4891 adults are actively following their treatment.

Source and study population

All HIV positive adults (≥18 years) who were enrolled for chronic HIV care at Gondar University referral Hospital ART clinic were the source population and those adults living with HIV/AIDS who came to Gondar University Referral Hospital for a follow up during the study period were our study population.

Inclusion and exclusion criteria

Adults age 18 and above living with HIV who visited the ART clinic during the study period were included in the

study while pregnant women and adult with spinal problem (kyphosis) were excluded from the study.

Sample size determination and sampling procedure

The required sample size was calculated using single population formula $n = \left(\left(z\frac{\alpha}{2}\right)^2 * p(1-p)\right)/w2$ [23], where **n** is the sample size, **z** is the value of standard normal distribution corresponding to a significant level of α of 0.005 which is 1.96, **w** is the margin of error which was taken as 5% and **p** is the estimated proportion of the target population by taking the prevalence of chronic energy deficiency as 25.2% [20] and adding 10% non- response error the final sample size computed was 319. In order to get sampling interval (k), the total population was divided by the sample size required. The data collection was planned to be finished within one month having 22 working days. To select our study participants, we considered the working days and the average daily patient flow in the ART clinic. The average daily patient flow was 30–40 (we took 35). The total expected number of patients to attend the clinic during the data collection period was 770 and to select 319 of our study participants, we used a systematic random sampling with a sampling interval of $770/319 \approx 2$. The first participant was selected using random starting point of lottery method. Subjects were chosen at regular intervals by adding two from each prior participant at their exit from the ART clinic.

Data collection tool and procedures

An interviewer administered pretested structured questioner was used to collect the socio demographic characteristics like sex, age, residence, marital status, educational level and occupation of study participants. Similarly, The household economic status of the participants was assessed by house hold wealth index questions which were extracted from EDHS 2011 [24]. It was assessed by using the selected household assets, house ownership, main materials of the roof and floor, toilet facility, source of drinking water and fuel, size of agricultural land, livestock ownership, microfinance bank account and receiving cash or food from safety net program. First variables were coded between 0 and 1. Then, principal component analysis was carried out. In the principal component analysis, the power of the variables to explain wealth status was determined step by step using the communalities values. Those variables having communality value of greater than 0.5 were used to produce factor scores. Hence, an Eigen value of greater than one was considered. Finally this factor scores were summed and ranked in to tertile as low, medium and high [25].

Tools for measuring the dietary diversity was adopted from FAO guidelines for measuring house hold and individual dietary diversity. Dietary Diversity Score (DDS) was assessed by asking the respondents to list all the food items they consumed in the last 24 h preceding the survey day. We used food groups in local context. Then the reported food items were classified into nine food groups. Respondents with dietary diversity score three and below were classified as having inadequate dietary diversity score while respondents with dietary diversity score above three were taken as having adequate dietary diversity score [26].

Anthropometric measurement (height and weight) was done to have information on the individuals' Body mass index (BMI). Weight of the study participants was measured to the nearest 0.1 Kg of a standing beam balance. It was measured with lightly clothing and no shoes. Calibration was done before weighing each participant by setting it to zero. Weighing scale also checked against a standard weight for its accuracy on daily basis. Height of the participant was measured using 'Seca' vertical height measuring scale standing upright in the middle of board. It was measured following standard procedures. Participants' takeoff their shoes, stand erect and look straight in horizontal plain. The occiput, shoulder, buttocks, and heels touched measuring board [27, 28] and it was recorded to the nearest 0.5 cm.. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). BMI was classified according to WHO classification [29]. Less than 18.50 kg/m^2 taken as chronic energy deficiency (CED) and it was further classified as Mild CED if BMI was 17.00–18.49 kg/m^2, Moderate 16.00–16.99 kg/m^2 and severe less than 16.00 kg/m^2. Patients who was considered as not having CED were normal (BMI 18.5–24.49 kg/m^2), overweight (24.5–30.0 kg/m^2) and obese (>30 kg/m^2).

Stage of the disease, ART status and drug regimen were accessed on the patients' medical chart. Blood sample was drawn from subjects as part of routine monthly ART follow up investigation to measure CD4 cell count and Hemoglobin level.

Laboratory

Hemoglobin was measured with Cell Dyne hematology analyzer (US). Hemoglobin level <13 g/dl for men and < 12.0 g/dl for women patients was considered as anemic [30].CD4+ T cell count was measured with BD FACS machine (US) and categorized according to different literatures by taking 200 as a cutoff point [31].

Data processing and analysis

Data were checked for completeness, entered and coded using EPI-INFO version 7 software. Analysis was carried out using Statistical Package for Social Science (SPSS) version 20 statistical program. Frequencies and graphs were used to explore the data. Binary logistic regression

analysis was used to identify the confounders. Variables with a p-value of <0.2 and variables which were highly significant in other studies were entered to multi-variable logistic regression (Back ward likelihood ratio variable selection method) to identify factors which have statistically significant association. Adjusted odds ratio (AOR) with 95% confidence interval and p-value <0.05 was used to show association between explanatory variables and dependent variable. The fit of the model was assessed using the Hosmer-Lemeshow goodness-of-fit test and p-value > 0.05 was taken as a cutoff point.

Result

A total of 317 adults living with HIV who were in pre and on ART care were included in the study with a response rate of 99.4%. Two hundred five (64.7%) of the participants were females and regarding the participants marital status, about half (50.2%) were currently married. The age of the respondent's ranges from 18 to 70 and the mean age of the respondents was 38.5 years with a standard deviation (SD) ± 9.86. One hundred and seventy (53.6%) of study participants were in the age range of 30–44 years old. Ninety (28.4%) were jobless while farmers accounted for 5.4% of cases. Of 317 participants, 287 (90.5%) were urban residents. About one third (30.6%) of the study participants had no formal education, while 38.8% had secondary education and above. Regarding the house hold wealth index, about one third had low wealth status (Table 1).

Table 1 Socio-demographic characteristics of adults living with HIV at Gondar University Referral Hospital, Gondar; May 2016 ($n = 317$)

Variable		Frequency	Percent (%)
Sex	Female	205	64.7
	Male	112	35.3
Age in years	18–29	54	17
	30–44	170	53.6
	>45	93	29.3
Residence	Urban	287	90.5
	Rural	30	9.5
Marital Status	Currently unmarried	158	49.8
	Currently married	159	50.2
Religion	Orthodox	295	93.1
	Muslim	22	6.9
Ethnicity	Amhara	288	90.9
	Others	29	9.1
Occupation	Unemployed	90	28.4
	Employed	227	71.6
Educational status	No formal education	97	30.6
	Primary	97	30.6
	Secondary and above	123	38.8
Wealth Index	Low	105	33.1
	Medium	106	33.4
	High	106	33.4

Clinical profile and anti-retroviral therapy status

The clinical status of participants showed that 267(84.2%) were at WHO stage one. Two hundred seventy five (86.8%) were on ART of which Ninety (36%) were on AZT-3TC-NVP and another eighty seven (31.6%) were on TDF-3TC-EFV Regimen. The median CD4+ T-cell count of participants were 400 cells/μl with Inter –quartile range (IQR: 266.5, 593.5).In addition, 25(7.9%) had history of diarrhea in the past two weeks prior to the survey (Table 2).

Nutritional status

The overall prevalence of chronic energy deficiency (BMI < 18.5 kg/m^2) among adults living with HIV was 18.3% (95%CI: 14.5%–22.7%). Mild, Moderate and Severe chronic energy deficiency was observed on 36(11.4%), 11 (3.5%) and 11(3.5%) participants respectively. The mean BMI was 21.5 ± 3.6Kg/m^2.Of 317 study participants, 278(87.7%) had inadequate dietary diversity, of which 41(81%) were having chronic energy deficiency (Fig. 1).

The prevalence of chronic energy deficiency among female participants was 19%. Among all patients who had chronic energy deficiency, the proportion of CED was high in age group between 30 and 44 which was 30 (51.7%) followed by age group 18–29 and ≥45 each accounted 14 (24.1%). Considering the participants residence, 48(82.8%) of chronic energy deficient participants were urban dwellers (Table 3).

Fourteen (24.1%) of participants who were on pre-ART and 44 (75.9%) who were on ART had chronic energy deficiency. Of the 58 chronic energy deficient individuals 10(17.2%) were having CD4 count less than two hundred.

The overall prevalence of anemia was 25.1% and among chronic energy deficient individuals 34.5% were anemic.

Associated factors of chronic energy deficiency

The covariates, residence, educational status, ART status, stage of the disease, toilet availability and diarrhea were significantly associated with chronic energy deficiency in the bi-variable analysis. In the adjusted analysis, educational status, stage of the disease and having diarrhea in the past two weeks prior to the survey were significantly associated with chronic energy deficiency. The risk of developing chronic energy deficiency of no formal education increased risk of by 2(AOR = 2.05,95%CI: 1.005,4.210) as

Table 2 Clinical Profile and ART status of adults living with HIV in GURH, 2016($n = 317$)

Variable	Frequency	Percent (%)
Stage of the disease		
One	267	84.2
Two	31	9.8
Three and above	19	6
ART status		
Pre-ART	42	13.2
On ART	275	86.6
Regimen		
AZT-3TC-NVP	99	36
AZT-3TC-EFV	40	14.5
TDF-3TC-EFV	87	31.6
TDF-3TC-NVP	36	13.1
Second line	13	4.1
CD4 count		
<200 cells/μL	130	41
≥ 200 cells/μL	187	59
Hemoglobin		
Normal	236	74.9
Anemic	79	25.1
Diarrhea		
Yes	25	7.9
No	292	92.1

compared to those having secondary education and above. With regard to the clinical stage of the disease, those who are in the WHO stage three and four were 3.84 times (AOR = 3.84, 95%CI: 1.83, 10.72) at risk of having chronic energy deficiency than those in stage one. Those who had history of diarrhea in the last two weeks prior to the survey were 4.43 times (AOR = 4.43, 95%CI: 1.83, 10.72) at risk of having chronic energy deficiency than their counter parts (Table 4).

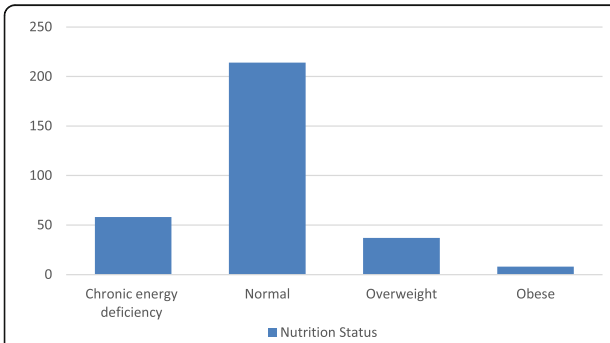

Fig. 1 Nutritional status of adults living with HIV in Gondar University referral hospital, Gondar, 2016

Discussion

Recognizing the magnitude of malnutrition in PLWH is important because it may predict disease progression and higher risk of morbidity and mortality. The presence of chronic energy deficiency is a predictor of worse outcome in HIV infected individuals [32]. This study aimed on assessing the prevalence of chronic energy deficiency and its associated factors among PLWH. In this study the overall prevalence of chronic energy deficiency was 18.3% and according to Nutrition Landscape Information System (NLIS) cutoff values, the burden of CEM was founds to be in medium public health significance [33]. Educational status, WHO clinical stage and having diarrhea in the last two weeks were significantly associated with chronic energy deficiency.

The overall prevalence of chronic energy deficiency in this study was similar with the studies done in Nepal and Singapore [34, 35], Tanzania [17] and Ethiopian studies done in Butajira, Dilla, Addis Abeba and Dembia [19–21, 36]. But it was lower than the findings from Iran, China, Brazil, Botswana, Bahirdar, Humera and Gondar [14, 18, 31, 37–40]. Higher prevalence of chronic energy deficiency was also observed in this study as compared to a study conducted in Nigeria [16]. The discrepancy in the prevalence of chronic energy deficiency among different countries might be due to the difference in sociocultural and economic characteristics, diet diversity, and year of the study. Especially the studies done in Bahirdar and Gondar which has a similar setting with the current study might be explained by the time variation between the studies and the improved nutrition assessment and counseling services in the country. High prevalence of CED in Humera is due to the study conducted among women living with HIV whom are biologically, socially and economically vulnerable groups and this will add fuel to their nutritional status. In addition, studies in Brazil and China were conducted among hospitalized patients among whom the probability of the presence of different opportunistic infections is increased which further predisposes to CED.

This study revealed that, being in WHO stage three and four had 3.84 times risk for chronic energy deficiency. Studies from Nepal (AOR = 2.09), Hosanna (AOR = 5.23) and Dilla (AOR = 12.9) also showed similar findings [34, 36, 41]. When the disease stage advances over time, the occurrence of CED is inevitable due to the occurrence and synergetic effect of different opportunity infections which increases their

Table 3 nutritional status and socio-demographic characteristics, ART status and Dietary diversity of adults living with HIV in GURH, 2016

Variable		Chronic-energy deficiency		total
		Yes Number (%)	No Number (%)	Number (%)
Sex	Female	39(19%)	166(81%)	205(100%)
	Male	19(17%)	93(83%)	112(100%)
Age in year	18–29	14(26%)	40(74%)	54(100%)
	30–44	30(17.6%)	140(82.3%)	170(100%)
	≥45	14(15%)	79(85%)	93(100%)
Marital status	Currently unmarried	34(21.5%)	124(78.4%)	158(100%)
	Currently married	24(15%)	135(85%)	159(100%)
Educational status	No formal education	27(27.8%)	70(72.1%)	97(100%))
	Primary	15(15.4%)	82(84.5%)	97(100%)
	Secondary and above	16(13%)	107(87%)	123(100%)
Residence	Urban	48(16.7%)	239(83.2%)	287(100%)
	Rural	10(33%)	20(67%)	30(100%)
Ethnicity	Amhara	53(18.4%)	235(81.5%)	288(100%)
	Others	5(17.2%)	24(82.7%)	29(100%)
Wealth Index	Low	26(24.7%)	79(75.2%)	105(100%)
	Medium	14(13.2%)	92(86.7%)	106(100%)
	High	18(17%)	88(83%)	106(100%)
Dietary diversity	Inadequate	47(17%)	231(83%)	278(100%)
	Adequate	11(39.2%)	28(60.7%)	39(100%)
ART status	Pre-ART	14(33.3)	28(66.7%)	42(100%)
	On ART	44(16%)	231(84%)	275(100%)

catabolic state, energy demand and loss of both macro and micronutrients by decreasing the intake and absorption of nutrients. In addition, when the disease stage advances fatigue increases and it decreases their physical activity and then work productivity which compromise their house hold income, food purchasing power and diminish their probability to get nutritious and adequate food further affect their nutritional status [5, 42].

Poor nutrition is associated with prolonged diarrhea. Each day of illness due to diarrhea produces a weight loss of 20–40 g [43]. Diarrhea increases caloric needs by 25% and often leads to a decreased oral intake, Increased loss of and decreased absorption of vitamin, mineral, protein, fat, and carbohydrate. In this study, those who had history of diarrhea in the last two weeks were 4.43 times at risk of having chronic energy deficiency than their counter parts. This findings consistent with the study conducted in Dilla(AOR = 3.40) [36] but not in a study done in Butajira and Humera [20, 40].

Educational status and Chronic energy deficiency show significant association and those having no formal education increased the likely hood of developing chronic energy deficiency by about two fold (AOR = 2.05) as compared to those having secondary education and above. Similarly, a study conducted in Nepal and Dilla revealed that Illiterate people were 2.3 and 3.5 times more likely to be chronic energy deficient as compared to people who can read and write respectively [34, 36]. A meta-analysis done among women living with HIV in SSA also supports this finding [13]. This could be explained by when Individuals having no formal education, they might not have the knowhow of eating diversified diet and hygiene which strongly affects their nutritional status. On the other hand, individuals having no formal education will have low employment opportunity which will affect their level of income and food consumption [44].

The limitation of the study was the study design which is cross-sectional; we cannot able to establish a cause and effect relationship. Since the questions were interviewer - administered there will be some social desirability bias in answering the dietary diversity and wealth index questions. The data collection period was during the fasting period, it affected the dietary diversity score of the participants since animal products excluded during fasting period.

Table 4 Factors Associated With chronic energy deficiency among Adults Living with HIV in Gondar university referral Hospital, NWE, Gondar, 2016

Variables	Chronic energy deficiency		COR 95%CI	AOR 95%CI
	Yes	No		
Sex				[b]
Male	19	93	.87 (0.68, 1.59)	
Female	39	166	1.00	
Age				[b]
18–29	14	40	1.97 (0.85,4.54)	
30–44	30	140	1.20 (0.60,2.41)	
≥ 45	14	79	1	
Religion				[b]
Orthodox	54	241	1	
Muslim	4	18	0.99(0.32,3.0)	
Residency				[b]
Urban	48	239	1	
Rural	10	20	2.49(1.09,5.65)[a]	
Marital status				[b]
Unmarried	34	124	1.54(0.86,2.74)	
Currently married	24	135	1	
Educational status				
No formal education	27	70	2.57(1.29,5.13)[a]	2.05 (1.01, 4.21)[c]
Primary education	15	82	1.22(0.57,2.61)	0.89(0.39,2.00)
Secondary and above	16	107	1	1
Occupation				[b]
Unemployed	14	76	0.766(0.39,1.48)	
Employed	44	183	1	
Wealth Index				[b]
Low	26	79	1	
Medium	14	92	0.46(0.22,0.94)	
High	18	88	0.62(0.31,1.21)	
Dietary Diversity				[b]
Inadequate	47	231	1	
Adequate	11	28	1.93(0.89,4.14)	
ART status				[b]
Pre-ART	14	28	2.6(1.28,5.38)[a]	
On ART	44	231	1	
Stage of the Disease				
One	41	266	1	1
Two	9	22	2.25(0.97,5.24)	2.02(0.83,4.91)
Three and four	8	11	4.0(1.52,10.50)[a]	3.84(1.39,10.61)[c]
CD4				
<200	10	38	1.21(0.56,2.59)	
>200	48	221	1	
Toilet availability				[b]

Table 4 Factors Associated With chronic energy deficiency among Adults Living with HIV in Gondar university referral Hospital, NWE, Gondar, 2016 *(Continued)*

Yes	45	231	1	
No	13	28	2.38(1.14,4.95)[a]	
Diarrhea				
Yes	12	13	4.93(2.12,11.49)[a]	4.43(1.83,10.72)[c]
No	46	246	1	1
Anemia				
Yes	20	61	1	
No	38	198	1.70(0.96,3.15)	

[a]variables which were significant by bivariate analysis
[b]variables which were not significant in multivariate analysis using back ward likelihood ratio variable selection method
[c]indicates variables which show significant association in multivariate analysis

Conclusion

The Prevalence of chronic energy deficiency in this study was medium. Educational status, Stage of the disease and having diarrhea in the last two weeks were the important risk factors associated with chronic energy deficiency. Health care workers better to bear in mind that in addition to giving HAART, consistent and proper nutritional assessment and early diagnosis and treatment of diarrhea should be a vital part of HIV management and a prerequisite to the planning of general nutritional care and support.

Abbreviations

AIDS: Acquired immuno deficiency syndrome; AOR: Adjusted odds ratio; ART: AntiRetro-viral treatment; AZT: Zidoviudine; BMI: Body mass index; CD4: Cluster of differentiation 4; CED: Chronic energy deficiency; CI: Confidence interval; DDS: Dietary diversity score; EFV: Efavirenz; GI: Gastro intestinal; GURH: Gondar University Referral Hospital; HAART: Highly active anti-retroviral treatment; HIV: Human immune virus; NNP: National nutrition program; NVP: Nevirapine; PLWH: People living with HIV; RNA: Ribonucleic acid; TDF: Tenofovir; VCT: Voluntary counseling and testing; WHO: World Health Organization

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Availability of data and materials

Data will be available up on the request of the corresponding author.

Authors' contributions

MF contributed in the generation of the topic, preparation of proposal, data collection, analyses and development of the manuscript. MM, MM, and AT contributed in reviewing the proposal, assisted in data collection, analysis and critical review of final manuscript. TA and KA contributed in critically reviewing the proposal, the manuscript and processed publication. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

Ethical clearance was obtained from ethical review committee of University of Gondar, College of Medicine and Health Sciences(Ref.No/IPH/2883/02/2016), Institute of Public Health prior to data collection. Written informed consent was obtained from each study participant after the purpose of the study explained. Individuals who were not volunteer to continue from the beginning or from any part of the interview were respected to do so. Privacy, anonymity and strict confidentiality were maintained during the interview process. Nutrition education was given to all subjects.

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