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Research Article

ASSESSMENT OF DIETARY PATTERN AND NUTRITIONAL STATUS OF PEOPLE LIVING WITH HIV/AIDS ATTENDING SOME VOLUNTARY AND COUNSELLING TEST (VCT) UNITS IN CROSS RIVER STATE

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Abstract

This study assessed the dietary pattern and nutritional status of People Living with HIV/AIDS (PLWHA) attending some voluntary and counseling test units in Cross River State. The studied subjects consisted of 74 adult patients infected with HIV between the ages of 18 and 60 years and 74 age-and-sexed-matched apparently healthy volunteers who were HIV negative as control group. A semi-structured questionnaire was used to collect information on the socio- economic and demographic characteristics of the subjects. Dietary diversity of the subjects and control were assessed using food frequency questionnaire. Blood serum total protein, total cholesterol, HDL and LDL cholesterol were determined spectrophotometrically while serum zinc and iron were measured using Atomic Absorption Spectrophotometer. Result obtained shows that majority of patients (39.19%) were between 26 and 33years. A sizeable percentages of patients (33.78%) and control (52.7%) were overweight (BMI ≥ 25.00kg/m2), while some patients (25.68%) and control (37.93%) were under weight (BMI < 18.49kg/m2). A significantly (P<0.05) higher total protein was observed in patients compared to

the control while significantly (P<0.05) lower levels of LDL-cholesterol and CD4 counts were recorded in HIV patients compared to the control. There was also significantly (P<0.05) lower levels of zinc and iron in HIV patients compared to the control. Good dietary diversity was observed in the HIV patients as their dietary pattern showed regular intake of energy and other food groups which may explain why more patients had good BMI contrary to the usually observed incidence of weight loss and wasting among PLWHIV. They also showed normal level of total cholesterol and HDL which implies low risk of atherosclerosis with just little proportion at risk as a result of high LDL levels. Normal zinc levels in the PLWHIV may explain the normal weight observed contrary to what is observed in HIV patients with frequent diarrhea as zinc is effective in the reduction of the incidence, severity and duration of diarrhea. The PLWHIV should be encouraged to maintain dietary diversification with adequate consumption of four or all the food groups. Also, attention should be given to other causes of death in PLWHA such as cardiovascular diseases and overweight.

Key Words: HIV/AIDS, Nutritional status, Counselling

Introduction

Acquired Immune Deficiency Syndrome, popularly known as AIDS, is caused by the virus, Human Immuno-deficiency Virus (HIV). This is a tiny germ that is invisible to the eye that attacks the immune system of the body. AIDS is a condition in which the virus damages the body immune system and renders it helpless against any infection, (Hawkes *et al*., 2002). According to the World Health Organization (2005), AIDS is the most dreaded, most feared and the most talked about disease in the world today. It is a deadly disease that has no cure. According to Ojedokun (2004), there are two main subtypes: HIV I and HIV II.

HIV I is the most common type all over the world while HIV II is only common in West Africa. The intensity and the pattern with which HIV/AIDS affects nutritional status are very much different from that in other infections and in ordinary case of inadequate nutrients intake. Due to lack of cure for HIV/AIDS, the immune system of infected patients is under constant exposure to infections which adversely affect the nutritional status and immune competence of the subjects in question. Malnutrition is a serious danger for people living with HIV/AIDS. Even at the early stages of HIV infection when no symptoms are apparent, HIV makes demands on the body's nutritional status (Walsh *et al.*, 2003), the risk of malnutrition increases significantly during the course of the infection. Good nutrition cannot cure AIDS or prevent HIV infection, but it can help to maintain and improve the nutritional status of a person with HIV/AIDS and delay the progression from HIV to AIDS-related diseases. It can therefore improve the quality of life of people living with HIV/AIDS. Nutritional care and support are important from the early stages of the infection to prevent the development of nutritional deficiencies. A healthy and balanced diet will help to maintain body weight and fitness. Eating well helps to maintain and improve the performance of the immune system, it aids the body's protection against infection and therefore helps a person to

stay healthy (Bartlett, 2003). Many of the conditions associated with HIV/AIDS affect food intake, digestion and absorption, while others influence the functions of the body (Bartlett, 2003). Many of the symptoms of these conditions (e.g. diarrhoea, weight loss, mouth and throat sores, nausea or vomiting) are manageable with appropriate nutrition. Good nutrition will complement and reinforce the effect of any medication taken.

In Cross River State, there are few data on the micronutrient status, lipid profile, prevalence of underweight and overweight among PLWHA. Hence, there is a need to study their nutritional status. Although weight loss and wasting is common in HIV infection, nutrition related problems such as obesity, diabetes, hyperlipideamia and hypertension also increasingly affect people living with HIV. A shift in causes of death from acute opportunistic infections to other causes such as cardiovascular diseases, diabetes and obesity indicates the need for a more comprehensive approach to healthy nutrition for persons infected with HIV (Walsh *et al*., 2003).

Research has also revealed that micronutrients can modify the course of viral infection and restore the functionality of the immune system (Jariwalla *et al*., 2011). Studies conducted with both single and multiple nutritional supplements have shown that micronutrients act to control HIV/AIDS by; suppression of virus multiplication and spread, restoration of cell- mediated immune responses and, slowing the rate of progression and reducing the severity of AIDS.

MATERIALS AND METHODS

Study Area

The study was conducted in the voluntary and counseling test (VCT) units of some selected Hospitals in Cross River State namely;

i. General Hospital, Calabar
ii. Bakor Medical Center, Calabar
iii. General Hospital, Akamkpa

People from different parts of Cross River come to these Hospitals for voluntary counseling and testing for HIV and positive subjects are managed and given free Anti-Retroviral drugs.

Study Design

The study was a cross-sectional, descriptive study, to assess the socio-economic and demographic status, dietary pattern, and some biochemical parameters of HIV/AIDS patients attending VCT Units in Cross River metropolis.

Study Population

A total of 74 subjects already on antiretroviral treatment were recruited for the study. The majority of patients at Voluntary Counseling and Testing (VCT) units in Cross River come from within Cross River State, with a significant number also coming from neighboring states within the North-Central part of Nigeria including Akwa Ibom, Rivers, Benue and Abia states. Majority of patients at VCT centres are adult HIV patients although children also attend the pediatric clinics. The social status of patients at VCT centre cut across all social strata with most of the adults being literate and employed in professional, skilled and manual labour.

Inclusion Criteria

For patients: All diagnosed HIV adult patients (18 – 60 years) who were on ART attending VCT units for at least three months prior to the study.

For control: Apparently healthy volunteers (18 – 60 years) who were screened and showed HIV negative at the time of the study were recruited from the Hospital and within the study area.

Exclusion Criteria

Patients below age 18 years and above 60 years were excluded from the study as nutritional deficiencies are inevitable consequences of aging.

Informed Consent

Informed consent for inclusion into this study was sought from the People Living with HIV/AIDS recruited for this study using standard protocol.

Ethical Approval

Ethical approval was obtained from the Ethical Committee of the Ministry of Health, Cross River State in accordance with the code of ethics on human experimentation drafted by the World Medical Association in 1964.

Sample Size Determination

A minimum sample size was determined using the formula: $N = Z^2pq/d^2$

Where:

N = Minimum sample size

Z = Standard deviation at 95% confidence interval = 1.96

p = Anticipated proportion/population of PLWHA = 5.1% (0.051).

q = Complementary probability = 1 – p

= 1 – 0.051= 0.949

d = Error margin/tolerance = 5% = 0.05

In Cross River state, a prevalence of 5.1% was reported in Cross River (National Agency for the control of AIDS, 2013.). Therefore, at 5.1% prevalence of HIV/AIDS, using 5% precision at 95% confident interval, the minimum sample size N for this study was calculated as 74. Therefore, 74 PLWHA were selected for the study. Similarly, 74 age- and sex - matched apparently healthy adults who tested HIV negative volunteered as controls for the study.

Sampling

The sampling method used was systematic sampling; of the equal – probability modality. This sampling interval was elucidated using the formula: K – N/n

Where:

K = sampling interval by which every Kth element/subject was selected from the sampling frame.

N = population size of patients = 850 n = sample size = 74 patients

K = 850/74 = 12

Therefore, within 12weeks of the research, every 12^{th} patient was recruited from the entire sampling frame of 850 patients to comprise the 74 patients as sample size, given the logical homogeneous composition of the population.

Sampling Techniques

A systematic random sampling technique was used to select subjects for the study from the population of people living with HIV/AIDS patients attending the VCT units

of General Hospital, Bakor Medical Center and General Hospital, Cross River State. Arrangements were made with the laboratory scientists to ensure that patient who satisfied the study inclusion criteria were selected.

Blood sample collection

Two milliliters of blood was collected from peripheral vein by venepuncture using a sterilized syringe. This procedure was carried out by the Medical Laboratory Scientists/Technicians. The blood was placed in sample EDTA and plain bottles. The sample in the plain bottles was allowed for 30-60 minutes of spontaneous blood clotting. The serum was then separated from the blood cells by centrifugation at 4000 rounds per minute (rpm) for 5 minutes at room temperature. The serum was decanted using a Pasteur pipette and the decanted serum was used for the assay.

Characteristics of study population

Data on demographic and socio-economic status of patients living with HIV/AIDS were obtained using semi-structured questionnaire.

Measurements of biochemical parameters

Serum total protein: Serum total protein levels were determined using biuret method. Biuret reagent (2.5ml) was pipetted into three test tubes labeled as blank, standard and test. Sample and standard (bovine serum albumin, 0.05ml) was pipetted each into the test and standard test tubes respectively. The contents of the three test tubes were properly mixed and incubated for 10 minutes at room temperature (25^{o}C) before measuring the absorbance of the test and standard at 540 nm against blank reagent using 1 cm light path cuvette. The total protein concentration in the sample was calculated using the formula below:

Total Protein Concentration (gm/dl) = Absorbance of Test x Standard Concentration/ Absorbance of Standard.

Serum albumin: Serum albumin levels were determined by the bromocresol green (BCG) method. Bromocresol green (BCG) reagent (2.5ml) was pipetted into three test tubes labeled as blank, standard and test. Sample and standard (0.01ml) was pipetted each into the test and standard test tubes respectively. The contents of the three test tubes were properly mixed and incubated for 10 minutes at room temperature (25°C), then the absorbance of test and standard was measured against reagent blank at 630 nm after the incubation using 1 cm light path cuvette.

The albumin concentration in the sample was calculated using the formula below:

Albumin Concentration (gm/dl) = Absorbance of Test x Standard Concentration/Absorbance of Standard

Serum Cholesterol: Cholesterol was determined using enzymatic end point method. Cholesterol reagent (1ml) was pipetted into three test tubes labeled as blank, standard and test. 0.01ml of distilled water, sample and aqueous cholesterol standard was pipetted each, into the blank, test and standard test tubes respectively. The contents of the three test tubes were properly mixed and incubated for 5 minutes at 37°C, and then the absorbance of test and standard were measured against blank at 500 nm using 1 cm light path cuvette. The

cholesterol concentration in the sample was calculated using the formula below: Cholesterol Concentration (gm/dl) = Absorbance of Test x Standard Concentration/Absorbance of Standard

Serum HDL-Cholesterol: HDL-Cholesterol was determined using CHOD-PAP method. Exactly 5ml of sample and standard were pipetted into clean centrifuge tubes; mixed and allowed to sit for 10 minutes at room temperature, then was centrifuged for 10minutes at 4000rpm. The clear supernatant was separated. Multi-sera reagent (1ml) was pipetted into three test tubes labeled as blank, standard and test. 0.01ml of distilled water, sample and standard was pipetted each into the blank, test and standard test tubes respectively. The contents of the three test tubes were properly mixed and incubated for 5 minutes at 37°C, and then the absorbance of test and standard was measured against blank at 500 nm using 1 cm light path cuvette. The HDL-cholesterol concentration in the sample was calculated using the formula below: HDL-Cholesterol Concentration (gm/dl) = Absorbance of Test x Standard Concentration/Absorbance of Standard

Serum Triglycerides: Triglycerides were determined using GPO-PAP Method. Multi-sera enzyme reagent (1ml) was pipetted into three test tubes labeled as blank, standard and test. 0.01ml of distilled water, sample and standard was pipetted each into the blank, test and standard test tubes respectively. The contents of the three test tubes were properly mixed and incubated for 5 minutes at 37°C, and then the absorbance of test and standard were measured against blank at 500 nm using 1 cm light path cuvette. The triglycerides concentration in the sample was calculated using the formula below: Triglycerides Concentration (gm/dl) = Absorbance of Test x Standard Concentration / Absorbance of Standard.

Serum LDL-Cholesterol: LDL Cholesterol was calculated using the Friedewald equation.

LDL-C = TC–HDL-C - TG/2.2 VLDL-C = TG/2.2

Serum zinc and iron: were determined using atomic absorption spectrophotometer model No. AA240FS. Exactly 250µl of sample was removed from the original sample and digested with 2ml trace metal grade concentrated HNO_3. The sample were then heated to 100°C for two hours and allowed to cool at room temperature. Once complete digestion was achieved, 300µl of 30% H_2O_2 was added to each sample followed by heat-instilling until dry. The sample was then reconstituted to 10ml with 0.5% HNO_3 in de-ionized water. The concentration of zinc/iron in samples and controls are determined from the interpolation of the absorbance on the known concentration of the standard, as ;Zinc/Iron Concentration (gm/dl) = Absorbance of Test x 17.9µmol/lStandard Concentration/Absorbance of Standard.

CD4 Count: The CD4 were counted using CYFLOW SL Green as described by Onyenekwe *et al.* (2006)

Measurements of Anthropometric Characteristics: a weighing scale and meter rule were used to elicit anthropometric characteristics. Weight and height were measured using standard techniques. BMI (kg/m2) was then calculated (Weight in

kilograms/Height in meters^2) and recorded.

Measurements of Atherogenic Index: Atherogenic index was calculatedusing the formula: = TC – HDL-CHDL-C

Assessment of Dietary Pattern: Data on the dietary patterns of the subject were obtained using Food Frequency Questionnaire (FFQ) in which the subject were presented with list of food groups and required to say how often each was eaten in broad terms. Foods chosen are usually for the specific purpose of this study and may not assess total diet. The results were analysed for frequency and percentage.

Statistical analysis: Statistical analysis was performed using (SPSS) program version 20. Results obtained were expressed as mean ± standard deviation. The results obtained from the questionnaire were subjected to descriptive statistics. The data obtained from people living with HIV and controls were compared using student's t-test. Pearson correlation was used to test the relationship between the trace elements and CD4 counts in patients. P-value of less than 0.05 ($p<0.05$) was considered as significant.

RESULTS AND DISCUSSION

This present study assessed the dietary pattern and nutritional status of People Living with HIV/AIDS (PLWHA) as well as some relevant trace elements. The result of this study showed that there was a significantly ($p<0.05$) lower BMI and weight of patients compared to the control group. The mean BMI of people living with HIV (PLWHIV) was 22.87kg/m2 and 22.87kg/m2 for the control group which indicates normal body mass (Table 1).

Table 1: Anthropometric Statistics of Patients Living with HIV/AIDS Attending VCT Units in Cross River

Parameters		Patients	Control
Height (m)	Male	1.53 ± 0.10^a	1.55 ± 0.13^a
	Female	1.50 ± 0.10^a	1.54 ± 0.12^a
	Total	1.52 ± 0.10^a	1.55 ± 0.13^a
Weight (Kg)	Male	54.22 ± 10.28^a	58.17 ± 12.83^a
	Female	49.66 ± 9.35^a	56.36 ± 10.40^b
	Total	52.43 ± 10.11^a	57.39 ± 11.80^b
BMI (Kg/m^2)	Male	23.23 ± 3.06^a	24.32 ± 2.79^a
	Female	22.32 ± 3.86^a	23.78 ± 2.83^a
	Total	22.87 ± 3.40^a	24.09 ± 2.80^b

Values are mean ± standard deviation. Values with different superscripts across the row are significantly ($P<0.05$) different.

The result is in accordance with reports from Opara *et al.*, (2007). The result of this study showed that 33.78% and 25.68% of the patients were overweight and underweight respectively. This agrees with Pasupathi, Bakthavathsalam, Saravanan and Devaraj (2008) who found the prevalence of overweight and underweight among PLWHA. Changes in body weight of PLWHA has been extensively studied and reported. Piwoz, (2004) reported that wasting (<18.50 kg/m2) was a major and disturbing sign of HIV/AIDS which was also a predictive mortality sign. Wasting can be caused by an extremely low energy intake, nutrients losses due to infection or combination of low intake and high nutrients losses. HIV/AIDS is associated with wasting UNICEF, (2012). Ojofeitimi and Fakande, (1998), achieved weight gain in PLWHA using nutritional counseling, food demonstration and soya bean milk.

Table 2: Mean Lipid Profile and Atherogenic Index of People Living with HIV/AIDS Attending VCT in Cross River

Parameters(mmol /L)		**Patients**	**Control**
Total Cholesterol	Male	4.29 ± 1.14^{a}	4.16 ± 0.31^{a}
	Female	3.80 ± 1.28^{a}	4.53 ± 0.51^{b}
	Total	4.10 ± 1.21^{a}	4.32 ± 0.44^{a}
HDL-C	Male	1.35± 0.50^{a}	1.52± 0.31^{a}
	Female	1.41± 1.93^{a}	1.53± 0.26^{a}
	Total	1.37± 1.26^{a}	1.53± 0.29^{a}
LDL-C	Male	2.15± 0.71^{a}	2.30± 0.30^{a}
	Female	1.95± 0.91^{a}	2.56± 0.30^{b}
	Total	2.07± 0.80^{a}	2.41± 0.32^{b}
Atherogenic Index	Male	1.46 ± 0.79^{a}	2.67 ± 0.12^{b}
	Female	1.61 ± 0.81^{a}	1.21 ± 0.88^{b}
	Total	1.52 ± 0.79^{a}	1.06 ± 0.67^{a}

Values are mean ± standard deviation. Values with different superscripts across the row are significantly (P<0.05) different.

This study also examined the lipid profile and the atherogenic index of PLWHA (Table 2). The results of this study showed no significant difference in the total cholesterol and HDL-C levels of patients compared to control group which indicates low risk of coronary heart diseases (CHD). The HDL-C is considered to have anti-atherogenic properties, since there is negative correlation between HDL-C and risk of cardiovascular disease. It is referred to as the ‗good' cholesterol because, HDL-C is involved in transport of cholesterol from peripheral tissues to liver and thereby reducing the amount stored in the tissue and the possibility of developing atherosclerotic plaques. (Toyin *et al*., 2008).

A significantly lower LDL-C level was observed in the patients indicating low risk of atherosclerosis. Elevated levels of a lllipo proteins except the HDL are associated with increased risk of atherosclerosis. High level of triglycerides and LDL are associated with coronary artery disease (Yakubu and Afolayan, 2009). Low density lipoprotein (LDL) transport cholesterol around to where it is needed. If cholesterol level is high, it may be deposited into the arteries. The result of this study further indicated that 36.49% of patients showed low levels of HDL-C (<1.0 mmol/L) and 2.7% showed elevated levels of LDL-C (>3.3 mmol/L) which implies that these proportion of the patients are at risk of developing coronary heart diseases. The LDL-C which is popularly known as the ―bad cholesterolll is highly atherogenic (Chia, 1991), because they are primary carriers of plasma cholesterol and builds up slowly in the walls of arteries feeding the heart and brain. As a result of this, it forms plaque that clots the arteries hereby causing atherosclerosis and increasing the risk of high blood pressure which may eventually lead to stroke (Toyin *et al.,* 2008). As coronary arteries narrow, it limits blood flow to the heart. If an area of plaque breaks open, it can result in a blood clot, which can block blood flow altogether. This has a great risk of heart attack which could lead to permanent heart damage or death if blood flow is not restored fast. Also when plaque builds up in the arteries that carry blood to the brain, the brain is deprived of oxygen and result to brain cell damage and death of cells (stroke). A stroke can cause brain damage, disability or death (Deaton *et al.*, 2011).

Also, no significant difference was observed in the atherogenic index of the patients compared to the control group with a mean value of atherogenic index of 1.52 indicating low risk (≤ 3.0) of atherosclerosis. The atherogenic index is a ratio, which can be calculated as TC/HDL, Non HDL- Cholesterol/ HDL, LDL/HDL, TG/HDL. Non HDL- Cholesterol is calculated as (TC/HDL). A total cholesterol /HDL ratio of ≤ 3 connotes a low risk, a ratio of around 4.5 an average risk and ratio of ≥ 8 a high risk of developing coronary artery disease (Chia,1991).

Mean serum protein levels in this study showed significantly higher levels in patients than in control, which may reflect presence of diseases such as chronic hepatitis, tuberculosis, or malnutrition and malabsorption (Table 3). Elevated protein level may be due to chronic infection such as tuberculosis or early stage of HIV (asymptomatic stage), while low levels may be due to malnutrition and malabsorption, liver diseases, diarrhea, severe burns, or

proteinuria. Proteins are the most abundant compounds in the serum.

Table 3: Mean Total protein and Albumin levels of People Living With HIV/AIDS attending VCT Units in Cross River

Parameters		Patient	Control
Total Protein (g/l)	Male	75.97 ± 6.63[a]	71.31 ± 6.97[b]
	Female	73.63 ± 8.54[a]	67.87 ± 8.77[b]
	Total	75.07 ± 7.46[a]	69.82 ± 7.93[b]
Albumin (g/l)	Male	40.29 ± 7.46[a]	39.57 ± 5.61[a]
	Female	38.74 ± 6.23[a]	36.00 ± 9.84[a]
	Total	39.29 ± 7.07[a]	38.03 ± 7.87[a]

Values are mean ± standard deviation. Values with different superscripts across the row are significantly (P<0.05) different.

Amino acids are the building block of proteins. In turn, proteins are the building blocks of all cells and body tissues, antibodies and clotting agents. Protein acts as transport substance for hormones, vitamins, minerals, lipids and other materials. The total serum protein represents the sum of albumin and globulins. Optimal ranges are 7.2 – 8.1 g/100ml (Kotler, 2000).The results further showed that no significant difference was observed in the albumin levels of the patients compared to control group and where patients (50%) showed low levels (<40g/l) of albumin which may suggest dehydration, liver dysfunction, or malnutrition. Low albumin levels of albumin are associated with malnutrition, liver dysfunction, and hypothyroidism (Kotler, 2000). Elevated albumin levels may be due to poor protein utilization, congenital, etc (Kotler, 2000). Albumin is synthesized by the liver using dietary protein. It's presence in the plasma creates an osmotic force that maintains fluid volume within the vascular space. Albumin is a very strong predictor of health. Optimal ranges are between 40 – 55g/l, (Kotler, 2000).

Furthermore, the study showed significantly lower levels of the mean CD4 counts of the patients compared to control groups with patients having a mean CD4 count of 598 cell/µl indicating normal CD4 count. The CD4 counts estimates the number of functioning CD4 cells in the blood. The higher the CD4 cells the stronger the immunity (or immune function). A normal CD4 count is typically around 500 to 1500 cells per cubic Millimeter of blood (ml)(WHO, 2008). The CD4 lymphocyte is the primary target of HIV infection because of the affinity of the

virus to the CD4 surface marker. Infection with HIV leads to a progressive impairments of cellular functions characterized by a gradual decline in the peripheral blood CD4 lymphocyte levels which result in an increasing susceptibility to a wide variety of opportunistic infection, viral, bacterial, protozoa and fungal infections (WHO, 2008).

Table 4: Mean CD_4 Cell Count of People Living With HIV/AIDS Attending VCT in Cross River

Parameter		**Patient**	**Control**
CD_4 Count (cell/µl)	Male	600.80 ± 178.29[a]	696.31 ± 144.75[b]
	Female	594.00 ± 183.14[a]	758.25 ± 252.90[a]
	Total	598.14 ± 178.98[a]	723.10 ± 199.70[b]

Values are mean ± standard deviation. Values with different superscripts across the row are significantly (P<0.05)

Traditionally CD4+ counts have been used as a means to determine when to start antiretroviral therapy and/or prophylactic drugs meant to prevent HIV-associated opportunistic infections. But in recent years, that role has been played down as global authorities now aim to initiate treatment or diagnosis once infected rather than waiting until the CD4 counts drops to below 500cells/ml (previous initiation threshold) (DHHS, 2013). CD4 count is still central in the classification of the stages of the disease with counts below 200cells/ml officially classified as AIDS. The CD4 count is also used to monitor an individual's response to therapy (NIH, 2015). The study showed significantly (P<0.05) lower levels of zinc in the patients compared to control groups where patients (16.22%) showed higher zinc levels above normal (>22.9µg/dl) with no incidence of zinc deficiency which may be responsible for the normal BMI (18.50 –24.99 kg/m2) observed in the patients studied contrary to frequent weight loss experienced by HIV infected patients with incidence of diarrhea. Optimal zinc level is associated with decreased incidence, severity and duration of diarrhea as the importance of zinc supplementation for treatment of diarrhea, particularly among children is relatively well established (Fischer *et al*., 2009). Also a trial in South Africa, HIV infected children were randomized to receive either oral zinc supplementation or placebo daily for six months. There were no differences in the viral load, CD4 T-cell counts, and hemoglobin concentration between the two groups; however, zinc supplementation reduced incidence of watery diarrhea (Bobat *et al.*, 2005). Zinc deficiency has been observed in acquired conditions, including malabsorption syndrome (McClain 1985), malnutrition (Keen, 1990), and chronic and acute infectious diseases such as HIV (Ripa and Ripa, 1994). Low zinc levels, either acquired or congenital are associated with immune

abnormalities, impaired healing process and increased susceptibility to infections. (Schlesinger *et al.*, 1993). Zinc depletion occurs either because it is not absorbed from the diet (excess copper or iron interference with absorption) or it is lost after absorption (Odeh, 1992). The amount of protein in the diet is a factor contributing to the efficiency of zinc absorption as zinc binds to protein. Small changes in protein digestion may produce significant changes in zinc absorption (Keen, 1990). Zinc is an essential element which is a component of various enzymes that help maintain structural integrity of proteins and regulate gene expression (King et al., 1999). It is a critical co-factor of carbonic anhydrase, alkaline phosphatase, and many other physiologically important proteins. The peptidases, kinases, and phosphorylases are most sensitive to zinc depletion. The biological function of zinc can be catalytic, structural or regulatory (King *et al*., 1999). Patients with AIDS exhibit clinical symptoms similar to those associated with zinc deficiency, including immune deficiencies, impaired taste and appetite, decreased food intake, gastrointestinal malfunction with diarrhea, alopecia, epithelial lesions and hypogonadism (King *et al*., 1999; Odeh, 1992). Tang *et al*., (1993, 1996) reported an association between excessive intakes of zinc and faster disease progression and death in HIV-1 infected men. It is well established that an excessive intake of zinc above recommended dietary allowance results in significant immune impairment of healthy adult men (Chandra, 1985). In addition, excessive intake of zinc may interfere with copper and iron utilization and affect HDL-cholesterol concentrations and monocyte function all which may contribute to HIV-1 disease progression (Fosmire, 1990, Sehlesinger et al., 1993).

Zinc is associated with suppression of cell-mediated immunity which may explain the protective effect on immunological failure. For example, Zinc deficiency has been shown to lead to decreased levels of serum thymulin, a zinc-dependent thymic hormone known to induce T cell differentiation (Prasad et al., 1988). Zinc deficiency was found to be associated with decreased T4/T8 ratio, interleukin 2 levels, and natural killer cell lytic activity (Prasad *et al*., 1988). Zinc is also required for the regeneration of new CD4 T-cell and for maintenance of T- cytolytic cells (Beck et al., 1997). Baum et al., (2010), in their report after a study with randomized controlled trial of zinc supplementation and it efficacy among HIV infected adults in USA, stated that after 18 months of zinc supplementation reduced 4-fold the risk of immunological failures. Furthermore, biochemical evidence of Zinc and Iron differences on CD4 cells has been reported in PLWHA, (Bilbis *et al*., 2010), who reported a progressive decline of serum Zinc and Iron levels in HIV subjects compared with the control. Such evidence has been provided by the present study which showed a positive correlation between zinc and iron and the CD4 counts of the patients. HIV infection has been reported to be associated with increased pro-inflammatory cytokines which was reported to lower the plasma levels of zinc and iron, (Kriton *et al*., 2001). Zinc is required for the regeneration new CD4+ cells and maintenance of T. cytolytic cells, (Beck *et al*.,1997).

The study showed significantly ($P<0.05$) lower levels of iron in the patients compared to control groups where

patients (41.89%) showed low iron levels (<60µg/dl) which may suggest inadequate consumption of iron-rich foods. Also experimental evidence had shown that serum iron may be increased or decreased depending on the stage of the disease although iron stores may decline in early asymptomatic HIV infection probably because of impaired absorption (Frii, 2001), they may however increase with progression of the disease as iron accumulates in the macrophages and other cells (Drakesmith and Prentice, 2008). The potential for the body concentration to be raised in HIV infection due to their accumulation in tissues such as liver, heart, pancreas and cells like macrophages is enormous and may result in free radical generation and accelerated catabolism of ascorbic acid (Delanghe *et al.*, 1998). Furthermore, potential availability of free iron due to abnormal physiology that may accompany iron overload can cause DNA double strand break and on cogene activation. Another dimension of consequences of iron increased levels is the fact that iron-rich environment not only renders the patients more susceptible to microbial infections like mycobacterium tuberculosis, candida albicans, salmonella and hepatitis viruses B and C, but promotes their proliferation with a significant contribution to the morbidity and mortality that accompanies HIV-1 infection. (Hulgan *et al.*, 2003). Iron is also an essential trace element present in biological systems in either ferrous (Fe2+) or Ferric (Fe3+) state. Transferrin, a β1 glycoprotein synthesized in the liver binds iron in ferric form and transports it from the storage site for utilization through a receptor mediated pathway (Boelart *et al.*,1996).

The result of this study showed that all food groups were consumed across the time intervals. Patients (28.38%) consumed bread, cereals and starch foods more on the basis of 2 – 4 times per week and least (6.76%) <1times per month which indicates adequate energy intake and may account for the normal BMI observed in the patients. The benefits of providing adequate amount of energy, protein and micronutrient for PLWHA are clear (Crum et al., 2006); however the exact amount of each type of nutrient needed is less clear. To prevent loss of weight and lean body mass, PLWHA should be encouraged to maintain adequate energy intake (Grinspoon and Mulligan, 2003). Adequate intake of macro- and micronutrients are essential to the restoration and maintenance of body cell mass and normal function including immunity (Knox et al., 2003). Few data are available on energy needs in HIV, and although no standard level of energy intake has been established for individuals with HIV infection, the Harris Benedict equation for basal energy expenditure (BEE) with an additional stress factor of 1.3 for asymptomatic patients has been used in many studies. Each patient energy need varies based on many factors, including altered metabolism, nutrient malabsorption, nutrient depletion, severity of the disease, and opportunistic infections (Shevtz *et al.*,1999).

Proportion of patients (28.38%) in this study consumed Meat, fish and poultry food groups more on the basis of 2 – 4times per month and Milk and dairy products were consumed by patients (34.85%) on the basis of 2 – 4times per month indicating adequate consumption of the food group which may be positively associated

with normal lean body mass observed in the PLWHIV. Protein is especially critical for the maintenance of body cell mass and normal function, including immunity (MaCallan *et al.*, 1995). The dietary reference intake recommends approximately 0.8 grams of protein per kilogram body weight each day for healthy adults (Trumbo et al., 2002). For asymptomatic HIV-positive individuals, this is likely to be adequate; however, for individuals infected with HIV who have wasted lean body mass, increased protein intake (up to 1.2 – 2.0g of protein per kilogram of body weight per day) may be beneficial. There is currently no evidence to support protein intake in excess of these levels for HIV-positive individuals. In a study conducted in 467 weight-stable men with HIV infection, protein intake was associated with lower lean body mass (Grinspoon and Mulligan, 2003). This suggests that protein intake may be positively associated with lean body mass in PLWHIV. Hence increased caloric and protein intake are necessary to fight the infection (Romeyn Many, 1998).

The result of this study also showed that patients (51.35%) consumed fats and oils more on the basis of ≥5times per week indicating adequate intake which may account for the normal levels (1.0 – 1.5mmol/l) of total cholesterol and HDL observed in the patients. Fat was mainly provided by red palm and vegetable oil used in frying, cooking and making of soup/sauces. There is currently no evidence that the fat requirements of PLWHIV are different from those of the general population. Although researchers are studying the potential benefits of n-3 fats in immune function, the recommendation for n-3 fats intake are currently no different than for the general population (Trumbo et al., 2002).

Food rich in micronutrients are likely to help HIV infected patients more effectively fight infection and improve overall health. Vegetables and fruits food group consumption by patients from this study showed that patients (26.39%) consumed more on the basis of 1 – 3 times per month and had least (11.11%) consumption of ≥5times per week indicating adequate intake which may be responsible for the normal CD4 counts (≥500 cells/µl) showed by good proportion of the patients (62.14%). Some studies suggest that deficiencies and /or high intake of certain micronutrients may affect the course of HIV disease (Jariwalla et al., 2010). Research has suggested that selenium deficiency may increase HIV-related mortality, excessive intake of zinc may be linked to poorer survival, increased intake of vitamin B1 (thiamin) and B2 (riboflavin) may enhance survival for those living with HIV, and other micronutrient deficiencies may exacerbate the oxidative stress that is associated with HIV infection (Jariwalla *et al*., 2011). Although the comprehensive role of micronutrients in the management of HIV is not yet well understood, the patient is likely to benefit from consuming a varied diet that is adequate in micronutrients.

CONCLUSION

The major findings of this work can be summarized as follows:

1. Age groups between 26–33years, (39.19%) were more in the studied population with more male patients (60.81%) and more students in male and female patients (24.32%).

2. Nutritional status of patients based on BMI indicated that 33.78% were overweight (BMI ≥25.00) with more males (35.56%) than female (31.04%) being overweight while 25.68% was underweight with more occurrences in females (37.93%).
3. The serum total protein levels were significantly higher ($p<0.05$) in patients while no significant ($p>0.05$) difference was observed in their albumin levels.
4. The LDL cholesterol levels were significantly ($p<0.05$) lower in patients with more occurrence in females (65.32%) than in males (57.78%). Low levels of HDL cholesterol (<1.0mmol/l) were also recorded in some males (33.33%) and females (41.38%) patients.
5. Atherogenic index of patients showed no significant ($p > 0.05$) difference to control group.
6. TheCD4 counts were significantly lower ($p < 0.05$) in patients and based on gender was also significantly lower ($p<0.05$) in males while no significant ($p > 0.05$) difference was observed in females.
7. The zinc and iron levels of the patients were significantly lower ($p<0.05$) and a significant ($p<0.01$) positive correlation was obtained when zinc and iron were correlated with their CD4 counts. Higher correlation was recorded for iron in females than in males while higher correlation for zinc in males than in females was recorded.
8. More female patients have their CD4 at normal level (≥500 cell/µl) than male patients.
9. Frequency of food consumption indicated that all food groups were consumed across the time intervals. Most patients consumed bread, cereal and starch, meat, fish and poultry, Milk and dairy products on frequency consumption of 2 – 4times/week while fat and oils, and vegetables and fruits were consumed on frequency consumption of ≥5 per week and 1 – 3times/month respectively.

The nutritional status of the HIV patients studied shows minimum incidence of underweight and overweight. Lower LDL levels were also recorded in few proportions while significantly lower levels of CD4 counts were observed in HIV patients. Normal total cholesterol and HDL level which implies low risk of atherosclerosis.

Good dietary diversity was achieved in HIV patients as their dietary pattern showed regular intake of energy and other food groups which may account for why a lot had good BMI contrary to the usually incidence of weight loss and wasting common among PLWHIV. Normal zinc and iron levels was recorded in HIV patients which may be responsible for the normal weight observed contrary to what is observed in HIV patients with frequent diarrhea as zinc is effective in the reduction of the incidence, severity and duration of diarrhea.

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