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

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MARCH, 2016

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MSC/SCIEN/21254/2012-2013

A DISSERTATION SUBMITTED TO SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF SCIENCE DEGREE IN NUTRITION

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MARCH, 2016

DECLARATION

I declare that the work in this dissertation entitled ASSESSMENT OF DIETARY PATTERN AND NUTRITIONAL STATUS OF PEOPLE LIVING WITH HIV/AIDS ATTENDING SOME VOLUNTARY AND COUNSELING TEST UNITS IN KADUNA METROPOLIS has been carried out by me in the Department of Biochemistry, AhmaduBello University, Zaria under the supervision of Prof. D. A. Ameh and Prof. K. M. Anigo. The information derived from the literature has been dully acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

Abraham EleojoAchadu	_____	_____
Name of Student	Signature	Date

CERTIFICATION

This dissertationentitled ASSESSMENT OF DIETARY PATTERN AND NUTRITIONAL STATUS OF PEOPLE LIVING WITH HIV/AIDS ATTENDING SOME VOLUNTARY AND COUNSELING TEST UNITS IN KADUNA METROPOLIS by Abraham EleojoAchadu meets the regulations governing the award of degree of Masters of Science in Nutritionin Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literacy presentation.

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DEDICATION

This work is dedicated to God Almighty and my beloved wife, Mrs Patience EneAchadu. Also to my beloved parent Barr. andMrsYahayaAchadu for their love, support and encouragement.

ACKNOWLEDGEMENTS

I hereby wish to pen down my appreciation and thanks to Almighty God for sparing my life throughout the course of my programme.

My profound gratitude goes to my Supervisors Prof. D. A. Ameh and Prof. K. M. Anigofor their time, patience, encouragements, support and guidanceduring the course of my work. Their constructive criticisms, corrections and numerous inputs that have led to the accomplishment of this work are highly appreciated.

I wish to appreciate the Head of Department, Prof. M. N. Shuaibu, the Postgraduate coordinator Dr. M. Auwal and all academic staffs for the knowledge impacted on me. I also appreciate the technical and non academic staff of the Department for their roles in the course of my research.

My appreciation goes to Dufil Prima Foods Plc, Makers of the widely consumed indomie noodles for the scholarship support given to me to run this programme.

I also appreciate the care, support, encouragement and assistance I received from my wife Mrs Patience EneAchadu, my beloved parents, Barr. and Mrs. YahayaAchadu and my brothers and sisters, my inlaws. I cherish and adore them all.

Special thanks go to my friends and classmates for their companionship, most especially Usman BelloJagwal, Kenny Statistics and host of others. Space will not permit me to mention names, but I treasure them all.

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 Kaduna metropolis.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 subjectsand 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 $\geq$ 25.00kg/m^2), while some patients (25.68%) and control (37.93%) were under weight (BMI < 18.49kg/m^2). 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 CD_4 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.

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List of Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ART	Anti Retroviral Therapy
BMI	Body Mass Index
BIA	Bioelectrical Impedance Analysis
CDC	Center for Disease Control
CHOD	Cholesterol Oxidase
CT	Computed Tomography
CVA	Cerebro-Vascular Accident
CSWs	Commercial Sex Workers
DEXA	Dual Energy XrayAbsortiometry
FANTA	Food And Nutrition Technical Assistance
FFQ	Food Frequency Questionnaire
FMOH	Federal Ministry Of Health
GOD	Glucose Oxidase
GPO	Glycerol-3-Phosphate Oxidase
HIV	Human Immuno-Deficiency Virus
HDL	High Density Lipoprotein
LDL	Low Density Lipoprotein
VCT	Voluntary And Counseling Test
MRI	Magnetic Resonance Imaging
NIH	National Institute of Health
PAP	Phenol Amino Phenazone
SSA	Sub Saharan Africa

STDs	Sexually Transmitted Diseases
PLWHA	People Living With HIV and AIDS
WHO	World Health Organization
VLDL	Very Low Density Lipoprotein
UNDP	United Nation Development Programme

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CHAPTER ONE

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 sub types: 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 (Piwoz and Preble, 2000). 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 (Piwoz and Preble, 2000).

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 (Piwoz and Preble, 2000). 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

– 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. Goodnutrition will complement and reinforce the effect of any medication taken.

In Kaduna 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.

1.1 STATEMENT OF PROBLEMS

Although weight loss and wasting remain common in HIV infection, nutrition related problems such as obesity, diabetes, hyperlipideamia and hypertension also increasingly affect people living with HIV (Piwoz and Preble, 2000). 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(Jariwalla et al., 2011).

1.2 JUSTIFICATION

There are many publications on the epidemiology of the HIV/AIDS and the factors fuelling the epidemic in Nigeria, but there is paucity of data on the nutritionalstatus of people diagnosed with HIV/AIDS.Assessment of nutrition and medical status is crucial to quality nutrition care for every person living with HIV;therefore, there is a need to carry out a

comprehensive study on the dietary pattern, biochemical parameters, anthropometric characteristics and micronutrient status for quality nutrition care for persons living with HIV in Kaduna metropolis.

1.3 AIM AND OBJECTIVES

1.3.1 Aim

To investigate the dietary pattern and nutritional status of People Living with HIV/AIDS (PLWHA) attending voluntary and counseling test (VCT) units of some Hospitals in Kaduna metropolis.

1.3.2 Specific objectives

The specific objectives of the study are:

i. To assess the socio-economicand demographic characteristics of People Living with HIV/AIDS attending voluntary and counseling test units in Kaduna metropolis.
ii. To determine the anthropometric characteristics of People Living with HIV/AIDS attending voluntary and counseling test units in Kaduna metropolis.
iii. To assess some biochemical parameters of People Living with HIV/AIDS attending voluntary and counseling test units in Kaduna metropolis.
iv. To correlate the micronutrient status with some biochemical parameters of People Living with HIV/AIDS attending voluntary and counseling test units in Kaduna metropolis.
v. To determine the dietary pattern of People Living with HIV/AIDS attending voluntary and counseling test units in Kaduna metropolis.

CHAPTER TWO

2.0LITERATURE REVIEW

2.1 HIV Prevalence

More than 33.2 million people are living with HIV throughout the world. The greatest burden of the disease is concentrated in developing countries, the least able to cope. In these regions, HIV/AIDS has deepened poverty and exacerbated food insecurity (UNAIDS & WHO 2009). HIV/AIDS and malnutrition effects are interrelated and exacerbate one another in a vicious cycle. HIV specifically affects nutritional status by increasing energy requirements, reducing food intake, and adversely affecting nutrient absorption and metabolism. Asymptomatic and symptomatic adults have energy requirements by 10% and 30% respectively to maintain body weight and physical activity (Steinhart, 2011). HIV prevalence was higher in the urban location (5.7%) than rural (3.7%) areas except in the Southeast zone of Nigeria (FMOH, 2008). The difference was more pronounced in the Southwest and Northeast. Generally, about 65% of all new adults HIV infections occur in young men and women of less than 30years old, (FMOH, 2008). The human immune-deficiency virus (HIV) targets the immune system, making an infected person susceptible to infections and neoplasm because of an impaired ability to mount an adequate immune response. Malnutrition and its' complication have been largely found to render HIV infected persons susceptible to opportunistic infection and reduce effectiveness and tolerance to medication and other therapies, (Castleman*et al*.,2004). Nutritional status is easily compromised during any type of infection. Generalized infections often result in low intake and absorption of nutrients, (Friis,2006). Inadequate nutrient intake or disturbance in the body's ability to process nutrients can result in lean body mass and wasting (Kotler,2000). Death occurs when a person's weight reaches about 60% of his/her ideal body weight regardless of the cause, (Kotler,2000).Evidence has shown that adequate nutrition for a person living HIV (PLHIV) is necessary to maintain and improve the overall health and nutritional status.

Promising developments have been seen in recent years in global efforts to address AIDS epidemic by increasing access to effective treatment and prevention programmes.

2.2 NUTRITIONAL STATUS

HIV and nutrition are interrelated and as antiretroviral drug become increasingly available in the poorest parts of the world, critical questions are emerging about how well the drugs work in people if they are short of food, and for those already receiving treatment, side effects such as body fat changes are a daily concern (Bartlett, 2003). Maintaining a good nutritional status is important to support the overall health and immune function of people living with HIV/AIDS (PLWHA). Adequate nutrition refers to intake of a diet which meets the specific nutritional needs for the specific individual for that specific period in time (Bartlett, 2003). The sole aim of adequate nutrition is to meet the growth and developmental demands of the unique, specific individuals' body (Walsh et al., 2003).

Inadequate nutrition in people with HIV infection may result from many factors including nausea, vomiting and anorexia that may prevent adequate intake of nutrients and medications; diarrheal infections that prevent absorption of nutrients and medications; Oral health conditions that interfere with chewing or tasting food like Oral Candidiasis in patients who present late; systemic illness (including HIV itself) that create a catabolic state; and psychological conditions such as depression that impair patients' ability to nourish themselves (Bartlett, 2003; Steinhart, 2011). In addition, financial constraints may limit patients' access to nutritious food (Walsh et al., 2003). Adequate nutrition helps to maintain and improve the nutritional and immunological status of a person with HIV/AIDS and delay the progression from HIV to AIDS-related diseases (Walsh et al., 2003). It can therefore improve the quality of life of PLWHA. Adequate nutrition will complement the effects of antiretroviral therapies and will help to maintain body weight and fitness, as well as improve the performance of the immune system already compromised by the infection (Walsh et al., 2003). Whereas starving people tend to lose fat first, the weight lost during HIV infection tends to be in the form of lean tissue such as muscle mass; this has been attributed to ARTs like Polymerase Inhibitors. This means

there may be changes in the makeup of the body even if the overall weight stays the same (WHO, 2005; WHO, 2008). One factor behind HIV-related weight loss is increased energy expenditure (Newell etal., 2003; Batterham, 2005). Many studies indicate that people with HIV tend to burn around 10% more calories while resting, compared to those who are uninfected (WHO, 2005; Batterham, 2005). Studies point to low energy intake combined with increased energy demands due to HIV infection and related infections as the major driving forces behind HIV-related weight loss and wasting. Based on increased resting energy expenditure (REE) observed in studies of HIV-infected adults, it is recommended that energy be increased by 10% over accepted levels for otherwise healthy people. The goal is to maintain body weight in asymptomatic HIV-infected adults. Although studies of energy expenditure have not shown an increase in total energy expenditure (TEE), this may have been the result of individuals compensating by reducing activity-related energy expenditure (AEE). Since maintaining physical activity is highly desirable for preserving quality of life and maintaining muscle tissue, it is undesirable that energy intake should only match a reduced level of AEE. The estimated energy requirement therefore allows for normal AEE levels on top of an increased level of REE. Increased energy intake of about 20% to 30% is recommended for adults during periods of symptomatic disease or opportunistic infection to maintain body weight. This takes into account the increase in REE with HIV-related infections. However, such intakes may not be achievable during periods of acute infection or illness, and it has not been proven that such high intake levels can be safely achieved during such periods. Moreover, it is recognized that physical activity may be reduced during HIV-related infections and the recommended increased intake is based on the energy needed to support weight recovery during and after HIV related illnesses. Intakes should therefore be increased to the extent possible during the recovery phase, aiming for the maximum achievable up to 30% above normal intake during the acute phase.

Current antiretroviral drug treatments control HIV infection and prevent severe wasting, as well as other AIDS – related conditions. Emaciated persons tend to regain weight once they begin

anti- retroviral therapy and stunted children experience catch-up growth (Newell etal., 2003); however the drugs do not eliminate wasting. In addition, some antiretroviral drugs have been linked to lipodystrophy, as well as lipid abnormalities by raising Low Density Lipoprotein (LDL) cholesterol, lowering High Density Lipoprotein (HDL) cholesterol and raising triglyceride levels in the blood. This may result in higher risks of heart disease, Cerebro-Vascular Accidents (CVA) and diabetes mellitus (De Wit,*et al.,* 2008). One study in Malawi found that patients with mild malnutrition (a Body Mass Index (BMI) of 17.00 - 18.49 kg/m2) were twice likely to die in the first three months of treatment; and for those with severe malnutrition (BMI less than 16.00 kg/m2), the risk was six times greater than those of healthy body weight (BMI ranging between 18.5 - 24.99 kg/m2) (WHO, 2005).

Since the beginning of the pandemic, over 30 million people have died from AIDS-related causes globally (Victoria et al., 2009). In Nigeria, an estimated 4.6% of the populations are living with HIV/AIDS (Hecht et al., 2009). Although HIV prevalence is much lower in Nigeria than in other African countries the enormous size of Nigeria's population makes this prevalence to be a large number. The HIV pandemic has also significantly compromised the food security of affected households and communities, reducing the availability of productive labor, diverting income, depleting savings and productive assets and impeding intergenerational knowledge transfer (Watkins, 2007). In some contexts, food insecurity may lead to more migratory livelihood strategies and high-risk sexual behaviors that increase the risk of HIV transmission (Hecht *et al*., 2010).

2.3 ASSESSMENT OF NUTRITIONAL STATUS

Nutritional assessment is the evaluation of an individual's health status from a nutrition perspective. Ongoing assessment of nutritional and medical status is crucial to quality nutrition care for every person living with HIV. (Whitney and Rolfes, 2007). A complete baseline nutrition assessment should be done for each patient for optimal care. Both baseline and ongoing assessment should examine changes in body composition as well as clinical and

biochemical parameters. There are four principal approaches to nutritional assessment: clinical, anthropometric, dietary and biochemical (Whitney and Rolfes, 2007).

2.3.1 Clinical Nutritional Assessment:

A complete clinical assessment provides information about the patient's medical history as well as physical parameters related to nutrition care. A comprehensive medical history includes the followings;

(a) Informationon any existing nutrition-related issues (such as hepatitis, diabetes, obesity,renal disease, cardiovascular diseases, cancers, neurological diseases, oral healthissues, and bone disorders);

(b) Family history of nutrition-related diseases; and

(c) Information about the patient's weight history and usual level of physical activity(Whitney and Rolfes, 2005).

Other key areas to be addressed in the clinical assessment include thepresence of any opportunistic infections that may affect intake or metabolism, gastrointestinalcomplications, potential food and drug interactions, the use of anycomplementary therapies, nutrition-related adverse effects from medications. (Whitney and Rolfes, 2007).

2.3.2 Anthropometric Nutritional Assessment:

Anthropometric measurements, including measures of body weight, bodymass index, and subcutaneous fat stores, can help the nutrition professional identifyand track changes in body composition. During the course of HIV treatment,the patient may experience muscle loss, subcutaneous fat loss, or fat hypertrophy,which may or may not be reflected in the patient's total body weight. Forthis reason, it is vital to assess body composition on a regular basis. The measurementof body composition may be done using a variety of techniques, such as bioelectricalimpedance analysis (BIA), computed tomography(CT) scans, dualenergyx-ray absorptiometry scans (DEXA), magnetic resonance imaging, or theuse of skin calipers. Regular assessment of body weight and body compositioncan help in the early detection and treatment

of morphologic changes, such asthe loss, accumulation, and/or altered distribution of fat as well as AIDS wastingsyndrome.

2.3.3 Dietary Nutritional Assessment:

Assessment of nutritional status based on dietary intake provides a record of an individual's eating habits and food intake and can help identify possible nutrient imbalances. Recording dietary intake can be done using various ways such as 24 hours recall, the usual intake record and food frequency questionnaire. Food models or photos and measuring devices can also help to identify the type of foods and quantities consumed.

2.3.4 Biochemical Nutritional Assessment:

Biochemical parameters offer insight into the patient's nutritional status. Indicatorsof disease progression, micronutrient status, metabolic syndrome, and comorbiditiessuch as diabetes and hyperlipidemia may be identified using biochemicalassessment (Whitney and Rolfes, 2007). Ongoing biochemical assessment can help identify lowlevels of certain micronutrients (such as zinc and selenium), which are common inHIV due to mal-absorption, alterations in metabolism, medication therapies, poordietary intake, and accelerated nutrient turnover. Biochemical assessment can alsohelp identify various types of anaemia that can occur with chronic HIV infection,including anaemia associated with inadequate nutrient intakes.Some biochemical measures may help predict outcomes of HIV infection.Research has suggested that low levels of serum albumin, vitamin A, vitaminB-12, and selenium may be associated with progression of HIV infection (Piwoz and Preble, 2000). Regularbiochemical assessment including albumin, haemoglobin, serum iron, magnesium,vitamin levels, blood lipids, renal function, and liver enzyme levels willgive the nutrition professional a more comprehensive picture of the patient's ongoingnutritional status and may help identify correctable nutritional deficiencies(Piwoz and Preble, 2000).

2.4 SOCIOECONOMIC CHARACTERISTICS

HIV/AIDS is a household name in Sub-Saharan Africa (SSA) and its toll on the general population is increasing daily. It is estimated that 1.9 million people were newly infected with

HIV in Sub-Saharan Africa (SSA) in 2007, bringing the total number of people living with HIV in SSA to 22 million, which is about 67% of the global total of 32.9 million (WHO, 2008). The HIV/AIDS epidemics in SSA vary from country to country with most countries in Southern Africa (Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia and Zimbabwe) having a HIV prevalence rate exceeding 15% (WHO, 2008). Although it is generally accepted that the prevalence rate of HIV/AIDS in Nigeria is relatively low (ranges between 3.1 and 4.6%) compared to the rest of sub- Saharan Africa (FMoH, 2008; WHO, 2008), Nigeria's large population size means a significantly high number of people are infected. In fact, HIV has been reported among a broad spectrum of the Nigerian population including healthy persons, blood donors, clients of Sexually Transmitted Diseases (STDs) clinics, tuberculosis patients, long distance truck drivers, pregnant women attending antenatal clinics, Commercial Sex Workers (CSWs) and their clients, clinically ill and healthy persons, infants and youths (FMoH, 2008; Laah, 2003; Mamman, 2003). Although HIV/AIDS is prevalent in all population groups, data from most countries suggest that it is more pronounced among those who are within the reproductive and productive age group. Data from the United States of America (USA) showed that among youths age 20 to 24 years, 64% of reported HIV infections occurred among young men and 36 per cent among young women. While among youths age 13 to 19 years, 57% of reported HIV infections occurred among women and 43% among young men (Schneider et al., 2008). In Nigeria, as it is in many sub- Saharan African countries, prevalence of HIV/AIDS is predominant in the age group 15-24 years (Salako et al., 2012). In the early years of the epidemic, prevalence rates were found to be higher among men than among women in many countries of the world where HIV/AIDS was found in the population. Giriet al., (1995) in an earlier study of the socio-demographic characteristics of HIV infection in northern Italia using data obtained from a study of 134 patients testing positive to HIV antibody, revealed that adult male appeared to have the highest HIV rates. A similar study in Kuala Lumpur based on data collected between 1987 and 1995 noted that over two third of those infected w ere males (Cheong et al., 1997). In the last one-decade, the prevalence rates of the HIV/AIDS epidemic

have been found to be higher in women than in men (Laah, 2003; Mamman, 2003; FMoH, 2008; NPC and ICF Macro, 2009).

2.4.1 Trend in HIV/AIDS prevalence in Nigeria

Since the first case of HIV/AIDS was diagnosed in Nigeria in 1986, the epidemic in the country has since extended beyond the high-risk groups to the general population. Nigeria has a rapidly growing HIV/AIDS epidemic that is characterized by a prevalence rate of 4.6% (UNAIDS and WHO, 2009) that is driven largely by heterosexual sex. Although there is a spatial variation in the HIV/AIDS prevalence in Nigeria as some parts of the country are more affected than others, there is no state or community that is not affected. Young people, especially women 20-24 years old, are increasingly vulnerable. Other affected groups include sex workers and people with tuberculosis. The prevalence of the HIV/AIDS is fuelled by low levels of male and female condom use, high rates of casual and transactional unprotected sex among young people, poverty, low literacy levels, cultural and religious factors, as well as stigma and discrimination (Mbakwen et al., 2012; NPC and ICF Macro, 2009; Inungu and Karl, 2010). Fig. 1 shows the trend in HIV/AIDS prevalence in Nigeria. The prevalence rate rose from 1.8% in 1991 to 5.8% in 2001, but between 2001 and 2005 the prevalence rate declined to 4.4% and increased to 4.6% in 2008 (FMoH, 2008; Chukwukaodinaka, 2014; NPC and ICF Macro, 2009). Despite the fact that Nigeria is one of the largest oil producing nations in the world it is ranked 158 out of 177 on the United Nations Development Program,(2007/2008) Human Poverty Index (Watkins, 2007). The ranking of Nigeria as one of the poorest in the world means that Nigeria is faced with very daunting task of fighting the HIV/AIDS epidemic (Mbakwen et al., 2012). Given the current efforts and resources the effects of the HIV/AIDS are likely to be overwhelming in the years ahead.

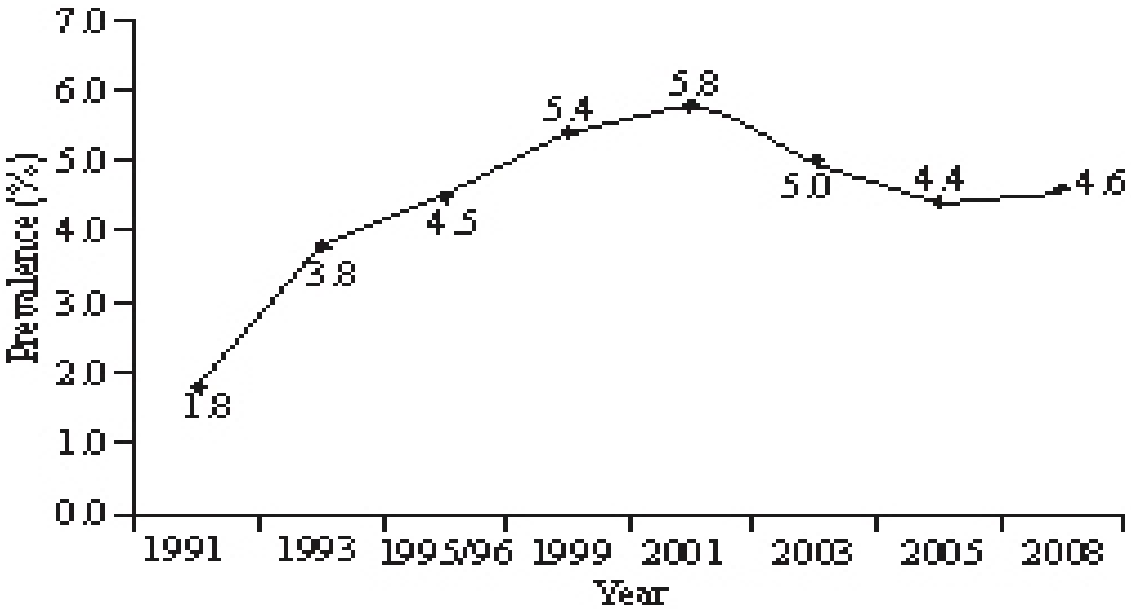


Figure 2.1: The trend in HIV/AIDS prevalence in Nigeria.

(Source: National Population Commission and ICF Macro, 2009).

2.5 HIV/AIDS AND NUTRITION

The HIV virus attacks the immune system. In the early stages of infection a person shows no visible signs of illness but later many of the signs of AIDS will become apparent, including weight loss, fever, diarrhoea and opportunistic infections (such as sore throat and tuberculosis). Good nutritional status is very important from the time a person is infected with HIV. Nutrition education at this early stage gives the person a chance to build up healthy eating habits and to take action to improve food security in the home, particularly as regards the cultivation, storage and cooking of food. Good nutrition is also vital to help maintain the health and quality of life of the person suffering from AIDS. Infection with HIV damages the immune system, which leads to other infections such as fever and diarrhoea. These infections can lower food intake because they both reduce appetite and interfere with the body's ability to absorb food. As a result, the person becomes malnourished, loses weight and is weakened, (Piwoz and Preble, 2000).One of the possible signs of the onset of clinical AIDS is a weight loss of about 6-7 kg for an average adult. When a person is already underweight, a further weight loss can have

serious effects. A healthy and balanced diet, early treatment of infection and proper nutritional recovery after infection can reduce this weight loss and reduce the impact of future infection.

A person may be receiving treatment for the opportunistic infections and also perhaps combination therapy for HIV; these treatments and medicines may influence eating and nutrition. Good nutrition will reinforce the effect of the drugs taken. When nutritional needs are not met, recovery from an illness will take longer. During this period the family will have the burden of caring for the sick person, paying for health care and absorbing the loss of earnings while the ill person is unable to work. In addition, good nutrition can help to extend the period when the person with HIV/AIDS is well and working, (FMoH, 2008; WHO, 2008).

2.6 BIOCHEMICAL PARAMETERS

2.6.1 CD4 T-cells

T-cells are a subset of white blood cells that play an important role in the body's immune system. CD4 is, by contrast, a type of glycoprotein found on the certain immune cells like T-cells, macrophages and monocytes. CD4 T-cellsare considered "helper" cells because they do not neutralize infections but rather triggers the body's response to infections. In response, CD8 T-cells classified as such because of the type of glycoprotein on their surface play a part as so-called "killer" cells by producing antiviral substances (antibodies) that help fight off foreign invaders. One of the conundrums of HIV infection is that the very cells meant to initiate an immune defense are the same ones targeted for infection by HIV. As a retrovirus, HIV needs to infect certain "host" cells in order to make copies of it. CD4 cells are the prime targets for this in the course of an infection. During infection, HIV attaches to these helper cells, emptying its genetic material within so that the host's genetic coding can be altered to produce other HIV virus. In doing so, the host CD4 cell is killed, and its ability to trigger an immune defense is gradually depleted to such a point as to leave the body open to opportunistic infections. The dynamics of an HIV are such that "killer" CD8 T-cells are increasingly left blind in an

advancing infection and eventually become unable to cope with the growing population of HIV (as measured by the viral load). If left untreated, the immune system will in all but rare cases completely collapse (or become compromised), (NIH, 2015).

A simple blood test called the CD4 count estimates the number of functioning CD4 cells in a cubic millimeter of blood. The higher the CD4 count, the stronger the immune function. In a healthy adult, a normal CD4 count can vary enormously (by population, age group, etc.) but is typically around 500 to 1500 cells per cubic millimeter of blood (ml). Traditionally, CD4 counts have been used as means by which to determine when to start antiretroviral therapy (ART) 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 on diagnosis rather than waiting until the CD4 counts drop to below 500 cells/ml, (the previous initiation threshold). With that being said, the CD4 count is still central to the staging of the disease with counts below 200 cells/ml officially classified as AIDS (or acquired immune deficiency syndrome)(NIH, 2015).

The CD4 count is also used to monitor an individual's response to therapy, with earlier initiation of ART generally correlating to more robust immune reconstitution. By contrast, people starting ART at very low CD4 counts (under 100 cells/mL) often have a more difficult time reconstituting their CD4 counts to normal levels, particularly after severe bout of illness.(May et al., 2012).

2.6.2 CHOLESTEROL

High levels of fats (including cholesterol) in the blood circulation, depending on how they are transported within lipoproteins, are strongly associated with the progression of atherosclerosis (arteriosclerotic vascular disease). Most ingested cholesterol is esterified and esterified

cholesterol is poorly absorbed. The body also compensates for any absorption of additional cholesterol by reducing cholesterol synthesis(Lecerfand De Lorgeril,2011). For these reasons, seven to ten hours after ingestion, cholesterol will show little, if any, effect on total body cholesterol content or concentrations of cholesterol in the blood. However, during the first seven hours after ingestion of cholesterol, the levels significantly increase(Dubois *et al.*,1994). Cholesterol is recycled. The liver excretes it in a non-esterified form (via bile) into the digestive tract. Typically, about 50% of the excreted cholesterol is reabsorbed by the small bowel back into the bloodstream.Animal fats are complex mixtures of triglycerides, with lesser amounts of phospholipids and cholesterol. As a consequence, all foods containing animal fat contain cholesterol to varying extents(William, 2003). Major dietary sources of cholesterol include cheese, egg yolks, beef, pork, poultry, fish, and shrimp(Jensen *et al*., 1978). Human breast milk also contains significant quantities of cholesterol(William, 2003).

2.6.3 HDL-CHOLESTEROL

HDL is the smallest of the lipoprotein particles. It is the densest because it contains the highest proportion of protein to lipids. Its most abundant apolipoproteins are apo A-I and apo A-II. (A rare genetic variant, ApoA-1 Milano, has been documented to be far more effective in both protecting against and regressing arterial disease; atherosclerosis). HDL transports cholesterol mostly to the liver or steroidogenic organs such as adrenals, ovary, and testes by both direct and indirect pathways. HDL is removed by HDL receptors such as scavenger receptor BI (SR-BI), which mediate the selective uptake of cholesterol from HDL(Gebhardt*et al*., 2008).

2.6.4 LOW-DENSITY LIPOPROTEIN

Low-density lipoprotein (LDL) is one of the five major groups of lipoproteins. These groups, from least dense to most dense, are: chylomicrons , very low-density lipoprotein (VLDL), intermediate-density lipoprotein (IDL), LDL, and High Density Lipoprotein (HDL), all of them, particles far smaller than human cells. In nutrition, LDL is sometimes referred to as "the

bad cholesterol." Lipoproteins transfer fats around the body in the extracellular fluid, can be sampled from blood and allow fats to be taken up by the cells of the body by receptor-mediated endocytosis(Dashti*et al*.,2011). Lipoproteins are complex particles composed of multiple proteins which transport all fat molecules (lipids) around the body within the water outside cells. They are typically composed of 80-100 proteins/particle (organized by a single ApoB for LDL and the larger particles). A single LDL particle is about 260-300 nm in diameter (submicroscopic) typically transporting 3,000 to 6,000 fat molecules/particle, varying in size according to the number and mix of fat molecules contained within. The fats carried include cholesterol, phospholipids, and triglycerides; amounts of each vary considerably.

LDL particles pose a risk for cardiovascular disease when they invade the endothelium and become oxidized, since the oxidized forms are more easily retained by the proteoglycans. A complex set of biochemical reactions regulate the oxidation of LDL particles, chiefly stimulated by presence of necrotic cell debris and free radicals in the endothelium. Increasing concentrations of LDL particles are strongly associated with increasing rates of accumulation of atherosclerosis within the walls of arteries over time, eventually resulting in sudden plaque ruptures and triggering clots within the artery opening, or a narrowing or closing of the opening, *i.e.* cardiovascular disease, stroke, and other vascular disease(Dashty*et al*., 2014).

2.6.5 BODY MASS INDEX

The body mass index (BMI) or Quetelet index is a value derived from the mass (weight) and height of an individual. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m^2, resulting from mass in kilograms and height in metres. The BMI may also be determined using a table or chart which displays BMI

as a function of mass and height using contour lines or colors for different BMI categories, and may use two different units of measurement(Eknoyan, 2008).The BMI is an attempt to quantify the amount of tissue mass (muscle, fat, and bone) in an individual, and then categorize that person as underweight, normal weight, overweight, or obese based on that value. However, there is some debate about where on the BMI scale the dividing lines between categories should be placed.Commonly accepted BMI ranges are underweight: under 18.5, normal weight: 18.5 to 25, overweight: 25 to 30, obese: over 30(Eknoyan, 2008).

2.7 DIETARY PATTERNS

Having proper nutrition in HIV/AIDS includes; consuming diversified or variety of foods that will provide the body with the necessary energy, protein, fats, vitamins and minerals (FMOH, 2008).

2.7.1 Food Diversity in Management of HIV/AIDS

Dietary diversity, the consumption of an adequate variety of food groups, is an aspect of dietary quality and can be considered an indicator of general nutritional adequacy (Mpontshaneet al., 2008). Low dietary diversity is associated with specific nutrient deficiencies. The main reason for promoting food diversification is that, no single food except breast milk contains all the nutrients the body needs in the right quantities and combinations (FMOH, 2008). Another study by Bukusubaet al., (2007) noted that there is very low dietary diversity in developing countries, the majority of studied households reported consuming fewer than six food groups (low quality diet)moreover their daily diet was dominated by one main staple food group mainly cereals. According to Castleman et al., (2004), maintaining adequate nutritional status means consuming a variety and adequate quantity of foods to meet energy, protein, and micronutrients needs. PLHIV should eat balanced and diverse diets consisting of starchy staples with cooked legumes, nuts and animal foods, fat and oil, fruits, and vegetables. A study by Mpontshaneet al., (2008) showed that in South Africa, diets for PLHIV were significantly less diverse than those of HIV negative individuals. However a balanced diet will ensure that the individual

consumes sufficient nutrients to maintain energy, normalize weight, and ensure the body's proper functioning. The main types of food people need to live a healthy life include energy-providing foods (i.e. carbohydrates, fats), body-building foods (i.e., proteins, minerals), and protective foods (i.e., vitamins, minerals) (Castleman*et al*., 2004).

2.7.1.1 Energy Giving Foods

This includes the carbohydrates, fats and oils that are in food groups like cereals, tubers, and plantain. Staples are good sources of energy. Staple foods should be the part of every meal and form the base and largest part of daily meals.

Cereals

Cereals are one of the staple foods in Africa and other parts of the world. Examples of cereals are maize, sorghum, millet, rice etc. Some cereals such as millet and sorghum contain some proteins and iron. However, they don't contain adequate nutrients on their own. Nutrients from staple foods may not be available to the body unless eaten in combination with other foods, (Williams *et al*., 2003).

Roots&Tubers

Tubers are known as good sources of energy. The most common tubers and roots that are consumed in Nigeria are sweet potatoes, cassava, yams, etc.

Fats/Oils and Dairy products

Fats and oils are the richest sources of energy. One gram of fat provides twice the energy of one gram of carbohydrate. Therefore people only need small amount of fats because excessive consumption of fats may predispose individuals to obesity and heart disease. Vegetable oils are obtained from corn, sunflower, cotton seed, shear butter, palm oil and margarine. Animal source fats include butter, cheese, whole milk, fatty meat and fish (including fish oil). Fat also facilitate absorption and utilization of some essential vitamins such as A, E, D and K.(Williams *et al*., 2003)

2.7.1.2 Body-Building Foods

Proteins are referred to as body-building foods. They are essential for cell growth, support the function and formation of the general structure of all tissues, including muscles, bones, teeth, skin and nails. The two main types of proteins are: plant source proteins and animal source proteins. Plant source proteins include beans and peas of different varieties, green grams, groundnuts, and soybeans, whereas animal source proteins include meat, milk (including products like cheese, yoghurt and fermented milk), fish and eggs. Williams et al. (2003) found that high protein diets are associated with increased gain of Body cell mass among HIV positive persons.

Legumes

Legumes include beans, peas, lentils, groundnuts, and soybeans. Legumes provide nutrients that are needed to develop and repair the body as well as building strong muscles. As compared to animal products, legumes provide cheaper source of protein and energy. Legumes when eaten with staple foods such as maize, millet, sorghum and rice, improve quality of the diet. Legumes are also rich in other essential nutrients including: the B vitamins, vitamin E, iron, and calcium.

Animal Products

Animal products supply good quality proteins, vitamins, minerals and extra energy. Micronutrients in animal products include iron, vitamin A, selenium and zinc that strengthen muscles and immune system. Animal products include beef, chicken, fish, eggs, offal and milk.

2.7.1.3 Protective Foods

Fruits and vegetables are known as protective foods because they provide vitamins and minerals that are important in strengthening the immune system. Vegetables and fruits are also major sources of fibre and roughage required for bowel movement and prevention of constipation.

Vegetables

Vegetables add taste, flavour and colour to our meals. Common vegetables include: spinach, ugu leaves, pumpkin leaves, cowpea leaves, carrots, cassava leaves, and green peppers. Cabbage is a vegetable that is important mainly as roughage. Vegetables contain useful immune substances called beta-carotenes. In many cases, vegetables are seasonal in availability, quality and prices. Hendricks et al., (2003) noted that HIV patients who consume high fibre foods have shown lower fat deposition in their bodies.

Fruits

A variety of fruits are grown in Nigeria. The deep yellow or orange coloured fruits are richer in vitamins, particularly beta-carotenes and vitamin A. Such fruits include avocadoes, mangoes, pawpaw, pumpkin, passion fruit, pineapple and jackfruit. Oranges, lemons and other citrus fruits are rich sources of vitamin C. Like vegetables, most fruits in Nigeria are seasonal. Fruits are known as good sources of antioxidant substances (Castleman*et al*., 2004).

2.7.2 Meal Frequency

The guideline by WHO (2005) on nutrition for PLHIV encourages people living with HIV to increase the amount and frequency of eating meals that are rich in energy, protein and plenty of fruits and vegetables. It also encourages eating of two to three snacks in addition to the main daily meals (Breakfast, lunch and Supper). By increasing meal frequency, PLHIV can meet the higher energy requirement of the body which is due to infection.

2.7.2.1 Nutrient Requirements of PLHIV

In general, PLHIV have different nutritional requirements than HIV negative person. Furthermore the nutrient requirements with in PLHIV can also be different depending on the progress of the infection. (Macallan*et al*., 1995) stated that poor dietary intake among HIV patients contributes to loss of lean mass or poor recovery among people with severe malnutrition.

2.7.2.2 Macronutrient Requirements

Energy Requirement

Energy requirements are elevated with high viral load, fever, opportunistic infection, the need for weight gain and the increased energy cost of breathing in respiratory infections (Xuereb, 2004). According to WHO (2003) recommendation, for symptomatic HIV positive adults should increase energy intake by 10% and 20-30%during the symptomatic phase over the requirement for healthy HIV positive people of the same age, sex, and physical activity level. These recommendations are also for PLHIV persons, including those taking HIV-related medications such as ARVs (Castleman*et al*., 2004).Researchers in United States found that weight gain and /or weight maintenance could be achieved among asymptomatic HIV positive individuals and among HIV positive people in the early stages of AIDS with no secondary infections, who received at least one day, high-energy, high protein, and liquid food supplementation along with nutritional counseling, (Stack *et al*.,(1996).

Protein Requirement

According to WHO (2003), data are insufficient to support an increase in protein requirements due to HIV infection. HIV-positive persons do not require more protein than the level recommended for healthy HIV negative persons of the same age, sex, and physical activity level, that is, 12% to 15% of total energy intake. However, Xuereb (2004) noted that, since energy requirements are higher, protein intake should increase proportionately with efforts to increase energy intake. On the other hand, there is the view that requirements are consistently elevated to provide substrate for immune cell replication (the acute phase response) lean body mass maintenance as well as during periods of septicaemia when protein needs are dramatically elevated to attenuate hyper catabolism of somatic protein stores. Protein deficiency is closely associated with energy deficiency: both are often deficient in HIV/AIDS. Waterlowet al. (1992) stated that establishing the amount of protein which an individual needs to maintain body composition and body function is difficult. Current evidence on macronutrient and HIV infection by WHO (2005) suggested that HIV positive individuals in a state of dietary protein depletion need greater amounts of protein. However more evident from animal and human

studies models on septic or catabolic states similar to HIV/AIDS show inadequately utilized amino acid from increased intake. (Tomkins *et al*., 1983 and Powell*et al*., 1984).

Fat Requirement

According to the WHO (2003) guidelines, there is no evidence that fat requirements are different during HIV infection. However, certain ARVs or certain infection symptoms such as diarrhoea may require changes in the timing or quantity of fat intake (Castleman et al.,2004). Despite the well documented evidence on fat mal-absorption in HIV/AIDS, Castaldoet al. (1996) suggested that it was possible to achieve nutritional rehabilitation using diets rich in fat.

2.7.2.3 Micronutrient Requirements of PLHIV

Micronutrients (Vitamins and minerals) are important in the HIV-nutrition relationship due to their critical roles in cellular differentiation, enzymatic processes, immune system reactions, and other body functions, (Piwoz and Preble, 2000). Several micronutrients are required by the immune system and major organs to fight infectious pathogens. Persons with inadequate intake of micronutrients have difficulty in resisting infection. As a result, the role of micronutrients in HIV/AIDS takes on special importance in individuals and populations with marginal or low micronutrient intakes (Friis*et al*., 2001). Although micronutrients requirements are likely to be reduced when the HIV patient is put on ARV, micronutrient deficiencies may persist and affect absorption and efficacy of drugs.

Zinc

Zinc is known for its role in functioning of many enzymes, immune reactions, transport of vitamin A and also it acts as an antioxidant (Castleman*et al*., 2004). Meat, fish, poultry, shell fish, whole grain cereals, legumes, vegetables and pumpkin seeds are the main sources of zinc (Castleman*et al*., 2004). In populations where there is a mild and marginal zinc deficiency, problems like depressed immunity, damage to epithelial lining of the intestine and respiratory tract are common.Zinc may have indirect effect on controlling of weight loss and wasting where as zinc inhibits tumor necrosis factor (TNF), a cytokine that is important in triggering the process of wasting in HIV infection, (Baum*et al*., 2000).

Iron

Iron has a vital role for all cells in generating energy. Iron is required by the body to produce new cells, amino acids, and hormones, as antioxidant and it is transported throughout the body to be used as needed. Iron is found in muscle, in blood, and in many enzymes required for metabolism,(Piwoz and Preble, 2000). Dietary sources of iron include red meat, poultry, shellfish, egg, peanut, groundnuts, deep green leafy vegetables, lentils, beans, cereals (Castleman et al., 2004). Iron deficiency occurs mainly when the iron stores are depleted and the dietary intake of the patient can not compensate for these requirements.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

3.1.1 Study Area

The study was conducted in the voluntary and counseling test (VCT) unitsof some selected Hospitalsin Kaduna metropolis namely;

i. BarauDikko Specialist Hospital, Kaduna,
ii. General Hospital, Kawo Kaduna,
iii. General Hospital, Sabo Tasha, Kaduna,

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

3.1.2 Study Design

The study wasa 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 Kaduna metropolis.

3.1.3 Study Population

A total of 74 subjects already on antiretroviral treatmentwere recruited for the study. The majority of patients at Voluntary Counseling and Testing (VCT) units in Kaduna come from within Kaduna state, with a significant number also coming from neighboring states within the North-Central part of Nigeria including Jos, Abuja, Kano, and Nassarawa 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.

3.1.4 Inclusion Criteria

I. **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.

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

3.1.5Exclusion Criteria

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

3.1.6 Informed Consent

Informed consent for inclusion into this study wassoughed from the People Living with HIV/AIDSrecruited for this study using standard protocol (Appendix I).

3.1.7 Ethical Approval

Ethical approval was obtained from the Ethical Committee ofthe Ministry of Health, Kaduna State in accordance with the code of ethics on human experimentation drafted by the World Medical Association in 1964 (Appendix II& III).

3.1.8 Sample Size Determination

A minimum sample size was determined using the formula:

$$N = \frac{Z^2 pq}{d^2}$$

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 Kaduna state, a prevalence of 5.1% was reported in Kaduna (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 healthyadults who tested HIV negative volunteered as controls for the study.

3.1.9 Sampling

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

$$K = \frac{N}{n}$$

Where:

K = sampling interval by which every K^{th} 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 recruitedfrom the entire sampling frame of 850 patients to comprise the 74 patients as sample size, given the logical homogeneous composition of the population.

3.1.10 Sampling Techniques

A systematic random sampling technique was used to select subjects for the study from the population ofpeople living with HIV/AIDS patients attending the VCT units of BarauDiko Specialist Hospital, General Hospital Kawo and Sabo, Kaduna Metropolis. Arrangements were made with the laboratory scientistswhereby patient who satisfied the study inclusion criteria were selected.

3.1.11 Chemicals

All assay kits used for the study were procured from Randox Laboratories Limited, 55 Diamond Road, Crumlin, County Antrim, BT29 4QY, United Kingdom and Biosystems S.A.

Costa Brava, 30. 08030 Barcelona, (Spain). All the chemicals and reagentsused for this study were ofanalytical grade.

3.1.12 Equipment

Hettich Universal Centrifuge (Model 80-1) was used to spin the blood specimens. Spectrophotometer (Model -SM23A Micro field) was used for the measurements of absorbance for serum total protein, albumin, total cholesterol, and HDL and LDL cholesterol determination. Atomic absorption spectrophotometer (Model- AA240FS) was used for the determination of serum zinc andiron.

2.2 METHODS

2.2.1 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.

Venepuncture

This was performed using a syringe and needle after cleaning the site with methylated spirit and allowed to dry. A tourniquet was applied a few centimeters above the antecubital fossa to distend the veins, after which blood was collected using a sterilized 5ml syringe and needle.

2.2.2 Characteristics of study population

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

2.2.3 Measurements of biochemical parameters

2.2.4 Serum total protein

Serum total protein levels were determined using biuret method as described by Reinhold (1953).

Principle

Cupric ions (Cu^{2+}) forms chelates with the peptide bonds of proteins in an alkaline medium (3% NaOH).The intensity of the violet colour formed is proportional to the number of peptide bonds which, in turn, depends upon the amount of proteins in the specimen. The absorbance of the coloured chelate is measured at 540nm.

Procedure

Biuret reagent (2.5ml) was pipetted into three test tubes labeled as blank, standard and test. Sample andstandard (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:

$$\textbf{Total Protein Concentration (gm/dl)} = \frac{\textbf{Absorbance of Test x Standard Concentration}}{\textbf{Absorbance of Standard}}$$

2.2.5 Serum albumin

Serum albumin levels were determined by the bromocresolgreen (BCG) method as described by Hill (1985).

Principle

Albumin reacts with the dye –bromocresol green which has specific affinity for it in acidic solutions to produce a coloured complex which was measured colorimetrically at 630nm. The intensity of the colour produced and absorbance is directly proportional to the concentration of albumin in the sample. The pH 4.2 was maintained during this reaction by a succinate buffer.

Procedure

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:

$$\textbf{Albumin Concentration (gm/dl)} = \frac{\textbf{Absorbance of Test x Standard Concentration}}{\textbf{Absorbance of Standard}}$$

2.2.6Serum Cholesterol

Cholesterol was determined using enzymatic endpoint method as described by Allain et al., (1974).

Principle

Cholesterol is determined after enzymatic hydrolysis and oxidation. The indicator quinoneimine is formed from hydrogen peroxide and 4-aminoanttipyrine in the presence of phenol and peroxidase.

Procedure

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:

$$\textbf{Cholesterol Concentration (gm/dl)} = \frac{\textbf{Absorbance of Test x Standard Concentration}}{\textbf{Absorbance of Standard}}$$

2.2.7 Serum HDL-Cholesterol

HDL-Cholesterol was determined using CHOD-PAP method (Allain et al., 1974).

Principle

Low density lipoproteins (LDL and VLDL) and chylomicron fraction are precipitated quantitatively by the addition of phosphotungstic acid in the presence of magnesium ions. After centrifugation, the cholesterol concentration in the HDL (high density lipoprotein) fraction, which remains in the supernatants, is determined.

Procedure

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:

$$\textbf{HDL-Cholesterol Concentration (gm/dl)} = \frac{\textbf{Absorbance of Test x Standard Concentration}}{\textbf{Absorbance of Standard}}$$

2.2.8 Serum Triglycerides

Triglycerides were determined using GPO-PAP Method (Jacobs and VanDemark, 1960).

Principle

The Triglyceridesare determined after enzymatic hydrolysis with lipase. The indicator is a quinoneimine formed from hydrogen peroxide, 4-aminophenazone and 4-chlorophenol under catalytic influence of peroxidase.

Procedure

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:

$$\textbf{Triglycerides Concentration (gm/dl)} = \frac{\textbf{Absorbance of Test x Standard Concentration}}{\textbf{Absorbance of Standard}}$$

2.2.9 Serum LDL-Cholesterol

LDL Cholesterol was calculated using the Friedewald equation (Friedewald et al., 1972).

LDL-C = TC – HDL-C - TG/2.2

VLDL-C = TG/2.2

2.2.10Serum zinc

Serum zinc was determined using atomic absorption spectrophotometer model No. AA240FS (Butrimovitz and Purdy, 1977).

Principle

The principle is based on the measurement of resonance radiant energy absorbed by unexcited radiant energy (ground state) free atoms in a sample cell. The population of the free atoms (the concentration) is directly proportional to the degree of the absorption.

Procedure

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^{o}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. After reconstituting the digested sample, the elements were analyzed using atomic absorption spectrophotometer.

2.2.11 Serum Iron

Serum iron was determined by the method of Garcic (1979).

Principle

The method is based on the formation of ternary complex: chromazurol B (CAB) – cetyl-trimethyl ammonium bromide (CTMA) – iron complex which is read in a spectrophotometer at 623nm. The concentration of iron in samples and controls are determined from the interpolation of the absorbance on the known concentration of the standard, as follows;

$$\textbf{Iron Concentration (gm/dl)} = \frac{\textbf{Absorbance of Test x 17.9µmol/lStandard Concentration}}{\textbf{Absorbance of Standard}}$$

2.2.12CD4 Count

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

2.2.13 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/m^2) was then calculated (Weight in kilograms/Height in $meters^2$) and recorded.

2.2.14 Measurements of Atherogenic Index

Atherogenic index was calculated as described by Schulpis&Karikas, (1998).

$$= \frac{\textbf{TC – HDL-C}}{\textbf{HDL-C}}$$

2.2.15 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.(Appendix III).

3.3 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 CD_4 countsin patients.P-value of less than 0.05 ($p<0.05$) was considered as significant.

CHAPTER FOUR

4.0: RESULTS

4.1: DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF PEOPLE LIVING WITH HIV/AIDSATTENDING VCT UNITS IN KADUNA METROPOLIS

The demographic and socio-economic characteristics of people living with HIV/AIDS attending VCT units in Kaduna metropolis is presented in Table 4.1. The results indicate that a great fraction of the patients (39.19%) and control (40.54%) were between 26-33 years. Patients and control groups had more males (60.81% and 56.76% respectively) than females. A large proportion of patients were single (53.70%), with 5.41% cohabiting while in the control group married people had the greatest percentage (51.35%). Secondary education was attained by 62.16% of the patients and 52.70% of control. About a quarter of both control (24.32%) and patients (28.38%) were students.

Table 4.1 Demographic and Socio-Economic Characteristics of People Living With HIV/AIDSAttending VCT Units in Kaduna Metropolis

Characteristic	Group	Patients		Control	
		Frequency (n=74)	Percentage (%)	Frequency (n=74)	Percentage (%)
Age(Years)	18-25	12	16.22	17	22.97
	26-33	29	39.19	30	40.54
	34-41	19	25.68	14	18.92
	42-49	9	12.16	10	13.51
	50-58	5	6.76	3	4.05
Sex	Male	45	60.81	42	56.76
	Female	29	39.19	32	43.24
Marital Status	Single	39	52.70	22	29.73
	Married	17	22.97	38	51.35
	Divorced	5	6.76	11	14.86
	Widow/Widower	9	12.16	3	4.05
	Cohabitation	4	5.41	0	0
Education status	Primary	12	16.22	17	22.97
	Secondary	46	62.16	39	52.70
	Tertiary	13	17.57	11	14.86
	Islamic	3	4.05	7	9.46
Occupation	Civil servant	17	22.97	14	18.92
	Trader	12	16.22	17	22.97
	Fulltime House wife	11	14.86	9	12.16
	Artisans	14	18.92	8	10.81
	Student	18	24.32	21	28.38
	Others	2	2.70	17	6.76

4.2: ANTHROPOMETRIC STATISTICS OF PEOPLE LIVING WITH HIV/AIDSATTENDING VCT UNITS IN KADUNA METROPOLIS

The anthropometric statistics of people living with HIV/AIDS attending VCT units in Kaduna metropolisis presented in table 4.2. The results reveal that there was no significant ($P>0.05$) difference in BMI, but a significant ($P<0.05$) different was observed in the weight of patients compared to the control.

The nutritional status based on BMI is also presented in Figure 4.1. The result indicate that a portion of both patients (33.78%) and control (52.7%) were overweight (BMI $\geq$ 25.00). In both patient and control groups, are males (35.56% and 59.53% respectively) more than females (31.04% and 43.75% respectively) were overweight, (BMI $\geq$ 25.00) with higher percentages recorded in control than in patient group. Also, the result showed that a portion of both patients (25.68%) and control (37.93%) were under weight (BMI < 18.49). In both patient and control groups, the females (37.93% and 12.5% respectively) more than males (17.77% and 4.76% respectively) were under weight, (BMI < 18.49) with higher percentages recorded in patients than in control group.

Table 4.2: Anthropometric Statistics of Patients Living with HIV/AIDSAttendingVCT Units in Kaduna Metropolis

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.

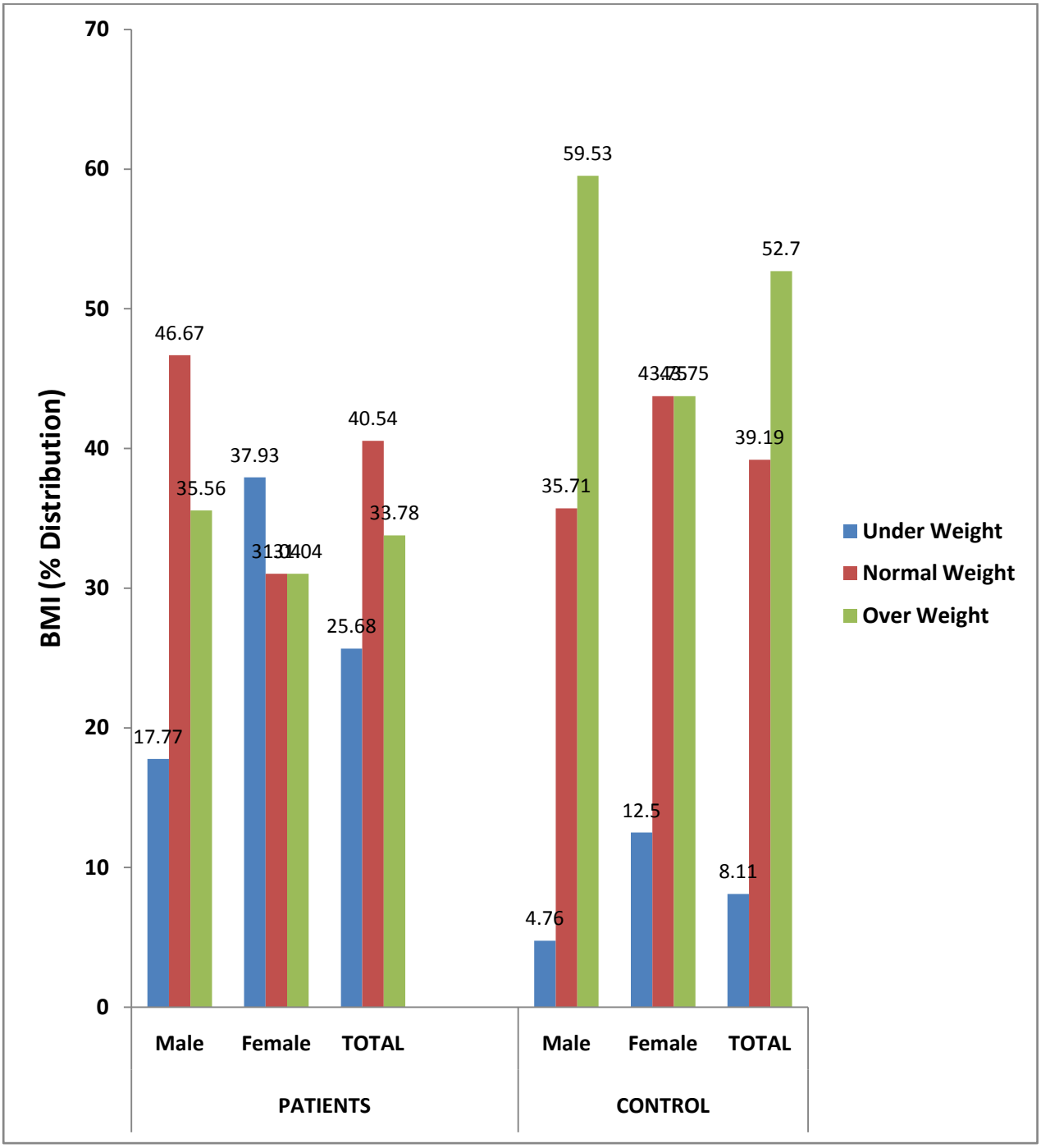


Figure 4.1: Distribution Based on Body Mass Index (BMI) of Patients Living with HIV/AIDS Attending VCT Units in Kaduna Metropolis

BMI – Underweight - < 18.5, Normal weight – 18.5 – 24.99l, Overweight >25.0

4.3: BIOCHEMICAL PARAMETERS OF PEOPLE LIVING WITH HIV/AIDS ATTENDING VCT UNITS IN KADUNA METROPOLIS

Some biochemical statistics of patients attending VCT in Kaduna metropolis is shown in Table 4.3. The results showed a significantly ($P<0.05$) higher total protein levels in patients compared to the control. No Significant ($P>0.05$) difference was observed for albumin in patients when compared to control. Analysis of albumin based on gender also showed no significant ($P>0.05$) difference in albumin of male and female patients compared to their respective controls.

The distribution based on some biochemical parameters is presented in Figure 4.2. The result indicated that patients (1.35%) and control (9.46%) showed low levels (<60g/l) of total protein. In both patients and control groups, the male (4.44% and 9.38% respectively) showed low levels (<60g/l) of total protein than in females (3.45% and 9.38% respectively) with higher percent observed in control than patients. Also, the result indicated that patients (50%) and control (48.65%) showed low levels of albumin (<40g/l). In both patients and control groups, the male (53.33% and 59.52% respectively) showed low levels of albumin (<40g/l) than in females (44.83% and 34.37% respectively) with higher percent observed in control than patients.

4.3 Mean Total protein and Albumin levels of People Living With HIV/AIDS attending VCT Units in Kaduna Metropolis

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.

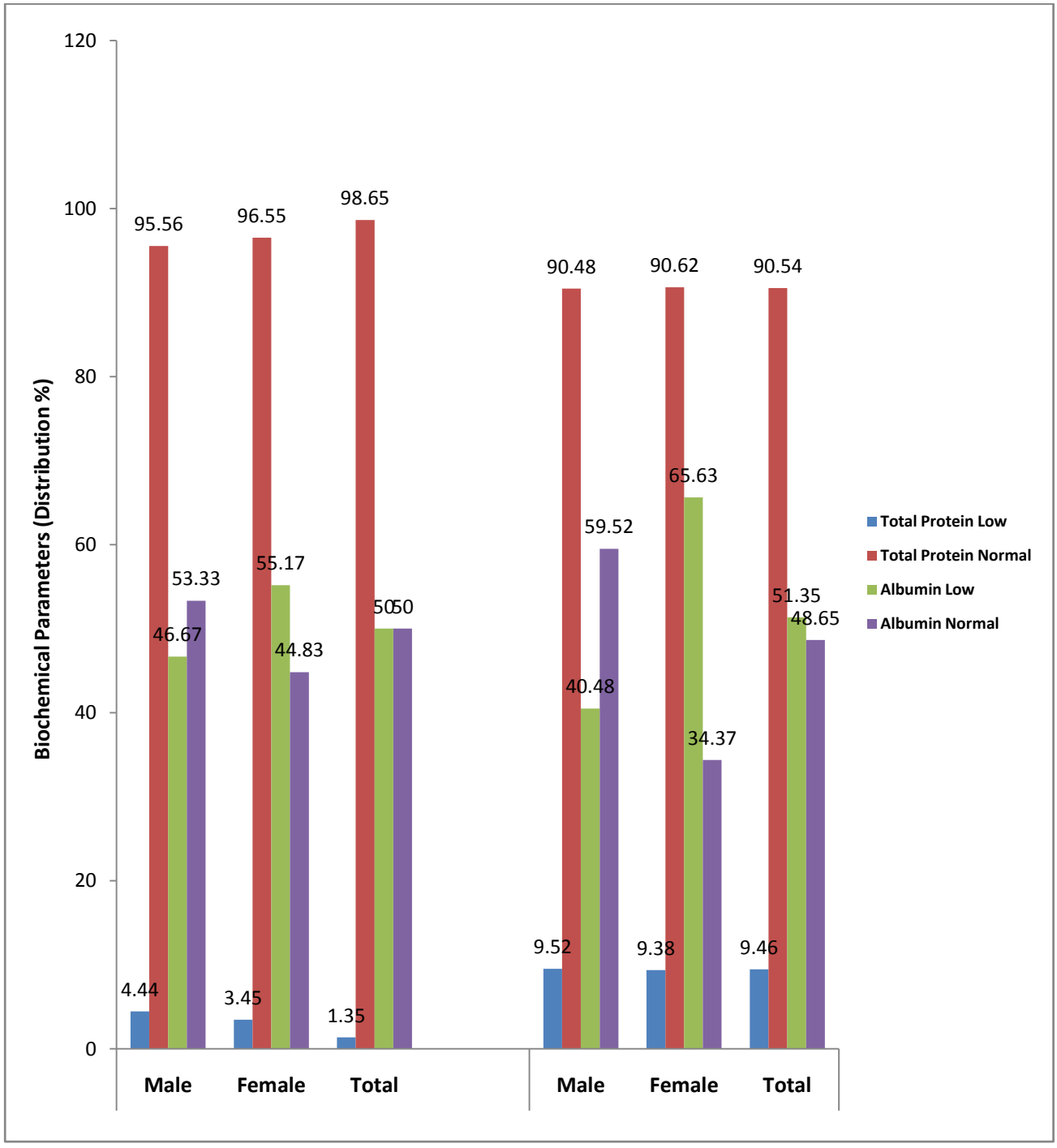


Figure 4.2: Distribution Based on Total Protein and Albumin Levels of People Living with HIV/AIDS Attending VCT Units in Kaduna Metropolis

Total Protein – Low - < 60g/l
- Normal 60 – 81g/l

Albumin – Low - < 40g/l
- Normal 40 – 50g/l

4.4 LIPID PROFLIE OF PEOPLE LIVING WITH HIV/AIDSATTENDING VCT UNITS IN KADUNA METROPOLIS

The lipid profile and atherogenic index of people living with HIV/AIDS patients attending VCT units in Kaduna metropolisis presented in Table 4.4. The results showed no significant ($P<0.05$) difference in the total cholesterol and HDL-cholesterol levels of patients compared to the control. A Significant ($P<0.05$) difference was observed in the total cholesterol when analyzed based on gender in females patients than in control group. A significant ($P<0.05$) difference was observed in LDL-cholesterol levels of patients compared to the control, and also a significant ($P<0.05$) difference was observed in LDL-cholesterol levels when analyzed based on gender in female patients than in control group. The results showed no significant ($P<0.05$) difference in the atherogenic index of patients compared to control group.

Lipid profile distribution of people living with HIV/AIDS attending VCT units in Kaduna metropolis is shown in Figure 4.3. The result indicated that patients (36.49%) and control (6.75%) showed low levels of HDL (<1.0mmol/l). In patients, the male (33.33%) showed low levels of HDL (<1.0mmol/l) than in females (41.38%) while in control group, the reverse is the case male (7.14%) and females (6.25%). Also elevated levels of LDL-cholesterol were observed in both patients (2.7%) and control (6.67%) with higher percentage recorded in control than patients group. Based on gender, patients male (2.22%) showed lower levels of LDL-cholesterol (<1.0mmol/l) than in females (3.44%), but the reverse was observed in control with male (7.14%) higher than female (6.25%).

Table 4.4: Mean Lipid Profile and Atherogenic Index of People Living with HIV/AIDS Attending VCT in Kaduna Metropolis

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.

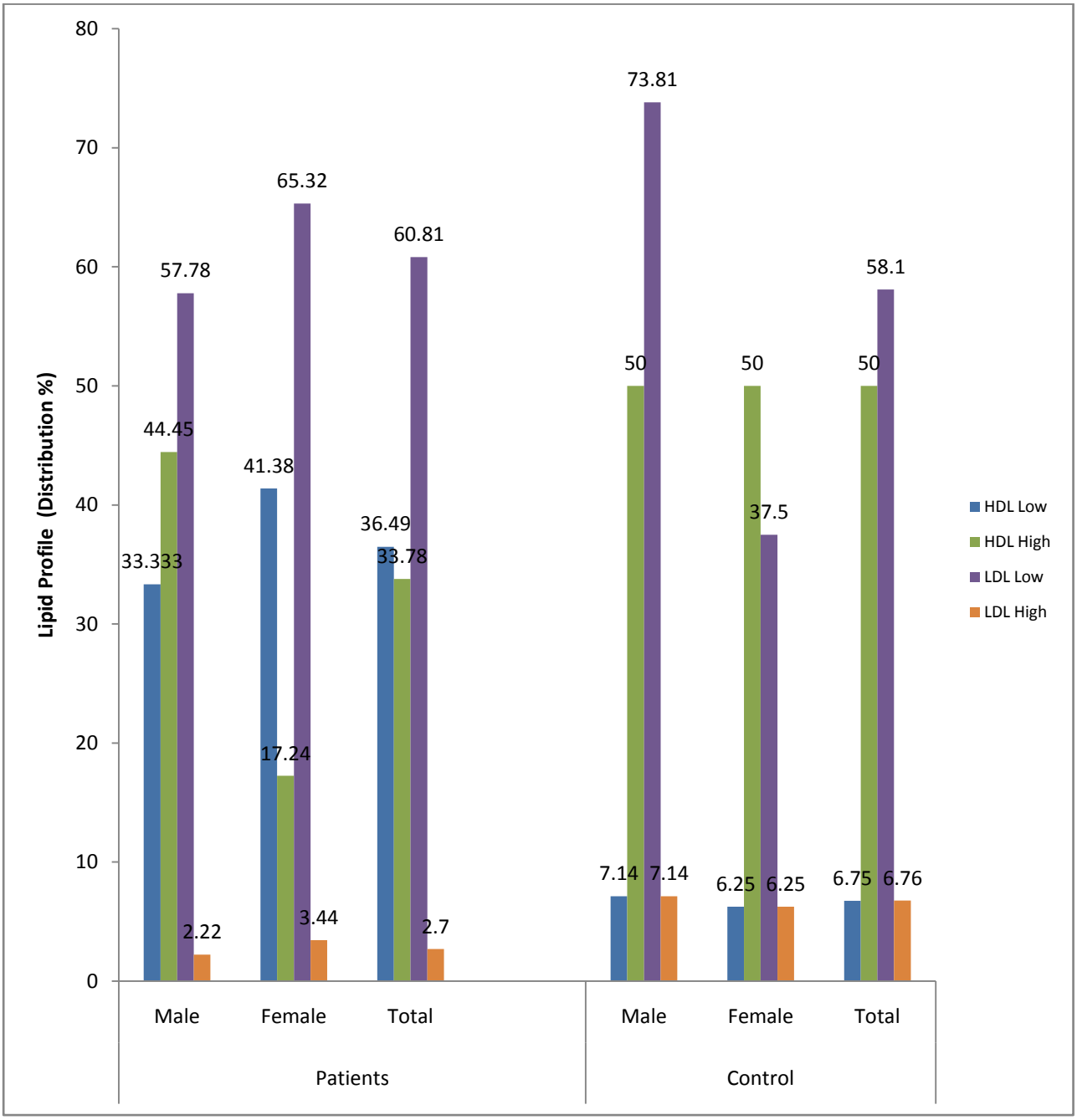


Figure 4.3: Distribution Based on Lipid Profile of People Living with HIV/AIDS Attending VCT Units in Kaduna Metropolis

HDL – Low - < 1.0 mmol/l, Normal – 1.0 – 1.5 mmol/l, High - >1.5 mmol/l
LDL – Low - < 2.6 mmol/l, Normal – 2.6 – 3.3 mmol/l, High - >3.3 mmol/l

4.5:CD_4 COUNTS OF PATIENTS LIVING WITH HIV/AIDS ATTENDING VCT UNITS IN KADUNA METROPOLIS

CD_4 count (in cells/µl) of patients living with HIV/AIDS attending VCT units in Kaduna is shown in Table 4.5. The result revealed that there was a significant ($p<0.05$) difference in the CD_4 counts of patients compared to the control. However analysis of CD_4 count based on gender revealed a significant ($P<0.05$) decrease in males but no significant ($P>0.05$) difference in females compared to their respective controls

Distribution of people living with HIV/AIDS based on CD_4 count is presented in Figure 4.4. The results showed that 37.84% of HIV infected patients and 8.11% of control have CD_4 count of <500cells/µl. Among the patients, 35.56% of males and 41.38% of females have CD_4 count <500cells/µl while in the control group 4.76% of males and 12.5% females have CD_4 count <500cells/µl, indicating more males than females have CD_4 count <500cells/µl in both patient and control groups.

Table 4.5: Mean CD_4 Cell Count of People Living With HIV/AIDS Attending VCT in Kaduna Metropolis

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 ($P<0.05$) different.

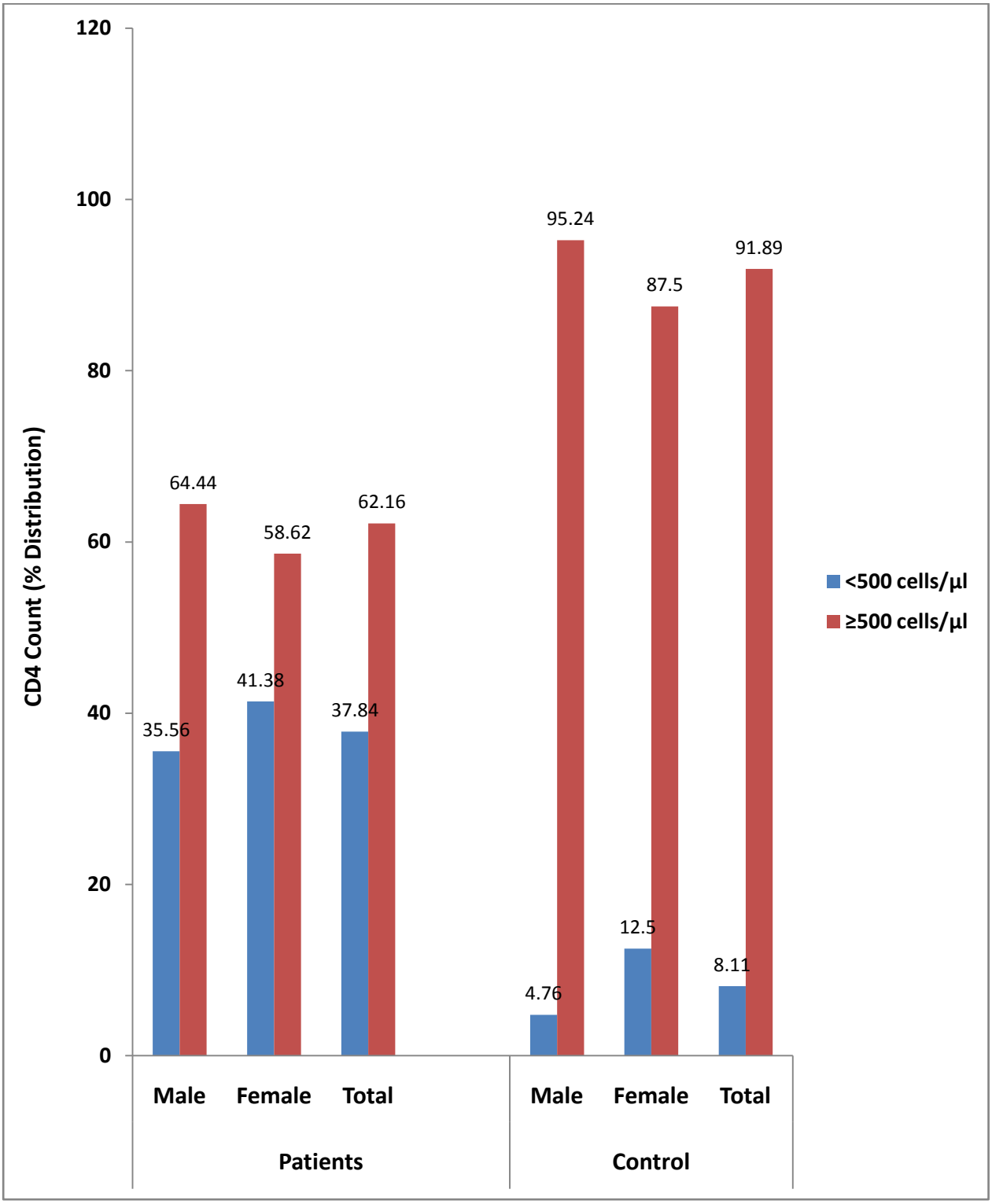


Figure 4.4: Distribution Based on CD_4 Count of People Living with HIV/AIDS Attending VCT Units in Kaduna Metropolis

4.6: CONCENTRATION OF ZINC AND IRON IN PEOPLE LIVING WITH HIV/AIDS ATTENDING VCT UNITS IN KADUNA METROPOLIS

Zinc and iron concentrations in patients living with HIV/AIDS attending VCT units in Kaduna metropolis is presented in Table 4.6. There was a significant ($P<0.05$) difference in zinc and iron levels of patients compared to control and based on gender also recorded a significantly ($P<0.05$) lower Zinc and Iron in both males and females compared to their control.

Distribution based on zinc and iron concentration is shown in Figure.4.5. The result indicated that patients (58.11%) and control (94.59%) showed elevated level of zinc (>22.9µg/dl). Low levels of iron were observed in both patients (41.89%) and control (5.41%). In both patients and control groups, the male (84.44% and 59.52% respectively) shows higher levels of zinc (>22.9µg/dl) than in females (82.76% and 40.63% respectively) with higher percent recorded in patients than in control group. Also, the result indicate that patients (41.89%) and control (5.41%) showed low levels of iron (<60µg/dl). In both patients and control groups, the male (42.22% and 7.14% respectively) showed low levels of iron (<60µg/dl) than in females (41.38% and 3.13% respectively) with higher percent recorded in patients than in control.

Table 4.6: Mean Zinc and Iron Concentration of Patients Living with HIV/AIDS Attending VCT in Kaduna Metropolis

Respondent		Patients	Control
Zinc (µmol/l)	Male	19.94 ± 2.83^{a}	22.42 ± 2.12^{b}
	Female	19.33 ± 3.04^{a}	23.80 ± 3.30^{b}
	Total	19.70 ± 2.91^{a}	23.02 ± 2.76^{b}
Iron (µg/dl)	Male	60.24 ± 5.21^{a}	65.54 ± 3.01^{b}
	Female	60.07 ± 5.93^{a}	66.52 ± 2.85^{b}
	Total	60.96 ± 2.96^{a}	65.96 ± 2.96^{b}

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

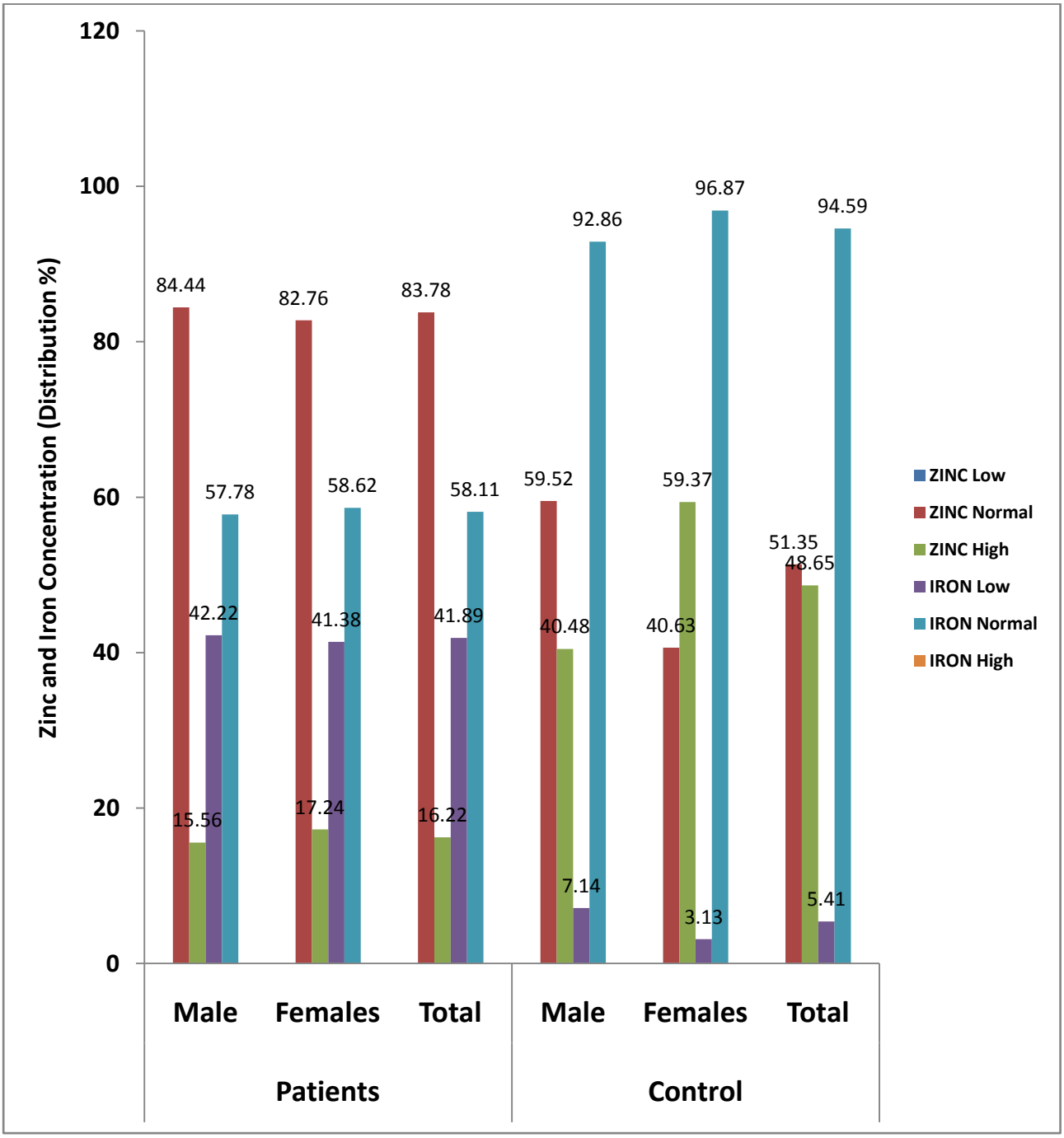


Figure 4.5: Distribution based on Zinc and Iron Concentration in People Living with HIV/AIDS Attending VCT Units in Kaduna Metropolis

Zinc – Low - < 10.7 µg/dl, Normal – 10.7 – 22.9 µg/dl, High - > 22.9 µg/dl
Iron – Low - < 60 µg/dl, Normal – 60 – 170 µg/dl High - > 170 µg/dl

4.6: CORRELATION OF CD_4 COUNTS WITHTHE CONCENTRATION OF ZINC AND IRON OF PATIENTS ATTENDING VCT IN KADUNA METROPOLIS

Correlation of CD_4 counts with concentration of zinc and iron of patients attending VCT in Kaduna metropolis is presented in Table 4.5. A significant ($P<0.01$) positive correlation was observed for both zinc and iron. Correlation coefficient of zinc was generally higher than in Iron. Higher correlation coefficient was recorded for iron in females than in males while higher correlation coefficient was recorded for zinc in males than in females.

Table 4.7: Correlation of CD_4 counts with Concentration of Zinc and Iron of People Attending VCT in Kaduna Metropolis

Parameter	Correlation Coefficients (r)		
	Male	Female	Total
Zinc	0.846**	0.811**	0.829**
Iron	0.677**	0.851**	0.750**

** Correlation is significant at the 0.01 level (2 tailed)

4.8: FREQUENCY OF FOOD CONSUMPTION

Frequency of food consumption by patients attending VCT in Kaduna metropolis and by control is presented in Table 4.8. The results indicated that all food groups were consumed across the time intervals. Bread, cereals and starch foods were frequently consumed across the time intervals with more consumption of 2- 4 times per week (28.38%) and least for frequency consumption of < 1 time per month (6.76%). Also meat, fish and poultry food groups were frequently consumed more in consumption of 1-3 times /month (28.38%) and least in for ≥5 times /week (10.81%). Frequency consumption of 2-4times/week (34.85%) was more for milk and dairy products food groups and least for 1 time /week (13.64%). Fat and oils foods were frequently consumed across the time intervals with more consumption of ≥5/week (24.66%) and least in consumption of once per week (16.22%). Also vegetables and fruits food groups were frequently consumed more on the basis of 1-3 times /month (26.39%) and least in for once per month (11.11%).

Table 4.8: Frequency of Consumption and Percentages of Food Groups of People Living with HIV/AIDS Attending VCT in Kaduna Metropolis

FOOD GROUPS	FREQUENCY OF CONSUMPTION (%)				
	<1 per month	**1-3 month**	**1 per week**	**2-4 per week**	**≥5 per week**
Bread, Cereals and Starch (N = 74)	5 (6.76)	19 (25.66)	18 (24.32)	21 (28.38)	11 (14.86)
Meat, Fish and Poultry (N = 74)	13 (17.56)	12 (16.22)	20 (27.03)	21 (28.38)	8(10.81)
Milk and Dairy Products (N = 66)	12 (18.18)	11 (16.67)	9 (13.64)	23 (34.85)	11 (16.67)
Fats and Oils (N = 73)	-	-	12 (16.22)	24 (32.43)	38 (51.35)
Vegetables and Fruits (N = 72)	8 (11.11)	19 (26.39)	16 (22.22)	11 (15.28)	18 (25)

n = sample size

CHAPTER FIVE

5.0 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/m^2 and 22.87kg/m^2 for the control group which indicates normal body mass. 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 Silva et al., (2001) and Kroll et al., (2012) 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/m^2) 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.

This study also examined the lipid profile and the atherogenic index of PLWHA. 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 levelswas observed in the patients indicating low risk of atherosclerosis. Elevated levels of all lipoproteins 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 cholesterol" 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 significantdifference was observed in theatherogenic 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). (Nandeesha et al., 2008). 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. 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. 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). Traditionally CD_4^+ 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). CD4count 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/m^2) 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 CD_4 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 CD_4 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 CD_4^+ 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 oncogene activation. (Reizenstein, 1991). 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 (Fe^{2+}) or Ferric (Fe^{3+}) 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 (Shevtz*et al*., 1999). 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 (MaCallan *et al*., 1995). There is currently no evidence to support protein intake in excess of

these levels for HIV-positive individuals (MaCallan *et al*., 1995). 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.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY

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

i. 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%).

ii. 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%).

iii. 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.

iv. 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

v. Atherogenic index of patients showed no significant ($p > 0.05$) difference to control group.

vi. TheCD_4 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.

vii. 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 CD_4 counts. Higher correlation was recorded for iron in

females than in males while higher correlation for zinc in males than in females was recorded.

viii. More female patients have their CD_4 at normal level (≥500 cell/µl) than male patients.

ix. 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.

6.2 CONCLUSION

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 HDLlevel 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.

6.3 RECOMMENDATIONS

i. The PLWHIV should be encouraged to maintain good dietary diversification with minimum consumption of four or all the food groups.

ii. Attention should be given to other causes of death in PLWHA such as cardiovascular diseases and overweight.

iii. Nutrition education and practices should be encouraged in the management of HIV/AIDS.

iv. Due to the cross sectional nature of the study, it is suggested that a longitudinal assessment be carried out in the study area in order to ascertain nutrients intake of HIV infected patient over a longer period of time.

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APPENDIX I

DEPARTMENT OF BIOCHEMISTRY, AHMADU BELLO UNIVERSITY, ZARIA

KADUNA STATE

MASTERS IN NUTRITION, SURVEY FORM/QUESTIONNAIRE

(This questionnaire is to be administered to People Living with HIV/AIDS between 18-60 Years of age)

Interviewer's Name_____ Signature_____

INFORMED CONSENT FORM

(to be administered to respondent)

SERIAL NUMBER…….

My name is ***Abraham EleojoAchadu***I am a student of the above named institution and conducting a research titled "***assessment of dietary pattern and nutritional status of the people living with HIV/AIDS attending voluntary and counseling test (VCT) units in Kaduna metropolis".*** I will need to ask you personal questions. Your answers will be kept completely confidential and will not be shown to other persons. The information collected from you and people like you will be used solely to come up with better ways to improve the micronutrient and nutritional status of people living with HIV/AIDS. Your honest answers to these questions will be greatly appreciated. You have the right to decline and withdraw at any given time if you choose to. However, your honest answers to these questions will help us better understand how to create more impact to improve the micronutrient and nutritional status.

The study would involve the collection of blood sample from you and will not pose any discomfort to you. I will greatly appreciate your help in responding to the survey and taking part in the study. The survey will take about 10 minutes to ask the questions. **[Interviewer will ask if the respondent has any questions and provides the necessary clarifications before proceeding with the informed consent].**Would you be willing to participate?

Consent: Now that the research has been well explained to me and I fully understand the content of the study process. I will be willing to take part in the programme.

…….. ……

Signature/Thumbprint of participant/Date Signature of Interviewer/Date

APPENDIX IV

ASSESSMENT OF DIETARY PATTERN, MICRONUTRIENT AND NUTRITIONAL STATUS OF THE PEOPLE LIVING WITH HIV/AIDS ATTENDING VCT UNITS OF SOME SELECTED HOSPITALS IN KADUNA METROPOLIS.

(This questionnaire is to be administer to People Living with HIV/AIDS between 18-60 Years of age)

SECTION 1: Background Information

Date…...../…..... /...… Questionnaire No ...… /...…/…..

State_____LGA_____Community_____

SECTION 2: Socio Economic and Demographic Characteristics of Respondent.

1. Age in years [ ] Years

2. Sex

a. Male [ ]

b. Female [ ]

3. Marital Status

a. Married [ ] b. Single [ ] c. Divorced [ ] d. Co-habitant [ ]

4. Tribe

a. Igbo [ ] b. Hausa [ ] c. Yoruba [ ] d. Others [Specify please_____]

5. Religion

a. Christianity [ ] b. Islam [ ] c. Others [Specify please _____]

6. Education

a. Primary Education [ ] b. Secondary Education [ ] c. Tertiary Education [ ] d. Islamic Education [ ] e. None [ ]

7. Family Size

a. Monogamy [ ] b. Polygamy [ ]

8. Occupation

a. Housewife [ ] b.Trader [ ] c. Civil Servant [ ] d. Student [ ]

e. Lecturer [ ] f. Contractor [ ] g. Unemployed [ ] h. Retired [ ]

9. Monthly Income

a. Less than N5, 000 [ ] b. Above N5, 000 less than N10, 000 [ ]

c. Above N10, 000 less than N20, 000[ ] d. Above N20, 000 less than N40, 000 [ ]

e. Above N40, 000 less than N60, 000[ ] f. Above N60, 000 less than N80, 000 [ ]

g. Above N80, 000 less than N100,000 [ ] h. N100,000 and above [ ]

SECTINON 3: Anthropometric Measurement of Respondent

Weight (kg) …… Height (m) ……BMI (kg/m^2) ……

SECTION 5: DIETARY INTAKE (Using Food Frequency Questionnaire)

Mark the column to show how often, on average, you ate the following foods.

Mark your usual serving size as small, medium or large (S, M, L)

- A small serving is about one-half (½) the medium serving size or less.
- A large serving is about one and a-half (1½) times the medium serving size or more.

BREADS, CEREALS AND STARCH									
	HOW OFTEN DID YOU EAT THESE FOODS?							**►**	**AMT ?**
	NEVER or less than once per month	1-2 Per month	3-4 Per month	1-2 Per week	3-4 Per week	1-2 Per day	3-4 Per day	Medium serving size	S / M / L
Cornflakes, Golden morn,								1 cup	
Regular potatoes chips and corn chips								2 handfuls or 1 small bag	

Plain popcorn (no butter) or low fat microwave popcorn								4 handfuls	
Cooked or roasted corn								2 cubs	
Buttered or regular microwave popcorn								4 handfuls	
Wheat flour products								6 medium	

MEAT, FISH, POULTRY

	HOW OFTEN DID YOU EAT THESE FOODS?							▶	AMOUNT?
	NEVER or less than once per month	1-2 Per month	3-4 Per month	1-2 Per week	3-4 Per week	1-2 Per day	3-4 Per day	Medium serving size	S / M / L
Eggs								2 eggs	
Beef, pork, goat,								2 slices	
Chicken liver and organ meats								1 large or 2 small pieces	
Chicken and turkey (roasted, stewed, grilled, fried or boiled)								1 large or 2 small pieces	

MILK AND DAIRY PRODUCTS

	HOW OFTEN DID YOU EAT THESE FOODS?							▶	AMOUNT?
	NEVER or less than once per month	1-2 Per month	3-4 Per month	1-2 Per week	3-4 Per week	1-2 Per day	3-4 Per day	Medium serving size	S / M / L

cheese including cheese used in cooking								1 slice or ¼ cup shredded	
All other cheese including cheese used in cooking								1 slice or ¼ cup shredded	
Yogurt, all types								1 cup	

VEGETABLES AND FRUITS									
	HOW OFTEN DID YOU EAT THESE FOODS?							**►**	**AMOUNT?**
	NEVER or less than once per month	1-2 Per month	3-4 Per month	1-2 Per week	3-4 Per week	1-2 Per day	3-4 Per day	Medium serving size	S / M / L
Green salad (lettuce or spinach)								1 cup	
Fresh tomatoes								1 medium or 4 slices	
Carrots								½ cup	
Cabbage								½ cup	
Green beans								½ cup	
Green peas								½ cup	
Apples and pears								1 medium or ½ cup	
Bananas								1 meduim	
Oranges, grapefruits and tangerines (not juice)								1 orange or ½ grapefruit	

Water melon, red melon and mango								1 medium slice	
Pineapple and cherries								½ cup	

FAT AND OILS									
	HOW OFTEN DID YOU EAT THESE FOODS?							**►**	**AMT ?**
	NEVER or less than once per month	1-2 Per month	3-4 Per month	1-2 Per week	3-4 Per week	1-2 Per day	3-4 Per day	Medium serving size	S / M / L
Palm oils								1 cup	
Vegetable oils								1 cup	