Food insecurity and undernutrition in treated HIV patients a (post-) conflict setting: A cross sectional study from Goma, Eastern Democratic Republic of Congo

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Abstract

Objective: To assess the prevalence of food insecurity and its impact on nutritional status among HIV infected patients on antiretroviral therapy in a conflict and post conflict setting.

Design: Cross-sectional study.

Setting: This Goma multicenter cross-sectional study was carried out from February 1st to March 3rd, 2016.

Subjects: Data on nutritional status among 583 HIV-infected patients on ART were measured using Body Mass Index as a proxy. Food insecurity was the primary independent variable and was measured using the Household Food Insecurity Access Scale. The prevalence of under nutrition and food insecurity was also estimated. A logistic regression model was used to identify the relationship between under nutrition and food insecurity, adjusted for other covariates.

Results: The prevalence of food insecurity in the study group was 91.3% (95% CI: 89.0 – 93.6%). The prevalence of undernutrition was 24.1% (95% CI: 20.6-27.6%).Nineteen percent of respondents were non- adherent (95% CI: 15.9% - 22.3%). Only two percent have received a nutritional support during the previous month. Being household food insecure (AOR = 4.47, 95% CI: 1.35 – 14.78) and living in a household with low socio-economic status (AOR = 2.02, 95% CI: 1.10 - 3.69) were significantly associated with under nutrition.

Conclusion: This study measured a high prevalence of food insecurity in Goma. The study highlight the negative impact of food insecurity on undernutrition and how the situation is exacerbated by the presence of HIV.Further studies are suggested to assess nutritional status with a high validity (sensitivity & specificity) way in HIV-infected patient on ART in this setting.

Keywords: Armed conflict; Food insecurity; Undernutrition; Non-adherence; Antiretroviral

Background

The triple burden of food insecurity, undernutrition, and Human Immunodeficiency Virus (HIV) in sub-Saharan Africa (SSA), significantly adds to morbidity and mortality, in particular in the context of armedconflicts. Despite significant advances in care for those with the HIV and increased funding for treatment, morbidity and mortality due to HIV in developing countries remains unacceptably high. A major contributing factor is that over 800 million people remain chronically undernourished globally, and the HIV epidemic largely overlaps with populations already experiencing low diet quality and quantity. Malnutrition, and more specific under nutrition, is generally associated with increased mortality among HIV infected individuals initiating Antiretroviral Therapy (ART) [1, 2].

Food insecurity is a key contributing factor to undernutrition. However, undernutrition rarely results from food insecurity alone, and it has many other underlying causes, including, but not limited to, inadequate care practices, unclean water, poor hygiene and sanitation, and poor access to health care [3]. Food insecurity and HIV are viciously linked as well-captured in a conceptual framework developed by Weiser et al. depicting the pathways involved in the bidirectional links between food insecurity and HIV [4].

Food insecurity is considered to be an important barrier to ART adherence, especially in resource-poor settings. Sustaining successful ART scale-up depends largely on the ability of ART programs to deliver ART in a way that supports optimal patient adherence, thereby maximizing durability of first- and second-line regimens. Adherence to ART is a predictor of virus suppression, emergence of HIV drug resistance, disease progression, and death [5-9].

According to the Food and Agriculture Organization of the United Nations (FAO), the four pillars of food security are food availability, stability of the food supply, food access and the utilization of food by the body [10]. Food availability is strongly affected by seasonality; many households are only able to produce sufficient food to meet their food requirements for less than six months of the year [11]. Food access may be affected by market conditions, but also by cultural and religious practices [12]. Even if people get enough to eat, good nutrition requires access to a sufficient, varied, safe and nutritious food to meet daily nutritional requirements [13].

In the Democratic Republic of Congo (DRC), the research setting of the current study, the Multi Indicator Cluster Survey (MICS) conducted in 2010 revealed that approximately 33% of the households experienced food insecurity, with the prevalence that varies from 5% in the capital of Kinshasa, to as much as 60% in some eastern provinces of the DRC [14]. The most recent demographic and health survey in the DRC has estimated the HIV prevalence at 1.2% among the population aged 15 - 49 years [15], while only 12.3% of eligible patients have access to ART [16].

A review of existing literature revealed that, unlike in resource-rich settings, limited data is available from validated measures of food insecurity that describe the association between food insecurity and nutritional status among patients on ART [17, 18] in SSA. Especially the link between food insecurity and adherence to ART seems to relate to treatment failure. Food insecurity, financial constraints, and fear of disclosure/stigma have been reported to be barriers to ART adherence among HIV-positive adults in the DRC [18].

Food security has been described as an important aspect in considering the wealth and economic sustainability of a nation. Moreover, household food insecurity has been identified as a possible determinant of malnutrition [19]. Poor dietary quality or diversity is a significant contributing factor to malnutrition, specifically, micronutrient deficiencies [20]. Therefore, food insecurity may be a core variable for understanding the nutritional status of low-income populations [21]. No published studies are available examining the relationships between HIV, food insecurity, and malnutrition in Africa, within a conflict environment using large sample sizes.

Undernutrition and food insecurity constitute an important threat to the success of HIV programs in sub-Saharan Africa, and failure to effectively address them may jeopardize the benefits gained so far in the fight against HIV. The current study, aims at determining the prevalence of food insecurity, and its impact on nutritional status among HIV infected patients receiving ART in conflict and post conflict setting. Such information is crucial for guiding context-specific interventions to optimize patient outcomes.

Subjects and Methods

Study design, participants and setting

This Goma multicenter cross-sectional study was carried out from February 1st to March 3rd, 2016. Goma, the capital city of the North Kivu province had an estimated population of 725,000in 2015 [22] and an HIV prevalence in the adult population of 0.9% [15]. The city has experienced armed conflict since 1996 and there are still areas where the conflict has not yet come to an end. In Goma in 2015 ten health centers were providing HIV care and treatment services [22], providing ART for a total of 3,586 patients aged 15 years and above. This survey included patients from five of these centers: Heal Africa Hospital (512 patients), Virunga Hospital (812 patients), the Charity Hospital (132 patients), General Military Hospital (77 patients) and Goma Provincial Referral Hospital (1,099 patients) [22]. None of these facilities provided food or any kind of nutrition support to patients. All of the hospitals had been providing HIV care for more than one year at the time of the study.

Participants were included in the study provided that they were at least 18 years old, on ART for at least 6 months, and had given written informed consent. Participants were interviewed during their routine visits to the treatment center from February 1st to March 3rd, 2016.

An interviewer-administered questionnaire was designed based on existing literature and subsequently used in the data collection, [17 and 18]. It was translated into French and Swahili and piloted in a sample of 20 respondents (not included in the final analysis). The interviews were conducted in French or Swahili, the most commonly used languages in Goma. The interviewers were provided guidance on questionnaire administration over two training sessions which were organized by the research team. Two trained research assistants in each hospital, measured height and weight of patients following standard recommended procedures [23]. Participants were compensated for their time and transportation with an amount of 2 US dollars.

Sample size determination

This sample size was calculated to correctly assess the proportion of HIV-infected individuals with food insecurity, based on the national data in the DRC of 57% [18]. The power calculation used the Kish-Leslie formula, with a 5 % level of

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precision, a confidence interval (CI) of 95 %. The minimal required sample size was 377. We added 10% for contingency and a total of 583 patients were invited to participate in the study.

Measures

Primary outcome: The primary outcome was the nutritional status which was assessed using Body Mass Index (BMI) as a proxy. Participant height and weight were measured.A BMI (weight (kg) / [height (m)]^2) of <18.5 was classified as undernutrition. The outcome was expressed as prevalence (%) of undernutrition among HIV-infected patients on ART.

Primary independent variable: Food insecurity was the primary independent variable, and was measured using the Household Food Insecurity Access Scale (HFIAS) developed by the USAID-funded Food and Nutrition Technical Assistance (FANTA) project [25]. The HFIAS is a validated instrument which has been shown to distinguish food insecure from food secure households across different cultural contexts. It is a compilation of nine questions designed to reflect universal domains of the experience of food insecurity including 1) anxiety and uncertainty about the household food supply, 2) insufficient quality (includes variety and preferences of the type of food), and 3) insufficient food intake and its physical consequences. Results in this study were presented in a categorical format, including 1) food secure, 2) mildly food insecure 3) moderately food insecure, and 4) severely food insecure [24], which we dichotomized into food insecure versus food secure. The Cronbach's alpha was 0.83, demonstrating a good internal consistency of the scale in the sample.

Other covariates: The other covariates included socio-demographic characteristics like age, gender, marital status, residence, size of household, educational level, and the household wealth index. The household wealth index was constructed based on principal component analysis [25] to create an index from a set of household assets (radio, tape recorder, television set, bicycle, hand torch, horse or donkey cart), housing conditions (roof material, number of rooms, wall type, windows, availability and type of latrine), and ownership of domestic animals. The study participants were ranked according to the wealth index score, divided into quintiles, from the lowest (first quintile) to the highest (fifth quintile). Higher quintiles indicate higher Socio-Economic Status (SES).

The adherence to ART was also measured. Adherence to medication taking behavior was based on patient reports. Patients were asked to quantify the number of days during which they failed to take their medicines over the previous 7 days. Self-reported non- adherence was defined as taking < 95% of the prescribed drugs over this period of time [26].

Statistical analysis

Data were analyzed using Stata 12. Univariate analysis was conducted to obtain descriptive statistics of all the variables. Mean and standard deviation of age and BMI, and proportions and their respective 95% confidence intervals for categorical data, were calculated.

Bivariate analyses were performed using Chi-square tests for categorical variables and the t-test for age and BMI (comparing food insecure and secure groups). Factors associated with food insecurity and undernutrition in bivariate analysis were entered into a logistic regression model to obtain adjusted odds ratios (AOR) and their 95% confidence intervals (95%CI). An interaction term was introduced between food insecurity and socio-economic status in the undernutrition regression model to assess the presence of effect modification. The Breslow-day test for assessing the interaction effect was used. Significance level was set at p< 0.05.

Results

Overall characteristics of patients

Of the 583 participants, 80.4% were women. The mean age was 40.9 years (standard deviation [SD] 10.8), with 52% of them aged more than 40 years. Forty percent of people over 40 years were widowed. In general, 27% of the patients were widowed. Only 18% of patients had completed at least secondary school. Eighty-eight percent of patients have shared their HIV status with others (sexual partners or others family member). Only 24% of the patients had been on ART for less than a year, and 32% had been on ART for more than 5 years. Two percent of the patients have declared receiving nutritional support during the previous month. Fifteen percent of the patients had a current CD4 cell count of under 200 cells/ml. Nineteen percent of respondents were non- adherent (95% CI: 15.9% - 22.3%). (Table 1).

Food insecurity

Based on the HFIAS, 51 participants (8.7%) were classified as food secure, 2 (0.4%) as mildly food insecure, 16 (2.7%) as moderately food insecure and 514 (88.2%) as severely food insecure. The overall prevalence of food insecurity among our participants was 91.3% (95%CI: 89.0 – 93.6%) (Table 2). Food insecurity was strongly associated with age and low socio economic status. Being over 40 years had 2 times higher the odds of being food insecure compared with those being less than 40 years old (AOR = 2.19, 95% CI: 1.06 – 4.53). Living in household in the lowest SES quintile presented a 17 fold increase in the odds of being food insecure compared to those living in a highest quintile of socio-economic status (Table 2).

Nutritional status

The average of BMI was 20.9 ± 3.6 Kg/m^2. The average of BMI was higher in food secure group than in the food insecure group (22.8 vs 20.8; p < 0.001). The average of BMI was different between food secure and food insecure group among female (23.1 vs 20.9 Kg/m^2; p < 0.001). There was no difference between food secure and food insecure group among male (21.0 vs 20.1 Kg/m^2; p =0.334). The average of BMI was different between food secure and food insecure group among patients aged of 25-34 years (22.9 vs 20.4 Kg/m^2; p= 0.003); among patients aged of 45-54 years (25.2 vs 20.8 Kg/m^2; p= 0.008) and among patients aged of 55 years and over (28.6 vs 20.9Kg/m^2; p=0.001). (Figure 1).

The overall prevalence of undernutrition (BMI <18.5 kg/m^2)

Table 1: Background characteristics of study participants.

Characteristics	Overall*	Gender		P
		male	female	
Age**				< 0.001
- ≤ Median	302(51.9)	88(77.2)	214(45.8)	
- >Median	280(48.1)	26(22.8)	253(54.2)	
Education level attained				< 0.001
- None/ primary	479(82.2)	74(64.9)	405(86.7)	
- Secondary or higher	103(17.8)	40(35.1)	62(13.3)	
Marital status				< 0.001
- Widowed	159(27.3)	9(8.0)	150(32.1)	
- Other	423(72.7)	104(92.0)	318(67.9)	
Household size				0.007
- ≤ 6 members	251(43.6)	62(54.9)	189(40.9)	
- > 6 members	325(56.4)	51(45.1)	273(59.1)	
Residence				0.101
- Urban	546(94.1)	111(97.4)	434(93.3)	
- Rural	34(5.9)	3(2.6)	31 (6.7)	
Disclosure HIV status				0.150
- Yes	511(88.1)	104(92.9)	407(87.2)	
- No	69(11.9)	9(8.0)	60(12.8)	
Duration on ART				0.262
- ≥ 5 years	185(32.2)	43(37.7)	142(30.9)	
- 1-4.9 years	253(44.0)	43(37.7)	210(45.7)	
- < 1 year	137(23.8)	28(24.6)	108(23.5)	
SES**				0.001
- Lowest quintile	164(28.1)	16(14.0)	148(31.6)	
- 2^{nd}quintile	86(14.8)	24(21.1)	62(13.2)	
- 3^{rd}quintile	100(17.2)	16(14.0)	84(17.9)	
- 4th quintile	117(20.1)	28(24.6)	88(18.8)	
- Highest quintile	116(19.9)	30(26.3)	86(18.4)	
Current CD4				0.969
- < 200	52(14.8)	10(14.9)	42(14.7)	
- ≥ 200	300(85.2)	57(85.1)	243(85.3)	
Nutritional support				0.872
- No	557(98.1)	112(98.2)	444(98.0)	
- Yes	11(1.9)	2(1.8)	9(2.0)	
Adherence to ART				0.492
- No	109(19.1)	19(16.8)	90(19.7)	
- Yes	462(80.9)	94(83.2)	368(80.3)	
Site				< 0.001
- Heal Africa	107(18.4)	3(2.6)	103(22.0)	
- Charite	111(19.0)	28(24.6)	83(17.7)	
- Provincial	148(25.4)	34(29.8)	114(24.4)	
- Militaire	40(6.9)	16(14.0)	24(5.1)	
- Virunga	177(30.4)	33(28.9)	144(30.8)	

*: percentage calculated for each group with available data; **: median age was 40 years; SD: standard deviation; ***: Socio-economic status

Table 2: Associated factors with food insecurity in the household where HIV infected patients receiving ART were living of Goma in 2016.

Characteristics*	Food insecurity		Crude OR (95%CI)	p	Adjusted OR (95%CI)	p
	Yes n (%)	No n (%)				
Age**						
- >median	287(95.0)	15(5.0)	2.82 (1.51 – 5.28)	< 0.001	2.19 (1.06 - 4.53)	0.035
- ≤ median	244(87.1)	36(12.9)	1		1	
Gender						
- Male	106(93.0)	8(7.0)	1.34 (0.61 -2.94)	0.462		
- Female	425(90.8)	43(9.2)	1			

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Education level attained						
- None/ primary	448(93.5)	31(6.5)	3.48 (1.89 - 6.40)	< 0.001	1.75 (0.87 - 3.53)	0.116
- Secondary or higher	83(80.6)	20(19.4)	1		1	
Marital status						
- Widowed	155(97.5)	4(2.5)	4.73 (1.67 - 13.36)	0.001	2,36(0.76 - 7.24)	0.135
- Other	377(89.1)	46(10.9)	1		1	
Household size						
- > 6 members	237(94.4)	14(5.6)	2.18 (1.15 - 4.12)	0.015	2.31 (1.14 - 4.69)	0.21
- ≤ 6 members	288(88.6)	37(11.4)	1		1	
Residence						
- Rural	33(97.1)	1(2.9)	3.33 (0.45 - 24.84)	0.356		
- Urban	496(90.8)	50(9.2)	1			
SES*						
- Lowest quintile	162(98.8)	2(1.2)	22.25 (5.15 - 96.10)	< 0.001	16.81 (3.68 -76.87)	< 0.001
- 2nd quintile	79(91.9)	7(8.1)	3.10 (1.27 - 7.56)	0.009	2.64 (0.99 - 7.03)	0.051
- 3rd quintile	91(91.0)	9(9.0)	2.78 (1.23 - 6.28)	0.012	1.97 (0.82 - 4.76)	0.130
- 4th quintile	109(93.2)	8(6.8)	3.74 (1.61 - 8.70)	0.001	3.56 (1.43 - 8.84)	0.006
- Highest quintile	91(78.4)	25(21.6)	1		1	
Duration on ART						
- 5 years and +	178(96.2)	7(3.8)	3.85 (1.56 - 9.49)	0.002	2.11 (0.78 - 5.74)	0.144
- 1-4.9 years	227(89.7)	26(10.3)	1.32 (0.70 - 2.51)	0.394	1.64 (0.81 - 3.33)	0.168
- < 1 year	119(86.9)	18(13.1)	1		1	
Overall	532(91.3)	51(8.7)				

*: with available data; **: median age was 40 years; SD: standard deviation; ***: Socio-economic status

was 24.1% (95% CI: 20.6% - 27.6%). Household food security was positively associated with nutritional status. In the bivariate analysis, patients who were household food insecure were 5 times more likely to be undernourished (BMI < 18.5 kg/m^2) as compared to those who were household food secure (AOR = 5.45, 95% CI: 1.67 - 17.79). There was a statistically association between the undernutrition and the low CD4 account (< 200) (AOR = 1.88, 95% CI: 1.02 - 3.49). Respondents who lived in households in the lowest SES quintile had a 2.5 times higher odds of being undernourished compared to those in the highest SES quintile (Table 3).

In the multivariate logistic regression analysis, household food insecurity and living in a household in the lowest SES quintile were statistically associated with undernutrition. Respondents from household with food insecurity were 4.5 times more likely to be significantly undernourished as compared to those who were household food secure (AOR = 4.47, 95% CI: 1.35 – 14.78). Respondents in the lowest SES quintile were 2.02 times more likely to be undernourished compared to those in the highest SES quintile (AOR = 2.02, 95% CI: 1.10 - 3.69) (Table 3).

Discussion

Our study has revealed an extremely high prevalence of food insecurity, and its strong association with undernutrition. Overall, 91%, 19%, and 24% of our participants were respectively food insecure, non-adherent, and undernourished.

Although there exist studies that have documented the same associations in Sub-Saharan Africa [8, 17-18], few have particularly focused on post-conflict settings in Africa.

The prevalence of food insecurity varies widely depending on settings and other contextual factors. Many studies in Africa and elsewhere have shown that households with HIV have a higher risk of household food insecurity [18, 27- 30].However, the prevalence reported in our study by far outstrips the documented food insecurity prevalence in Kinshasa [18]. The particular context of insecurity in the region can provide an explanation; the city of Goma has been affected by civil war for many years. In a conflict context, basic social infrastructure may be dilapidated, subsistence activities are limited and poverty can prevail, making access to food difficult. Poverty has been identified as a determinant of food insecurity in previous studies as well as in our study [31, 32].

In the current study, an association between food insecurity and older age. In this study 40% of people being over 40 years were widowed, which classifies them as vulnerable. Patients who were widowed were more food insecure as indicated from the bivariate analysis. They may remain the only breadwinner in the household and they may have had catastrophic health expenditures in relation to their spouse's illness and death.

A high prevalence of undernutrition was measured among treated HIV-patients in Goma. Approximately one fourth of HIV-infected adults in Goma were malnourished. A meta-analysis conducted in 11 sub-Saharan countries reported that the pooled prevalence estimates of HIV-related undernutrition of 10.3% is lower when compared to the current study [33].It is proposed that the difference could be due to the nature of the participants, who were HIV positive, female, and not eligible for ART. Those not eligible for ART still have a good nutritional and immunological status. The results reported here show an association between undernutrition and immunological status. Further studies, which include viral load monitoring, would clarify the mechanism by which undernutrition is associated with low CD4 counts among individuals receiving ART in Goma. The etiology of HIV-associated

Table 3: Associated factors with under nutrition among HIV infected patients receiving ART in five Hospitals of Goma in 2016.

Characteristics*	Under nutrition		Crude OR (95%CI)	p	Adjusted OR (95%CI)	p
	Yes n (%)	No n (%)				
Age**						
- >median	66(22.1)	232(77.9)	1			
- ≤ median	73(26.3)	295(73.7)	0.87 (0.60 - 1.27)	0.466		
Gender						
- Male	29(25.7)	84(74.3)	1.12 (0.70 - 1.80)	0.636		
- female	109(23.5)	354(76.5)	1			
Education level attained						
- None/ primary	113(23.8)	361(76.2)	1			
- Secondary or higher	26(25.5)	76(74.5)	1.09 (0.67 - 1.79)	0.724		
Marital status						
- Widowed	46(29.1)	112(70.9)	1.44 (0.95 - 2.18)	0.083		
- Other	93(22.2)	326(77.8)	1			
Household size						
- > 6 members	60(24.3)	187(75.7)	1.01 (0.68 - 1.48)	0.969		
- ≤ 6 members	78(24.1)	245(75.9)	1			
Residence						
- Urban	127(23.5)	413(76.5)	1			
- rural	12(35.3)	22(64.7)	1.77 (0.85 - 3.68)	0.120		
Duration on ART						
- 5 years and +	49(26.5)	136(73.5)	1.04 (0.63 - 1.72)	0.879		
- 1-4.9 years	50(20.2)	198(79.8)	0.73 (0.44 - 1.19)	0.209		
- < 1 year	35(25.7)	101(74.3)	1			
SES**						
- Lowest quintile	54(33.1)	109(66.9)	2.45 (1.36 - 4.43)	0.003	2.02 (1.10 - 3.69)	0.023
- 2nd quintile	19(22.4)	66(77.6)	1.42 (0.70 - 2.89)	0.327	1.25 (0.61 - 2.57)	0.538
- 3rd quintile	22(22.0)	78(78.0)	1.40 (0.70 - 2.76)	0.338	1.24 (0.62 - 2.47)	0.547
- 4th quintile	25(21.6)	91(78.4)	1.36 (0.70 - 2.64)	0.363	1.18 (0.60 - 2.31)	0.637
- Highest quintile	19(16.8)	94(83.2)	1		1	
Food insecurity						
- Yes	136(25.8)	391(74.2)	5.45 (1.67 -17.79)	0.002	4.47 (1.35 - 14.78)	0.014
- no	3(6.0)	47(94.0)	1		1	
current CD4**						
- < 200	20(38.5)	32(61.5)	1.88 (1.02 - 3.49)	0.042		
- ≥ 200	74(24.9)	223(75.1)	1			
Adherence to ART						
- Yes	112(24.5)	346(75.5)	1.13 (0.69 - 1.87)	0.625		
- no	24(22.2)	84(77.8)	1			
Over all	139(24.1)	438(75.9)				

*: with available data; **: median age was 40 years; SD: standard deviation; ***: Socio-economic status; ****: there were data for only 352 patients, there was not interaction between food insecurity and socio-economic status (Breslow-day test, p= 0.277).

undernutrition is multifactorial. Weight loss is a major symptom of AIDS before starting ART. However, several mechanisms need to be explored.

In this study it was found that undernutrition was associated with food insecurity and low socioeconomic status. The results reported here are consistent with a similar study conducted earlier which showed that those who were food insecure were more likely to be undernourished [34, 35]. However, in the study conducted in Senegal, the authors did not find an association between severe food insecurity and undernutrition [17]. This is likely a consequence of lack of power because of small sample size. These results are suggesting a plea for nutritional support to patients on ART in the Goma hospitals. In the present study, only two percent of the patients have declared nutritional support during the last month.

In examining differences of BMI between food insecurity and food security group for men and women, our study measured a statistically significant difference of BMI between household food insecurity and food security group for women, but not for man. The small numbers of men that were food secure might have limited our power to detect any differences between the two groups. Nevertheless, a significant was measured between the

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two groups of female. Results from this study indicate a greater BMI in food secure when compared to food insecure groups. Whereas in the developing world, food insecurity is generally associated with underweight [36], multiple cross-sectional studies in developed countries have reported a relationship between food insecurity and obesity [37, 38]. The relationship between food insecurity and BMI is complex and varies by population and study [39, 40]. Obesity can in these studies can easily be explained by the overconsumption of energy dense foods. To maintain adequate energy intake, people who must limit their expenditure on food are prone to select low-quality, energy dense, inexpensive foods [41, 42]. Food insecurity may also lead to various psychological and behavioral changes, such as a preoccupation with food, stress, depression, and physical limitations in adults, all of which can lead to an increased risk for obesity [41, 42]. Food insecurity may or may not be accompanied by hunger, which is defined as the "uneasy or painful sensation caused by a lack of food" [43]. In the HIV-infected, anorexia is very common [44]. In HIV-infected patients, there is also food insufficient. Food insufficiency is defined as "inadequacy in the amount of food intake because of a lack of money or resources that provide access to enough food" [45]. Thus, food insecurity is a broader term that encompasses food insufficiency, as well as psychological and qualitative aspects of food supply and intake [45].

In this study, food insecurity and malnutrition was associated with socioeconomic factors. This finding is consistent with previous studies in which malnutrition has been associated with lower socioeconomic status [46, 47]. Undernutrition and food insecurity constitute an important threat to the success of HIV programs in sub-Saharan Africa, and that failure to address them accordingly may jeopardize the benefits gained so far in the fight against HIV, especially in those settings affected by conflict.

The current study had several limitations though, such as its cross-sectional design, which makes it difficult to determine temporal relationship between exposure and outcome. Also, the study might have excluded confounders of undernutrition and food insecurity unknown to the research team. Results could be biased by socially desirable answers especially in reporting of missed medication pills in the self-reported assessment of ART adherence, since the interviews were conducted by health care workers. In order to minimize this potential bias, interviewers were provided extensive training to process the survey questionnaire in a non-judgmental manner. The researchers used a composite measure coupling both subjective (self-reported adherence) and objective (pharmacy refill adherence) measures to limit the measurement error in adherence. Other limitations included the limited breakdown of age categories due to a large number of subjects that did not know their exact date of birth, subjects that under-report their assets in the hope of receiving aid, etc. could all contribute towards data quality.

Conclusion

This study measured a high prevalence of food insecurity in Goma. The study highlight the negative impact of food insecurity on undernutrition and how the situation is exacerbated by the presence of HIV. Further studies are suggested to assess nutritional status with a high validity (sensitivity & specificity) way in HIV-infected patient on ART in this setting.

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