

Factors Associated with Dietary Diversity among HIV Positive Adults (\geq 18 years) Attending ART Clinic at Mettema Hospital, Northwest Ethiopia: Cross-sectional Study

Amare Tariku Woldemariam^{1*}, Melkie Edris Yusuf¹, Teresa Kisi Beyen² and Melaku Kindie Yenit²

¹Department of Human nutrition, Institute of Public Health, College of Medicine and Health science, University of Gondar, Gondar, Ethiopia

²Department of Epidemiology and Biostatistics, Institute of Public Health, College of Medicine and Health Science, University of Gondar, Gondar, Ethiopia

Abstract

Background: HIV/AIDS has become a global health crisis and a leading cause of death in the developing world. Since 1981, more than 25 million people worldwide have died from this immunodeficiency syndrome. Very early in the AIDS epidemic, it was recognized that protein calorie malnutrition and specific micronutrient deficiencies were common in HIV and AIDS patients. Non-diversified diet and inadequate dietary intake could contribute to this severity of HIV/AIDS progression and to the depletion of CD4 count. Therefore, this study assess factors associated with dietary diversity among HIV positive adults (\geq 18 years) attending Anti-retroviral treatment clinic in Mettema hospital, Northwest Ethiopia.

Methods: Facility based cross sectional study design was used in Mettema hospital at anti-retroviral treatment clinic from March 18 to May 16, 2013. A total of 378 adult HIV positive individuals who are attending ART clinic selected by systematic random sampling technique were included in the study. Data were collected using a pretested structured questionnaire using interview data collection method. Data were entered into Epiinfo software and analyzed using Statistical Package for Social Sciences for windows version 16 and logistic regression methods were used.

Result: A total of 376 respondents (with 99.5% response rate) were included in the study. Mean individual dietary diversity score showed that more than half (58.8%) of adult HIV positive individuals had low dietary diversity (95% CI: 0.49, 0.69). Significant factors associated with low dietary diversity were being lowest wealth quintile [AOR = 9.51, CI: 2.69, 33.48], being self-employed [AOR = 0.33; 95% CI: 0.13, 0.83] and daily laborer [AOR = 0.24; 95%: 0.08, 0.73], individuals with shorter duration of anti-retroviral treatment (less than one and half year) [AOR = 3.69; 95% CI: 1.47, 9.25] and taking Cotrimoxazole prophylaxis [AOR = 2.26; 95% CI: 1.3, 4.96].

Conclusion: Low dietary diversity was nutritional problem among HIV positive adults. Therefore efforts should be strengthened to improve employment status and consumption of animal based food items.

Keywords: Dietary diversity; People living with HIV; Ethiopia

Introduction

HIV/AIDS is major health problem linked to malnutrition and micronutrient deficiency. Individual with HIV/AIDS are characterized by progressive depletion of a specific group of immune cells called (CD4⁺) helper T-lymphocytes whose loss leads to opportunistic infections and cancer. Very early in the AIDS epidemic it was recognized that protein calorie malnutrition and specific micronutrient deficiencies were common in HIV and AIDS patients [1,2].

The relationship between HIV infection and nutrition and impact of HIV on nutrition is very complex. Micronutrients are essential for maintaining proper immunologic function so maintaining proper nutrition, weight and immune function is thought to delay disease progression, prolong the asymptomatic phase and improve survival. However this, significant numbers of PLWH took less than the recommended eating occasions and energy intake [3-5]. Inadequate dietary intake could contribute to micronutrient deficiencies that further leads to HIV/AIDS disease progression and to the depletion of CD4 count which increases risk of opportunistic infections in addition to the oxidative stress. Besides this, HIV infection impairs micronutrient status, and low micronutrient status and intake on the other hand affects risk of HIV transmission, progression, morbidity and mortality. Vitamin A and C deficiency depresses a cell mediated immune response and vitamin E deficiency impairs T cell mediated function and lymphocyte proliferation. Among the B vitamins, riboflavin deficiency impairs the immune system and Zinc Supplementation reduces the risk

of diarrhea and respiratory tract infection [3,6].

The link between nutrition and HIV/AIDS can be modified by various factors. In resource-limited countries across the world including Ethiopia, low quality monotonous diets are the norm but food insufficiency and low dietary diversity are known contributors to poor health. Even though it is generally understood that no food item contains all necessary nutrients diversity in the diet, it is necessary to ensure a balanced diet and to meet overall micronutrient and energy demand. Findings showed that stages of disease and presence of opportunistic infection like diarrhea and respiratory infection affects individual dietary diversity [7,8]. Other studies evidenced that as stage of HIV/AIDS progresses, coupled with opportunistic infections and metabolic demand, HIV-infected individuals may be unable to meet their required nutritional needs due

***Corresponding author:** Amare Tariku Woldemariam, Department of Human nutrition, Institute of Public Health, College of Medicine and Health science, University of Gondar, Gondar, Ethiopia, Tel: +251913002871; E-mail: amaretariku15@yahoo.com

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to decreased oral intake, decreased nutrient absorption [7,8]. Other predictors for level of dietary diversity were age, place of residence, HIV disease stage and other physiological factors, nutritional status (BMI) [9,10], educational status and annual household income.

Dietary diversification is a recommended approach to alleviate nutritional problems. Dietary diversity, the consumption of an adequate variety of food groups, is an aspect of dietary quality and can be considered as an indicator of general nutritional adequacy [11]. It is known that non-diversified diet can have negative consequences on individuals' health, well-being and development, mainly by reducing physical, social, cognitive, reproductive and immunological capacities. So, Providing evidence on level of dietary diversity and its determinant on HIV positive individuals will play a crucial role in improving quality of nutritional care and counseling provided by health care providers which in turn improves clients (PLWH) quality of life, physical and social capacity. Therefore the objective of this study was to assess and factors associated with dietary diversity among HIV positive adults (≥ 18 years) attending ART clinic at Metema hospital, Metema Woreda in Northwest Ethiopia.

Methods

Study area and study period

Facility based cross-sectional study design was used in Mettema hospital at ART clinic from April 18 to May 16, 2013. The district hospital was established in 1986 at Gendewuha town, which is 878 Km far from Addis Ababa, capital city of Ethiopia. Mettema hospital provides service for more than 130,000 populations and the area is well known by hot climate and low land topography. Since the establishment of ART at the hospital since 2005; about 2,927 HIV positive adults were registered to receive care and support at the ART clinic.

Participants

Source populations were all HIV positive adults who were registered for care and support at ART clinic of Mettema Hospital. Study populations were HIV positive adults (≥ 18 years) who were attending ART clinic within the data collection period. However, HIV positive adults with previously diagnosed diabetes mellitus, hypertension and pregnancy, and those who were admitted for inpatient management as well as those who participated in the special festival within the last 24 hour prior to data collection were excluded from the study.

Sample size and sampling procedure

Sample size was determined by StatCalc of Epi Info version 3.5.3 for population survey by considering 50% as proportion of HIV positive adults with low dietary diversity, 95% level of confidence and 5% level of precision. The sample size becomes 384 and after considering the population correction formula (since study population is $<10,000$) and considering non-response rate of 10%, the final sample size was 378. Study participants were selected by Systematic random sampling technique at every K^{th} (5^{th}) intervals (k is sampling fraction; which is calculated as $N/n=1800/378=5$). The numerator 1800 was estimated as average number of HIV positive clients attending ART clinic per month. The starting sample was selected by lottery method among the first five client charts. The procedure continued until the required sample size was obtained. Data were collected in every working day and one study subject recruited only once.

Data collection tools and procedures

Structured interviewer administered questionnaire and

standardized individual dietary diversity score tool (FANTA 2011) with 24 hour food recall method was used to assess dietary diversity of HIV positive adults. The questionnaire was designed to capture socio-demographic and economic, Health and behavioral related and nutrition related characteristics of study participants.

Regarding respondents socio-demographic and economic variables: age, sex, educational status, place of residence, marital status, family size, type of family, wealth index, employment status, household main source of food were collected. Wealth index was computed based on list of household assets summarized for both urban and rural residents as one measurement index. A score of 1 was given if the asset was present and 0 if absent. The asset mean scores were re-categorized into five different wealth quintiles of equal proportion (Lowest, Second, Middle, Fourth and Highest wealth control groups) by using Principal Component Analysis (PCA).

The questionnaire was first prepared in English by reviewing literatures and then translated into Amharic then back to English to maintain its consistency and pretested was done on 19 adult HIV positives (5% of the total respondents) at Shinfa Health Center. Data were collected by three clinical nurses by interview using well standardized and pretested questionnaire after obtaining an informed consent. Two B.Sc. nurses were supervised the data collection process. Completion, accuracy, and clarity of the collected data were checked carefully on daily basis.

Measurement of dietary diversity score

Individual dietary diversity scores reflects the probability of micronutrient adequacy of the diet as a result nine food groups which are tailored for this purpose are used [12], i.e., starch staples, legumes, nuts and seeds, dark green leafy vegetables, other vitamin-A rich fruits and vegetables, other fruits and vegetables, meat and fish, organ meat, egg, and milk and milk products. Hence oils and fats do not contribute much to micronutrient density of the diet [13], this food groups are not used in estimating individual dietary diversity score. But oils and fats food groups are energy dens and important for the absorption of fat soluble vitamins as a result proportion of study participants consuming this food group was also estimated alone.

Determination of individual dietary diversity score of the respondents was started by listing all foods consumed in the last 24 hour prior to the data collection by respondents (both inside and outside home). Listing of food was started from breakfast which is considered to be eaten between 6:00 AM and 10:00 AM then lunch (12:00 AM-4:00 PM) and Dinner (8:00 PM-12:00 PM) while snacks considered to be eaten before or after the major meal. Then food eaten by the respondent was classified into nine food groups. Participants received 1 point if they consumed food at least once during the last 24 hours within each subgroup and 0 point if they never consumed the food. Individual Dietary Diversity Score (IDDS) was calculated as the sum of food groups consumed over 24 hours. Mean individual dietary diversity score, i.e., 3.29 (SD ± 1.77) used as cut off point and those participants who consume four and above food groups within 24 hour in a day were considered as having high dietary diversity (diversified diet) and participants with IDDS below four i.e. consume three and below food groups were considered as having low dietary diversity (undiversified diet).

Data management and analysis

Data were cleaned, coded and entered into Epi info version 3.5.3 and exported to SPSS version 16 for further analysis. Descriptive part

of result was presented using frequency table, graph, percentage, mean and standard deviation. The outcome variable i.e. dietary diversity score was categorized as high and low dietary diversity by considering mean IDDS as cut off point. Binary logistic regression model was used as fitted model. Bi-variate analysis was run for each independent variable to check the association with dietary diversity. Those variables which were found to have significant association ($p < 0.2$) in the bi-variate analysis were run in to multi-variate analysis so as to control for possible effect of confounders. Those variables which were found to have significant association with dietary diversity were identified using adjusted odds ratio (AOR) with 95% CI and p -value < 0.05 . Hosmer and Lemeshow goodness of fit-test of model was computed and provided p -value of 0.51 and model chi-square of 7.29.

Ethical considerations

Ethical clearance was obtained from ethical Review Board of University of Gondar and submitted to Metema hospital administration office prior to data collection to get permission. Objective of the study was explained and informed verbal consent obtained from each participant. Client records were coded to keep the privacy of the study participants and only accessed by research team. Participants who are refused to participate were not forced. Three HIV positive adults with sever acute malnutrition (SAM) and four with moderate acute malnutrition (MAM) criteria were linked to the respective rehabilitation center of the hospital during data collection.

Result

Socio-demographic and economic characteristics

A total of 376 HIV positive adults were participated in the study which accounts response rate of 99.5%. Out of the total respondents 219 (58.2%) were females and the mean age of respondents was 35.9 years with standard deviation of 9.22. Three hundred forty (90.4%) respondents were orthodox Christians and 148 (39.4%) were divorced. Substantial numbers of respondents (70.3%) were from urban Kebeles and did not take formal education (73.9%). The mean family size of respondents was 3.05 with standard deviation of 2.05 and above one third of HIV positive adults (38%) were living in the household size of four and above. Two hundred sixty seven (71%) and 96 (25.5%) of respondents main household source of food was accessed through purchasing from market/grocery store and farm/garden, respectively (Table 1).

Health related characteristics

Larger proportions of HIV positive adults (92.8%) were fall under WHO clinical stage I and 230 (61.2%) had CD_4 count of less than 350 mg/dl. Three hundred thirty seven (89.6%) respondents were taking Anti-retro viral treatment (ART) in which larger percentage (65.9%) of them took ART for less than three and half year (42 month). Two hundred seventy three were (72.6%) taking Cotrimoxazole prophylaxis (Table 2).

Nutritional related characteristics

Out of 376 respondents, one hundred forty (37.2%) were underweight and 296 (78.7%) have received nutritional counseling on general feeding, ART and other drugs and opportunistic infection at both ART clinic and pharmacy (Table 3).

Food variety and meal frequency

By considering the mean meal frequency (2.92, $SD = \pm 0.7$) as cut

Variables		frequency	percent
Sex	Male	157	41.8
	Female	219	58.2
Age	18-28	100	26.6
	29-34	97	25.8
	35-41	91	24.2
	≥42	88	23.4
Religion	Orthodox	340	90.4
	Muslim	36	9.6
Educational status	No formal education	278	73.9
	Primary education	73	19.4
	Secondary and above	25	6.6
Employment status	Self employed	138	36.7
	Government employee	12	3.2
	Daily laborer	140	37.2
	Unemployed	86	22.9
Marital status	Single	38	10.1
	Married	158	42
	Divorced	148	39.4
	Widowed	32	8.5
Place of residence	Urban	266	70.7
	Rural	110	29.3
Family size	≤3	233	62
	≥4	143	38
Head of household	Yes	280	74.5
	No	96	25.5
Wealth index	Lowest quintile	74	19.7
	Second quintile	75	19.9
	Middle quintile	77	20.5
	Fourth quintile	75	19.9
	Highest quintile	75	19.9
Household food source	Purchase	267	71.0
	Farm/garden	96	25.5
	Relative or friends	13	3.5

Table 1: Socio-demographic characteristics of adult PLWHA (≥ 18 years) at Metema Hospital, Metema Woreda, Northwest Ethiopia, 2013 (n = 376).

off point, three hundred thirty five (89.1%) respondents had high meal frequency i.e. ate three and above meal within past 24 hour and 264 (70.2%) ate three times in a day within past 24 hour before the data collection. Most commonly eaten foods as stated by the respondents were starchy staples (98.7%), legumes, nuts and seeds (78.5%) and oils and fats (87.8%) and other fruits and vegetables (62.8%). The least food groups eaten by the respondents were egg (2.4%), milk and milk products 11 (2.9%) and organ meat 24 (6.4%).

Regarding consumption of vitamin-A and haeme-iron rich food groups, one hundred twenty (31.9%) respondents were consume at least one of vitamin-A rich source of plant based food groups (carotinoid source: dark green leafy vegetables and other vitamin-A rich fruits and vegetables). But only 41 (10.9%) respondents ate at least one of vitamin-A rich source of animal based food groups (Retinol source: organ meat, egg and milk and milk products). Hundred twenty six (33.5%) of adult PLWH ate at least one of haeme-iron rich source of animal based food groups, i.e., meat and fish, and organ meat food groups.

Level of dietary diversity and dietary pattern

The mean individual dietary diversity score was 3.29 with

Variables		Frequency	Percent
ART status	Yes	337	89.6
	No	39	10.4
Duration of ART	6-18 month	119	35.3
	19-42 month	103	30.6
	≥ 43	115	34.1
CPT prophylaxis	Yes	273	72.6
	No	103	27.4
Last CD ₄ count	<50mg/dl	7	1.9
	51-199mg/dl	89	23.7
	200-349mg	134	35.6
	>350mg/dl	146	38.8
Opportunistic infection	Chronic cough	9	2.4
	Tuberculosis	11	2.9
	Diarrhea	33	8.8
	Oral/esophageal thrush	7	1.9
	Other*	3	0.8
	No OI	313	83.2
GI upset	Nausea and vomiting	35	9.3
	Diarrhea	33	8.8
	No	308	81.9
Cigarette smoking	Yes	14	3.7
	No	362	96.3
Drinking alcohol	Yes	46	12.2
	No	330	87.8
Chewing chat	Yes	16	4.3
	No	360	95.7

Table 2: Health related characteristics of adult PLWH (≥ 18 years) at Metema Hospital, Metema woreda, Northwest Ethiopia, 2013 (n = 376) *Implies that angular chilitis and herpes zoster.

Variables		Frequency	Percent
BMI	<18.5kg/m ²	131	37.2
	≥ 18.5 kg/m ²	236	62.8
On RUTF	Yes	26	6.9
	No	350	93.1
RUTF use daily	Yes	23	88.5
	No	3	11.5
Sharing with others	Yes	4	15.4
	no	22	84.6
Nutritional counseling	Yes	296	78.7
	No	80	21.3

Table 3: Nutritional related characteristics of adult PLWHA (≥ 18 years) at Metema Hospital, Metema woreda, Northwest Ethiopia, 2013 (n = 376).

Total respondents	Low dietary diversity	High dietary diversity
Starchy staples ¹	Starchy staples ¹	Starchy staples ¹
Legumes, nuts and seeds ²	Legumes, nuts and seeds ²	Legumes, nuts and seeds ²
		Other fruits and vegetables ³
		Meat and fish ⁴

Table 4: Food groups eaten by $\geq 50\%$ of HIV positive adults (≥ 18 years) at Metema hospital, Metema woreda, northwest Ethiopia, 2013 (n = 376). Note: The green colored food groups, i.e., other fruits and vegetables³, Meat and fish⁴ were additional food groups consumed by $\geq 50\%$ of respondents with high dietary diversity.

1.77 standard deviation. By considering the mean individual dietary diversity score, about 58.8% (95%, CI: 0.49, 0.69) of HIV positive adults had low dietary diversity.

Regarding dietary pattern, starchy staples and legumes, nuts and seeds were the only two food groups predominantly consumed by at

least fifty percent ($\geq 50\%$) of respondents who had low dietary diversity. Four food groups' i.e. starchy staples, legumes, nuts and seeds, meat and fish and other fruits and vegetables were food groups predominantly consumed by at least fifty of ($\geq 50\%$) respondents who had high dietary diversity (Table 4).

Factors associated with level of dietary diversity

The result of Bivariate analysis showed that there was significant association between dietary diversity and employment status, wealth quintile, duration of anti-retro-viral treatment, Cotrimoxazole prophylaxis use and WHO clinical state. But after controlling for possible confounders, the result of multivariate analysis reveals that employment status, wealth quintile, duration of anti-retro-viral treatment and Cotrimoxazole prophylaxis use was significantly associated with dietary diversity of HIV positive adults (Table 5).

Discussion

Finding of this study reveal that about 58.8% of HIV positive adults had low dietary diversity, the result was consistent with study conducted in Jimma (55.8%) [14] and Eastern Uganda (59%) [15]. This could be related to poor dietary habit and poor household food security status of HIV positive adults. But it is also true that the dietary habit of other segments of the community in developing country is based on monotonous, energy dense but poor micro-nutrient source of starchy staples [16]. The study done in Jimma also revealed that, there is high prevalence of food insecurity among peoples living with HIV in Ethiopia [14]. Given that poor dietary habit and poor household food security status might result in feeding monotonous food group which ultimately affects dietary diversity. But the condition worsens among people living with HIV because of poor food access as a result of multi-dimensional socio-economic impact of HIV/AIDS. As evidenced by other studies showed that, there was more than 50% decrease in an average monthly household income among HIV affected households than non HIV affected households because of HIV related mortality coupled with high medical expense and higher dependency ratio [17].

Finding of the study revealed that wealth quintile was associated with dietary diversity of HIV positive adults. It was noticed that HIV positive adults at the lowest wealth quintile were more than nine times more likely to have low dietary diversity than those HIV positive adults at highest wealth quintile. This finding was consistent with the study finding in rural Mali [18], Kenya [19] and Rwanda [20]. This might be explained as having good economic status creates better opportunity to secure the household per capita food availability and to purchase Variety and nutritious foods both inside and outside of home. As a result dietary habit or food consumption pattern of HIV positive individuals with poor economic status may largely based on low cost, least nutritious and monotonous food groups.

Employment status was the other factor significantly associated with dietary diversity. HIV positive adults who had their own work (i.e., employed) were less likely to have low dietary diversity than unemployed HIV positive adults. Finding of this study was in line with the study conducted in Jimma among adults (≥ 40 years), in which employment status was associated with dietary diversity. Being merchant was associated with higher intake of animal source food [21]. This might be explained as unemployment status would result in greater economic constraint to purchase Variety of food and in losing economic capacity for food access at large. This negative economic impact as a result of unemployment status increases likelihood of having low dietary diversity. However, this finding is not in line with the finding in

variables	Dietary diversity		COR (95% CI)	AOR (95% CI)	p-value
	low	High			
Employment status					
Self employed	71	67	0.51 (0.29, 0.89)	0.33 (0.13, 0.83)	<0.05
Government employee	6	6	0.48 (0.14, 1.63)		
Daily laborer	86	54	0.77 (0.44, 1.35)	0.24 (0.08, 0.73)	
Unemployed	58	28	1	1	
Wealth index					
Lowest quintile	58	16	7.25 (3.49, 15.06)	9.51 (2.69, 33.48)	<0.001
Second quintile	53	24	4.42 (2.24, 8.7)	10.59 (2.47, 45.39)	
Middle quintile	46	29	3.17 (1.63, 6.19)	10.73 (3.37, 34.18)	
Fourth quintile	39	36	2.17 (1.12, 4.19)		
Highest quintile	25	50	1		
CPT prophylaxis					
Yes	172	101	1.88	2.26 (1.03, 4.96)	<0.05
No	49	54	1	1	
ART duration					
<18 month	86	33	3.05 (1.77, 5.25)	3.69 (1.47, 9.25)	<0.05
19-42 month	58	45	1.51 (0.88, 2.57)		
>42 month	53	62	1		
WHO clinical state					
Stage-I	196	153	0.09 (0.12, 0.7)		
Stage-II	11	1	0.79 (0.04, 14.03)		
Stage-III	14	1	1		

Table 5: Factors associated with dietary diversity of HIV positive adults (≥ 18) attending ART clinic at Metema Hospital, Metema woreda, Northwest Ethiopia, 2013 (n = 376).

India [22], in which employment status is not associated with dietary intake. This discrepancy may be due to difference in socio-economic status between the two study areas and presence of better social and financial support for peoples with HIV in India. This Financial support may enable to purchase variety of food even if they (people living with HIV) were unemployed. It is also evident that better social support is predictor of improved Quality of life among PLWH [23].

Duration of anti-retroviral treatment was significantly associated with dietary diversity. It was noticed that HIV positive adults who were on ART for less than one and half year (<18 months) duration were more than threefold more likely to have low dietary diversity than those on ART for more than three and half year. This might be due to most ARV drugs (zidovudin, stavudin, Efavirenz, Lamivudine and Nevirapine) were found with gastro-intestinal tract (GIT) related side effects like nausea, change in food test, anorexia, diarrhea, stomatitis and dyspepsia [24]. In the early periods of initiation of ART, Clients may face challenges in adapting the above side-effects as compared to taking ART for longer duration. This condition might increase the likelihood of having reduced food consumption, low meal frequency and low dietary diversity [25]. The other reason could be in the early period of initiation of ART, clients had low CD₄ count as a result they might suffer from different opportunistic infection (OI) like diarrhea, oral candidiasis and others. Therefore Symptom complex of OI may lead to reduced capacity to eat and prepare food [24] which in turn results to low dietary diversity. Finally, in the early period of initiation of ART, client may experience Mood changes like anxiety and depression as a result of introduction to lifelong treatment, social stigma and

other psycho-social factors. The above mood changes may result in suppressed appetite, which in turn may result low dietary intake and low dietary diversity.

One of the unexpected finding of this study was taking Cotrimoxazole prophylaxis was inversely associated with dietary diversity. HIV positive adults who were taking Cotrimoxazole prophylaxis were more than twofold more likely to have low dietary diversity than those who did not take Cotrimoxazole prophylaxis. This could be due to Gastro-intestinal related side effects of Cotrimoxazole prophylaxis like nausea, vomiting and dyspepsia. HIV positive client suffering from the above gastro-intestinal upset may fails to have good appetite which in turn leads to low dietary intake and low dietary diversity. This condition may also worsen by Gastro-intestinal side effects of taking ARV drugs. However, it is evident that combination of Cotrimoxazole prophylaxis with initiation of anti-retro-viral therapy reduces risk of mortality by 36% [25]. But in the early periods of initiation and long term use of Cotrimoxazole prophylaxis may result side effect like nausea, vomiting and dyspepsia.

Even though this study addressed very important variables related to food diversity, information related to serving size of food and nutritional related biochemical parameters was not included, as a result findings could not directly tell us adequacy of micro-nutrient intake of an individual. Even though using 24 hour food recall method minimizes recall bias, it only provides a snap shoot of information rather than trend of dietary habit. This study is also not independent of the limitation of cross sectional study design like indicating temporal relationship.

Conclusion

In conclusion low dietary diversity was significant nutritional problem among HIV positive adults in Metema District. Unemployment status, lowest wealth quintile, early periods of initiation of anti-retroviral treatment and taking Cotrimoxazole prophylaxis were significantly associated with low dietary diversity. Therefore efforts should be strengthened to improve employment status and consumption of animal based food groups and dark green leafy vegetable. Special priority in nutritional care should be given for HIV positive clients taking Cotrimoxazole prophylaxis and on early period of initiation of ART.

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