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Research Article

Effect of Demographic and Socio-Economic Factors in Nutritional Status of People Living with Human Immunodeficiency Virus Enrolled in Antiretroviral Therapy in Khartoum State - Sudan

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Abstract

Background: Human Immunodeficiency Virus (HIV) is responsible for the occurrence of a disease that known Acquired Immunodeficiency Syndrome (AIDS) are highly prevalent in Sub-Saharan Africa, that weakens the immune system to such a degree that it is no longer able to fight off infections, otherwise harmless to healthy individuals.

Aim: The aim of this study is to assessment demographic and socio-economic factors in Nutritional Status of AIDS patients enrolled in Antiretroviral Therapy (ART) in Khartoum State - Sudan.

Methodology: A cross-sectional hospital-based study was carried out at all (ART) centers in Khartoum State. The study population involved adult AIDS patients who are currently on Antiretroviral (ARV) therapy for period not less than six months. 301 participants were included in this study through a systematic randomization selection, and participants were interviewed using a structured questionnaire. Collecting data included demographic and socio-economic characteristics of participants, their nutritional anthropometry based on body mass index BMI, dietary intake assessment and hemoglobin (Hb) were reported. Statistical package for social sciences (SPSS) version 20 was used for data entry and analysis.

Results: The results showed that 56.5% of the participants were males, and 61.5% were in the age group 30 to less than 40 years, 44% were married, about two thirds(65.2%) had low level of education, and 46.8% were of low socio- economic status. Concerning nutritional status the data indicated that mean BMI was (23.55 ± 4.13) for females compared to (22.94 ± 3.68) for the males; and (23.21 ± 3.9) for all. 50.8% of the participants had normal BMI, and 33.3% were overweight. Significant relationship between nutritional status BMI and participants' gender was found (P-value 0.031). Males are more likely to be under weight than females who showed tendency for being overweight and obese. Hemoglobin levels also were found to be significantly associated with the gender of the participants (P-value 0.001) and nutrition status (0.000), as more than two thirds 67.1% of males were anemic compared to less than half 49.2% of the females, and participants with low BMI are more likely to be anemic compared to those with normal or high BMI.

Conclusion: Although the study showed that the majority of participants were anemic, but the positive effect of treatment was reflected on the BMI, thus combination of antiretroviral treatment and provision of good nutritional services is expected to improve the quality of life of (PLHIV) in Sudan through decreasing morbidity and mortality. In addition, nutritional status assessment and nutritional therapy should be considered as an integral part of the HIV care and treatment program in the country.

Keywords: *Nutrition Status; HIV; AIDS; BMI; Hb; Socio- Economic*

Introduction

Globally, the total number of people living with HIV increased from 33.3 million in 2010 to 36.7 million in 2015. On the other hand, the number of new infections has decreased to 2.1 million in 2015 compared to 2.2 million in 2010. Similarly, the total number of HIV-related deaths has decreased from 1.5 million in 2010 to 1.1 million in 2015. Regarding the major interventions, treatment coverage with ART has increased from 7.5 million in 2010 to 17 million PLHIV in 2015 [1].

In 2015, the prevalence of HIV among adult population in Sudan is estimated at 0.3% with about 56,000PLHIV, 3,000 HIV-related deaths, and 5,600 new infections. Also, in the same year the total number of mothers needing ARVs for preventing mother-to-child transmission (PMTCT) has been estimated at 2,600 [1].

Nutrition is an important element for HIV patient, nutrition interventions can improve quality of life; assist in symptom management, support medication therapy, and help guard protect against infections and complications. A nutrition-related complications in HIV-positive people is prevalent and has an impact on disease progression and risk of mortality [2].

HIV exacerbates malnutrition due lack of food intake, increased energy needs, and reduced absorption of nutrients. This can lower the progression of HIV and worsen it by weakening the immune system, increasing susceptibility to opportunistic infections and reducing the effectiveness of treatment. The malnutrition-infection complex which is a result of HIV and AIDS is a significant factor between adults [3].

The link between nutrition and HIV/AIDS amplify the negative effects of HIV infection on human development at individual, household, community and national levels. The biological and social factors leading to mal nutritional status and weight loss, which are an important cause of morbidity in individuals infected with HIV, resulting in a poor quails [4].

The effect of HIV infection on nutrition was identified early in the epidemic. HIV induced immune impairment and heightened risk of infection can worsen nutritional status, lead to nutritional deficiencies through decreased food intake, mal absorption, and increased utilization and excretion of nutrients. These processes in turn hasten the progression of HIV infection to AIDS, while HIV infection exacerbates malnutrition by attacking the immune system and by negatively impacting nutrient intake, absorption and the body's use of food. Like HIV and AIDS, malnutrition also compromises the immune function and thus increases susceptibility to severe illnesses and reduces survival. Nutritional status modulates the immunological response to HIV infection, affecting the overall clinical outcomes and wasting is one of the most visible signs of malnutrition as patients progress from HIV to AIDS [5,6].

A good nutritional status is defined as when the body has enough and right kinds of food to meet its requirements for functioning, growth, repair and maintenance of health [7]. The relationship between HIV and nutritional status is multi-factorial and correcting ,this status becomes more difficult as infection progresses increasing the nutritional demand to be met which is usually affected by other factors such as poverty [8,9].

However, it is found that sufficient food has a positive influence on the health status of PLHIV as well as on the function of ARV drugs and adherence leading to significant impact on the survival of PLHIV [10].

The HIV-induced immune impairment and heightened risk of infection which can worsen nutritional status, leads to nutritional deficiencies through decreased food intake, mal absorption, and increased utilization and excretion of nutrients. These processes in turn hasten the progression of HIV infection to AIDS, while HIV infection exacerbates malnutrition by attacking the immune system and by

negatively impacting nutrient intake, absorption and the body's use of food. Like HIV and AIDS, malnutrition also compromises the immune function and thus increases susceptibility to severe illnesses and reduces survival. Nutritional status modulates the immunological response to HIV infection, affecting the overall clinical outcomes [6,7].

Almost all studies found that the nutritional status of PLHIV is poor including the occurrence of wasting syndrome [11].

On the other hand, most of these studies also focused on identifying the factors affecting the nutritional status of PLHIV. In this endeavor many studies examined the reasons behind the poor nutritional status of PLHIV. These reasons can be grouped into: reduced food intake result to food insecure it, and Socio-demographic as factors, food insecurity and poverty can also contribute to lower levels of empowerment, Including women's empowerment, which can negatively impact health outcomes for HIV [10,12-18].

Age and level of education also play important role in reducing food intake. Numbers of cross-sectional studies assessing determinants of dietary diversity in adult populations have found that dietary diversity is associated with socioeconomic status. Household income as a proxy indicator for socio-economic status was determined by study it found that the income was strongly associated with access to adequate food intake/food security, while another study pointed that food access is strongly associated with the control over household resources or income, particularly for women and their children. In the other hand the quantitative results from US survey aimed to establish the relationship between income and food insecurity indicated that lower income respondents were more likely to experience food insecurity [12-15].

The Wright and complete information of PLHIV nutritional status in Sudan, that would make the national and international AIDS programs able to design interventions for improving treatment outcomes and quality of life of PLHIV.

Aim of the Study

The aim of this is study, is to assess the nutritional status of HIV patients on antiretroviral therapy (ART) in Khartoum State, through**:** determination of the nutritional status of PLHIV regarding followings: Anthropometric measurement; body mass index (BMI), Food intake**,** and levels of Hemoglobin Hb, also to assess the relationship between nutritional status of participants and Socio economic and demographic factors.

Methodology

This is a cross-sectional hospital-based study, conducted at the all seven ART centers in Khartoum State; Omdurman Teaching Hospital, Omdurman Military Hospital, Bahri Teaching Hospital, Elban Gadeid Hospital-Al Hag Yousif, Khartoum Police Hospital (Al Ribat), Khartoum Teaching Hospital, and Bashayer Hospital. The first center of ART was established in 2003 in Omdurman Teaching Hospital. The study population involved all adult PLHIV who are currently on ARV at the ART centers in Khartoum state for period above six months. And the total number of patients of HIV/AIDS in Khartoum state currently on treatment are1,601 patients and those on treatment for fifteen months or less are 168 patients. Patients on ART for more than fifteen months are 1,433 patients [19].

The following inclusion criteria for enrolling participants in this study are the followings: adult patients (male/female) who have been on treatment for at least six months or more, patients who are transferred in during the study period and who have been on treatment for at least six months, and eligible patients who agree to participate in the study. While exclusion criteria included: less than 18 years old, patients who are transferred out at the time of the study, and patients who refuse to consent for participation in the study.

Sample size

The sample size was calculated by using this formula: (n = N/(N-1)e2+1).

Accordingly, "n" was calculated at 1433/ (1432).052+1 = 313. The final selection of the sample units was done through a systemic randomization. A total of 301 PLHIV on ART responded to the questionnaire thus the size of the sample in this study consisted from 301 HIV patients.

Study area and period

Data collection took place during the period October2014 to March 2015 in all ART centers in Khartoum state. The data have been collected from different sources: primary and secondary data (related articles). The primary data depended on questionnaire and the secondary data was collected from records date (as reports and registry books), references, books, journals, previous studies and internet).

Study design

The first step was the designing and testing the study questionnaire. Testing of the questionnaire for validity of the questionnaire and to check the feasibility of the methodology was done on 10 adult people living with HIV Appropriate changes were made and it was found that completion needed about 30 minutes. The final questionnaire included data on: demographic characteristics of patients which include general and socio-economic aspects, anthropometric measurements for Weight and Height, and laboratory investigation including Hb were measured.

Data was collected by interviewing the participants and data recorded in the designed questionnaire. The average time that was taken during each interview was 30 minutes to fill the questionnaires and measuring anthropometrics (weight and Height). Questionnaires were filled by well-trained data collectors at the ART centers.

Assessment of the nutritional status

The Nutritional Status of the patients was assessed by BMI, dietary intake, and measurement of Hemoglobin.

Measurement body mass index BMI

The body mass index (BMI), or Quetelet index, is a statistical measurement which compares a person's weight and height. Though it does not actually measure the percentage of body fat, it is a useful tool to estimate a healthy body weight based on how tall a person is. Due to its ease of measurement and calculation, it is the most widely used diagnostic tool to identify obesity and underweight. Formula for BMI is weight in kilograms divided by height in meters squared.

Weight (kg)/[height (m)]2. The weight status category for the classification of BMI according to categories are based on WHO, (1995) recommendations.

Hemoglobin measurement

Anemia is diagnosed by measuring the hemoglobin level in the blood (by using full automation system). People with Hemoglobin levels below the expected value for their age group are considered anemic.

Data analysis

Data collected through questionnaires or measurements tools were analyzed by statistical package for social sciences (SPSS) version 20. Frequencies and percentages were calculated and Chi-Square test was performed to investigate the significance in the association of the different independent variables with the outcome variables of our study namely BMI and Hb level.

Ethical consideration

Ethical approval was obtained from the ethical review committee of Ministry of Health -Khartoum State, and prior to data collection, permission was taken from Hospitals administrators. Participants were told that they had full right to participate or not, and they were also informed that all the data obtained from them would be kept confidential using codes instead of any personal identifiers. Finally, those participants identified as under nutrition were given nutritional counseling in collaboration with the clinicians working in ART clinic at these Hospital.

Results

The aim of this study is to assess the nutritional status of HIV patients on antiretroviral therapy (ART) in Khartoum State. On the above mention objectives, the results of data collected were presented in the following sections inform of tables and figures.

Demographic and Socio-economic characteristics of study participants

The above table shows males represented 56.5% of the total study participants and most of the participants (61.5%) were in the age group 30 - 39 years. Less than half (44%) of the participants were married and 23.6%, 22.4% were single and divorced respectively. Concerning the educational level primary education was highest among the participants 42%, followed by secondary 25.5% and Illiterate 23.2%.

Variables	Classifications	Frequency	Percent
Sex	Male	170	56.5%
	Female	131	43.5%
	Total	301	100%
Age	19-Less than 30 years	30	10%
	30-Less than 40 years	185	61.5%
	40-Less than 50 years	63	20.9%
	50years -above of that	23	7.6%
	Total	301	100%
Marital Status	Single	71	23.6%
	Married	132	44%
	Divorced	67	22.4%
	Widowed	26	9%
	Separate	3	1%%
	Refuse answer	2	1%
	Total	301	100%
Level of education	Illiterate	70	23.2%
	Khalwa/Primary	126	42%
	Secondary	77	25.5%
	Higher	27	9%
	Refuse answer	1	0.3%
	Total	301	100%

Table 1A: *Socio-demographic characteristics of participants (n = 301).*

Variables	Classifications	Frequency	Percent
Occupation	Without job	104	34.6%
	Employee	1 8	6%
	Laborer	21	7%
	Free lance	42	14%
	Student	6	2%
	Military	7	2.3%
	House wife	98	32.5%
	Others (Non stable employee)	5	1.6%
	Total	301	100%
Source of support for those not working	Family	91	30.2%
	Relatives	58	19.3%
	Friends	17	5.7%
	governmental association	26	8.6%
	voluntary charitable organization	2	.7%
	International Organizations	1	0.3%
	Have no support	106	35.2%
	Total	301	100%
Monthly income of the family in SDGs	500 SDGs -Less than 1000SDGs	82	27.2%
	1000 SDGs - Less than 1500 SDGs	38	12.6%
	1500 SDGs - Less than 2000 SDGs	21	7%
	2000 SDGs – above of that	8	2.7%
	Have no relation with this question	152	50.5%
	Total	301	100%
Ownership of house	Owner	117	38.9%
	Governmentally	38	12.6%
	Rent	93	30.9%
	Share	53	17.6%
	Total	301	100%
Number of family members	2 members	71	23.6%
	3 - 6 members	180	59.8%
	≥ 7 members	50	16.6%
	Total	301	100%

Table 1B: *Socio- economic characteristics of participants (n = 301).*

The above table reflects the general socio-economic status of the participants. Almost two thirds of participants were either without jobs (34.6%) a housewives (32.5%). More than one third of participants were supported by family members/relative and 35.2% depended on them. On the other hand, 49.5% of those who responded to the family income question and earned less than one thousands SDG/month were 27.2%. however38.9% were the owners of their houses while the remains either rent 30.9%/share 30.9, more than half of them59.8% lived within a medium family size (3 - 6 members).

As shown in table 2, 21.8% of the males compared to 10.7% were having low BMI; this difference is found statistically significant when Pearson Chi square test was used (p 0.031). No significant associations were found between BMI and age, level of education and occupation. However low rates of low BMI were reported for participants younger than 40 years (13%), those with secondary or higher (13% - 11%) education, housewives and those who have jobs (11.3% and 15%).

			BMI (kg/m^2)		Total	*P. Value*
		Low	Normal	High		
Sex	Male	37 (21.8%)	84 (49.4%)	49 (28.8%)	170 (100.0%)	0.031
	Female	14 (10.7%)	69 (52.7%)	48 (36.6%)	131 (100.0%)	
Age	19 - 29 years	4 (13.3%)	14 (46.7%)	12 (40.0%)	30 (100.0%)	0.276
	30 - 39 years	25 (13.5%)	97 (52.4%)	63 (34.1%)	185 (100.0%)	
	40 - 49 years	16 (25.4%)	31 (49.2%)	16 (25.4%)	63 (100.0%)	
	50+ years	6 (26.1%)	11 (47.8%)	6 (26.1%)	23 (100.0%)	
Level of education	Illiterate	17 (24.3%)	34 (48.6%)	19 (27.1%)	70 (100.0%)	0.275
	Khalwa/Primary	21 (16.7%)	64 (50.8%)	41 (32.5%)	126 (100.0%)	
	Secondary	10 (13.0%)	44 (57.1%)	23 (29.9%)	77 (100.0%)	
	Higher	3 (11.1%)	11 (40.7%)	13 (48.1%)	27 (100.0%)	
Occupation	Idle	25 (24.0%)	48 (46.2%)	31 (29.8%)	104 (100.0%)	0.177
	Housewife	11 (11.3%)	54 (55.7%)	32 (33.0%)	97 (100.0%)	
	Has a job	15 (15.0%)	51 (51.0%)	34 (34.0%)	100 (100.0%)	
Total		51 (16.9%)	153 (50.8%)	97 (32.2%)	301 (100.0%)	

Table 2: *Relationships between demographic characteristics and BMI.*

Analysis of HB-level

Just more than two thirds (67.1%) of male participants were anemic compared to less than half (49.2%) of the female ones. This difference has been found statistically significant when Fisher's Exact Test was applied. When we cross-tabulated HB and age and level of education of participants, no significant statistical difference has been observed between the different categories (Table 3). Also, we found a significant association between occupation and HB levels, where idles (64.4%) and those who have jobs (67%) were more anemic compared to housewives (45.8%).

		Level of Hb (%)		Total	P.Value
		Not anemic	Anemic		
Sex	Male	56 (32.9%)	114 (67.1%)	170 (100.0%)	0.001
	Female	66 (50.8%)	64 949.2%)	130 (100.0%)	
Age	19 - 29 years	13 (43.3%)	17 (56.7%)	30 (100.0%)	0.47
	30 - 39 years	79 (42.7%)	106 (57.3%)	185 (100.0%)	
	40 - 49 years	24 (38.7%)	38 (61.3%)	62 (100.0%)	
	50+ years	6 (26.1%)	17 (73.9%)	23 (100.0%)	
Level of education	Illiterate	22 (31.4%)	48 (68.6%)	70 (100.0%)	0.089
	Khalwa/Primary	50 (40.0%)	75 (60.0%)	125 (100.0%)	
	Secondary	33 (42.9%)	44 (57.1%)	77 (100.0%)	
	Higher	16 (59.3%)	11 (40.7%)	27 (100.0%)	
Occupation	Idle	37 (35.6%)	67 (64.4%)	104 (100.0%)	0.005
	Housewife	52 (54.2%)	44 (45.8%)	96 (100.0%)	
	Has a job	33 (33.0%)	67 (67.0%)	100 (100.0%)	
Total		122 (40.7%)	178 (59.3%)	300 (100.0%)	

Table 3: *Relationships between demographic characteristics and Hb.*

Table 4 shows the relationship between sex of participants and their HB results when we controlled forage. Although the overall relationship was statistically significant, this statistically significant difference between males and females was only observed at the age group 40 - 49 years (p 0.000) when 80.6% of the male patients were anemic compared to 34.6% of the females.

Age	Sex	Status (Hb%)		Total	P Value
		Not anemic	Anemic		
19 - 29 years	Male	7 (38.9%)	11 (61.1%)	18 (100%)	0.711
	Female	6 (50.0%)	6 (50.0%)	12 (100%)	
	Total	13 (43.3%)	17 (56.7%)	30 (100%)	
30 - 39 years	Male	40 (39.6%)	61 (60.4%)	101 (100%)	0.35
	Female	39 (46.4%)	45 (53.6%)	84 (100%)	
	Total	79 (42.7%)	106 (57.3%)	185 (100%)	
40 - 49 years	Male	7 (19.4%)	29 (80.6%)	36 (100%)	0.000
	Female	17 (65.4%)	9 (34.6%)	26 (100%)	
	Total	24 (38.7%)	38 (61.3%)	62 (100%)	
50+ years	Male	2 (13.3%)	13 (86.7%)	15 (100%)	0.131
	Female	4 (50.0%)	4 (50.0%)	8 (100%)	
	Total	6 (26.1%)	17 (73.9%)	23 (100%)	
Total	Male	56 (32.9%)	114 (67.1%)	170 (100%)	0.002
	Female	66 (50.8%)	64 (49.2%)	130 (100%)	
	Total	122 (40.7%)	178 (59.3%)	300 (100%)	

Table 4: *Association between sex and results of Hb controlled by age.*

Discussion

Characteristics of the patients

The study shows males represented 56.5% of the total study participants and most of the participants (82.4%) were in generating age group 19 - 50 years. This corresponds well to the general PLHIV in German [20].

Less than half (44%) of the participants were married and 23.6%, 22.4% were single and divorced respectively. Concerning the educational level, primary education was highest among the participants 42%, followed by secondary 25.5% and Illiterate 23.2%. Previous studies demonstrated that Education status was significantly associated with nutritional status, in that illiterate people were more likely to be under nourished, the studies of Unge., *et al*. [21] underlying the factors in under-nutrition among the illiterate demonstrate that differences may include their dietary pattern, their understanding on the disease processes, and ART adherence.

A study carried out in Ethiopia by Hailemariam., *et al*. [22] indicated that occupation and economic status might account for the vulnerability of illiterate people to under nutrition. The sample used in this study shows a relative high unemployment rate almost two thirds of participants were either without jobs (34.6%) and housewives (32.5%). Studies show that un employed PLWHA face more issues regarding their measured (HIV stage, psychiatric diseases) and their self assessed health. Unemployed patients have a more progressed HIV disease (AIDS) than employed patients: HIV stage C is found in 38.8 % of the unemployed and in 23.7 % of the employed PLWHA.HCV co-infection is found in 3.0 % of unemployed and 3.7 % of employed PLWHA, which implies that the difference between the two groups is small for this health factor status [23]. Thus the increase in the rate of unemployment among the subjects after detection of HIV due to poor health conditions and HIV infection emphasis the importance of counseling of PLHIV at the time of detection of the HIV positive status.

The current study demonstrated more than two third of participants were supported by family members/relative and even those who earned monthly income it was less than one thousands SDG. This means that households experience an immediate impact of HIV/AIDS, because families are the main caregivers for the sick and suffer AIDS-related financial hardships during the long period of illness caused by AIDS, the loss of income and cost of medical caring may hit the households taking into account only 38.9% were the owners of their houses while the remains either rent/share.

Assessment of the nutritional status of the participants: Anthropometric measurement of study participants (BMI)

The results showed that majority of participants were either with normal BMI or overweight, the findings similar to the results of two studies in Brazil and Uganda, where prevalence of thinness in the first study was found to be 8.8% [24] while 64.9% of the participants in the Ugandan study were with normal BMI [25]. In contrary to this findings, most of the reviewed studies from China [26], Ethiopia [27-30], Malawi [31], Tanzania [32] and West Africa [33] reported higher prevalence rates (33 - 56%) of underweight among PLHIV. Other studies from Ethiopia [34], Kenya [35], Nigeria [36] and Senegal [37] had reported moderate levels of underweight that ranged from 19.2% in Dakar/Senegal to 26.7% in Nigeria. Recent studies were also supporting such explanation as documented in studies from Malawi [38], West Africa [33] and Zambia [39] where low BMI was reported insubstantial proportions of PLHIV at the time of initiation of treatment. Substantial evidence attribute the positive effect of antiretroviral treatment in preventing wasting and weight loss to boosting the immunity of PLHIV and hence reducing the likelihood for getting opportunistic infections including those which increase energy and protein metabolism and those might lead to low food intake and/or malabsorption such as fever, oral and esophageal lesions, anorexia and diarrhea [24,28,36,40]. Although ART has positive effect on PLHIV nutritional profiles, however it is not the only factor since dietary and genetic differences as well as the socioeconomic factors play role in determining the nutritional status of PLHIV [24,33].

The results BMI and sex showed significant relationship between BMI and participants' sex that males are more likely to be under weight than females and that the tendency for being overweight is more among females. Also this could be explained by the difference in height between males and females where males were significantly taller than females besides there was no marked difference in the mean weight between the two groups.

Although no statistically significant association between age and BMI was obtained, however the participants older than 40 years were as twice most likely to be under-weight compared to those younger than 40 years old. Similarly, younger patients are most likely to be over-weight compared to other groups.

These two observations neutralize each other giving no difference in malnutrition between the different age groups. This finding is similar to the finding of the study in Southern Ethiopia where they found no statistically significant association between age and malnutrition [29]. In contrary, Mariz., *et al*. [24] found significant relationship between older age and overweight among HIV patients in Brazil. This might be explained by that young PLHIV are usually more active compared to older patients which lead to preserving their muscle bulk.

At the same time, young persons are more likely to consume fast food which is rich in carbohydrates and fats, therefore increasing their tendency to be overweight.

Similarity was detected between studies in Ethiopia [29,34] and the findings of BMI and the education level of PLHIV showed no statistically significant relationship between BMI and the education level of PLHIV. However, it was observed that overweight increases with the educational level; the highest proportions of overweight together with the lowest proportions of underweight are observed in participants with higher and secondary education while the opposite was observed in illiterate and Khalwa/primary education participants.

Hb measurement

Almost all studies and literature around the world agreed on anemia as the most common hematological abnormality in HIV infected patients [41]. The same finding has been reported by in this study, when the prevalence of anemia among PLHIV participants is estimated at 59.3%. High rates of anemia greater than 50 percent were reported by studies from Nepal (55.8%) [42], West Africa (60%) [33], Brazil (84%) [40] and Malawi (88.4%) (Mvan, 2005). In contrary, low and moderate rates of anemia were reported by studies from South Africa (25.8%) [41], Cleveland - Ohio (47%) [43], and in Tanzania (44.1-48.2%) [44]. Literature showed that causes of anemia among PLHIV are multi factorial, including iron deficiency, infections and blood disorders. In addition, anemia has significant associations with many factors including socio-demographic characteristics of PLHIV.

Strong association between the sex of participants and level of hemoglobin was detected where more than two thirds of the male participants were anemic compared to just less than half of the females. This finding is different from the associations reported between sex and anemia among PLHIV in South Africa [41], Nepal [42], and Brazil [40] where anemia was mainly associated with female sex. The highest prevalence of anemia among male and female PLHIV in this study was mainly among those with low BMI. ,and also the increased rate of anemia among male participants compared to female ones might be explained also by the increased probability of males to be exposed to pathogenic intestinal parasitic infections as reported by several investigators such as *Entamoeba histolytica, Giardia lamblia*, *Trichuris* and infections by hookworm causing iron deficiency anemia [29]. Although no significant association was found between anemia and age, yet the researcher observed that proportions of anemia increases with age.

Almost three quarters of participants 50 years and older were anemic compared to other age groups, this finding is about to be similar to the Nepal study where they found statistically significant association between age and anemia; increased levels of anemia with increased age [42]. Some of the possible interpretations of this finding is that food intake deceases with increase of age and also frequencies of mal absorption. Also this observation has been reported by Ana [40] in Brazil where they found advance age is a risk factor of anemia in patients with HIV On the other hand, anemia results showed a unique pattern of anemia among male participants where proportion of anemic males increases with the increase in age. However, this pattern was lost among female participants. In addition, the statistically significant association between sex and hemoglobin was limited only to participants in the age group 40 and less than 50 years old.

Concerning the educational level no statistically significant relationship between anemia and the level of education was found. However, we noticed inversely proportionate relationship between level of education and anemia was noticed, i.e. less anemia proportions with higher educational levels and vice versa. Again this finding is closer to literature from developing countries where high rates of anemia were associated with lower levels of education [42]. Also, positive relationship between anemia and education level was reported by a study in Malawi where lower education levels were more likely to be associated with anemia [31]. The relationship between lower levels of anemia and high education could be explained by that persons with higher educational levels might have better nutritional knowledge, food intake, income, and living conditions. All these will lead to better nutritional status including normal hemoglobin levels. The results showed significant association between hemoglobin levels and patients' occupation where housewives were least anemic among all others.

However, most of the idle and those who have jobs are males, so that is why we observed higher levels of anemia among these two categories. This holds true when this association was controlled for sex; the association turned to be statistically insignificant. These findings were similar to the findings from the study in Nigeria [45] where investigators found no statistically significant association between occupation and anemia among HIV patients on ART.

Conclusion

Based on the findings of this study the following conclusions can be drawn:

The results showed that majority of participants were either with normal BMI or overweight. Those who fell under the category of underweight represented the smallest proportion of all participants. The main reason behind this distribution of BMI might be related to the effect of antiretroviral therapy on the study sample.

- Despite the good BMI among the study participants, the results showed high prevalence of anemia (59.3%) with statistically significant variation between male (67.1%) and female participants (49.2%).
- Sex is the only variable that has significant association with presence of anemia. This finding was mainly among participants aged 40 - 49 years old.
- Males are more likely to be underweight and anemic compared to female participants.

Recommendations

All people infected with HIV should have the benefit of a nutrition management plan that includes both nutrition education and medical nutrition therapy as part of the multidisciplinary interventions plan. The patients should have access to nutritionist or dietician for assessment and follow-up.

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