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Body Composition and CD4 Cell Count of HIV Sero-Positive Adults Attending Out-Patient Clinic in Chulaimbo Sub-District Hospital, Kenya

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Abstract: In both adults and children, weight loss is one of the major complications of HIV infection and constitutes a factor of bad prognosis. The aim of this study was to assess the prognosis value of Body Mass Index and CD4 cell count among HIV sero-positive adults attending Academic Model for Prevention and Treatment of HIV/AIDS (AMPATH) outpatient clinic, to improve the nutritional management of HIV-infected patients. A prospective cohort study of 497 patients infected with human immunodeficiency virus in Chulaimbo hospital, Kenya assessed the nutritional status. Evaluation of nutritional status was done using anthropometry and immune integrity by use of CD4 cell count. Among the 497 patients recruited the Male: Female sex ratio was 1:4 and mean age: 39.0±10.5 years). The men were leaner (BMI = 20.5kg/m^2 in men) than the women (BMI = 21.7kg/m^2) and patients with a CD4+ T cell count < 200 cells/mm^3(category three) tended to have the lowest mean values for all anthropometric measurements. 79.7% had normal nutritional status with a mean CD4 cell count of 431 cells/mm^3. Malnutrition was observed among patients in all the three categories (mild, 20.8%, moderate, 43.6% and severe, 35.6%). Determining the BMI in HIV sero-positive adults could constitute an objective and quick method for assessing the prognosis of malnutrition. Given its high frequency, malnutrition should be prevented, detected, monitored and treated from the early stages of HIV infection among patients attending AIDS clinics in order to improve survival and quality of life. Insights were gained about relative value of using various measurements to assess nutritional status of HIV-infected populations.

Key words: Human immunodeficiency virus, malnutrition, BMI, CD4, nutritional assessment

INTRODUCTION

Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS) represents a major cause of morbidity and mortality worldwide and has been described since the outset of the AIDS pandemic (Serwadda *et al.*, 1985; Guenter *et al*., 1993). The CD4 lymphocytes are the key cells in the collaboration of events in forming immune responses to foreign agents, as well as being the primary target cells for HIV. The progressive loss of these cells eventually results in the loss of the ability to mount a desirable immune response to pathogens, so resulting in the death of those patients in the terminal stage of HIV infection or Acquired Immune Deficiency Syndrome (AIDS) (Pattanapanyasat and Thakar, 2005; Ncayiyana, 2007). Nutritional status has been associated with immune status and function, including cytokine levels, as well as with the risk of opportunistic infections, all of which tend to lead to a more rapid HIV disease progression (Wafaie *et al*., 2001; Ncayiyana, 2007). Studies of the nutritional status of HIV infected patients have shown a substantial weight loss during the course of HIV infection (Castetbon *et al*., 1997; Sharpstone *et al*., 1999; Malvy *et al*., 2001). According to Malvy weight loss plays a predictive role in HIV disease progression to AIDS, independently of powerful indicators, such as low CD4 cell count (Malvy *et al*., 2001). HIV related malnutrition has several causes (Macallan *et al*., 1995), including but not limited to a decrease in food intake, the effects of Opportunistic Infections (OI), metabolic inefficiencies due to cytokine activity and diarrhoea. Malnutrition itself can induce immunodepression (Chandra, 1983) and worsen HIV-related immunodepression (Raiten, 1991). Despite its importance for daily patient management, the prevalence and characteristics of malnutrition among HIV infected patients has mostly been investigated among inpatients (O'Sullivan *et al*., 1985; Ysseldyke, 1991). Nutritional compromise in HIV infection is associated with increased morbidity and mortality, even with moderate malnutrition (Chlebowski *et al*., 1989). Survival is closely related to amount of lean body mass. Malnutrition, defined as BMI<18.5 kg/m^2, is especially likely in settings where poverty and poor access to care prevail. Without prompt attention, malnutrition can worsen disease progression and prognosis through mechanisms that include but are not limited to higher metabolic rate, malabsorption, impaired food intake and metabolic aberrations (Joint United National

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Programme, 2002; Chlebowski *et al*., 1989). Routine nutrition screening can facilitate prompt treatment and dietary interventions, which in turn can reduce the frequency and duration of opportunistic infections as well as prevent weight loss (Guenter *et al*., 1993). Research observations suggest that unintentional weight loss can progress even when nutrition interventions are provided. However, nutrition interventions early in the disease course or before the development of opportunistic infections can prevent unintentional weight loss successfully (Guenter *et al*., 1993). Such timely nutrition inventions can only be feasible if free-living People Living with HIV and AIDS (PLWHA) are routinely screened for malnutrition. Unfortunately, this important care component is not readily available to all PLWHA. Routine nutrition screening in PLWHA is particularly important in Kenya because of the large number of PLWHA. In Kenya, the national HIV prevalence is estimated at 7.4% (Kenya Bureau of Statistics, 2010). There is little information on the nutritional status of PLWHA, despite the critical role of nutrition in disease progression. Healthy eating guides for PLWHA and nutrition and HIV/AIDS guidelines for providers caring for PLWHA have been developed to address some of these challenges; their utilization and impact, however, remain unknown (Tang *et al*., 2002). To some extent the utilization of these aids can be facilitated by the awareness of PLWHA of their nutrition risk. This requires access to dietary and nutrition screening tools, particularly those tools with indicators that can be easily understood and used by most people, including PLWHA themselves. Among such indicators, unintentional weight loss is a strong predictor of disease progression and mortality in PLWHA (Suttmann *et al*., 1995). The frequency and overt nature of unintentional weight loss in HIV positive adults lend it amenable for use in nutrition screening tools and as the focus of preventive nutrition education and interventions. The importance of routinely screening PLWHA with tools with such indicators cannot be overemphasized. To examine some of these gaps, data were collected from HIV sero-positive adults. With the general aim of improving the management of HIV sero-positive patients, we assessed the nutritional status of HIV-sero-positive outpatients attending AMPATH clinic in Chulaimbo Sub-district hospital, Kenya. Results of this study will inform health workers on the relative value of using various measurements to assess nutritional status of HIV-infected populations.

MATERIALS AND METHODS

Study site and population: This study was carried out in Kisumu West District is in Nyanza Province. Chulaimbo Sub-district hospital is located along Kisumu-Busia Road about 17 km from Kisumu town. This prospective study was performed in the AMPATH clinic at Chulaimbo Sub-district hospital in Western Kenya. The clinic has an outpatient department and social work department. The study population was selected among HIV sero-positive patients attending the outpatient clinic from February 2010 to July 2010, who gave informed written consent. Patients requiring hospitalization were excluded. The inclusion criteria was male and female patients between 18 and 60 years of age that were HIV sero-positive, willing to sign the statement of informed consent and had been enrolled in the AMPATH clinic as outpatients for the last six (6) months preceding the study. The study was approved by the Institutional Review Ethics Committee of School of Medicine, Moi University, (FAN: IREC 000470).

Data collection: The study was performed two days a week. Each patient was recruited once, on his or her first visit during the study period. Validated interview schedule were used to determine the socio-demographic profile. The patients were first sensitized on the objectives and importance of the study during the health talks in the morning before the clinic sessions started. The researcher with the help of the psychosocial worker gave a nutrition/health introductory talk. The patients included in the study had their files and clinic cards tagged with labeled green stickers. This was done to be able to identify the patients on every visit to the clinic for the period of the study. Physicians on duty in the outpatient department on these selected days attended to the patients after the interviews and gave them a return date of one month. This study used the CD4 cell count to classify the patients into three categories; <200 cells/mm^3 was severe, 200-499 cells/mm^3 as moderate and >500 cells/mm^3 as mild. Severe immunosuppression was considered as 3, moderate as 2 and mild as 1.

A calibrated scale was used to obtain height and weight with patients in light clothing and without shoes, to 0.5 cm and 0.5 kg, respectively. Height (H) was measured with the patient standing erect and Weight (W) measured on a standing scale. These measurements were used to calculate the Body Mass Index (BMI) using the formula kilograms/height in meters^2. CD4 cell count was used to assess the disease progression. These BMI indices were categorized using the WHO (World Health Organization), 2005 reference standards to classify the patients into their nutritional status. Patients were categorized into four classes according to the Body Mass Index (BMI), calculated by reference to the weight (kg) and height (m^2), as follows:

(1) <18.5 (underweight)
(2) 18.5-24.9 (normal range)
(3) 25.0-29.0 (overweight)
(4) >30 (obese)

Administration of data collection instruments: Socio-demographic details such as age, gender and residential area were obtained from each patient using a standardized interview schedule. Information concerning financial and employment status, level of education, marital status, monthly income and number of persons living in the house were obtained and recorded. The interview schedule elicited demographic information in either English or Kiswahili. When necessary, translation of the interview schedule into local dialects was provided by the research assistants. The socio-demographic interview schedule was completed only at the first visit. There was follow up on the patient's economic characteristics for five months. Laboratory analysis was done at the AMPATH laboratory in Eldoret. This was done with the assistance of qualified laboratory technicians. The blood samples were collected at Chulaimbo Sub-district hospital laboratory and stored appropriately then transported to Eldoret for analysis. Documented laboratory results were recorded for the CD4 cell count of each patient.

Data analysis: Data were entered in Microsoft excel 2007 then imported to SPSS version 15.0 and the alpha level (") was set at 0.05. Data was analyzed quantitatively using descriptive and inferential statistics. Independent sample t-test was used to establish if there was any significant difference in the means of BMI between the male and female patients.

RESULTS

The demographic characteristics of patients who participated in the study are shown in Table 1. A total of 497 patients were recruited (mean age: 39±10.5 years, M: F sex ratio: 1.4). Majority of the patient were in the age bracket 31-40 years. There were statistically significant differences in age and HIV status as shown in Table 2. There was high percentage of widowed patients (42.8%) and majority had attained primary level of education (64.8%). Patients were categorized into three groups according to their CD4 cell count. Majority of the patients had a BMI of 18.5 kg/m^2 and above. As illustrated in Fig. 1, majority of the patients in the moderate and severe category had a BMI of <18.5 kg/m^2. Those in the mild and second category had a higher percentage of patients with a BMI above 30 kg/m^2. Even though majority of the patient were not severely malnourished, malnutrition was seen in all the three categories <18.5 kg/m^2 (1st 20.8%, 2nd 43.6% and 3rd 35.6%). There were no obese (>30) patients in the 3rd category. It may be envisaged that the patients in the third category were experiencing weight loss which can be related to a decrease in body fat, with preservation of lean body mass.

Table 1: Distribution of HIV patients by factors related to food availability (n = 497)

Characteristics	Male No. (%)	Female No. (%)	Total No. (%)
Age			
18-20	1 (1.0%)	10 (2.6%)	11 (2.2%)
21-30	18 (17.1%)	85 (21.7%)	103 (20.7%)
31-40	33 (31.4%)	153 (39.0%)	186 (37.5%)
41-50	27 (25.7%)	95 (24.2%)	122 (24.5%)
51-60	26 (24.8%)	49 (12.5%)	75 (15.1%)
Total	105 (100.0%)	392 (100.0%)	497 (100.0%)
Marital status			
Single	11 (10.5%)	31 (7.9%)	42 (8.5%)
Married	51 (48.6%)	170 (43.4%)	221 (44.5%)
Widowed	39 (37.1%)	174 (44.3%)	213 (42.8%)
Separated	3 (2.8%)	12 (3.1%)	15 (3.0%)
Divorced	1 (1.0%)	5 (1.3%)	6 (1.2%)
Total	105 (100.0%)	392 (100.0%)	497 (100.0%)
Education			
No education	7 (6.7%)	25 (6.3%)	32 (6.4%)
Primary	64 (60.9%)	258 (65.8%)	322 (64.8%)
Secondary	31 (29.5%)	103 (26.3%)	134 (27.0%)
University	2 (1.9%)	6 (1.6%)	8 (1.6%)
Other (Tertiary)	1 (1.0%)	0 (0.0%)	1 (0.2%)
Total	105 (100.0%)	392 (100.0%)	497 (100.0%)

Table 2: Difference between demographic characteristics and sex

Characteristics	t for equivalence of means	df	Sig.
Age	3.245	159.146	0.001*
Marital status	-1.470	164.815	0.144
Education	1.126	128.237	0.262

*p<0.05 = significant

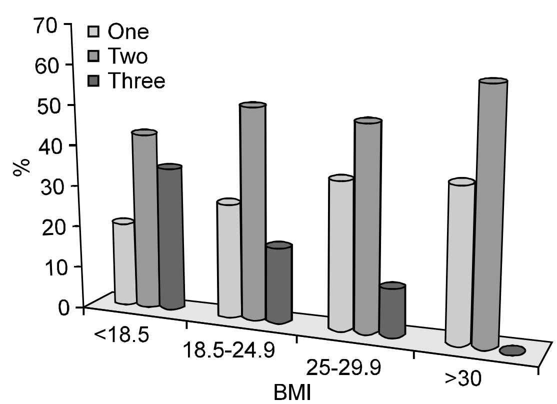

Fig. 1: BMI by mild, moderate or severe category

Results shown in Table 3 revealed that in February 20.3% had a BMI of less than 18.4, followed by 64.0% between 18.5-24.9, 13.1% between 25.0-29.0 and 2.6% above 30. In March 20.3% had a BMI of less than 18.4, 64.0% between 18.5-24.9, 13.1% between 25.0-29.0 and 2.6% above 30. In April 20.3% had a BMI of less than 18.4, 64.0% between 18.5-24.9, 13.1% between 25.0-29.0 and 2.6% above 30. In May 20.3% had a BMI of less than 18.4, 64.0% between 18.5-24.9, 13.1% between 25.0-29.0 and 2.6% above 30. In June 20.3% had a BMI of less than 18.4, 64.0% between 18.5-24.9,

Table 3: Distribution of HIV patients by BMI over six months

	BMI			
	<18.5	18.5-24.9	25.0-29.0	>30
Month	No. (%)	No. (%)	No. (%)	No. (%)
n = 497				
February	101 (20.3%)	318 (64.0%)	65 (13.1%)	13 (2.6%)
n = 495				
March	86 (17.4%)	336 (76.9%)	63 (12.7%)	10 (2.0%)
n = 493				
April	110 (22.3%)	311 (63.1%)	60 (12.2%)	12 (2.4%)
May	115 (23.3%)	307 (62.3%)	58 (11.8%)	13 (2.6%)
June	108 (21.9%)	309 (62.7%)	65 (13.2%)	11 (2.2%)
July	100 (20.3%)	312 (63.3%)	67 (13.6%)	14 (2.8%)

Table 4: Distribution of HIV patients by BMI and sex

BMI (kg/m^3)-Month	Sex	N	Mean (±SD)
BMI-February	Male	105	20.39 (±3.65)
	Female	392	22.01 (±6.27)
BMI-March	Male	105	21.02 (±3.54)
	Female	390	21.58 (±3.65)
BMI-April	Male	105	20.32 (±3.86)
	Female	388	21.42 (±3.81)
BMI-May	Male	105	20.32 (±3.86)
	Female	388	21.41 (±3.77)
BMI-June	Male	105	20.39 (±3.65)
	Female	388	22.01 (±6.27)
BMI-July	Male	105	20.60 (±3.54)
	Female	388	21.58 (±3.77)

Table 5: Mean difference between BMI and sex over six months

Month	t for equivalence of means	df	Sig.
February	-3.409	286.018	0.001*
March	-1.422	286.018	0.157
April	-2.608	162.980	0.010*
May	-2.583	164.551	0.011*
June	-1.910	165.542	0.058
July	-2.466	173.210	0.015*

*p<0.05 = significant

13.1% between 25.0-29.0 and 2.6% above 30. In July 20.3% had a BMI of less than 18.4, 64.0% between 18.5-24.9, 13.1% between 25.0-29.0 and 2.6% above 30.

This was done by finding the difference between the means of the male and female patients based on the BMI of the patients. Independent sample *t*-test was used and the results on the difference in the means are displayed in Table 4. To shows if there is any significant relationship between BMI and HIV/AIDS status, independent sample t-test was used. This t-test was based on the weight (kg) and height (m^2) measurements (BMI), Table 5. Shows that there was a significant difference on the means in the months of February (t = -3.409, df = 286.018, p = 0.001), April, (t = -2.608, df = 162.980, p = 0.010) May (t = -02.583, df = 164.551, p = 0.011) and July (t = -2.466, df = 173.210, p = 0.015). There was no significant difference in March (t = -1.422, df = 286.018, p = 0.157) and June (t = -1.910, df = 165.542, p = 0.058).

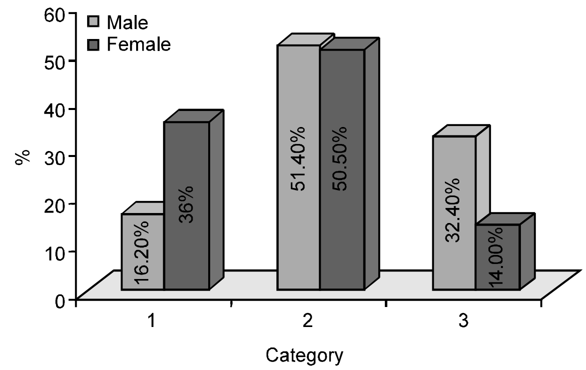

Fig. 2: CD4 cell count by category

Using the BMI, the body composition was assessed for six months and the results displayed in Table 5. The table shows the means of both female and male patients from February to July. There was a significant difference in the means in the months of February (20.387 male and 22.011 female), April (20.315 male and 21.419 female), May (20.341 male and 21.414 female) and July (20.602 male and 21.577 female) between the male and female patients (Table 5).

Having considered the WHO staging in the study, the researcher re-categorized the immune integrity of HIV patients into three independent groups based on CD4 cell count (<200 mm^3, was severe, 200-499 mm^3 as moderate and >500 mm^3 as mild). There were 156 (31.3%) in the mild category, 252 (50.7%) in the moderate and 89 (17.9%) in the severe category. Of these 17 (16.2%) male and 139 (35.5% female were in the mild category, 54 (51.4%) male and 198 (50.5%) female in the moderate and 34 (32.4%) male and 55 (14.0%) female in the severe. There were a higher percentage of males in the severe category where majority of the patients had their CD4 cell count below <200 mm^3, as illustrated in Fig. 2. This indicated severe immunosuppression and this may be attributed to the male patients seeking medication when the HIV infection has progressed and also due to stigma. It may be envisaged that the rate of disclosure among the female is higher than the male. Early diagnosis helps in starting treatment on time thus avoiding progression to AIDS.

DISCUSSION

CD4 cell count is the most used index of the level of cell mediated immunity in HIV infected patients. In this study, there were more females in stage 1 (21.9%), 2 (29.5%) and 3 (40.4%) this might be due to their tendency to seek health care early, during the disease process thus preventing them from progressing into stage 4 (3.8%). On the contrary, males have poor health seeking behaviour and many may have reported too late thereby progressing into the stage 4 (12.4%). It was observed from this study that majority of the patients (males 315 cells/mm^3 and females 463 cells/mm^3) had a compromised immune system. This is consistent with a study reported in Great Britain that majority of the patients had a mean CD4 cell count of between mean 200-500 cells/mm^3 (Ly Mee *et al*., 1997). Studies have confirmed that nutrient deficiencies are associated with immune dysfunction and accelerated progression to AIDS (Macallan, 1999; Fawzi *et al*., 2005). The male patients had a significantly lower CD4+ lymphocytes count than the female patients (p<0.001), as illustrated in Fig. 2. Relatively high CD4+ cell count among the female patients might be due to shorter duration of HIV infection. Duration of infection has been shown to be a major predictor of CD4+ lymphocyte count and disease progression among HIV infected adults (Begtrup *et al*., 1997). CD4 cell count was significantly correlated with BMI. This suggests that the observed association was related to HIV disease. Previous studies have reported that a CD4% of 10, 20, 25 and 30% corresponds broadly to a CD cell count of 100, 200, 250 and 300 cells/mm^3 respectively, for the purpose of clinical prediction (Ly Mee *et al*., 1997). However this is not true for this study which established that HIV patients CD4% ranged between 15-20%. CD4 percentage is important as the result does not vary much as the CD4 cell count. This study established that majority of the patients were within the normal range for WBC 5503.3 cell mm^3 (5749.1 males and 5564.1 females) but the ranges for platelets 265957 cell/mm^3 (256398.7 males and 268517.9 females) and CD4 cell percentage 19.3% (15.4% males and 20.4% females) was below the normal range. The platelet count may have been low in the patients in this study due to the intestinal walls damaged thus passing of mores blood stained stool.

Weight loss is very common in HIV and AIDS and has been correlated with disease progression and mortality, (Kotler *et al*., 1989; Wheeler *et al*., 1998). During weight loss in HIV and AIDS the proportion of body stores that are lost, be they protein, fat or carbohydrate depends on the underlying nutritional state and the dietary intake, (Cuff, 1990; Watson, 1994). Malnutrition is frequent and a marker for poor prognosis among HIV-infected patients (Guenter *et al*., 1993; Kotler *et al*., 1989). Weight loss strongly predicts illness or death among people with HIV and increased energy expenditure is one factor behind HIV-related weight loss. There was a significant difference in the BMI between the male and female patients (February p = 0.001, April, p = 0.010, May p = 0.011 and July p = 0.015). The female patients had a higher BMI compared to the male patients, as illustrated in Table 4. Even at moderate levels, malnutrition has been shown to have a detrimental impact on HIV outcome (Chlebowski *et al*., 1989; Suttmann *et al*., 1995). This association has been related to survival independent of the CD4 cell count (Guenter *et al.*, 1993). The mean BMI of the patients was 20.5 kg/m^2 in male and 21.7 kg/m^2 in female. This is lower compared with population norms for the United States, where mean BMI has been estimated as 25.9 kg/m^2 for adult males (Allison *et al*., 2002) and 26.3 for adult females (Zhu *et al*., 2003). The mean for the entire study population was only slightly above one known cutoff 18.5 kg/m^2 for malnutrition. This study shows that there is moderate malnutrition with 20.3% of the overall study sample being malnourished. These results confirm that malnutrition is an important issue in the management of HIV-infected patients. The changes in weight may be related to decreased food intake, increased whole-body protein turnover (Macallan *et al*., 1995) and the release of cytokines (Evans *et al*., 1989; Grunfeld and Feingold, 1992; Salehian *et al*., 1993). Severe malnutrition has long been known as an independent risk factor for infections (Kotler *et al*., 1989; Ludy *et al*., 2005), including opportunistic infections in HIV sero-positive patients (Guenter *et al*., 1993). The life expectancy of HIV-infected patients is related, among other parameters, to their nutritional status (Kotler *et al*., 1989; Graham *et al*., 1993). Increased BMI is associated with an increased CD4 cell count and with lower rates of the events that characterize the progression of HIV disease (Forrester *et al*., 2001). Weight and body composition, in relation to the CD4 cell counts, indicate that there is a significant trend towards lower weight and BMI with lower CD4 counts (Forrester *et al*., 2001). This study observed that majority of the patients in the severe category (CD4 <200 cell/mm^3) had a BMI of less than 18.5 kg/m^2. Those in the mild and moderate categories had a higher percentage of patients with a BMI above 30 kg/m^2 (38.5% mild and 61.5% moderate). There were no patients in the severe category with a BMI>30 kg/m^2 and it may be envisaged that the patients were wasted and therefore there was no chance of becoming obese or overweight. Malnutrition was associated with several risk factors: Malaria (8.7%), diarrhoea (37.8%), pneumonia (16.1%) and tuberculosis (14.9%). Although longitudinal data is not available, there is growing evidence that increased BMI is associated with an increased CD4 cell count and with lower rates of the events that characterize the progression of HIV disease (Forrester *et al*., 2001).

Conclusion: Good dietary practices are essential for maintaining a healthy lifestyle. Nutritional compromise in HIV has long been known to be associated with morbidity and mortality. 20.3% of the HIV-infected adults in this study were malnourished using the WHO BMI cut-off for underweight. The female patients had significantly higher CD4 cell count than the male patients. Most of the HIV patients were symptomatic in WHO clinical stage 3, but CD4 cell counts were lower among men with stage 3 and 4 disease. These gender differences in CD4 lymphocyte counts suggest a delay of initiation of therapy in men compared with women. If this delay unfavourably influences progression, treatment guidelines should be revised so that men can benefit equally from HAART (Highly Active Anti Retroviral Therapy). Majority were in stage 3 with a CD4 cell count of less than 500 cells/mm^3, this is an indication of immunosuppression in the patients. Nutritional status strongly influences the well being and survival of individuals living with Human Immunodeficiency Virus (HIV) infection, which compromises nutritional status in complex ways that may produce malnutrition via multiple mechanisms. The results of this study provide data on the nutritional status of HIV-sero-positive patients; particularly those living in Kisumu West District, Kenya and perhaps reflect the nutritional status of HIV sero-positive patients in the African community.

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