

# Nutritional Status and CD4 Cell Counts in HIV/AIDS Patients under Highly Active Antiretroviral Therapy in Addis Ababa, Ethiopia

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## Abstract

**Introduction:** The introduction of highly active antiretroviral therapy significantly improved the life expectancy and quality of life of HIV infected people. However, malnutrition is still a concern. The Nutritional status of HIV/AIDS patients and HIV disease progression association should be thoroughly investigated. The aim of this study is to investigate the association of nutritional status and CD4 cell counts in HIV/AIDS patients who are under HAART in Zewditu Memorial Hospital, Addis Ababa, Ethiopia.

**Method:** This cross sectional study was conducted on 395 HIV/AIDS patients taking HAART in Zewditu Memorial Hospital from January to June 2016, Addis Ababa, Ethiopia. Socio-demographic information was collected using structured data collection sheet. Weight and Height of all HIV/AIDS patients were measured. Venous blood samples were collected using EDTA tubes for the determination of CD4, albumin and total protein. Data analysis was done using SPSS version 20 software. Chi-square test for the association between dependent and independent variables and multivariate regression analysis to evaluate the role of confounding variables were performed. The level of significance was set to 0.05 ( $\alpha=5\%$ ).

**Results:** The male to female ratio was 0.69:1. The mean age was  $39.1 \pm 10.15$  years. The prevalence of malnutrition based on BMI was 60 (15.2%) with the mean BMI of  $22.88 \text{ kg/m}^2$  (SD  $4.17 \text{ kg/m}^2$ ). Three hundred thirty six (85.1%) CD4 cell counts were  $>200 \text{ cells/mm}^3$ . Albumin level, BMI, opportunistic infection status and total protein level were not significantly associated with diminished CD4 cell counts ( $P \text{ value} > 0.05$ ). The CD4 cell count was significantly associated with patients WHO AIDS stage ( $P\text{-value}=0.008$ ) and year on HAART ( $P=0.048$ ).

**Conclusion:** Although there was no statistically significant association between nutritional status and CD4 cell counts, malnutrition is continued as a problem in HIV/AIDS patients taking HAART. So regular follow-up mainly nutritional and opportunistic infections assessment is necessary.

**Keywords:** Nutrition; HIV; ART; HAART; Ethiopia

**Abbreviations:** ART: Antiretroviral Therapy; HAART: Highly Active Antiretroviral Therapy; HIV: Human Immune Deficiency Virus; AIDS: Acquired Immune Deficiency Syndrome; CD4: Cluster of Differentiation 4; SD: Standard Deviation; ZMH: Zewditu Memorial Hospital; BMI: Body Mass Index; WHO: World Health Organization; EDTA: Ethylenediaminetetraacetic Acid

## Introduction

Antiretroviral therapy increases CD4 lymphocyte counts, reduce risk of opportunistic infections and improve survival of HIV infected people [1]. Before a widespread of ART, malnutrition was seriously associated with the diminished life expectancy [2,3]. The accessibility of ART in resource limited areas greatly reduced the morbidity and mortality of HIV infected people [4]. Especially the introduction of HAART, significantly improved the life expectancy and quality of life of HIV infected people [3,5,6]. The HAART regimens comprise nucleoside-analog reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), protease inhibitors (PIs) and entry inhibitors [7]. Although HAART improved the life expectancy of HIV infected people, malnutrition is still a concern [1]. Malnutrition is associated with repeated opportunistic infections, rapid disease progression, and increase in the incidence of HIV-related mortality [8].

CD4 lymphocytes are the primary target cells for HIV [9]. In patients with HIV, there is an association among low albumin levels, low body mass index (BMI) and CD4 count  $<200 \text{ cells/mm}^3$  [1]. The Nutritional status of HIV/AIDS patients and HIV disease progression association

should be thoroughly investigated for developing strategies to diminish mortality of HAART taking HIV/AIDS patients. In Ethiopia, there were more than 222,000 patients on ART at the end of 2010 and ART has improved the survival of patients with HIV/AIDS and the quality of life [10]. The aim of this study is to investigate the association of nutritional status and CD4 cell counts in HIV/AIDS patients who are under HAART in Zewditu Memorial Hospital, Addis Ababa, Ethiopia.

## Materials and Methods

### Study area

The association of nutritional status and CD4 status in HIV/AIDS patients who are under highly active antiretroviral therapy in Zewditu Memorial Hospital (ZMH) from January to June 2016, Addis Ababa, Ethiopia was evaluated. ZMH is located in Addis Ababa, the capital city of Ethiopia. It is one of the largest hospitals in Addis Ababa with very high patient load. It gives its service for over 2 million people. Since ZMH is

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a government hospital people with low socio economic status get treated in this hospital. The hospital provides many health care services including HIV testing, counseling and ART. Zewditu Memorial Hospital (ZMH) has the first and model ART center in Ethiopia. Currently over 18,000 HIV/AIDS patients are following HAART in this hospital.

### Study participants

This cross sectional study was conducted on 395 HAART taking study participants. All the study participants were on HAART from 1-3 years. HIV/AIDS infected individuals who are taking HAART and age between 20 and 65 years were included while patients with incomplete records and those who are on HAART less than 1 and above 3 years were excluded.

### Data collection and analysis

Socio-demographic information and other important possible risk factors of the study participants were collected from the ART data base and from their medical records using structured data collection sheet. The nutritional status of all HIV/AIDS patients was evaluated. Evaluation includes measurement of Height and weight of patients. Weight measured by using a digital scale with a maximal capacity of 160 kg and a precision of 100 g. Height was determined using a metal stadiometer with a capacity of 2 m and a precision of 1 cm. Body mass index (BMI) of all study participants were calculated using the BMI formula. Based on their BMI patients were grouped as underweight (BMI<18.5kg/m<sup>2</sup>, adequate weight (BMI ≥ 18.5-25kg/m<sup>2</sup>) and overweight (BMI>25).

### Laboratory investigation

Four ml of venous blood samples were aseptically collected using EDTA vacutainer tubes for the determination of CD4, albumin and total protein from each patient. The CD4 count was determined by flow cytometry using BD FACScalibur (Beckton Dickinson, San Jose, California). Total protein and albumin level were analyzed by using HumaStar 200 automated clinical chemistry analyzer (Human, Max-Planck-Ring 21, 65205Weisbaden, Germany). All the laboratory analyses were performed following standard operating procedures in Zewditu Memorial Hospital laboratory which is nationally accredited.

The normal value taken for albumin and total protein was higher than 3.5 g/dl and <6.4 g/dl in both sexes respectively; the cutoff point for CD4 cell count was 200 cells/mm<sup>3</sup> (lower than 200 cells/mm<sup>3</sup>). According to Ethiopian ministry of health recommendation this cutoff point is used to define AIDS in patients with HIV, together with nutritional status and the presence of opportunistic diseases)

Data quality was checked and were entered to Microsoft excel and exported to SPSS version 20 software and analyzed. Chi-square test for the association between dependent and independent variables was used. The level of significance was set to 0.05 (α=5%).

### Results

The study involved 395 HIV/AIDS patients who were having follow-up and under highly active antiretroviral therapy (HAART) in Zewditu Memorial Hospital (ZMH) were evaluated. Of the study participants 233 (59.0%) were females. The male to female ratio was 0.69:1. Majority of the study participants were in the age group of 20-39 years with 223 (56.3%) (Table 1). The mean age of the study participants were 39.1 ± 10.15 years. The mean BMI was 22.88 kg/m<sup>2</sup> (SD 4.17 kg/m<sup>2</sup>). In this study BMI and Albumin level were used as an indicator of malnutrition. The prevalence of malnutrition was different based on

Demographic characteristic		Number	Percentage
Age in years	20-39	223	56.3
	40-60	151	38.2
	>60	21	5.3
	Total	395	100.0
Sex	Male	162	41.0
	Female	233	59.0
	Total	395	100.0
Educational status	No education	48	12.1
	Primary	85	21.5
	Secondary	183	46.3
	Tertiary	79	20.0
	Total	395	100.0
Marital status	Single	106	26.8
	Married	193	48.9
	Widowed	49	12.4
	Divorced	47	11.9
	Total	395	100.0

**Table 1:** Demographic characteristic of the HIV/AIDS patients who are taking HAART at Zewditu Memorial Hospital Addis Ababa, Ethiopia in 2016.

Characteristics		Number	Percentage
CD4 counts	CD4<200 cells/mm <sup>3</sup>	59	14.9
	CD4>200 cells/mm <sup>3</sup>	336	85.1
	Total	395	
WHO AIDS stage	I	71	18.0
	II	114	28.9
	III	148	37.5
	IV	62	15.7
	Total	395	100.0
Opportunistic infection status	Yes	231	58.5
	No	164	41.5
	Total	395	100.0
Albumin level	<3.5 g/dl	5	1.3
	>3.5 g/dl	390	98.7
	Total	395	100.0
Total Protein level	<6.4 g/dl	0	0.0
	>6.4 g/dl	395	100.0
	Total	395	100.0
BMI	<18.5 kg/m <sup>2</sup>	60	15.2
	18.5-25 kg/m <sup>2</sup>	225	57
	>25 kg/m <sup>2</sup>	110	27.9
	Total	395	100.0
Year on HAART	1	128	32.4
	2	168	42.5
	3	99	25.1
	Total	395	100.0

BMI: Body Mass Index; WHO AIDS Stage: World Health Organization Acquired Immune Deficiency Syndrome Stage; OI Status: Opportunistic Infection Status; CD4: Cluster of Differentiation 4

**Table 2:** Clinical and nutritional status of HIV/AIDS patients who are taking HAART at Zewditu Memorial Hospital Addis Ababa, Ethiopia in 2016.

the method used. Based on BMI 60 (15.2%) of HIV/AIDS patients were classified as malnourished and 110 (27.9%) were overweight. While based on the Albumin level only 5 (1.3%) patients were classified as malnourished. Majority of the study participants 336 (85.1%) CD4 cell counts were >200 cells/mm<sup>3</sup>. Regarding the opportunistic infection status of 231 (58.5%) the study participants had different opportunistic infections (Table 2).

		CD4<200 cells/mm <sup>3</sup>		CD4>200 cells/mm <sup>3</sup>		Total		P-value
		n 59	% 15	n 336	% 85	395	100%	
BMI:	<18.5 kg/m <sup>2</sup>	8	2.0	52	13.2	60	15.2	0.904
	18.5-25 kg/m <sup>2</sup>	35	8.9	190	48.1	225	57.0	
	>25 kg/m <sup>2</sup>	16	4.1	94	23.8	110	27.9	
Albumin level	<3.5 g/dl	1	0.3	4	1.0	5	1.3	0.749
	>3.5 g/dl	58	14.7	332	84.1	390	98.7	
OI status :	Yes	31	7.9	200	50.6	231	58.5	0.316
	No	28	7.1	136	34.4	164	41.5	
WHO AIDS stage	I	5	1.3	66	16.7	71	18.0	0.008
	II	12	3.0	102	25.8	114	28.9	
	III	26	6.6	122	30.9	148	37.5	
	IV	16	4.1	46	11.7	62	15.7	
Total protein	<6.4 g/dl	0	0.0	0	0.0	0	0.0	0
	>6.4 g/dl	59	15	336	85	395	100	
Year on HAART	1	12	3.0	116	29.4	128	32.4	0.048
	2	33	8.4	135	34.2	168	42.6	
	3	14	3.5	85	21.5	99	25	

BMI: Body Mass Index; WHO AIDS Stage: World Health Organization Acquired Immune Deficiency Syndrome Stage; OI Status: Opportunistic Infection Status; CD4: Custer of Differentiation 4

**Table 3:** Association among CD4 cell count, albumin level, BMI, Opportunistic infection status, Year on HAART and WHO AIDS stage in patients with HIV receiving HAART and hospitalized at Zewditu Memorial Hospital Addis Ababa, Ethiopia in 2016.

The mean albumin level was 5.39 g/dl (SD 0.68 g/dl). Albumin level, BMI, Opportunistic infection status and total protein level were not significantly associated with diminished CD4 cell counts (P value>0.05). Multivariate regressions was run to predicted CD4 cell counts level from the independent variables studied in this study. Only patients WHO AIDS stage was statistically significantly predicted cell counts (P-value=0.001). Multivariate regression analysis showed the independent variables in this study showed (R<sup>2</sup>=0.34) 34% of the showed. The CD4 cell count was significantly associated with patients WHO AIDS stage (P-value=0.008) and year on HAART (P=0.048). Majority of HIV/AIDS patients with lower CD4 counts 26 (6.58%) were on WHO AIDS III stage. Regarding the 15% patients with the CD4 cell counts <200 cells/mm<sup>3</sup>, the albumin level, The BMI and total protein were normal in majority of the study participants (Table 3).

## Discussion

According to the Joint United Nations Program on HIV/AIDS (UNAIDS) report in sub-Saharan Africa six in 10 adults living with HIV are currently woman [1]. The present study was also in agreement with the UNAIDS report. In this study, among the study participants 233 (59%) of HIV/AIDS patients taking HAART were females. In contrast to the report from a study conducted in Brazil in this study majority of HIV/AIDS patients who had CD4 cell counts <200 cells/mm were females.

Many studies showed the introduction of HAART greatly improved the life expectancy and quality of life; however malnutrition is still a concern [1,6]. Despite this fact, there was no any statistically significant association between CD4 cell count and the malnutrition indicators used in this study. This might be due to the excellent adherence of patients with HAART and the effectiveness of HAART in limiting HIV disease progression. Some studies reported up to 35% increase CD4 lymphocyte counts after one month of the start of HAART [7]. HAART can also reduce the burden of opportunistic infections in HIV infected people which are responsible for the development of malnutrition [8]. Beside the good adherence and the positive effect of HAART, in this study the educational status of majority of the study participants were secondary school and above. This might help them to have better

awareness about HIV/AIDS disease. As a result they can improve their life style to overcome the disease progression.

In the present study the mean BMI was differed from that reported by Ana Célia Oliveira dos Santos, who found a mean BMI of 19.64kg/m<sup>2</sup> (SD 4.6kg/m<sup>2</sup>) in patients receiving HAART in Brazil [1]. The prevalence of excess weight (overweight or obesity) was higher than the prevalence of malnutrition. This finding was in agreement with Tyler Tate et al report [11].

In this study the prevalence of malnutrition using BMI as a predictor of malnutrition was 60 (15.2%) which was lower than previous studies [1,12]. This can be justified that all HIV/AIDS patients were adhered to their HAART treatment and they all are usually assessed for any opportunistic infections and get treated with respective drugs. Another possible reason is due to the consultation service given by the nutritional department. Governmental and non-governmental organizations provide aid for HIV infected people which might help them to take care of their nutritional and other life styles. This all might be the reason why majority of the study participants BMI is in normal range. The time of diagnosis and early start of HAART might also play a role in maintaining their BMI in normal range.

In the present study the prevalence of malnutrition was higher in females (8.1%) than males (7.1%). This finding was agreed with a report from Brazil in 2009, the prevalence of malnutrition among patients using HAART was only 6.4% among men and 12.7% among women.

The mean serum albumin level in this study was higher than previous studies [1,13]. Similarly in the present study majority (98.7%) of the investigated samples had serum albumin level in normal range.

## Conclusion

In this study although there was no statistically significant association between nutritional status and CD4 cell counts, malnutrition is continued as a problem in HIV/AIDS patients taking HAART. So regular follow-up of HAART taking HIV/AIDS patients is necessary. Mainly frequent nutritional and opportunistic infections assessment is required.

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This study was fully funded by the **Addis Ababa** University.

## Availability of Data and Materials

The authors confirm that all data underlying the findings are fully available without restriction. All relevant data are within the manuscript.

## Authors' Contributions

DG\* and NY involved in proposal writing, designed the study and participated in all implementation stages of the project. DG\* and DG also analyzed the data and finalized the write up of the manuscript. DG\* and DG were responsible for critically revising the proposal and the manuscript. NY was responsible for data collection and drafting of manuscript. All authors reviewed and approved the final manuscript.

## Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Ethical Review Committee of Zewditu Memorial Hospital. Patient willingness was asked using consent form.

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