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High magnitude of food insecurity and malnutrition among people living with HIV/AIDS in Ethiopia: A call for integration of food and nutrition security with HIV treatment and care Programme

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Abstract

Background: Food insecurity and malnutrition has been reported to have a strong connection with human immunodeficiency viruses (HIV); this is more pervasive in Sub-Saharan Africa including Ethiopia. In this study, we examined the predictors of food insecurity and factors associated with malnutrition among people living with HIV (PLHIV) in Benishangul Gumuz Regional State, Ethiopia. **Methods:** We conducted a cross-sectional study at outpatient antiretroviral therapy (ART) clinics. Data were collected using participant interview, anthropometry, and participants' chart review. Interviews were carried out with 390 PLHIVs who were on antiretroviral treatment follow-up. Four robust multivariate linear regression models were used to identify predictors of food insecurity and factors associated with malnutrition. **Results:** The prevalence of food insecurity and malnutrition among PLHIV were found to be 76% and 60%, respectively. The predictors of food insecurity were: urban residence; household dependency; average monthly income below 53.19 USD; poor asset possession; CD4 count below 350 cell/μL; and recurrent episodes of opportunistic infections (OIs). Correspondingly, malnutrition among PLHIV was found strongly associated with: female gender; urban residence; income below 53.19 USD; poor asset possession; duration of less than one year on ART; and recurrent episodes of OIs. **Conclusion:** The study findings suggest that the higher prevalence of food insecurity and malnutrition among PLHIV underscore: the need for economic and livelihood intervention; addressing contextual factors including the gender dimensions; adoption of nutrition-specific and sensitive interventions; and integration of food and nutrition security with HIV treatment and care programmes.

Keywords

Food security, nutrition, human immunodeficiency viruses (HIV)/acquired immunodeficiency syndrome (AIDS), integration, people, people living with HIV

Introduction

Food insecurity, defined as the economic and social condition of limited or uncertain access to adequate food (United States Department of Agriculture, 2019), and malnutrition, is a condition which occurs when individual diet lacks adequate nutrients or when an individual is unable to adequately utilize food consumed (World Health Organization, 2019), are global problems becoming challenges both in developing and developed countries (Food and Agricultural Organization of the United Nations et al., 2018), and is strongly interconnected with human immunodeficiency viruses (HIV)/acquired immunodeficiency syndrome (AIDS) (Duggal et al., 2012; Palermo et al., 2013; United Nations Programme on HIV and AIDS, 2014). Fighting hunger, malnutrition and HIV pandemics has received significant momentum at global and national levels through initiatives such as the millennium development goals and the United Nations Sustainable Development Goals (SDG), thus significant achievement was made

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and in progress (Food and Agricultural Organization of the United Nations et al., 2018). Despite the progress, the deep-rooted nature of socioeconomic inequalities, political conditions and environmental factors in different regions of the world, mainly in Sub-Saharan Africa, are captivating policy-makers and development partners to envisage food security and nutrition among the top development and health agendas (Food and Agricultural Organization of the United Nations et al., 2018; United Nations Programme on HIV and AIDS, 2018).

The scientific literatures has documented the intricate connotations of food insecurity, malnutrition and HIV/AIDS. Food insecurity impacts on the overall nutrition and health status of people living with HIV (PLHIV) (Palermo et al., 2013; United Nations Programme on HIV and AIDS, 2014), accelerates the progression of HIV to AIDS, and deters the achievement of the desired optimum treatment outcome (Musumari et al., 2014). Malnutrition, on the other hand, exacerbates the effects of HIV and accelerates AIDS-related illnesses (Hu et al., 2011; Musumari et al., 2014). Conversely, HIV infection itself further undermines food security and nutrition status by increasing household dependency and reducing the work capacity of PLHIV (Laar et al., 2015; United Nations Programme on HIV and AIDS, 2014). The impact of food insecurity and malnutrition in the case of PLHIV in Ethiopia is not different.

The government of Ethiopia is committed to achieve the SDG target for ending the AIDS epidemic as a public health threat by 2030 and has made significant achievements on responding to epidemics (Federal Ministry of Health of Ethiopia, 2015; United States President's Emergency Plan for AIDS Relief, 2018). However, the emerging literature is indicating a state of increasing food insecurity and malnutrition among PLHIV in the Ethiopia (Gebremichael et al., 2018; Tesfaye et al., 2016), and that this is significantly impeding treatment outcomes and quality of life of PLHIV (Hadgu et al., 2013; Tiyou et al., 2012). Lack of food forces PLHIV not to take their medications as treatments are supposed to be taken within relation to meals (either before, after or with food) (Anema et al., 2014; Berhe et al., 2013; Young et al., 2014). Correspondingly, if PLHIV are not properly taking their medication due to food insufficiency, the clinical HIV outcome will be poorer, there will be higher morbidity and mortality, and they will develop resistance to antiretroviral therapy (ART) (Iacob et al., 2017; Nachega et al., 2011), and that, in turn, will hinder the Ethiopian government from achieving the SDG targets set for the year 2030.

In order to develop effective and targeted interventions to address food insecurity and malnutrition, a better understanding of the relationships among various factors, including the predictors of food insecurity and factors in the malnutrition are needed. No study has, to the best of our knowledge, concurrently assessed the predictors of food insecurity and factors associated with malnutrition among PLHIV in Ethiopia. Taking all this into consideration, the present study was conducted with the objective of investigating the predictors of food insecurity and factors associated with malnutrition among PLHIV in Benishangul Gumuz Regional State, Ethiopia. The results from this study aimed to inform the need to integrate food and nutrition security with HIV treatment and care programmes in Ethiopia and similar countries.

Methods

Study setting and participants

Benishangul Gumuz Regional State is one of the nine regional states of the Federal Democratic Republic of Ethiopia located in the north-western part of the country. The study was conducted among two referral hospitals and three health centres which provide comprehensive HIV care services in the region. These health facilities were purposely targeted as they are utilized by the majority of PLHIV in the region. A cross-sectional study design was used from December 2016 to February 2017. Using the formula for the estimation of single proportion, $n = \frac{(z)^2 p(1-p)}{d^2}$, where proportion ($p$) of HIV-positive individuals with food insecurity is 63% – taken from the previous study in Ethiopia (Tiyou et al., 2012), margin of error (d) = 5%, and 95% confidence limit ($Z = 1.96$). By adding 10% to cater for a non-response rate, a total of 394 respondents were enrolled into the study. Proportional to this, an allocation method was employed to allocate the number of participants among each study site. Based on allocated numbers, a simple random sampling technique by using a sampling frame developed from the registration book of the patients was used to enrol respondents at each study site. The study entry criteria were: (a) 18 years of age or older; (b) HIV-positive and receiving ART from the selected health facilities; (c) resided in Benishangul Gumuz Regional State for at least two years; and (d) no cognitive health problem.

Data collection

An interviewer-administered questionnaire was used with PLHIV leaving the ART clinics and pharmacy refill. Abstraction of medical records was employed for clinical data including CD4 count and duration on ART.

Variables and measure

Food insecurity and malnutrition are outcome variables. The following variables were measured.

Household food insecurity. Measured using the standard Household Food Insecurity Access Scale (HFIAS) (Coates et al., 2007). This is a nine-items questionnaire assessing household food insecurity on the domains of anxiety about household food access, insufficient quality of food and insufficient food intake in the past 30 days.

Nutritional status. The body mass index (BMI) was calculated as weight in kilograms divided by the square of height

in meters (kg/m^2). Respondents with BMI less than 18.5 kg/m^2 were considered as malnourished.

Household dietary diversity. This is the economic ability of a household to access a variety of foods during the past seven days, and measured based on dietary measurement method (Swindale and Bilinksy, 2006). Twelve questions were used to assess dietary diversity. The household dietary diversity score was constructed as the sum of some food groups consumed over the past week, ranging from 0 to 12. A high value indicated diversified diet.

Household possession of assets. This was elicited by asking participants a series of 13 questions about household assets and housing characteristics such as: housing quality (floor, walls, and roof material); source of drinking water; type of toilet facility; the presence of electricity; type of cooking fuel; and ownership of modern household durable goods and livestock (e.g., bicycle, television, radio, motorcycle, telephone, refrigerator, mattress, bed, and mobile phone) (Filmer and Pritchett, 2001).

Household effective dependency ratio. This was reviewed to compare the percentage of the total population, classified as working age, that will support the rest of the non-working age of the households. Accordingly, the dependency ratio relates to the number of children (0–14 years old), working age who are chronically ill, and the ratio of older persons (65 years or over) to the working-age population (15–64 years old) (Rowland and Donald, 2003).

Other covariates. We included socioeconomic characteristics such as age, gender, marital status, religious affiliation, place of residence, educational status, employment, and income in the interview administration. Clinical characteristics such as duration on ART and history of opportunistic infections (OIs) were also collected.

Data analysis

Both descriptive and inferential statistics were calculated to analyse the data. Bivariable analyses were conducted to identify differences in HFIAS and BMI scores by key independent variables. For binary predictors, comparisons of mean HFIAS and BMI scores were conducted using an independent *t*-test. For predictors with more than two response categories, one-way analysis of variance and Kruskal–Wallis tests were used. A simple linear regression method using ordinary least squares was used to examine bivariable associations between HFIAS, BMI scores, and continuous predictor variables. All independent variables that showed significance at a *p*-value less than 0.05 in the bivariate analysis were extended to multivariate linear regression analysis. The results of diagnostic tests and residual analyses indicated absence of heteroscedastic and highly collinear data thus the multivariable statistical assumptions were not violated. Robust regression analysis was used to address the non-normality of predictor variables by employing four multivariate linear regression models. In the final analysis, a *p*-value <0.05 was considered as statistically significant. All statistical analyses were conducted in IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp.).

Results

A total of 390 study participants responded to the study with a response rate of 98.9%. The mean age of respondents was 36 + 8.6 years – women constituted 259 (66.4%). About half, 195 (50%) respondents were married: 355 (91%) were urban residents; and 301 (77.2%) were Christian faith followers. Half of them (50%) were Amhara ethnic groups, while 10.5% of them were a mix of ethnic groups living in the region. Table 1 shows the study participants' characteristics.

About 36.4% of the study participants had never been enrolled into school, and only 16 (4%) of them went to college/university. About 122 (31.3%) were not employed; the majority 281 (72%) of them earn a monthly income below 1500 Ethiopian Birr (51.19 USD). The average household effective dependency ratio is 0.8 (that is for every 10 working households, there are eight people of not working age). Nearly 60% of the respondents were in the relative lower asset tertiles. The mean dietary diversity score of the participants was 7.5. About a quarter of them were unemployed, 122 (31.3%). Overall, the prevalence of food insecurity is 76%, which was 67.5% in women and 32.5 in men. The prevalence of malnutrition was 60%: 69.8% among females; and 30.1% among males.

The numbers of years since started on ART ranged from 1 year to 13 years with an average of 5.7 years on ART. About 107 (27%) of them have a CD4 count of below 350 cell/μl. Nearly 34% of them suffered from recurrent OIs in the last three months.

Predictors of food insecurity

The results of bivariate analysis indicated that the food insecurity differs with sociodemographic characteristics including marital status, ethnic group, place of residence, effective dependency ratio, socioeconomic factors (education, income and asset possession), and clinical features (CD4 count and OIs) (see Table 2).

To determine the predictors of food insecurity, multivariate logistic regression was extended from the bivariate analysis with four models (Table 3). Model 1 estimated HFIAS scores by controlling for sociodemographic characteristics, and model 2, considers socioeconomic factors on top of those variables included in model 1. Model 3, added clinical features of the study participants together with variables included in model 2. Model 4 used a backward elimination technique to determine the final predictors of food insecurity among PLHIV.

Table 1. Characteristics of people living with human immunodeficiency viruses and acquired immunodeficiency syndrome attending antiretroviral therapy (ART) in Benishangul Gumuz Regional State, Ethiopia, 2020.

Participants' characteristics	*n* (%); Mean + SD
Demographic characteristics	
Gender:	
Female	259 (66.4)
Male	131 (33.6)
Age:	
Less than 25 years	33 (8.5)
25 to 35 years	182 (46.7)
Above 35 years	175 (44.9)
Marital status:	
Single	46 (11.8)
Married	195 (5.0)
Divorced	101 (25.9)
Widowed	41 (10.5)
Ethnic groups:	
Amhara	240 (61.5)
Oromo	78 (20.0)
Agew	36 (9.2)
Berta	12 (3.1)
Others	24 (6.2)
Religious affiliation:	
Christian	301 (77.2)
Muslim	89 (22.8)
Residence:	
Urban	355 (91.1)
Rural	35 (8.9)
Household dependency rate	0.85 + 0.15
Economic characteristics	
Education:	
Never been to school	142 (36.4)
Primary level (1–6 grades)	166 (42.6)
Secondary level (7–12 grades)	66 (16.9)
College/university level	16 (4.1)
Employment status:	
Unemployed	122 (31.3)
Employed	268 (68.7)
Monthly mean income quartiles (in Ethiopian Birr):	
< 1500	281 (72)
>1500	109 (28)
The household wealth index	0.85 + 0.15
Household Food Insecurity Access Scale score	15.06 + 4.2
Body mass index score	18.02 + 3.1
Clinical features	
Duration on ART:	
Less than 1 year	37 (9.5)
1–5 years	155 (40.5)
> 5 years	198 (51
Recent CD4 cell count (cell/μl):	
<350	107 (27)
351–500	81 (21)
> 500	202 (52)
Opportunistic infections:	
Yes	131 (33.6)
No	259 (76.4)

Note: *n* (%), frequency or percentage of categorical variable; mean + SD, mean score and standard deviation for continuous variables.

Table 2. Characteristics of people living with human immunodeficiency viruses and acquired immunodeficiency syndrome attending antiretroviral therapy (ART) in Benishangul Gumuz Regional State, Ethiopia and their bivariable associations with Household Food Insecurity Access Scale (HFIAS) and body mass index (BMI) scores, 2020.

	HFIAS score	BMI score
Characteristics	Test statistics	Test statistics
Demographic characteristics		
Gender:		
Female	$t = 0.9$	$t = -2.7$
Male	($p = 0.090$)	($p = 0.007$)
Age:		
Less than 25 years	$F = 0.6$	$F = 1.3$
25 to 35 years	($p = 0.550$)	($p = 0.300$)
Above 35 years		
Marital status:		
Single	$F = 2.7$	$F = 1.2$
Married	($p = 0.029$)	($p = 0.390$)
Divorced		
Widowed		
Ethnic groups:		
Amhara	$F = 3.6$	$F = 3.7$
Oromo	($p = 0.013$)	($p = 0.006$)
Agew		
Berta		
Others		
Religious affiliation:		
Christian	$t = -0.9$	$t = 0.6$
Muslim	($p = 0.370$)	($p = 0.600$)
Residence:		
Urban	$t = 4.4$	$t = -3$
Rural	($p < 0.0001$)	($p = 0.004$)
Household dependency rate	$F = 20$	$F = 7.7$
	($p < 0.0001$)	($p = 0.006$)
Economic characteristics		
Education:		
Never been to school	$F = 3.3$	$F = 3.5$
Primary level (1–6 grades)	($p = 0.019$)	($p = 0.015$)
Secondary level (7–12 grades)		
College/university level		
Employment status:		
Unemployed	$t = -0.9$	$t = -0.9$
Employed	($p = 0.370$)	($p = 0.370$)
Monthly mean income quartiles (in Ethiopian Birr):		
< 1500	$t = 3.2$	$t = -4.6$
≥1500	($p = 0.002$)	($p < 0.0001$)
The household wealth index	$F = 77$	$F = 22$
	($p < 0.0001$)	($p < 0.0001$)
Household dietary diversity scores	–	$F = 31.8$
		($p < 0.0001$)
Food insecurity	–	$F = 28.2$
		($p < 0.0001$)
Clinical features		
Duration on ART:		
Less than 1 year	$H = 2.3$	$H = 3.2$
1–5 years	($p = 0.090$)	($p = 0.017$)
> 5 years		
Recent CD4 cell count (cell/μL):		
<350	$F = 12$	$F = 1.7$
351–500	($p < 0.0001$)	($p = 0.180$)
> 500		
Opportunistic infections:		
Yes	$t = 7$	$t = 6.7$
No	($p < 0.0001$)	($p < 0.0001$)

Note: statistical tests: *t*, Independent *t*-test; *F*, one-way analysis of variance or ordinary least squares test; and *H*, Kruskal–Wallis tests.

Table 3. Predictors of food insecurity among people living with human immunodeficiency viruses and acquired immunodeficiency syndrome attending antiretroviral therapy in Benishangul Gumuz Regional State, Ethiopia, 2020.

Characteristics	Model 1			Model 2			Model 3			Model 4		
	β	*p*	95% confidence interval (CI)	β	*p*	95% CI	β	*p*	95% CI	β	*p*	95% CI
Sociodemographic												
Marital status	0.07	0.15	-0.07, 0.45	0.04	0.44	-0.15, 0.3	0.04	0.38	-0.3, 0.33			
Ethnic group	0.03	0.5	-0.15, 0.29	0.7	0.1	-0.04, 0.3	0.06	0.13	-0.05, 0.34			
Place of residence	0.2	0.000	0.8, 2.3	0.22	<0.0001	1.0, 2.4	0.19	0.000	0.82, 2.2	0.2	<0.0001	0.87, 2.2
Household dependency ratio	0.22	0.000	0.32, 0.82	0.17	<0.0001	0.20, 0.66	0.14	0.001	0.16, 0.60	0.15	0.001	0.15, 0.59
Socioeconomic												
Education				0.06	0.21	-0.09, 0.4	0.07	0.14	-0.06, 0.42			
Income				-0.09	0.048	-0.92, -0.04	-0.09	0.04	-0.89, -0.01	-0.1	0.026	-0.94, -0.06
Asset possession				0.4	0.00	0.73, 1.1	0.4	0.000	0.63, 1.03	0.34	<0.0001	0.59, 0.97
Clinical features												
CD4 cell count							-0.11	0.014	-0.51, -0.06	-0.11	0.015	-0.0, -0.06
Opportunistic infections							-0.21	0.000	-1.4, -0.6	-0.21	<0.0001	-1.4, -0.6
R^2 (change in R^2)	0.099			0.257			0.33			0.32		

In model 4 using the backward elimination method, 32% of food insecurity was found as a result of seven independent variables: urban residence; household dependency ratio; household income; asset possession; dietary diversity; CD4 count below 350 cell/μL; and recurrent episodes of OIs. The study found that 20% of food insecurity among PLHIV was intermediated by urban residence (β = 0.2, 95% confidence interval (CI): 0.87, 2.2, $p < 0.0001$). It was also found that 15% of food insecurity among respondents is as a result of shortage of working household members that indicates household dependency predicting the severity of food insecurity among PLHIV households (β = 0.15, 95% CI: 0.15, 0.59, $p = 0.001$). The majority (72%) of the study participants who earn a mean monthly income of below 1500 Ethiopian Birr (USD 53.19) found food insecure (β = -0.1, 95% CI: -0.94, -0.06, $p = 0.026$). Again, it was also found as a magnitude of wealth index increases by 1 unit, that the HFIAS score decreases by 0.34 units (β = 0.34, 95% CI: 0.59, 0.97, $p < 0.0001$).

Of clinical features, CD4 count below 350 cell/μL (β = -0.11, 95% CI: -0.5, -0.06, $p < 0.0001$), and history of recurrent episodes of OIs (β = -0.2, 95% CI: -1.4, -0.6, $p < 0.0001$) were among the predictors of food insecurity.

Factors associated with malnutrition

To determine the factors associated with malnutrition, factors in the bivariate logistic regression analysis were extended to a four model (models 1, 2, 3, and 4) logistic regression (Table 4).

Accordingly, in the final model, model 4, female gender (β = 0.15, 95% CI: 0.38, 1.6, $p = 0.001$), urban residence (β = 0.1, 95% CI: 0.09, 2.1, $p = 0.033$), average monthly income below 1500 Ethiopian Birr (β = 0.20, 95% CI: 0.75, 2.1, $p < 0.0001$), poor asset possession (β = -0.22, 95% CI: -0.98, -0.35, $p < 0.0001$), food insecurity (β = -0.92, 95% CI: -0.27, -0.02, $p = 0.0029$), and less than one year on ART (β = -0.12, 95% CI: -0.85, -0.11, $p = 0.01$) were associated with malnutrition. The study found that as the duration on ART advances, the BMI of the participants increases. Recurrent episodes of OIs were also associated with malnutrition (β = 0.1, 95% CI: 0.05, 1.3, $p = 0.036$). Ethnic group, household dependency, education level, and dietary diversity were not associated with malnutrition in the final model.

Discussion

The interconnectedness of food insecurity, malnutrition and HIV poses important public health problems, and requires a robust response to envisage the ending of the AIDS epidemic as a public health threat in Sub-Saharan Africa, including Ethiopia. In this study, four important predominant themes emerged. The first, high prevalence of food insecurity and malnutrition exists among PLHIV in Benishangul Gumuz Regional State, Ethiopia. Second, food insecurity and malnutrition were found strongly to be the

Table 4. Factors associated with malnutrition among people living with human immunodeficiency viruses and acquired immunodeficiency syndrome attending antiretroviral therapy (ART) in Benishangul Gumuz Regional State, Ethiopia, 2020.

	Model 1			Model 2			Model 3			Model 4		
Characteristics	β	*p*	95% confidence interval (CI)	β	*p*	95% CI	β	*p*	95% CI	β	*p*	95% CI
Sociodemographic												
Gender	0.12	0.019	0.13, 1.4	0.2	0.003	0.30, 1.5	0.14	0.003	0.30, 1.5	0.15	0.001	0.38, 1.6
Ethnic group	0.4	0.48	-0.17, 0.35	0.03	0.602	-0.18, 0.32	.027	0.56	-0.17, 0.32			
Place of residence	-0.14	0.005	-2.6, -0.44	0.11	0.019	0.21, 2.3	0.10	0.037	0.07, 2.1	0.1	0.033	0.09, 2.1
Household dependency ratio	-0.11	0.024	-0.76, -0.05	-0.04	0.41	-0.49, 0.20	-0.03	0.48	-0.46, 0.22			
Socioeconomic												
Education				0.08	0.11	-0.07, 0.65	0.07	0.18	-0.11, 0.61			
Income				0.2	<0.0001	0.78, 2.1	0.20	<0.0001	0.77, 2.1	0.2	<0.0001	0.75, 2.1
Food insecurity				-0.92	0.012	-0.29, 0.03	-0.8	0.019	-0.27, 0.06	-0.92	0.029	-0.27,0.02
Dietary diversity				0.05	0.43	-0.09, 0.21	0.03	0.61	-0.11, 0.19			
Asset possession				-0.2	0.003	-0.9, -0.18	-0.18	0.002	-0.91, -0.21	-0.22	<0.0001	-0.98, -0.35
Clinical features												
Duration of ART							-0.11	0.018	-0.83, -.08	-0.12	0.01	-0.85, -0.1
Opportunistic infections							0.09	0.058	-0.02, 1.3	0.1	0.036	0.05, 1.3
R^2 (change in R^2)	0.053			0.182			0.199			0.192		

problem of socioeconomic factors. Third, food insecurity and malnutrition were viciously intertwined with HIV clinical outcomes. The fourth, malnutrition is the outcome of food insecurity mediated by HIV/AIDS.

Our study reveals that the vast majority of PLHIV in Benishagul Gumuz Regional State, Ethiopia, suffered from higher levels of food insecurity, 76%. This finding is similar to the findings of other studies reported from different countries in Sub-Saharan Africa. For example, food insecurity was reported as 19.4% in Tanzania (Kabalimu et al., 2018), 67% in Namibia (Hong et al., 2014), 71.7% in Nigeria (Sholeye et al., 2017), and 35.2% in Central Ethiopia (Gebremichael et al., 2018). Hence, such higher prevalence of food insecurity among PLHIV continues affecting the health and development of the region (Laar et al., 2015; United Nations Programme on HIV and AIDS, 2014), affects treatment outcome (Yacobson et al., 2016; Young et al., 2014), and quality of life (Palermo et al., 2013; Ivers and Cullen, 2011; Tsai et al., 2016).

The present findings concur with evidence linking food insecurity to a greater extent as the problem of poor socioeconomic status. Factors of socioeconomic status such as education level, income and asset possession were found as predictors of food insecurity. Those PLHIV who are never enrolled to school or studied lower grade were found with severe food insecurity. This is similar to the findings of other studies in Ethiopia (Asnakew et al., 2015; Tamiru et al. 2016), Nigeria (Sholeye et al., 2017), Tanzania (Semali et al., 2011), Rwanda (Sirotin et al., 2012), and India (Dasgupta et al., 2016). Evidence has shown that HIV/AIDS negatively impacts on the income of PLHIV by tumbling the chance of employment and employability that, in turn, exposes them to food insecurity (Moyo et al., 2017; Zekeri and Diabate, 2014). Similarly, there are indications that poor asset possession is a predictor of food insecurity (Nagata et al., 2012; Tsai et al., 2011), while the highest asset possession is a predictor of food security among PLHIV (Masa et al., 2017). The findings call for policies and programmes aimed at improving the economic situation and livelihood of PLHIV.

The HIV clinical outcomes were found as strong predictors of food insecurity. As has been reported, the likelihoods of food insecurity are much higher among those whose CD4 count is less than 350 cell/μL compared to those whose CD4 count is above 350 cell/μL (Aibibula et al., 2016; Weiser et al., 2014). The present findings also concur that the level of food insecurity varies with episodes of OIs. The result of this finding is also consistent with the longitudinal cohort study conducted in Uganda, where food insecurity was found to be associated with worse OIs (Weiser et al., 2012b). Likewise, food insecurity was reported as a mediating factor for recurrent episodes OIs among PLHIV in India (Shin et al., 2018).

The prevalence of malnutrition among PLHIV in the region is much higher, 60%. This finding is higher than other studies reported in Ethiopia. For example, malnutrition was found in 12.3% in Southern Ethiopia

(Hailemariam et al., 2013), 23.6% in Central Ethiopia (Gebremichael et al., 2018), and 46.8% in Southwest Ethiopia (Mulu et al., 2016). It has been reported that HIV and malnutrition are viciously intertwined and that this has a synergistic effect on PLHIV (Duggal et al., 2012; Hu et al., 2011). Malnutrition among PLHIV remains a major challenge to achieve the full impact of interventions aimed at improving their quality of life (Rawat et al., 2014; Thapa et al., 2015).

Our study highlights that the indicators of poor socioeconomic status such as income level, food insecurity and asset possessions were found associated with malnutrition. With the earning of less than 53.19 USD per month, 72% of the participants live in absolute poverty (below 1.9 USD a day) (The World Bank Group, 2019). Similar studies conducted in Southwest Ethiopia (Tiyou et al., 2012), Tanzania (Kabalimu et al., 2018), Democratic Republic of Congo (Tshingani et al., 2014), and Brazil (Andrade et al., 2012) indicated that very low daily per capita household income increased the prevalence of malnutrition in PLHIV. Likewise, poor asset possession was found as a strong predictor of malnutrition. Analogous to this finding, the study conducted in other parts of Ethiopia indicated that lowest asset possession is associated with malnutrition (Weldehaweria et al., 2017). On the other hand, higher wealth index was found associated with better nutritional status, and is less likely to exhibit malnutrition compared with their counterparts (Sunguya et al., 2017).

Malnutrition is viciously intertwined with HIV clinical outcomes. The study has shown that duration on ART and falling ill with OIs were associated with the factors in malnutrition. According to the results of this study, substantial and higher prevalence of malnutrition was found among participants who were on ART for less than one year. This is similar to the study conducted in central Ethiopia (Gebremichael et al., 2018). The study signposted that as the number of years on ART advances, the probability of being predisposed to malnutrition declines. This is because as PLHIV stay longer on ART, their immunity improves, and their physical strength increases, leading to a reduction in the risk of contracting OIs (Sirotin et al., 2012). As reported in this study, the higher prevalence of malnutrition and the strong association with OI is demonstrated by other scientific studies (Andrade et al., 2012; Hu et al., 2011; Thapa et al., 2015). Therefore, strong consideration is required on integrating nutrition programmes with HIV prevention, treatment, and care as adequate nutrition intervention mitigates the side effects of ART, and improves physical health (de Pee and Semba, 2010).

Malnutrition among PLHIV was significantly associated with food insecurity. In other words, the effect of food insecurity mediates the incidence of malnutrition. In this study, of 235 malnourished PLHIV, 82.5% of them were food insecure and heavily associated with malnutrition. Analogous to these findings, the studies in Uganda (Rawat et al., 2014), Nepal (Thapa et al., 2015), Western Shewa, Ethiopia (Gebremichael et al., 2018), Bahir Dar, Ethiopia (Daniel et al., 2013), and Humera, Tigrai, Ethiopia (Hadgu et al., 2013) have signposted the strong association of food insecurity and malnutrition through various pathways. Moreover, our study found that malnutrition and food insecurity overlap on structural factors including socioeconomic and clinical factors, as similar to the findings of Aberman et al. (2014) and Weiser et al. (2012a). Lack of access to nutritious food prevents PLHIV from maintaining or improving their health, even when receiving treatment. This is because malnutrition exacerbates the progression of HIV infection as a result of the interconnection of malnutrition and food insecurity (Bahwere et al., 2011; Gebremichael et al. 2018); therefore, inclusive programming is required to interrupt such an intricate cycle.

Of sociodemographic factors, urban residence is associated with both food insecurity and malnutrition. As a high percentage of the study participants are from urban areas (91%), this can inflate the association of urban residence with food insecurity and malnutrition. Nevertheless, Ethiopia is rapidly urbanizing (Ozlu et al., 2015), and such urbanization makes food insecurity and malnutrition a complex issue (Crush et al., 2011). Consequently, the HIV response needs proactive measures which would have to target food insecurity and nutritional issues tailored to urban environments. Another demographic factor associated with household food insecurity is the dependency ratio. A higher household dependency ratio is found as a strong independent predictor of food insecurity. Corresponding to this study, studies conducted in Wolaita Sodo town, South Ethiopia (Tantu et al., 2017), and in Zambia (Masa et al., 2017) reported that household dependency ratio was associated with food insecurity because HIV weakens the immune system of breadwinners in the household, which, in turn, leads to a rise in the numbers of non-working dependent members of the family.

Our analysis has shown that the severity of malnutrition is higher among female PLHIV. This finding concurred with other studies conducted in Ethiopia (Daniel et al., 2013), Tanzania (Sunguya et al., 2017), and Zimbabwe (Takarinda et al., 2017), which have demonstrated that female PLHIV were more affected by malnutrition. The possible reason for females to become more malnourished than males may be that females take care of their household vis-à-vis diet preparation as well as prioritizing food for their children and to their family members instead of taking care of themselves. Traditional practices such as gender-based feeding arrangements exist for this study sample (Wohabie and Teka, 2018), where boys eat together with their fathers while girls and mothers have to wait till the male members finish eating, and avoid eating protein foods such as meat, egg, milk and some vegetables during their reproductive age with the belief that if a pregnant female consumes those foods, the foetus will get fat and delivery will be complicated (Wohabie and Teka, 2018). This finding highlights the importance of gender roles and the need for designing social and behavioural change communication strategies that can be tailormade to local

customs, particularly as such practices accelerate the alteration of HIV to AIDS (Musumari et al., 2014; Weiser et al., 2012a).

Our study had limitations. Due to the cross-sectional study design, we were unable to evaluate the temporal sequence of the change in the association of food insecurity and malnutrition, and the progression to HIV/AIDS that can be studied prospectively. There might be social desirability bias as the respondents want to get food support, thus they may not tell the real information about their food security status. There might be recall bias in the response of participants on the assessment of food insecurity and dietary diversity as the response depends on the past one-month period and 24 hours, respectively.

Conclusion and recommendations

In conclusion, the prevalence of food insecurity and malnutrition among PLHIV in Benishangu Gumuz Regional State, Ethiopia is high, and largely associated with socio-economic factors. Our findings suggest that the interventions needed to address food insecurity and malnutrition include programmes and policies that comprise: livelihood support for PLHIV; adopting effective behavioural change communication on the gender-based roles to improve nutritional status of women and girls; and integration of food and nutrition security programmes with HIV treatment and care. These interventions need to be realised across a multisectoral approach in order to bridge the resource gap.

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Availability of data

The dataset used during and/or analysed during the current study is available from the corresponding author on reasonable request.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical statement

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References

Aberman N-L, Rawat R, Drimie S, et al. (2014) Food security and nutrition interventions in response to the AIDS epidemic: Assessing global action and evidence. *AIDS and Behavior* 18(5): 554–565.

Aibibula W, Cox J, Hamelin A-M, et al. (2016) Food insecurity and low CD4 count among HIV-infected people: A systematic review and meta-analysis. *AIDS Care* 28(12): 1577–1585.

Andrade CS, Jesus RP, Andrade TB, et al. (2012) Prevalence and characteristics associated with malnutrition at hospitalization among patients with acquired immunodeficiency syndrome in Brazil. *PLOS ONE* 7(11): e48717.

Anema A, Kerr T, Milloy M-J, et al. (2014) Relationship between hunger, adherence to antiretroviral therapy and plasma HIV RNA suppression among HIV-positive illicit drug users in a Canadian setting. *AIDS Care* 26(4): 459–465.

Asnakew M, Hailu C and Jarso H (2015) 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(1): e1289. Available at: https://www.scirp.org/pdf/OALibJ_2016070808492954.pdf (accessed 12 June 2020).

Bahwere P, Deconinck H, Banda T, et al. (2011) Impact of household food insecurity on the nutritional status and the response to therapeutic feeding of people living with human immunodeficiency virus. *Patient Preference and Adherence* 11(5): 619–627.

Berhe N, Tegabu D and Alemayehu M (2013) Effect of nutritional factors on adherence to antiretroviral therapy among HIV-infected adults: A case control study in Northern Ethiopia. *BMC Infectious Diseases* 13: 233.

Coates J, Swindale A and Bilinsky P (2007) Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide: Version 3: (576842013-001). American Psychological Association. Available at: http://www.fao.org/fileadmin/user_upload/eufao-fsi4dm/doc-training/hfias.pdf (accessed 08 May 2020).

Crush J, Drimie S, Frayne B, et al. (2011) The HIV and urban food security nexus in Africa. *Food Security* 3: 347–362.

Daniel M, Mazengia F and Birhanu D (2013) Nutritional status and associated factors among adult HIV/AIDS clients in Felege Hiwot Referral Hospital, Bahir Dar, Ethiopia. *Science Journal of Public Health* 1(1): 24–31.

Dasgupta P, Bhattacherjee S and Das D (2016) Food security in households of people living with human immunodeficiency virus/acquired immunodeficiency syndrome: A cross-sectional study in a Subdivision of Darjeeling District, West Bengal. *Journal of Preventive Medicine and Public Health* 49(4): 240–248.

de Pee S and Semba RD (2010) Role of nutrition in HIV infection: Review of evidence for more effective programming in resource-limited settings. *Food and Nutrition Bulletin* 31(4): S313–S344.

Duggal S, Chugh TD and Duggal AK (2012) HIV and malnutrition: Effects on immune system. *Clinical and Developmental Immunology* 2012: ID 784740. Available at: https://www.hindawi.com/journals/jir/2012/784740/ (accessed 11 April 2020).

Federal Ministry of Health of Ethiopia (2015) *Health Sector Transformation Plan 2015/16 - 2019/20 (2008-2012 EFY)*. Addis Ababa, Ethiopia: Goverment Press.

Filmer D and Pritchett LH (2001) Estimating wealth effects without expenditure data – or tears: An application to educational enrollments in states of India. *Demography* 38(1): 115–132.

Food and Agricultural Organization of the United Nations, International Fund for Agricultural Development, United Nations Children's Fund, et al. (2018) The State of Food Security and Nutrition in the World 2018. Building Climate Resilience for Food Security and Nutrition. Rome, Italy: Food and Agricultural organization of the United Nations. Available at: http://www.fao.org/3/I9553EN/i9553en.pdf (accessed 19 May 2020).

Gebremichael DY, Hadush KT, Kebede EM, et al. (2018) Food insecurity, nutritional status, and factors associated with malnutrition among people living with HIV/AIDS attending antiretroviral therapy at public health facilities in West Shewa Zone, Central Ethiopia. *BioMed Research International* 2018:1913534.

Hadgu T, Worku W, Tetemke D, et al. (2013) Undernutrition among HIV positive women in Humera hospital, Tigray, Ethiopia, 2013: Antiretroviral therapy alone is not enough, cross sectional study. *BMC Public Health* 13:943.

Hailemariam S, Bune GT and Ayele HT (2013) Malnutrition: Prevalence and its associated factors in people living with HIV/AIDS, in Dilla University Referral Hospital. *Archives of Public Health* 71(1): 13. Available at: https://archpublichealth.biomedcentral.com/articles/10.1186/0778-7367-71-13 (accessed 03 March 2020).

Hong SY, Fanelli TJ, Jonas A, et al. (2014) Household food insecurity associated with antiretroviral therapy adherence among HIV-infected patients in Windhoek, Namibia. *Journal of Acquired Immune Deficiency Syndromes* 67(4): e115–e122.

Hu W, Jiang H, Chen W, et al. (2011) Malnutrition in hospitalized people living with HIV/AIDS: Evidence from a cross-sectional study from Chengdu, China. *Asia Pacific Journal of Clinical Nutrition* 20(4): 544–550.

Iacob SA, Iacob DG and Jugulete G (2017) Improving the adherence to antiretroviral therapy, a difficult but essential task for a successful HIV treatment—Clinical points of view and practical considerations. *Frontiers in Pharmacology* 8: 831. Available at: https://www.frontiersin.org/articles/10.3389/fphar.2017.00831/full (accessed 07 April 2020).

Ivers LC and Cullen KA (2011) Food insecurity: Special considerations for women. *The American Journal of Clinical Nutrition* 94(6): 1740S–1744S.

Kabalimu TK, Sungwa E and Lwabukuna WC (2018) Malnutrition and associated factors among adults starting on antiretroviral therapy at PASADA Hospital in Temeke District, Tanzania. *Tanzania Journal of Health Research* 20(2): 8.

Laar A, Manu A, Laar M, et al. (2015) Coping strategies of HIV-affected households in Ghana. *BMC Public Health* 15(1).

Masa R, Chowa G and Nyirenda V (2017) Prevalence and predictors of food insecurity among people living with HIV enrolled in antiretroviral therapy and livelihood programs in two rural Zambian hospitals. *Ecology of Food and Nutrition* 56(3): 256–276

Moyo N, Maharaj P and Mambondiani L (2017) Food challenges facing people living with HIV/AIDS in Zimbabwe. *African Journal of AIDS Research* 16(3): 225–230.

Mulu H, Hamza L and Alemseged F (2016) Prevalence of malnutrition and associated factors among hospitalized patients with acquired immunodeficiency syndrome in Jimma University Specialized Hospital, Ethiopia. *Ethiopian Journal of Health Sciences* 26(3): 217–226.

Musumari PM, Wouters E, Kayembe PK, et al. (2014) Food insecurity is associated with increased risk of non-adherence to antiretroviral therapy among HIV-infected adults in the Democratic Republic of Congo: A cross-sectional study. *PLoS ONE* 9(1): e85327.

Nachega JB, Marconi VC, van Zyl GU, et al. (2011) HIV treatment adherence, drug resistance, virologic failure: Evolving concepts. *Infectious Disorders – Drug Targets* 11(2): 167–174.

Nagata JM, Magerenge RO, Young SL, et al. (2012) Social determinants, lived experiences, and consequences of household food insecurity among persons living with HIV/AIDS on the shore of Lake Victoria, Kenya. *AIDS Care* 24(6): 728–736.

Ozlu MO, Alemayehu A, Mukim M, et al. (2015) Ethiopia – Urbanization Review: Urban Institutions for a Middle-Income Ethiopia. 100238, 1 January. The World Bank. Available at: http://documents.worldbank.org/curated/en/543201468000586809/Ethiopia-Urbanization-review-urban-institutions-for-a-middle-income-Ethiopia (accessed 1 July 2019).

Palermo T, Rawat R, Weiser SD, et al. (2013) Food access and diet quality are associated with quality of life outcomes among HIV-infected individuals in Uganda. *PLoS ONE* 8(4): e62353.

Rawat R, Faust E, Maluccio J, et al. (2014) The impact of a food assistance program on nutritional status, disease progression, and food security among people living with HIV in Uganda. *Journal of Acquired Immune Deficiency Syndromes* 66(1): 15–22.

Rowland and Donald T (2003) *Demographic Methods and Concepts*. Oxford: Oxford University Press.

Semali I, Edwin T and Mboera L (2011) Food insecurity and coping strategies among people living with HIV in Dar es Salaam, Tanzania. *Tanzania Journal of Health Research* 13(4): 86–94.

Shin SS, Carpenter CL, Ekstrand ML, et al. (2018) Household food insecurity as mediator of the association between internalized stigma and opportunistic infections. *AIDS and Behavior* 22(12): 3897–3904.

Sholeye O, Animasahun V and Oyewole B (2017) Household food insecurity among people living with HIV in Sagamu, Nigeria: A preliminary study. *Nutrition and Health* 23(2): 95–102.

Sirotin N, Hoover D, Segal-Isaacson C, et al. (2012) Structural determinants of food insufficiency, low dietary diversity and BMI: A cross-sectional study of HIV-infected and HIV-negative Rwandan women. *British Medical Journal Open* 2(e000714). Available at: https://bmjopen.bmj.com/content/bmjopen/2/2/e000714.full.pdf (accessed 23 July 2020).

Sunguya BF, Ulenga NK, Siril H, et al. (2017) High magnitude of under nutrition among HIV infected adults who have not started ART in Tanzania – A call to include nutrition care and treatment in the test and treat model. *BMC Nutrition* 3(1): 58. Available at: https://bmcnutr.biomedcentral.com/articles/10.1186/s40795-017-0180-0 (accessed 08 February 2020).

Swindale A and Bilinksy P (2006) Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (Version 2).: 15. Available at: https://www.

fantaproject.org/sites/default/files/resources/HDDS_v2_Sep06_0.pdf (accessed 08 February 2020).

Takarinda KC, Mutasa-Apollo T, Madzima B, et al. (2017) Malnutrition status and associated factors among HIV-positive patients enrolled in ART clinics in Zimbabwe. *BMC Nutrition* 3(1): 15. Available at: https://bmcnutr.biomedcentral.com/articles/10.1186/s40795-017-0132-8 (accessed 11 May 2020).

Tamiru D, Argaw A, Gerbaba M, et al. (2016) Household food insecurity and its association with school absenteeism among primary school adolescents in Jimma zone, Ethiopia. *BMC Public Health* 16(1):802. Available at: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-016-3479-x (accessed 09 May 2020).

Tantu A, Gamebo T, Sheno B, et al. (2017) Household food insecurity and associated factors among households in Wolaita Sodo town, 2015. *Agriculture & Food Security* 6(1): 19. Available at: https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-017-0098-4 (accessed 24 June 2020).

Tesfaye M, Kaestel P, Olsen M, et al. (2016) Food insecurity, mental health and quality of life among people living with HIV commencing antiretroviral treatment in Ethiopia: A cross-sectional study. *Health and Quality of Life Outcomes* 14(37). Available at: https://core.ac.uk/download/pdf/189821048.pdf (accessed 24 January 2020).

Thapa R, Amatya A, Pahari D, et al. (2015) Nutritional status and its association with quality of life among people living with HIV attending public anti-retroviral therapy sites of Kathmandu Valley, Nepal. *AIDS Research and Therapy* 12(14).

The World Bank Group (2019) Poverty Overview: Ethiopia. Available at: https://www.worldbank.org/en/topic/poverty/overview (accessed 8 April 2019).

Tiyou A, Belachew T, Alemseged F, et al. (2012) Food insecurity and associated factors among HIV-infected individuals receiving highly active antiretroviral therapy in Jimma zone Southwest Ethiopia. *Nutrition Journal* 11(1).

Tsai AC, Bangsberg DR, Emenyonu N, et al. (2011) The social context of food insecurity among persons living with HIV/AIDS in rural Uganda. *Social Science & Medicine* 73(12): 1717–1724.

Tsai AC, Tomlinson M, Comulada WS, et al. (2016) Food insufficiency, depression, and the modifying role of social support: Evidence from a population-based, prospective cohort of pregnant women in peri-urban South Africa. *Social Science & Medicine* 151: 69–77.

Tshingani K, Schirvel C, Mukumbi H, et al. (2014) Vulnerability factors for malnutrition among people living with HIV under antiretroviral treatment in an outpatient clinic: Kinshasa, Democratic Republic of Congo. *HIV & AIDS Review* 13(1): 18–25.

United Nations Programme on HIV and AIDS (2014) UBRAF thematic report: integrating food and nutrition into the HIV response. UNAIDS.

United Nations Programme on HIV and AIDS (2018) Global HIV & AIDS statistics — 2018 fact sheet. Available at: http://www.unaids.org/en/resources/fact-sheet (accessed 17 April 2019).

United States Department of Agriculture (2019) Definitions of Food Security. Available at: https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx (accessed 8 April 2019).

United States President's Emergency Plan for AIDS Relief (2018) US President's Emergency Plan for AIDS Relief (PEPFAR). 2018. Ethiopia Country Operational Plan (COP/ROP) 2018: Strategic Direction Summary. Available at: https://www.pepfar.gov/documents/organization/285863.pdf (accessed 02 July 2020).

Weiser SD, Gupta R, Tsai AC, et al. (2012a) Changes in food insecurity, nutritional status, and physical health status after antiretroviral therapy initiation in rural Uganda. *Journal of Acquired Immune Deficiency Syndromes)* 61(2): 179–186.

Weiser SD, Tsai AC, Gupta R, et al. (2012b) Food insecurity is associated with morbidity and patterns of healthcare utilization among HIV-infected individuals in a resource-poor setting. *AIDS (London, England)* 26(1): 67–75.

Weiser SD, Palar K, Frongillo EA, et al. (2014) Longitudinal assessment of associations between food insecurity, antiretroviral adherence and HIV treatment outcomes in rural Uganda. *AIDS (London, England)* 28(1): 115–120.

Weldehaweria NB, Abreha EH, Weldu MG, et al. (2017) Psychosocial correlates of nutritional status among people living with HIV on antiretroviral therapy: A matched case-control study in Central zone of Tigray, Northern Ethiopia. *PloS One* 12(3): e0174082.

Wohabie B and Teka Z (2018) Marriage practices and gender role socialization among the Gumuz of Ethiopia. *African Journal of History and Culture* 10(4): 51–56.

World Health Organization (2019) Malnutrition. Available at: https://www.who.int/topics/malnutrition/en/ (accessed 12 February 2019).

Yacobson I, Malkin M and Lebetkin E (2016) Increasing access and adherence to the PMTCT cascade: Is there a role for economic strengthening interventions? *International Journal of Population Research* 2016. ID 4039012. Available at: https://www.hindawi.com/journals/ijpr/2016/4039012/ (accessed 24 April 2020).

Young S, Wheeler A, McCoy S, et al. (2014) A review of the role of food insecurity in adherence to care and treatment among adult and pediatric populations living with HIV and AIDS. *AIDS and Behavior* 18(0 5): 505–515.

Zekeri A and Diabate Y (2014) Food insecurity and psychological well-being among women living with HIV/AIDS on antiretroviral therapy in the Alabama Black Belt. *Professional Agricultural Workers Journal* 2(1). Available at: https://tuspubs.tuskegee.edu/pawj/vol2/iss1/4 (accessed 11 March 2020).