

**NUTRITIONAL ASSESSMENT OF PRISONERS LIVING WITH HIV/AIDS
IN SELECTED PRISONS IN TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULLFILMENT OF THE
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ABSTRACT

This study was conducted to assess the nutritional status of prisoners living with HIV/AIDS in Tanzania prisons. A total of 768 (384 HIV-infected, 384 non-infected) prisoners were assessed for nutritional status, dietary intake, Hb status and body fat mass. Results showed that, 75.5% (N=768) of prisoners had good nutritional status of whom 38.3% were HIV-infected and 37.2% were non-infected inmates. About 6.6% (N=768) of the inmates were under-weight, (2.9% HIV-infected, 3.7% non-HIV infected). The study also revealed that, 62.7% (N=768) of the prisoners were anaemic (32.2% being HIV-infected and 30.5% non-HIV infected). Dietary intake revealed that, average energy consumption was above the WHO (2002) recommended dietary intake (2100-2510 kcal for HIV-infected and 2100 kcal for non-HIVinfected) while protein intake was lower than the WHO recommended dietary intake (50-80g). Body fat mass composition showed that, 57.3% (N=768) of the respondents were healthy (31.0% HIV-infected, 26.3% non-infected) while 30.9% (N=768) were either over-fat or obese (13.5% HIV-infected, 17.4% non-infected). The nutritional status of majority of the prisoners was generally good, although there were small proportions of inmates who were overweight (13.9%, N=768), obese (4%, N=768) and under-weight (6.6%, N=768).Haemoglobin status showed that, 11.3% (N=768) of the inmates were moderately anaemic, 51.4% were mildly anaemic while only 37.3% had normal Hb levels. It was concluded from this study that, poor nutritional status is still a problem among prisoners as some were under-weight while others were overweight and obese. Iron deficiency anaemia was also a serious problem among many prisoners. It is therefore recommended that, nutritional status monitoring should be

conducted among prisoners and appropriate interventions should be made to improve their nutritional status especially of those who are under-weight, over-weight, obese and anaemic.

DECLARATION

I, MUSA LUCAS MWAKYOSO, do hereby declare to the Senate of the Sokoine University of Agriculture that this work is my original work and has not been submitted for a degree award in any other University.

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DEDICATION

This study is dedicated to my brother and sister Mr. Abysalom Mwakyoso and Mrs. Neema Kyoso for laying down the foundation of my education which made me what I am today.

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LIST OF ABBREVIATIONS

ACA	American Correction Association
ACLU	American Civil Liberties Union
ACSS	Access Control and Security System
AED	Academic for Educational Development
AIDS	Acquired Immunodeficiency Syndrome
ANOVA	Analysis of Variance
APA	American Psychiatric Association
ARVs	Anti-Retroviral drugs
BIA	Bioelectric Impedence Analyzer
BMI	Body Mass Index
CDC	Centre for Disease Control and Prevention
CED	Chronic Energy Deficiency
CGP	Commissioner General of Tanzania Prisons
CPHA	Canadian Public Health Agent
Cu	Copper
DH	Department of Health
DHHS	Department of Health and Mental Health Services in Prisons
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization of the United Nations
Fe	Iron
FHI	Family Health International

HB	Haemoglobin
HIV	Human Immunodeficiency Virus
HRW	Human Right Watch
ICRC	International Committee of the Red Cross
IDA	Iron Deficiency Anaemia
IDU	Injecting Drug Users
Kcal	Kilocalories
MDG	Millennium Development Goals
MDR	Multi-drug Resistant
Mn	Manganese
MSF	Médecins Sans Frontières (Doctors without borders)
NAS	National Academy of Science
NBS	National Bureau of Statistics
NIMR	National Institute for Medical Research
NMA	Norwegian Medical Association
No.	Number of respondents
NRTI	Nucleoside Reverse Transcriptase Inhibitor
NYSDH	New York State Department of Health
OIs	Opportunistic Infections
PEPFAR	The United States Presidents Emergency Plan for AIDS Relief
PH	Prison Health
PI	Protease Inhibitor
PLHA	People Living With HIV/AIDS
POI	Prison Officer In charges

RCQHC	Regional Centre for Quality Health Care
RDA	Recommended Dietary Allowance
RDI	Recommended Dietary Intake
RPO	Regional Prisons Officer
Se	Selenium
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
TB	Tuberculosis
TDHS	Tanzania Demographic and Health Survey
TFNC	Tanzania Food and Nutrition Center
UN	United Nations
UNAIDS	United Nations Development Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNGA	United Nations General Assembly
UNU	United Nations Universities
USA	United States of America
USAID	United States Agency for International Development
VAD	Vitamin A Deficiency
WHO	World Health Organization
WPA	World Psychiatric Association
Zn	Zinc

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

A prison is an institution where diverse people who have run afoul of the law live (Harrison *et al.*, 2006). On the other hand, prisoners are people who are being held in an institution such as prison or jail, they have no control over their environment as a result of their incarceration. Prison is not just a mechanism for inflicting punishment on the prisoner, but also a centre of rehabilitation (Harrison *et al.*, 2006). Prisoners are therefore not freely living people as their life is restricted from the types of physical work they do and control of the quality and quantity of meals they consume. Prisons are usually administered by the state (Awofeso, 2004). Prisoners depend on prison diet and they have no freedom to decide what to eat and at what amount.

In a situation where food and meals are restricted, adequacy of nutritional requirements is a great issue of concern (John *et al.*, 2006). Prisoners are at high nutritional risk because they lack diet diversity as they depend on one kind of food for a long time and may not be receiving enough quantities (Dolan *et al.*, 2007). Presence or absence of some nutrients or excess of some nutrients in their diet may have effect on their nutritional status (Harrison *et al.*, 2006). Provision of a diet that is healthy and nutritionally balanced and acceptable to the consumers is a factor which must be considered in any food service operation (John *et al.*, 2006).

Approximately 33 million people around the world were living with HIV by the end of 2007. Sub-Saharan Africa has 22 million of the 33 million PLHA globally, and in 2007 had 1.5 million of the approximate 2 million deaths caused by HIV and AIDS globally (UNAIDS, 2008). HIV is now the leading cause of death in sub-Saharan Africa and the fourth-largest global killer (UNDP, 2004). In the worst affected countries, HIV has reduced life expectancy by more than 20 years (UNAIDS, 2008). In Southern Africa, the average life expectancy has dropped below 50 years, the same level as in the 1950s (UNAIDS, 2008). In countries heavily affected by HIV, the infection is the cause of over one-third of child deaths (UNAIDS, 2008). In the seven sub-Saharan African countries hardest hit by HIV, under-five mortality has increased by 36 percent as a result of the disease (WHO, 2004). Women account for 59% of infections among adults in sub-Saharan Africa. Young women aged between 15–24 years bear the greatest burden of HIV, about 3.2% are infected with HIV compared with 1.1 % of men in the same age group (UNAIDS, 2008).

1.2 Problem Statement and Justification

Prison health is a neglected area. Prisoners carry greater burden of nutritional problems than other members of the society. They harbour nutritional problems that are influenced both by the prison environment and by the kind of physical work they do while in prison (Gupta *et al.* 2006). Those who are incarcerated represent a nutritionally underserved population and are at a high risk of nutritional deficiency disorders (Amuga, 2006). The people living with HIV/AIDS are observed to have nutritional problems such as underweight and wasting. This is due to inadequate intake of food/nutrients and under-utilization of the nutrients by the body, and

diseases such as diarrhoea, nausea, and vomiting amongst others (Nabiryoet *al.*, 2004).

Chronic Energy Deficiency (CED), Iron Deficiency Anaemia (IDA) and Vitamin A Deficiency (VAD) are among the major nutritional problems in Tanzania (NBS, 2010). According to NBS (2005), anaemia is estimated to be present in about one third of the population. HIV infection also continues to be a major health problem in Tanzania. According to NBS (2010), until 2009 about 1.4 million people were living with HIV/AIDS in Tanzania. The prevalence rate of HIV infection among people aged 15 – 49 years was 5.7% at national level while prevalence among females and males was 6.6 and 4.6% respectively. HIV-infection prevalence among youths aged 15 – 19 years was 1%, while for the young adults aged 35-39 years, the prevalence was 10%. HIV prevalence in prisons has been reported to be higher than the prevalence in the general population (WHO, 2005). However, prisoners have been neglected and no information is available regarding the nutritional status of the HIV infected prisoners, (Seumoet *al.*, 2003).

This study was an attempt to assess the nutritional status of HIV infected prisoners living in selected prisons in Tanzania. Results of this study will be useful in advising the policy makers and in planning nutrition support and intervention programmes for prisoners in Tanzania.

1.3 Objectives

1.3.1 Main objective

The main objective of this study was to assess the nutritional status of HIV-infected prisoners living in selected prisons in Tanzania.

1.3.2. Specific objectives

The specific objectives were to:

- i. Determine the nutritional status, Hb status and body fat mass of HIV-infected prisoners in selected prisons in Tanzania.
- ii. Determine the nutritional status, Hb status and body fat mass of the normal, non-HIV infected prisoners living in the same prisons.
- iii. Determine the dietary intake and meal patterns of prisoners in the selected prisons in Tanzania.

1.4 Hypothesis

The study hypothesis was:

HO: The nutritional status, Hb status and body fat mass of HIV-infected prisoners do not differ from that of non-infected, normal peers.

H1: Nutritional status, Hb status and body fat mass of HIV-infected prisoners differs from that of non- infected, normal prisoners.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 The Purpose and Structure of Prisons

Historically, imprisonment was meant for punishing those who wronged society, by inflicting suffering of the body (Atherton *et al.*, 2001). But according to Adams *et al.* (2004), today's imprisonment is no longer intended as an acute form of corporal punishment, but a method by which to work on a person's mind as well as his body, through retribution, incapacitation, deterrence and rehabilitation.

Adams *et al.* (2004), stated that, these four aspects when interlinked into a single process are intended to remove criminals from the society and sculpt them into productive and law abiding citizens who may later be re integrated into society. According to Adams *et al.* (2001), retribution means punishment for crimes against society. Depriving criminals of their freedom is a way of making them pay a debt to society for their crimes. Incapacitation refers to the removal of criminals from society so that they can no longer harm innocent people. Deterrence means the prevention of future crime. Caplow *et al.* (2009) stated that, prisons provide warnings to people thinking about committing crimes, and that the possibility of going to prison will discourage people from breaking the law. Rehabilitation refers to activities designed to change criminals into law abiding citizens, and may include providing educational courses in prison, teaching job skills and offering counseling with a psychologist or social worker (ACSS, 2002). However, according to Blumstein *et al.* (2009), the four

major purposes of prisons have not been stressed equally through the years and as a result, prisons differ in the makeup of their staffs, the design of their buildings and their operations.

Cohen (2000a) stated that, safe keeping comprises of keeping inmates locked away, counted, and controlled whilst allowing for isolated moments of welfare activities to satisfy needs through recreation, education and counseling. But according to Bottoms (2006), the welfare and psychological freedom of the individual inmate does not depend on how much education, recreation, and counseling he receives but rather, on how he manages to live and relate, with other inmates who constitute his crucial and only meaningful world.

According to Cohen *et al.* (2004), lockups and isolation have the habit of dehumanizing prisoners by making them feel anonymous and breeding ill feelings because of their rejection and condemnation by society as a whole. Branham (2004) reported that, offenders are drawn from a society in which possessions are closely linked with concepts of personal worth by numerous cultural definitions. However, in prison inmates find themselves reduced to a level of living near bare subsistence.

The entire prisons structure is based on solitude and separatism (Cohen *et al.*, 2004). According to Cohen *et al.* (2004), the convict is isolated from the external world and everything that motivates his/her offences is to a large extent isolated from him/her. ACLU (2001) stated that, during the 18th century prisoners were forced to wear facemasks that did not allow vision or communication during exercise periods.

The use of solitary confinement was originally designed to allow prisoners to rediscover their own conscience and better voice through spiritual conversion (Cohen, 2000b). According to Cohen (2002), it was later discovered that no form of torture could have been worse than solitary confinement because it ended up causing within many prisoners adverse psychological effects such as delusions, dissatisfaction with life, claustrophobia, depression, feelings of panic, and on many instances madness.

2.2 Lifestyles of Prisoners

It is estimated that over ten million people are held in prisons at any given time annually due to the high turnover in the prison population. Over 30 million people are imprisoned globally (Austin *et al.*, 2004). Prisoners usually live in unhygienic conditions that lead to high prevalence of skin and respiratory tract infections because of lack of water and overcrowding (Coyle, 2004). According to Simpson (2006), the health care services in prisons are poor and the food supply is low leading to high prevalence of malnutrition. Prisoners wear torn and ragged uniforms and lack blankets during the coldest months. A study conducted by NMA (2004), revealed that, shower facilities in prisons are either missing entirely or only occasionally accessible. Butler (2003) reported that, prisoners lack soap and water to wash themselves and their clothes and sleep in poorly ventilated and overcrowded cells. According to Awofeso (2004), prison cells have no access to external latrines; instead buckets are placed inside the cells and emptied on the morning.

A study conducted by Olatunji (2010) revealed that, most of the African prisons were built before 1960s, many are in need of renovation, the infrastructure is old and decrepit, and there is overcrowding, poor sanitation, lack of decent meals and medicines. Prisoners have limited contact with families and friends which is damaging to the physical and mental well being of inmates. John *et al.* (2008) stipulated that, food plays a major role in the life of prisoners; poorly designed meals, inadequate portion sizes, lack of variety and poorly cooked foods contribute to serious health conditions in prisons. A study conducted by Harrison *et al.* (2006) revealed that, majority of prisoners in developing countries are young adults who fell under active working group. According to Harrison *et al.* (2008), these groups while in prison lack adequate physical activities which make them engage in bad sexual behaviours, drug abuse and smoking.

2.3 Health Risks Associated with Prisoners

Health is one of the key indicators of wellbeing of a society and prisons serve as mirrors of society (CDC, 2006). Understanding health conditions in prisons would help us to improve our public health system (WHO, 2005a). According to WHO (2005b), health is a state of complete physical, mental and social wellbeing and not merely the absence of diseases or infirmity. Prison and jail environments are increasingly being recognized as settings in which society's diseases are concentrated (Fazel and Danesh, 2002).

As a class, prisoners are a group of individuals at high health risk compared to free persons (WHO, 2005). Prison conditions in many countries do not meet the minimum

requirements set out in the UN Standard and minimum rules for the treatment of prisoners (CDC, 2006). According to CDC (2006), lack of adequate space, drinking water and good nutrition, poor sanitation, lack of natural light and fresh air are characteristic features of many prisons worldwide. Many of these factors increase the chances of someone being infected with both communicable and non-communicable diseases (Conklin *et al.*, 2008). A prison sentence often entails an increased risk of becoming seriously ill or a lost opportunity to recover from an existing illness or dependency (Austin *et al.*, 2008). Those who enter with a health related problem often leave the prison without having received proper medical attention. A study conducted by MSF (2007), in selected prisons in Guinea showed that, 49% of prisoners had skin infections, 18% had intestinal parasites, 8% had diarrheal diseases, 4% had HIV infection while 2% had Tuberculosis infection. Another study conducted by Akinlotan (2010) revealed that, 80% of prisoners had malaria, 15% had body pains, 3% had hypertension while 2% had respiratory tract infections. In a study conducted by Nnaemeka (2009) to determine the intestinal parasite distribution among inmates of Oworri prison in Nigeria, Nnaemeka reported that, 77% (n=200) of the inmates were infected with different intestinal parasites. According to WHO (2005b), the major health risks associated with prisoners are malnutrition, HIV/AIDS, tuberculosis and mental disorders.

2.3.1 Malnutrition

Malnutrition is a major health risk associated with prisoners in developing countries (MSF, 2007). Prisoners suffer from diseases caused by being deprived of vitamins

and proteins. As a result, beriberi, pellagra, chronic energy deficiency and other nutritional problems are very common in prisons (WHO, 2007).

A study conducted by MSF (2009) in Zimbabwe revealed that, prisons have been the hardest hit by the country's current economic challenges resulting in malnutrition and outbreaks of diseases. According to MSF (2009), in Kwekwe prison, 17% (n=179) of prisoners were malnourished. In another nutritional survey conducted by MSF in the same year revealed that, 4% (n=2000) of the inmates in other 15 prisons were severely malnourished, 5% moderately malnourished while 14% were at risk of developing malnutrition. MSF stated that, prisoners were failing to meet dietary requirements. A survey of water and sanitation showed that, a basic and reliable water supply was lacking and water storage possibilities were absent. The condition of latrines was dreadful due to lack of water for flushing. Soap or other disinfectants were missing, making a high risk of outbreak of diseases (MSF, 2007). According to Sokwawele (2007), 23 inmates died in Chikurubi prison in Zimbabwe from an outbreak of pellagra and many more were ill from the outbreak.

In Uganda, the International Committee of the Red Cross (2011) conducted a rapid nutritional assessment in Gulu central prison where results revealed that, 12.75% (n=800) of the inmates had severe malnutrition while several others were living with other types of malnutrition. A survey conducted by MSF (2007), at the MACA prison in Ivory Coast revealed that, 14% (n=5400) of inmates were suffering from beriberi and seven died from the disease. MSF stated that, beriberi was being consistently underreported among prisoners and recommended further attention to be given to the

illness. The International Committee of the Red Cross (ICRC) launched an emergency nutrition programme in the main prison of the capital Abidjan in 2008 in a bid to stamp out a beriberi epidemic in which 181 prisoners suffered. According to MSF (2007), the UN Mission in Cote d'Ivoire has reported that, malnutrition is the leading cause of deaths in the country's prisons.

In an initial nutritional screening conducted by MSF (2007) in Guinea prisons showed that, 38% of prisoners suffered from acute malnutrition, 21% were severely malnourished while 17% were moderately malnourished. In 2008, MSF conducted another emergency nutritional intervention in the civilian prison of Guéckédou in Southeastern Republic of Guinea, where malnutrition was found in one out of every three adult male prisoners and one out of every five inmates suffered from severe acute malnutrition. According to MSF (2007), appalling hygienic conditions had led to dehydration and rampant skin and respiratory infections. Health care was only infrequently available.

A study conducted by Katharine (2012) among prisoners in 15 countries revealed that, female prisoners were 18% more likely to be obese than the general female population. She stated that, this was the evidence suggesting that, female prisoners were simply supplied with a diet designed for males. She further reported that, this finding was in line with the current concerns that prisons are institutions designed by men for men with little concern for the needs of women who form a minority of the global prison population.

2.3.2 HIV/AIDS

Statistics by WHO (2005a) showed that, in most countries in the world the rates of HIV infections are much higher among prisoners than the outside population. Reports by WHO in European countries, Africa, Central Asia and U.S.A. revealed great variation in the rates of HIV infection among prisoners. According to WHO (2005a), prisons are a breeding ground for HIV/AIDS and other infectious diseases due to injection of drugs in the absence of sterile syringes, sharing other injection equipment and razors, toothbrushes, high prevalence of hepatitis C and B, tattooing, piercing, scarification, unprotected sexual relations, prostitution, rape, accidental punctures with infected needles, searches in the cells, limited access to health care and the use of unsterile medical equipment.

2.3.3 Tuberculosis

Since the early 1990s, Tuberculosis outbreaks in prisons have been reported in many countries in the world. Due to overcrowding and poor nutrition, tuberculosis rates in many prisons are 10–100 times higher than in the community outside prisons (Department of Health, 2001). TB strains transmitted in prisons are more likely to be drug-resistant or associated with HIV co-infection (WHO, 2007). According to WHO (2007), rates of multidrug-resistant TB are higher among prisoners than people outside prisons.

Prisons in countries of the former Soviet Union have some of the highest multidrug-resistant TB rates in the world (Lobacheva *et al.*, 2005). A study conducted by Lobacheva *et al.* (2007), in Russia revealed that, the percentage of multidrug-resistant

TB in prison populations ranged from 12 to 55% in previously treated patients. According to a study by CDC (2006) in Georgia, 78% of prisoners were resistant to any drug while 13% were multidrug-resistant TB. In a study conducted by Shin (2006) among inmates who were not responding to TB treatment in Azerbaijan, 89% were multidrug-resistant TB. These countries also have some of the highest prevalence rates of TB in the general population. According to studies conducted by CDC (2006) in Russia, the prevalence was 4,560 per 100,000 persons and in Georgia the prevalence was 5,995 per 100,000 persons.

Studies from Western Europe showed higher rates of TB infections and diseases among prisoners than in civilian populations (Aerts *et al.*, 2006). Studies in Turkey and France showed high prevalence rates of 341 per 100,000 persons and 215 per 100,000 persons, respectively (Kiter *et al.*, 2003; Hanau, 2000). In Italy, 17.9% of inmates had TB infection while in Spain 17.9% of prisoners with TB was also co-infected with HIV (Rodrigo *et al.*, 2006).

Countries in Asia have high rates of TB in prisons as evidenced by Thailand (568 per 100,000 persons) and Taiwan (259 per 100,000 persons) (Jittimanne *et al.*, 2007). According to Jittimanne, there are also high rates of deaths. A study by Leung (2005), in Singapore and Hong Kong revealed a prevalence of 1.1-1.2% active TB cases in prison populations. Thailand studies conducted by Lincoln *et al.* (2004), showed high rates of drug resistance of 50% to at least 1 drug, 39% resistance to isoniazid, and 19% to multidrug-resistance.

In Africa, some countries have extremely high rates of TB in their prison populations (CDC, 2006). According to Habeenzu (2007), prevalence rate of Tuberculosis in Zambia prisons was 4,000 per 100,000 persons, while in Botswana prisons the prevalence was 3,797 per 100,000 persons (CDC, 2002). In a study conducted by Rutta *et al.* (1997) in Tanzania, results showed that, 41% of prisoners had active TB. In Cameroon, Ivory Coast and Malawi, the amount of active TB ranged from 3.5% to 5.8 % (CDC, 2006). The Zambian study showed that, 9.5% were multidrug-resistant (Habeenzu, 2007).

Three studies conducted in Pakistan showed prevalence of TB of 3.9% among inmates which was 3.8 times higher than in the general population (Hussain *et al.*, 2003). A study in Australia showed an annual risk of TB infection of 3.1% (Aerts *et al.*, 2006). Two studies conducted in Brazilian prisons by Fournet (2006), showed a prevalence rate of TB disease of 4.6%.

2.3.4 Mental disorders and substance use in prisons

Mental disorders are health problems present in all cultures and societies. An estimated 450 million people worldwide suffer from mental or behavioural disorders. The prevalence of mental illness in prison settings is significantly higher than the prevalence in the general population (Andersen, 2004). In an Australian study, the prevalence of any psychiatric illness in 2007 was 80% in prisoners and 31% in the community. In some countries, people with severe mental disorders are inappropriately locked up in prison which is also called as transinstitutionalisation, simply because of the lack of mental health services (Davies, 2002). A study

conducted by Fazel and Danesh (2002), in 62 prisons from 12 countries covering more than 23,000 prisoners worldwide results showed that, 7.7% of inmates had psychotic illnesses, 22% major depression, and 65% a personality disorder. According to Ruck (2005), many of these disorders maybe present before admission to prison, and may be further exacerbated by the stress of imprisonment. However, Ruck reported that, mental disorders may also develop during imprisonment itself, as a consequence of prevailing conditions and due to torture or other human rights violations in prisons. Also according to Cooke (2007), there are other factors in many prisons that have negative effects on mental health, including overcrowding, dirty and depressing environments, poor food, various forms of violence, physical or verbal aggression, lack of privacy, lack of meaningful activity in prison, lack of opportunities for quiet relaxation and reflection, isolation from social networks, insecurity about future prospects and inadequate health services, especially mental health services in prisons. Also, Davies (2001) stated that, prisons issued uniforms play a large part in destroying personal identity, leading to psychological effects.

The use of substances such as alcohol, tobacco, bhang, nicotine, cocaine, opioid and amphetamines are very common among prisoners (Fazel and Danesh, 2002). Drugs are related to crime due to the effects they have on the user's behaviour and by influencing violence and perpetuating illegal activities. Hence, it is said that violence, crime and drug use go hand-in-hand (Butler *et al.*, 2006). A large part of the mental morbidity is contributed by substance abuse and its related consequences. Data from the Central Prison, Bangalore (Math *et al.*, 2011), showed that 67.3% of the prison population reported ever using tobacco in some form in their lives and 43.5% of

resident prisoners fulfilled diagnostic criteria for lifetime alcohol dependence and 14% for current alcohol dependence one year prior to prison entry.

According to Hammett *et al.* (2001), the close interaction of prison health and public health systems is essential for success. Prisoners come from and usually return to the community, thus limiting the spread of diseases in prison benefit both prisoners and the wider community and reduces the burdens on health system as a whole (WHO, 2003). Figure 1 shows the interaction present between the community and prisons.

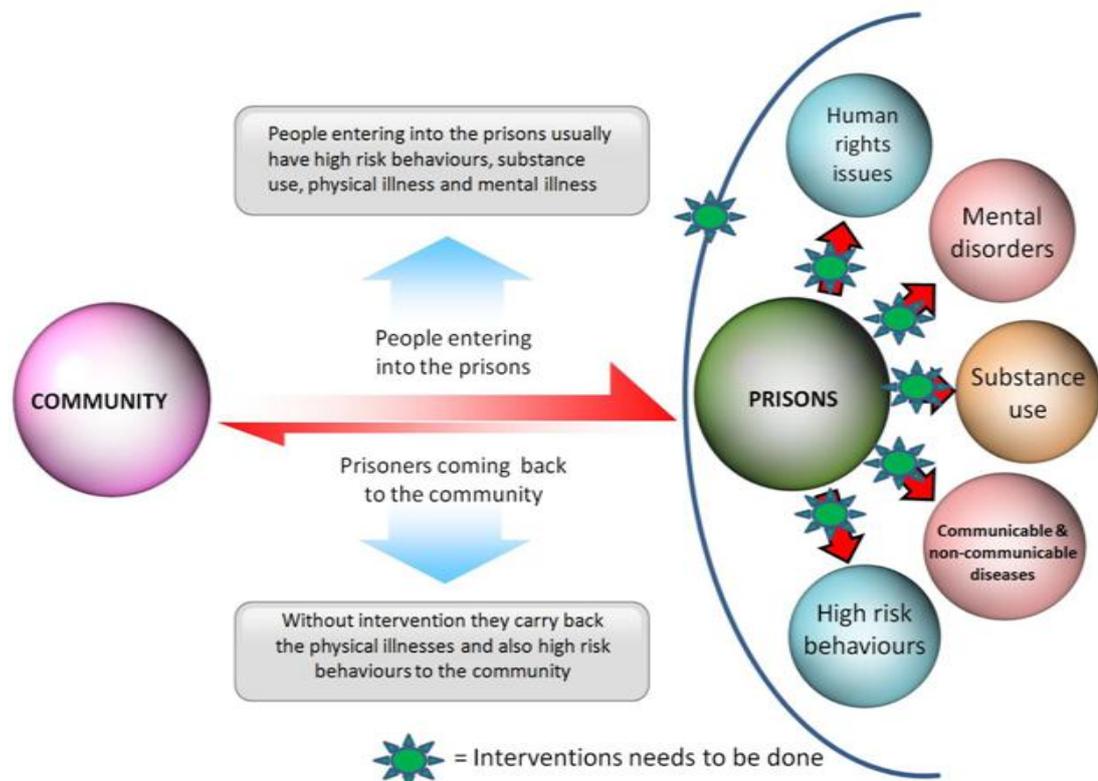


Figure 1: The continuum between the community and prison

Source: Prison Health (2012)

2.3.5 Health issues for women in prison

Although women constitute a very small proportion of the total prison population in the world, the number of women in prison is increasing rapidly. Women who are sent to prison bring with them complex problems, needs, anxieties, illnesses and distress. Prison worsens these problems and increases the vulnerability of most women (Bisingwa *et al.*, 2011). According to Bisingwa *et al.* (2011), incarcerated women are far more likely to have traumatic experiences in early childhood than incarcerated men, such as early sexual, mental and physical abuse.

A study conducted by Mallik (2008) revealed that, at least 75% of women entering prisons in Africa are estimated to have health problems. According to Mallik and Visher (2008), mental disorders are overrepresented among women prisoners with 80% of women in prison having an identifiable mental illness. Two thirds of women prisoners have post-traumatic stress disorder. One in ten has attempted suicide before being imprisoned. Women prisoners are more likely to harm themselves and commit suicide than male prisoners, whereas suicide is more common among men outside prison.

A study conducted by Kariminia *et al.* (2007) revealed that, many women in prison are mothers and usually the primary or sole care providers for their children. According to Kariminia *et al.*(2007), about ten thousand children in Africa are affected by their mother's imprisonment. In most African countries, young children can stay in prison with their mothers, three years is the most common age limit and facilities vary widely between countries for these mothers and their children.

Women prisoners often have a higher prevalence of HIV and other infectious diseases than male prisoners (Pratt *et al.*, 2006). Women prisoners have specific needs related to reproductive health such as menstruation, pregnancy and menopause. These include access to regular showers and a greater need for adequate nutrition and personal care products (Binswanger *et al.*, 2010).

2.4 HIV Situation in Prisons

Prisons are extremely high risk environments for transmission of HIV, due to overcrowding, poor nutrition, limited access to health care, continued drug use, unsafe injecting practices, unprotected sex and tattooing (CDC, 2006). A study conducted by New York State Department of Health (NYSDH, 2010) revealed that, many inmates come from marginalized populations such as injecting drug users (IDU), already at high risk of HIV. HIV/AIDS is a serious problem for prison populations across the world. According to Marushack *et al.* (2010), the HIV situation in prisons is exacerbated by high rates of tuberculosis (often multidrug-resistance), sexually transmitted infections, hepatitis B and C and poor general health. The number of prisoners living with HIV varies between countries (WHO, 2005). According to WHO, the HIV prevalence in the general population reflects the prevalence in prisons.

According to Gates *et al.* (2004) more than 2% (n=21,987) of all inmates in the U.S.A. state and federal prisons have HIV or AIDS. In Africa, South Africa has a high percentage of HIV positive inmates. The HIV prevalence in the general population is also high, at an estimated 17.8% (WHO, 2005). In Tanzania, almost

9.2% (n=39,951) of Tanzanian prisoners in 2008 were HIV positive, according to a 2008 Human Rights report (HRW, 2009). Jails in Tanzania are overpopulated, far surpassing the facilities' official capacity of 12,298 inmates. In Zimbabwe, a study conducted by Sokwawele (2007) revealed that, prevalence of HIV among prisoners was 51%.

In Europe, in the year 2000 it was estimated that, 7% of inmates were infected with HIV (WHO, 2003). High rates of HIV infections among prisoners have been reported in some western European countries as well (Taxman *et al.*, 2002). In most countries, HIV prevalence among female prisoners is higher than among male prisoners (ACLU, 2010).

2.5 Relationship Between Nutrition and HIV/AIDS

HIV infection progressively destroys the immune system, leading to recurrent opportunistic infections, debilitation and death. Opportunistic infections are infections that take advantage of a weak immune system (FHI, 2001). Poor nutritional status is one of the major complications of HIV and a significant factor in full-blown AIDS. In resource-limited settings like in prisons, many people who become infected with HIV may already be undernourished. Their weakened immune systems further increase their vulnerability to infection (Amuga and Onulwiri, 2006). Infections lead to increased loss of nutrients which, if not replenished, may lead to malnutrition. Malnutrition, on the other hand leads to immune impairment which in turn speeds up the progression of HIV to AIDS. When a malnourished person acquires HIV, the progression to AIDS is fast as the immune system is already too weak to fight off

infections (Piwoz *et al.*, 2000). A well-nourished individual has strong immune system which delays the progression of HIV to AIDS (WHO, 2003c). Malnutrition in HIV-infected person manifests in weight loss, muscle wasting, reduced immune system function, minerals and vitamins deficiencies and increased susceptibility to infections. Generally, good nutrition increases resistance to infections and diseases by providing energy to build up the body and stabilize the immune system (WHO, 2003).

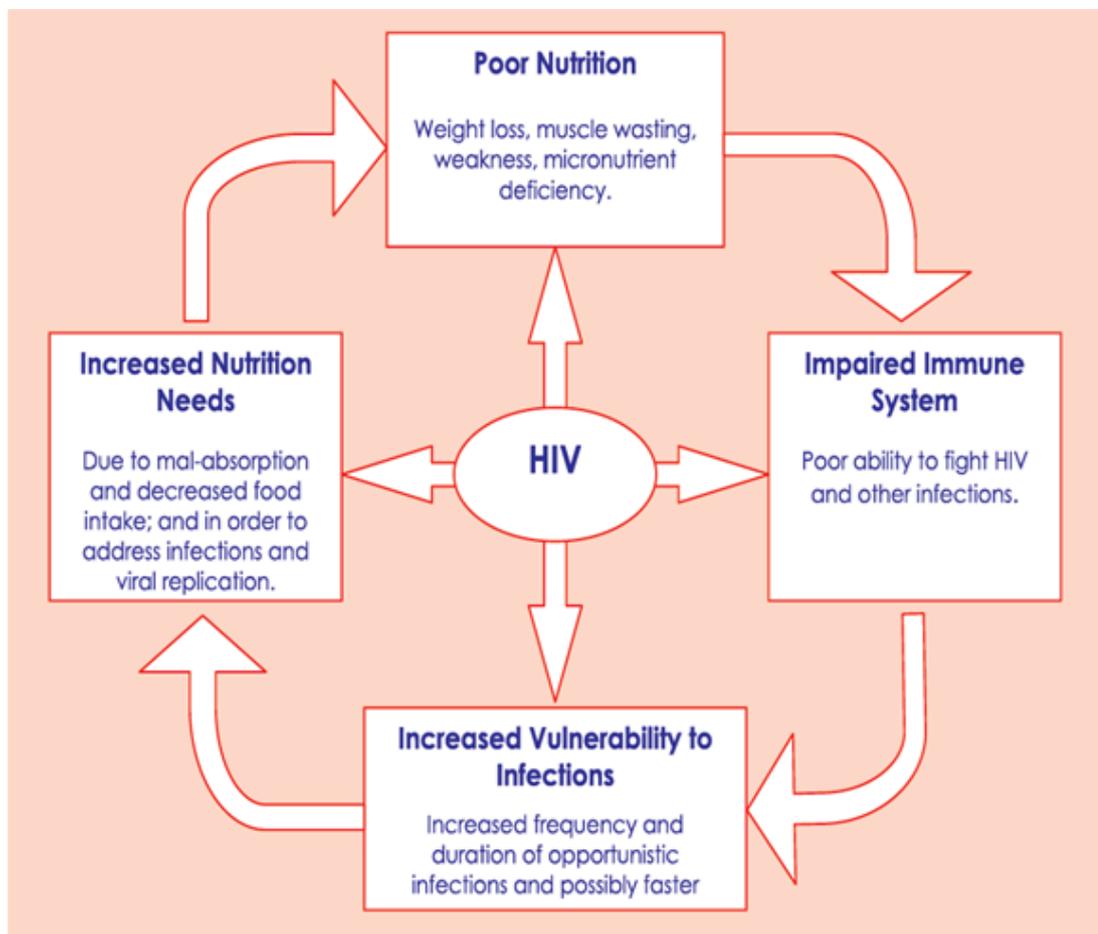


Figure 2: Relationship between Nutrition and HIV

Source: FANTA and RCQHS (2003a)

2.6 Effects of HIV/AIDS on Nutrition

The HIV and AIDS effects on nutrition include reduced food intake, poor absorption of nutrients and changes in metabolism (Dolan *et al.*, 2007).

2.6.1 Reduced food intake

People living with HIV/AIDS may fail to take adequate food due to loss of appetite and difficulty in eating as a result of mouth and throat sores or fever and side effects from medication including nausea and vomiting. Other reasons include fatigue, mental and psychological depression, infections and illnesses (FANTA, 2004).

2.6.2 Poor absorption of nutrients

HIV infection causes increased intestinal permeability, deterioration of the lining wall of the gut and risk of getting opportunistic infections leading to diarrhea. As a result, impairment of absorption of proteins, carbohydrates, fats, vitamins, minerals and water occurs (FAO, 2005). HIV infection makes the body fail to digest, absorb and assimilate food properly. As a result, there is poor nutrient absorption, severely reduced food intake, anorexia, infections and illnesses. Poor food digestion mainly occurs in proteins, fats and carbohydrates (FAO and WHO, 2002).

2.6.3 Increase in nutrient requirements

When a person is infected with HIV the immune system becomes highly active. The body reacts to the virus with an immune response that uses more energy and nutrients (PEPFAR, 2004). As a response to the HIV pathogens, the body releases pro-oxidant cytokines and other reactive oxygen species. This leads to increased utilization of the anti-oxidant vitamins (A, C, E) as well as the minerals that form anti-oxidant

enzymes (Zn, Se, Fe, Mn, Cu,). The body, therefore, gets depleted of those nutrients (FANTA, 2004). According to WHO (2001), the body's cytokine-mediated reaction to the infection also leads to an increase in the basic energy and protein requirements. Increase in pro-oxidants increases the rate of HIV viral replication and hence higher viral load. These, in turn, hasten the progression of HIV to AIDS and, consequently, increase in nutrient requirements (WHO, 2003). In a weakened immune system, the HIV infected person acquires more readily opportunistic infections. Infections and fever increase nutrient needs by speeding up processes in the body (FAO, 2002).

2.7 Nutrients Requirements for PLHA

2.7.1 Energy

Available evidence shows that, PLHA have additional energy requirements as compared to non-infected persons (WHO, 2007). The energy needs for PLHA increase as the disease progresses from the early infection stage to early symptoms and advanced stages (Piwoz *et al.*, 2000). A healthy HIV uninfected adult requires an average of 2100 kcal per day. The following are the daily recommended intakes of energy for different groups of PLHA. An adult with early infection (asymptomatic stage) needs 10% to 20% extra energy above the RDA of a non-infected adult of the same sex and age. This is equivalent to 210 – 420 additional kcal (Allard *et al.*, 1998). An adult with advanced infection (symptomatic stage) needs 20% to 30% extra energy above the RDA of a non-infected adult of the same sex, age and physiological status. This is equivalent to 420 to 630 kcal, depending on the severity of the symptoms (FANTA, 2004).

2.7.2 Protein

According to WHO (2003a), there is no evidence that HIV infection increases protein requirements above the RDA of the non-infected individuals. PLHA should consume adequate amounts of animal and plant sources of protein so as to ensure adequate supply of amino acids to meet their RDA for protein (FHI, 2001). A healthy non-HIV infected individual requires protein intake ranging from 12% to 15% of the total energy intake. On average, this is equivalent to 50 to 80g of protein daily (WHO, 2003). According to WHO (2003) recommendations, an adult (non-pregnant and non-lactating) should consume 1.2 to 1.5 gram of protein per kilogram body weight daily.

2.7.3 Fats

There is no evidence that fat requirements are different because of HIV infection (WHO, 2003). PLHA with ARV or certain infection symptoms such as diarrhoea may require changes in the timing or quantity of fat intake in some cases (Chintana, 2008).

Table 1: Recommended body fat mass ranges for adult male and females

Age (Years)	Under fat		Healthy		Over fat		Obese	
	Female	Male	Female	Male	Female	Male	Female	Male
20-39	0-21%	0-8%	21-33%	8-20%	33-39%	20-25%	>39%	>25%
40-59	0-23%	0-11%	23-34%	11-22%	34-40%	22-28%	>40%	>28%
60-79	0-24%	0-13%	24-35%	13-25%	35-42%	25-30%	>42%	>30%

Source: WHO (2002).

2.7.4 Vitamins and minerals

There is no sufficient evidence suggesting that an HIV-infected person requires more vitamins and minerals than a non-infected individual's RDA (Møller *et al.*, 2000). PLHA therefore are advised to consume one RDA of all vitamins and minerals of a non-infected individual of the same age, sex and physiological status. Those with signs of vitamin or mineral deficiency as well as those who are vulnerable to micronutrient deficiencies should consume between one and two RDAs (FAO and WHO, 2002).

2.7.5 Water

Water is essential to transport nutrients, remove waste, assist in metabolic activities, lubricate moving parts, and regulate body temperature. For PLHA, two liters (8 glasses of 250ml/glass) of safe, clean potable water per day are recommended. PLHA should avoid or limit intake of alcohol (WHO, 2004).

2.7.6 Antiretroviral drugs / therapy and nutrition

PLHA often use medications to reduce the effect of HIV in their bodies and to treat opportunistic infections which, occur as a result of weakened immune system. Some of them also use micronutrient supplements such as iron and vitamin A or multivitamins (Fawzi, 2003). Medications can interact with certain nutrients. The interaction may result in negative or positive drug-nutrient interactions. Such interactions include poor absorption, poor appetite and altered metabolism which may consequently lead to reduced food intake, weight loss and other nutritional problems

(WHO, 1995). Antiretroviral drugs (ARVs) are drugs used to manage HIV by lowering the viral load and thus reducing morbidity and mortality. These drugs can influence the utilization of food and nutrients by the body. Likewise, food can affect the way the medicines work (DHHS, 2005).

ARV can interact with food and nutrition in a variety of ways, resulting in both positive and negative outcomes. It is thus critical to understand the specific ARV-nutrient interactions and implications to enable effective management of the resulting condition (WHO, 2002). Some food ingredients affect the efficacy of certain ARVs and other drugs by affecting their absorption, metabolism, distribution and excretion. As a result, those foods can either enhance or reduce the efficacy of some ARVs (Singhanetra *et al.*, 2001). A high energy, high fat and high protein meal decreases absorption of the Protease Inhibitor (PI) indinavir while a high fat meal increases the bioavailability of the Nucleoside Reverse Transcriptase Inhibitor (NRTI) tenofovir (Sharma, 2003). Certain protease inhibitors such as ritonavir and nelfinavir, can cause changes in metabolism of lipids (fats), resulting in an elevation of blood cholesterol and triglyceride levels. This in turn increases the risk for coronary heart diseases among PLHA (WHO, 2002).

2.8 Methods of Nutritional Assessments in Adults

Monitoring of nutritional status in adults is an important aspect of nutrition care for PLHA. According to WHO (2007), the process includes anthropometric, biochemical, clinical and dietary intake measurements.

2.8.1 Clinical assessment

Clinical assessment involves taking medical history. Medical history provides information on other co-illnesses that the individual may have such as diabetes and TB which also warrant good nutrition, dietary interventions and care. According to Soha (2006), clinical assessment also helps to identify any potential drug-nutrition or drug-food interactions that can be harmful. The assessment includes also assessing symptoms of nutrient deficiencies or illness that affect food intake and absorption. Examples of symptoms of nutrient deficiencies are wasting, pallor of the tongue indicating anaemia, corneal/ulcer or scar indicating xerophthalmia and bleeding gums indicating scurvy. Common symptoms which affect food intake and absorption include diarrhoea, nausea, vomiting, anorexia, mouth and throat sores and oral thrush. Diarrhoea, in particular, is one of the illnesses that are common among PLHA (Tony *et al.*, 2008).

2.8.2 Anthropometric measurement

This involves the measurement of mid upper arm circumference, weight, height and the calculation of body mass indices. The commonly used anthropometric indices are:

2.8.2.1 Weight change over time

It is a useful indicator for regular monitoring of changes in body composition. Body weight needs to be checked regularly at least once a week. Weight loss of about 6-7 kg per month for an average person indicates onset of clinical AIDS (WHO, 2005).

2.8.2.2 Body mass index (BMI)

Body Mass Index (BMI), is one of the measures of nutritional status, which uses weight and height to estimate body fat stores especially in adults. BMI is a ratio of weight in kilograms to the height in meters squared. It is a useful indicator to assess an individual's nutritional status (WHO, 2003). The cut off points of nutritional status as defined by WHO (2003) are summarized in Table 2.

Table 2: BMI references for adults

BMI (Kg/m ²)	Classification	Risk of co-morbidities
<16.0	Severe under nutrition	Very high
16.0-17.0	Moderate under nutrition	High
17.1-18.4	Mild under nutrition	Moderate
18.5-24.9	Good nutrition status	Healthy
25.0-29.9	Overweight	Mild increased risk
>30.0	Obesity	High risk

Source: www.who.org

2.8.3 Biochemical assessment

Biochemical assessment of nutritional status is done in the laboratory, where nutrient deficiencies are detected. Where available, tests for blood, protein (serum albumin), micronutrients (vitamin B₁₂, iron, zinc, folic acid and iodine) and lipid (cholesterol and triglycerides) can be used to monitor nutritional status of PLHA (WHO, 2004). Haemoglobin level is one of the indicators used to monitor anaemia (WHO, 2005). Anemia can be monitored clinically or by laboratory methods. Clinical observation involves assessing pallor (paleness) in the palms, eyelids, and tongue and on the nail

beds. Laboratory method is the measurement of haemoglobin levels (WHO, 2003). The cut off points for diagnosing anaemia as defined by Latham (1997), are summarized in Table 3.

Table 3: Cutoff points for diagnosing anaemia

Population group	Hb level g/dL
Children 6 months – 5 years old	< 11.0
Children 6 – 14 years old	< 12.0
Adult males	< 13.0
Adult females (non pregnant)	< 12.0
Pregnant women	< 11.0

Source: Latham (1997).

2.8.4 Dietary intake assessment

Dietary intake assessment methods involve assessing the types and amounts of food consumed (FAO and WHO, 2002). Usually, the information about the type and amount of food intake is obtained either by recording or by interviewing the person or caretakers (FANTA, 2004). The intended result is in terms of energy and nutrient intake (quantitative assessment) or food frequency (qualitative assessment). The quantitative assessment involves either chemical analysis in the laboratory of samples of the dishes or foods consumed or indirectly whereby the quantities of foods consumed is obtained and later on conversion of those quantities of foods into amounts of energy and nutrients ingested using food composition tables (FAO, 2005).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Areas

This study was conducted in four selected Central Prisons in Tanzania. The selection was based on geographical location. The function of Central Prisons is to accommodate prisoners who are serving long-term sentences, life imprisonment or those who are condemned and remands with difficult cases such as armed robbery, murder cases or raping. The selected prisons were Ruanda (Mbeya), Segerea (Dar es Salaam), Isanga (Dodoma) and Butimba (Mwanza).

3.1.1 Ruanda prison

Ruanda prison is found in Mbeya City. It is the only central prison in Mbeya region and in the southern highlands. The region is located in South West of Tanzania between longitudes 33-30⁰E and latitudes 08-15⁰ S. It accommodates prisoners and remands of all types from all regions in the Southern highlands. The prison accommodates 1200 to 1600 inmates per day.

3.1.2 Segerea prison

Segerea prison is found in Ilala Municipality in Dar es Salaam City. The prison is among the three central prisons found in Dar es salaam region, both located in Ilala Municipality. Other prisons are Ukonga and Keko. The region is located in Eastern part of Tanzania between latitudes 06-5⁰S and longitudes 33-12⁰E. Segerea central

prison accommodates remands of all types including short-term sentenced prisoners from the Eastern parts of Tanzania. It is the only prison which accommodates female inmates and young offenders in Dar es Salaam region. The prison accommodates 1700 to 2000 inmates daily.

3.1.3 Isanga prison

Isanga Central Prison is found in Dodoma region. It is the only central prison in Dodoma region. The region is located in central part of Tanzania between latitudes 06° - 08° S and longitudes 35° - 45° E. Isanga prison accommodates prisoners and remands of all types from the central regions of Tanzania. Isanga prison accommodates 1400 to 1500 inmates per day.

3.1.4 Butimba prison

Butimba central Prison is found in Mwanza City. It is the only central prison in Mwanza region. The region is located in Northwest of Tanzania between latitudes 02° - 30° S and longitudes 32° - 58° E. It accommodates prisoners and remands of all types from different parts of Western and Northern Tanzania. Butimba prison accommodates 1400 to 1600 inmates per day.

3.2 Study Design

A cross sectional study design was employed (Kothari, 2004). Data were collected at a single point in time.

3.3 Sampling Frame (Population)

The study units were prisoners, both HIV-infected and non-infected. The inclusion criteria were those prisoners who had stayed in the prison for at least three months before the study. The exclusion criteria were those prisoners who had stayed in the prison for less than three months by the time the survey was conducted, those with permanent ailment which require dietary or medical care on a daily basis such as diabetes mellitus type 2, pregnant women and those who were mentally ill.

3.4 Sampling Technique

A simple random sampling technique was employed in obtaining representative sample from the prisoners. The HIV status was ascertained from the prison medical records available at prison health facilities.

3.5 Sample Size Determination

The sample size was determined by using the formula by Fisher *et al.* (1991).

$$n = \frac{Z^2PQ}{d^2}$$

Where: n = Sample size required in the study

Z = Standard normal deviation that corresponds to a level of statistical
Significance of 1.96

P = Prevalence of the malnutrition in prisons (50%)

$$Q = 1-P (1-0.5)$$

D = Margin of error which is the precision of results required (5%).

Therefore: $n = [1.96 \times 1.96 \times 0.5 \times (1-0.5)] / [0.05 \times 0.05] = 384 \times 2 = 768$ HIV-infected and non-infected prisoners. The distribution of the sample for each centre

was Butimba prison-164 (21.4%), Isanga prison-102 (13.3%), Ruanda prison-228 (29.6%) and Segerea prison-274 (35.7%). This distribution was based on the number of prisoners available and eligible HIV-AIDS cases in each prison. A control group on non-infected prisoners was taken from each prison.

3.6 Data Collection

3.6.1 Construction of a questionnaire

A structured questionnaire was constructed and it was divided into four sections. Section A solicited information about background information, section B solicited information about dietary information and meal patterns, health information and water sources. Section C solicited information about anthropometric measurements and section D solicited information about body composition measurements.

3.6.2 Training of enumerators

Sixteen enumerators, four from each prison were trained on how to interview the subjects and take anthropometric measurements.

3.6.3 Administration of questionnaire

Face to face interviews were conducted at the central prisons soon after completion of the morning prison routines.

3.6.4 Measurements taken

Measurements taken were body weight, height, haemoglobin and body fat mass composition.

3.6.4.1 Height measurement

The subject stood on the stadiometer, with minimum clothing, bare footed, heels together, arms on the side, legs straight, and shoulders relaxed. The head was positioned so that he looked straight ahead. The head board was lowered upon the highest point of the head with enough pressure to compress the hair. The measurement was read and recorded to the nearest 0.1cm.

3.6.4.2 Weight measurement

Body weights were obtained by using Bioelectrical Impedance Machine. Subjects were weighed with minimal clothing on. The weight was read and recorded to the nearest 0.1kg.

3.6.4.3 Haemoglobin measurement

The procedure for determining the amount of iron in blood was started by switching on the START-site Meter, manufactured by Stambio Company in U.S.A. A test card with a CODE number that matched the CODE of the meter was fully inserted into the START-site meter. The left hand ring finger was cleaned by using alcohol swabs then dried by using sterile gauze before pricking the finger tip. The first drop of blood was wiped away by using a gauze pad. A large drop of blood was allowed to form at the pricked site. About 12 μ L of whole blood was collected by using a lancet. The lancet with blood sample was carefully placed at the center of the test card. After placing the sample at the center of the test card, the countdown test results begun. When the test was completed, the final results were displayed on the START-site meter. Results were recorded to the nearest 0.1g/dL.



Figure 3:Haemoglobin testing START-site meter

3.6.4.4 Measuring body fat mass

Bioelectrical Impedence Analyzer (BIA) Machine manufactured by TANITA Company was placed on a flat, hard surface. It was then connected to the electric current on the wall then switched on. The subject was then asked to stand on the machine bare footed without touching anything and with the body weight equally distributed on the feet. The feet were supposed to fit properly on both electrodes indicated in both sides of the machine. Information about the subject was entered into the BIA machine. Information entered included gender, age, height and physical activity. After entering this information, a drop of 1% saline solution was placed at the top of each electrode (gray area). This helped to increase the electric conductance. The subject was there after requested to step onto the electrodes. The BIA machine flushed first the weight of the subject on the top section of the LCD display, while percent body fat mass was displayed at the bottom part of the LCD. The body fat mass then recorded to the nearest 0.1%.



Figure 4: Bioelectrical Impedance (BIA) machine

3.7 Data Analysis

BMI were determined by WHO (2006) AnthroPlus Program. Body fat mass was analyzed by using TANITA body fat mass card. Variability in Hb was determined by using a one-way ANOVA using SPSS for windows program version 16.0. The dietary intakes based on 24 hours recalls were computed by using Diet Organizer software.

3.8 Ethical Clearance

Permission to carry out the research in the selected prisons was obtained from the Commissioner General of Tanzania Prisons (CGP). Ethical clearance was obtained from the National Institute for Medical Research (NIMR). Participants signed a consent form to affirm their willingness to participate in the study. Confidentiality was maintained during the entire study and no data collected could trace the subject from whom they were collected.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-demographic Characteristics of the Respondents

The socio-demographic characteristics in this study were age, education level and sex of the respondents. The information on socio-demographic characteristics is summarized in Table 4.

Table 4: The socio-demographic characteristics of the respondents (N=768)

Parameters	No. of respondents	Percent
Age:		
20 - 49	672	87.5
50 - 79	96	12.5
Education level:		
Informal	132	17.2
Primary	518	67.4
Secondary	96	12.5
College level	22	2.9
Sex of the respondents:		
Male	554	72.1
Female	214	27.9

4.1.1 Age of the respondents

Table 4 shows the socio-demographic characteristics of the respondents. Majority (87.5%, N=768) of the respondents were within 20-49 years. This implies that, most of the prisoners were young adults who fell under active working group. In a similar

study conducted by Akinlotan (2010), young adults (18-49 years) accounted for 94% (N=187) of inmates. Having such young adults in prisons may have negative effect on the economic development of the country since this age group is the most active and could contribute to productivity. On the other hand, spending time in prison or jail can have profound effects on a young person's future. Harrison *et al.*(2004) reported that, high rates of recidivism mean that many youth, once in the prison system, will stay there for significant portions of their lives, affecting their personal development in future.

According to Richard (2003), the age of an inmate appears to determine the psychological effects of imprisonment. Younger inmates aged twenty five or below, are initially more resistant to the prison structure which makes them more likely to be the targets of victimization in comparison to older inmates who assume passive avoidance roles in prison hence, increasing psychological effects of imprisonment. Younger age inmates also tend to return to jail or prison within a few years after release (Beck, 2010). Youth who have been incarcerated experience diminished income in future compared to their never-incarcerated peers (Harrison, 2006). Imprisonment in young age leads to future economic hardship as a results of lower levels of mental well-being, physical health, social attachments and a lower life expectancy (Minton, 2006).

4.1.2 Education level of the respondents

Table 4 shows the educational background of the respondents. Most of the respondents (67.4%, N=768) had primary education, 17.2% (N=768) had no formal

education, 12.5% (N=768) had secondary education while 2.9% (N=768) had college and vocational education. Majority of the respondents therefore had primary education level and only a few had college and vocational education. Education level has a direct relationship with crime in the society. Results of this study supports the findings by the American Correctional Association who reported that an increase in an individual's education level leads to decrease in his subsequent probability of engaging in crime (ACA, 2003). According to ACA, this trend is due to the increase in awareness and economic independence.

4.1.3 Sex of the respondents

Table 4 shows the gender distribution of the respondents among the four prisons. From the table, male participants were 72.1% (N=768) while females were 27.9% (N=768). The number of male prisoners was therefore higher compared to that of female prisoners. This observation supports a finding by Eryn (2012) who reported that, prisons are institutions designed by men for men. Women form only a minority of the global prison population. According to Buss (2005), high percentage of male prisoners is the truth that males are typically more openly aggressive than females, who usually tend to show their aggression in less overt and less physical ways. Females on the other hand, display more verbal and relational aggression, such as social rejection. Men express their aggression with violence more often than women. A study conducted by Anine (2007), attributed women's lesser involvement in crime largely to their unique biology, stressing, their lack of courage, their 'piety, maternity, want of passion, sexual coldness, weakness, and undeveloped intelligence'. According to Anine (2007), the vast majority of crimes in society are being

committed by men due to their behavioral traits. A report by a Canadian Public Health Agency (2010) revealed that, the rate of violent crimes in Canada doubled among males during the year 2008 compared to female youths.

In the United States, men are much more likely to be incarcerated than women. According to Karberg (2004), nearly nine times as many men as women had ever been at one time incarcerated in a State or Federal prison in the year 2001. Karberg (2004) reported, however, that women were the fastest growing demographic group in prison. A study by Goredema (2003) revealed that, women, especially in developing countries, constitute an increasing proportion of criminals, although they are still in the minority.

4.2 Nutritional Status of the Respondents

4.2.1 General nutritional status of the prisoners

Body Mass Index (BMI), is a significant determinant of nutritional status (FANTA, 2003). Figure 5 summarizes the general nutritional status of the respondents (both HIV-infected and non-infected) based on BMI categories.

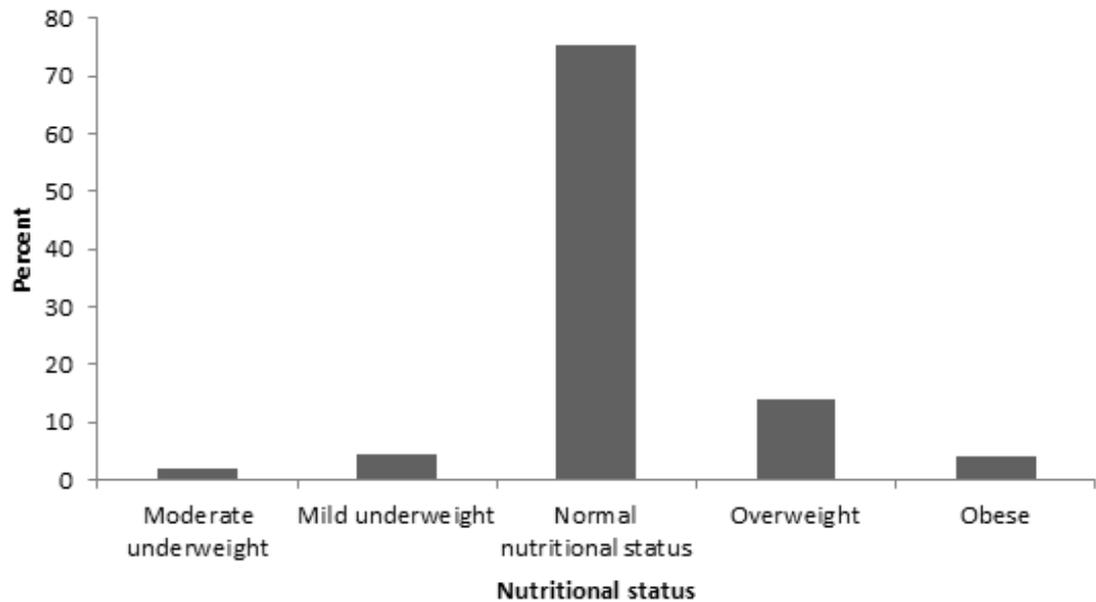


Figure 5: General nutritional status of the respondents

Results shows that, more than three quarters of the respondents had normal nutritional status (75.5 %, n=768, BMI 18.5-24.9), 13.9% were overweight (BMI 25.0-29.9), 4.0% were obese (BMI >30.0), 4.6% were mildly underweight (BMI 17.1-18.4) while 2.0% were moderately underweight (BMI 16.0-17.0).

These results corroborate findings by Akinlotan *et al.* (2010) who observed that most of the respondents (59%) in their study had normal nutritional status, 4% were underweight, 29% were overweight while 7% were obese. Our findings, however, contradicted findings by Lines (2008) who observed that, almost half of prisoners in his study were obese and overweight contrary to society view that most prisoners are underweight. In our study, only a small proportion of the respondents (17.9%, n=768) were overweight and obese. These results also show that both overweight and underweight are prevalent in prisons with the former being more prevalent.

Overweight and obesity are abnormal or excessive fat accumulation that may impair health. Overweight and obesity are now on the rise in prisons worldwide (WHO, 2007). According to WHO, both obesity and underweight have been associated with diseases. Obesity has been associated with several non-communicable diseases such as hypertension, diabetes and lipid disorders as well as with increased morbidity and mortality among adults. On the other hand, underweight is associated with infections such as tuberculosis. In prisons a double burden of obesity, suggesting over-nutrition on one hand and underweight, suggesting under-nutrition on the other hand is not uncommon (Bakari, 2005). According to Bakari, overweight and obesity in prisons are linked to more deaths in developed countries than underweight, and 65% of the prison's population lives in countries where overweight and obesity kill more people than underweight.

The fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended (FAO, 2003). According to (WHO, 2007) the cause of increasing obesity and overweight in prisons is the increased intake of energy dense foods and a decrease in physical activity due to the increasingly sedentary nature of many forms of work in prisons. Maintenance of good nutritional status for prisoners is important because it improves their health, prevents them from repeated infections, makes them creative and hence guarantees sustainable labour productivity (John *et al.*, 2006).

4.2.2 Nutritional status of infected and non-infected prisoners

Figure 3 shows the nutritional status of HIV-infected and non-infected prisoners.

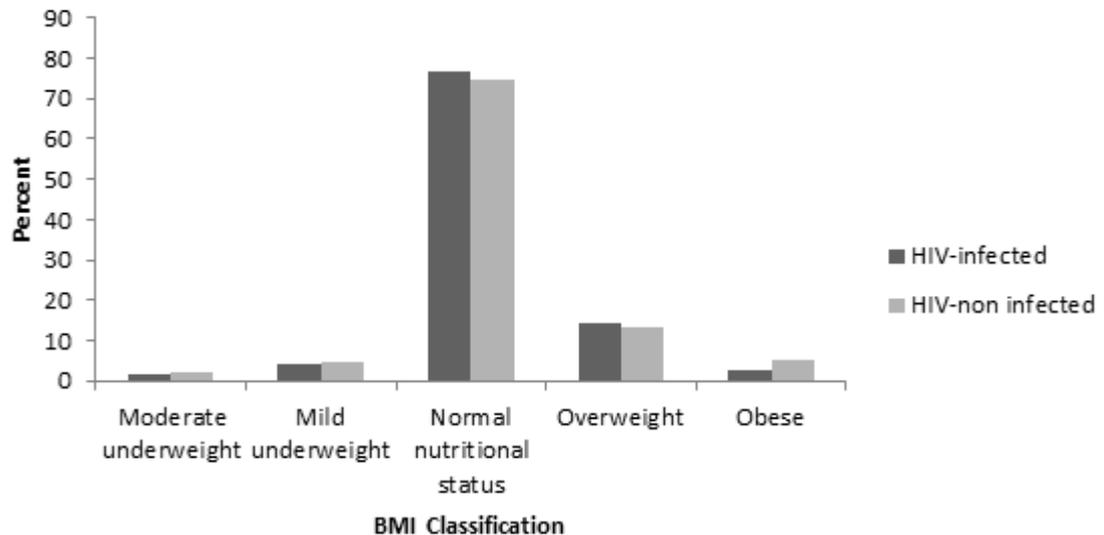


Figure 6: Nutritional status of HIV-infected and non-infected inmates

From the figure, 1.6% (n=15) of the infected prisoners were moderately underweight (BMI 16.0-17.0); 4.6% (n=35) were mildly underweight (BMI 17.1-18.4); 76.8% (n=580) had normal nutritional status (BMI 18.5-24.9); 14.6% (n=107) were overweight (BMI 25.0-29.9) while 2.9% (n=31) were obese (BMI >30.0). The figure also shows that, 2.3% (n=15) of the non-infected prisoners were moderately underweight (BMI 16.0-17.0), 4.9% (n=35) were mildly underweight (BMI 17.1-18.4), 74.5% (n=580) had normal nutritional status (BMI 18.5-24.9), 13.3% (n=107) were overweight (BMI 25.0-29.9) while 5.2% (n=31) were obese (BMI >30.0). Statistically there was no significant difference in the BMI between the two groups (p=0.745). These findings do not support the findings by John *et al.* (2006) and

Lines (2008) who observed increasing tendencies of overweight and obese cases in prison settings. In the study conducted by John *et al.* (2006), 39% of the inmates were overweight. In another study by Lines (2008), it was observed that, almost half of the prisoners were either overweight or obese. He suggested that, this could be due to inadequate physical activity and feeding habits of the inmates before incarceration. In this study the prevalence of overweight was 13.3% and obesity was just 5.2%. According to the Tanzania Demographic Health Survey (NBS, 2010), the prevalence of overweight and obesity for adults in the general population was 15 and 6%, respectively.

Maintenance of good nutrition among people living with HIV/AIDS is important because it improves nutritional status, helps to strengthen the immune system and decreases vulnerability to infections (FANTA, 2004). According to WHO (2003), a well-nourished individual has strong immune system, which delays the progression of HIV to AIDS. Malnutrition in HIV-infected person it leads to immune impairments, which then speeds up the progression of HIV to AIDS (FAO and WHO, 2002). According to WHO, (2003a) malnutrition in HIV-infected person manifests itself in weight loss, muscle wasting, reduced immune system function, minerals and vitamins deficiencies and increased susceptibility to infections. Wasting, which is common among many HIV/AIDS patients was found only on a small proportion of subjects (5.7%) involved in this study. Good nutrition increases resistance to infections and diseases by providing energy to build up the body and stabilize the immune system (WHO, 2007). According to FANTA (2005), malnutrition can occur due to insufficient intake of foods, improper digestion or poor absorption of nutrients.

Malnutrition can also occur due to eating too much of one type of food and not enough of another (Department of Health, 2001). The maintenance of good nutrition to prisoners is important because it improves their health, prevents them from repeated infections, makes them creative and hence guarantees sustainable labour productivity (John *et al.*, 2006).

4.2.3 Nutritional status of the inmates by gender

Nutritional studies in prison populations worldwide show that female prisoners are more likely to be obese than their male counterparts (Katharine, 2012). Figure 7 shows the nutritional status of male and female prisoners.

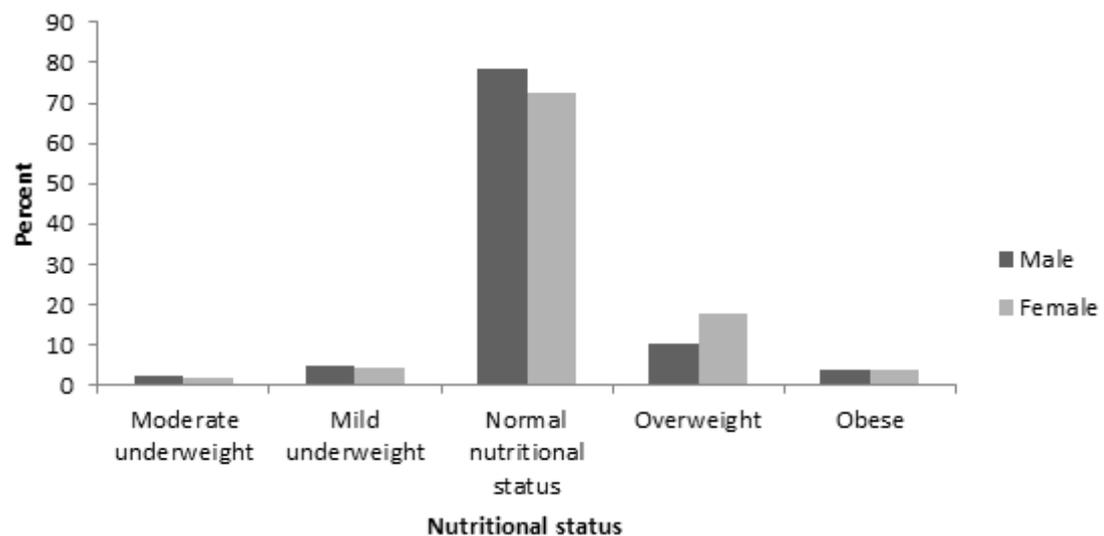


Figure 7: Nutritional status of male and female prisoners

Results showed that 2.4% (n=554), of the male prisoners were moderately underweight (BMI 16.0-17.0); 5.0% were mildly underweight (BMI 17.1-18.4); 78.5% had normal nutritional status (BMI 18.5-24.9); 10.3% were overweight (BMI

25.0-29.9) while 4.0% were obese (BMI >30.0). Also figure 7 shows that, about 1.6% (n=214) of the female prisoners were moderately underweight (BMI 16.0-17.0); 4.2% were mildly underweight (BMI 17.1-18.4); 72.7% had normal nutritional status (BMI 18.5-24.9); 17.5% were overweight (BMI 25.0-29.9) while 4.0% were obese (BMI >30.0). Females were at a higher risk of becoming overweight and obese compared to their male inmates.

4.2.4 Distribution of nutritional status by age groups

Figure 8 summarizes the distribution of nutritional status of the inmates according to age groups.

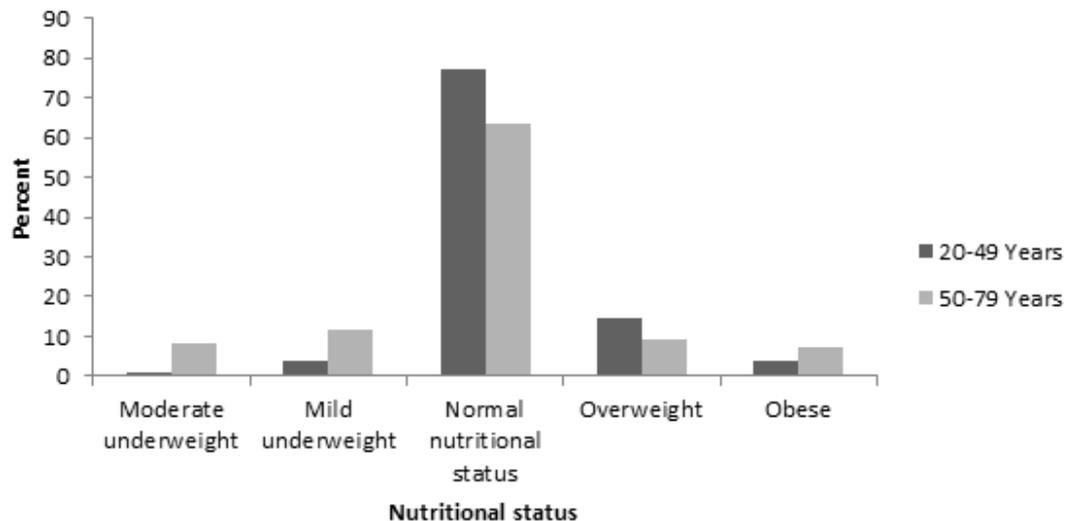


Figure 8: Distribution of nutritional status by age groups

Figure 8 shows that, majority of the respondents from both age groups fell on normal nutritional status category. The young inmate group (20-49 years) had 77.2%, (n=672) of them with normal nutritional statuses, while the older age group (50-79

years) had 63.5%, (n=96) of them with normal nutritional status. Only a small proportion of the respondents from the younger age group were moderately underweight (1.0%, n=672) compared to the older age group which was 8.3%, (n=96). About 3.6%, (n=672) of the respondents from the younger age group were mildly underweight while from the older age group the proportion was 11.5%, (n=96). In the overweight category, 14.6%, (n=672) of the younger age group were overweight, while from the older age group (50-79 years) 9.4%, (n=96) were overweight. The older age group had 7.3%, (n=96) of them classified as obese while from the younger age group (20-49 years) obese cases were 3.6%, (n=672).

Overweight and obesity result from energy imbalance. Body weight is maintained when calories eaten equals the number of calories the body expends. When more calories are consumed than burned, energy balance is tipped towards weight gain, overweight, and obesity (Flegal, 2010). The World Health Organization (WHO, 2005) estimates that, globally, at least 1 billion people are overweight and three hundred million are obese.

The prevalence of obesity and overweight has increased globally in all age groups (Nicholas, 2007). Young adults are prone to obesity in the transition from adolescence to adulthood. The periods of strong oscillation and transition of body adiposity which occur in adolescence are thought to be the critical stages for the development of obesity (Darius, 2005). Darius (2005) reported that, approximately half of obese children become obese adults, while only one tenth of non-obese children grow to be obese adults.

Individuals who are obese have a significantly increased risk of cardiovascular diseases compared with healthy weight individuals (Eric, 2003). The risk of cardiovascular diseases increases as you age. Generally, adults 45 years and older are more likely to have two or more cardiovascular related diseases, while hypertension and diabetes is the most common combination for people aged 45 to 64 years, but those 65 years or older are more likely to have hypertension plus other types of cardiovascular diseases (Anne, 2006). For men, the risk of cardiovascular diseases starts to climb at about age 45, when one out of every 100 men develops signs of heart disease. By age 55, the risk has doubled to about 2.1 out every 100 men. It continues to increase until, by age 85, about 7.4 out of every 100 men have cardiovascular disease (Mokdad *et al.*, 2003). Mokdad *et al.* (2003) reported that, for women, the risk of cardiovascular disease also climbs with age, but the trend begins about 10 years later than in men and especially with the onset of menopause.

4.2.5 Distribution of nutritional status among the prisons

Figure 9 summarizes information on nutritional status among the surveyed prisons.

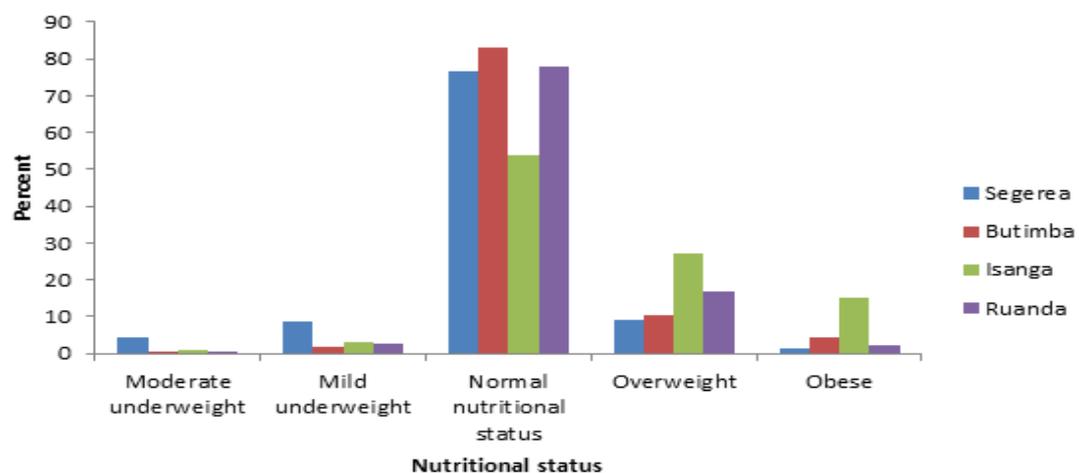


Figure 9: Nutritional status of inmates in the four prisons

Figure 9 shows that, Butimba prison had the highest percentage of respondents who had normal nutritional status (82.9%;n=580, BMI 18.5-24.9), followed by Ruanda prison (77.9%, n=580), Segerea prison 76.5%, (n=580) and Isanga prison (54.0%, n=580). Segerea prison had the highest number of inmates who were moderately underweight (4.4%, n=15;BMI 16.0-17.0) and mildly underweight (8.5%, n=35; BMI 17.1-18.4). Butimba, Isanga and Ruanda prisons had very few numbers of inmates who were moderately underweight (0.6%, 1.0% and 0.4%, n=15; respectively). Segerea prison also had the highest number of inmates who were mildly underweight (8.5%, n=35;BMI 17.1-18.4), followed by Isanga prison (3.0%, n=35), Ruanda prison (2.7%, n=35) while Butimba prison had 1.8%, (n=35). Isanga prison had the highest number of inmates who were overweight (27.0%, n=107; BMI 25.0-29.9), followed by Ruanda prison (16.8%, n=107), Butimba prison(10.4%, n=107) while Segerea prison had 9.2%, (n=107) inmates who were overweight. Isanga prison also had the highest number of inmates who were obese (15.0%, n=31; BMI>30), followed by Butimba prison (4.3%, n=31), Ruanda prison (2.2%, n=31) and Segerea prison (1.5%, n=31). Nutritional status can differ between one individual and another due to a number of factors. According to Stewart (2006), factors that affect the nutritional status of an individual are the chronic illness, quality and quantity of the food they eat, the efficiency of their digestive systems in absorbing and utilizing the eaten food and bioavailability.

4.3 Haemoglobin Status

4.3.1 General haemoglobin status of the respondents

Anaemia, characterized by a low level of haemoglobin in the blood, is a major health problem in Tanzania and it affects all age groups. According to Tanzania Demographic Health Survey report, the most common cause of nutritional anaemias is inadequate dietary intake of nutrients necessary for synthesis of haemoglobin, such as iron, folate, vitamin B12, or other nutrients (NBS, 2010). According to Latham (1997), normal Hb levels range from 13-18g/dL for males and 12-14g/dL for females. Latham (1997) reported that, haemoglobin levels ranging from 10 to 12g/dL is diagnosed as mild anaemia, 7 to 9.9 g/dL as moderate anaemia, 4 to 6.9g/dL as severe anaemia and Hb below 4g/dL as very severe anaemia. Fig.10 shows the haemoglobin status of the respondents.

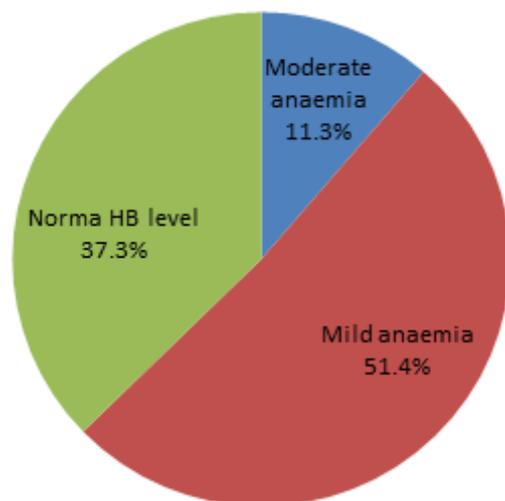


Figure 10: General haemoglobin status of the respondents

Most of the respondents (62.7% n=768) were anaemic (moderate and mild anaemia), with Hb<13g/dL for males and <12g/dL for females. Only 37.3% of the respondents had normal iron status (HB 13-18g/dL for males and 12-14g/dL for females). There were no cases of severe and very severe anaemia observed in the study. This prevalence of anaemia was above the national level for adults of 40% (NBS, 2010).

According to Gupta *et al.* (2006), anaemia is among the major nutritional problems in institutionalized individuals and prisoners due to inadequate consumption of iron rich foods such as green vegetables, fruits and animal products. Also, according to Nnaemeka and Okolie (2009), other causes of high prevalence of anaemia among prisoners are intestinal worms due to poor hygiene, shortage of adequate water supply in prisons and repeated attacks of malaria infections. A study conducted by Nnaemeka and Okolie (2009) showed that, 43.1% (n=140) of prisoners were anaemic with Hb levels below 13g/dL. According to WHO (2007), when a HIV-infected person becomes anaemic, the progression of HIV to AIDS is normally faster. Anaemia is a problem of public health significance in Tanzania since it affects also the general population. According to NBS (2010), prevalence of anaemia in women of child bearing age was 40%. Anaemia for prisoners can be prevented by eating more iron-rich foods such as animal products, green leafy vegetables, fruits, taking iron supplements, deworming, sleeping under insecticide treated nets and by clearing bushes and long grasses around prison yards (Amuga and Onwuliri, 2006).

4.3.2 Haemoglobin status of the HIV-infected and non-infected respondents

Figure 11 presents the haemoglobin status of HIV-infected and non-infected respondents in the four prisons

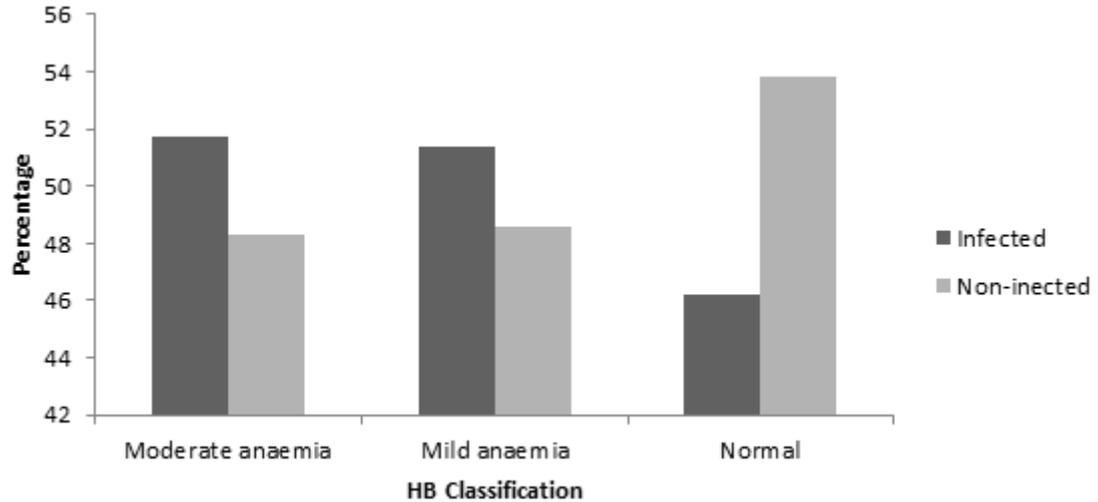


Figure 11: Haemoglobin status of HIV-infected and non-infected inmates

Figure 11 shows that, 53.8% (n=283) of the non-infected respondents had normal haemoglobin levels (Hb 13-18g/dL for males and 12-14g/dL for females), 48.6% (n=392) were mildly anaemic (Hb10-12.9g/dL for males and 10-11.9g/dL for females), while 48.3% (n=87) of the respondents were moderately anaemic (Hb 7-10g/gL). Figure 11 also shows that, 46.2% (n=283), of the HIV-infected respondents had normal haemoglobin levels, 51.4% (n=392) were mildly anaemic while 51.7% (n=87) were moderately anaemic. There was a significant difference in the haemoglobin levels between the two groups (p=0.0327).

4.3.3 Haemoglobin status of the inmates by gender

Figure 12 shows the distribution of haemoglobin according to gender of the respondents.

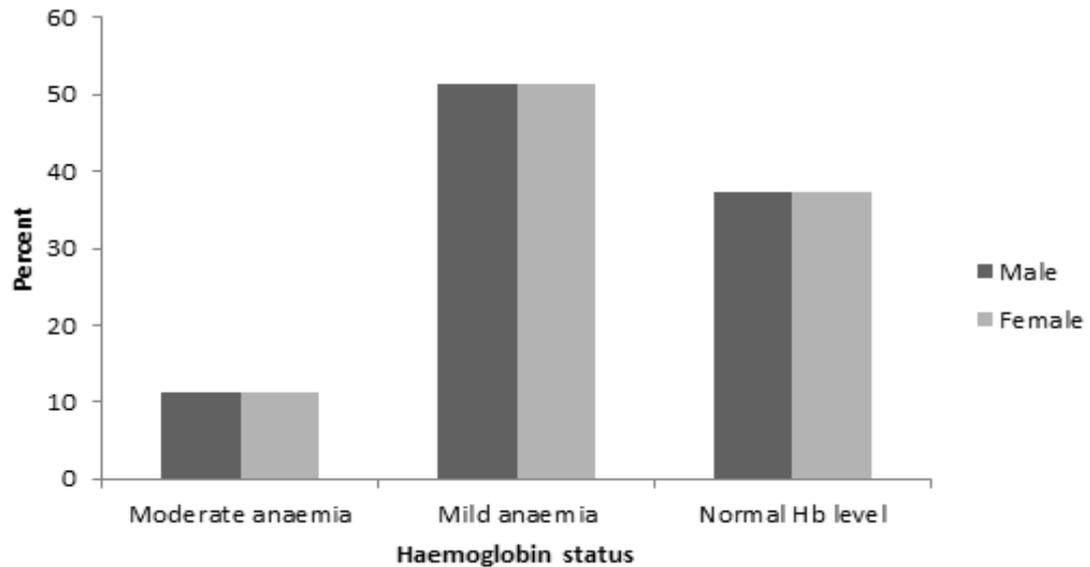


Figure 12: Distribution of haemoglobin among male and female inmates

The haemoglobin levels were almost the same in the two groups. About 11.4%, (n=87) of the male inmates were moderately anaemic, (Hb7 to 9.9 g/dL) while 11.2% (n=87) of their female counterparts were moderately anaemic. Mild anaemia cases (Hb10 to 12g/dL) for male inmates were 51.4%, (n=395), while for female inmates the prevalence was the same (51.4%, n=395). About 37.2 % (n=286) of the male inmates had normal haemoglobin levels (13-18g/dL) while (37.4%, (n=286) of their female peers had normal Hb levels (Hb12-14g/dL). Prevalence of anaemia between the males and females was therefore similar (p=0.8972).

4.3.4 Distribution of haemoglobin status according to age groups

Figure 13 shows the haemoglobin levels in the two age groups

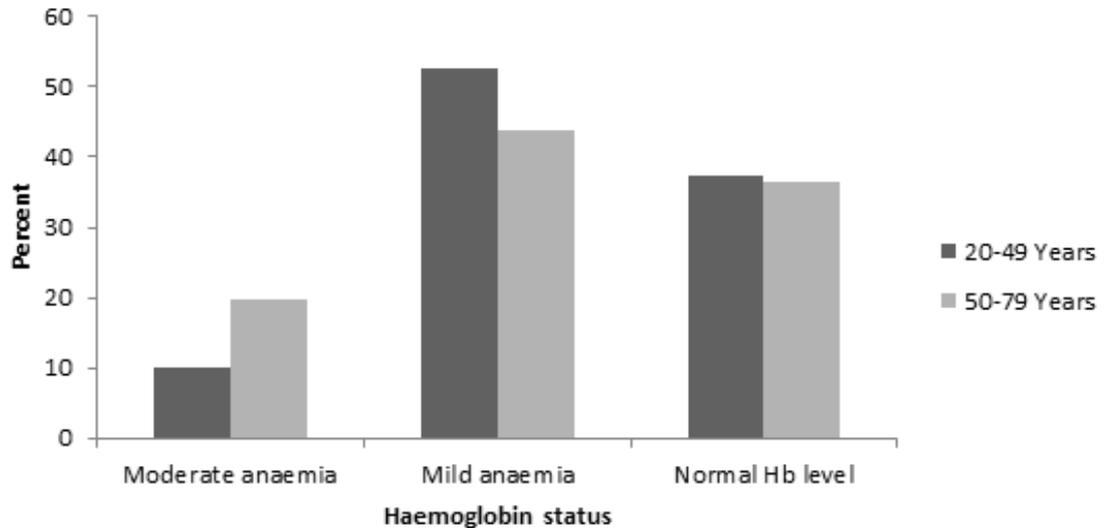


Figure 13:Haemoglobin distribution between the two age groups

Majority of the respondents from both age groups were anaemic. The older age group (50-79 years) were more moderated anaemic (19.8%, n=96) compared with the younger age group (20-49 years) which had 10% (n=672). Likewise, 52.5% (n=672) of the younger group were mildly anaemic while 43.8% (n=96) of their older peers (50-79 years) were mildly anaemic. The two age groups had almost equal proportions of inmates who had normal Hb status. More than 37% (n=672) of the younger age group (20-49 years) had normal Hb levels while 36.5% (n=96) of their older age peers had normal Hb levels.

Haemoglobin is the red blood cell protein that carries oxygen in the blood. Anaemia is an unhealthy condition indicated by low haemoglobin levels, and can ultimately be the result of iron, folate or B₁₂ deficiency, renal insufficiency, chronic inflammation,

acute or chronic bleeding, or other causes (Guralnik, 2004). Haemoglobin concentration varies according to age and sex. Normal range of haemoglobin levels as defined by the World Health Organization (2005), is between 17 to 22g/dL in new born babies, 11 to 13g/dL in children, 14 to 18 g/dL in adult male, 12 to 16g/dL in adult female, 12.4 to 14.9 g/dL in elderly male and 11.7 to 13.8 g/dL in elderly female. By WHO (2005) criteria, anaemia is defined as a haemoglobin concentration lower than 13 g/dL in men and lower than 12 g/dL in women. Severe anemia is characterized as $Hb < 10$ g/dL (Charves et al., 2004).

Haemoglobin levels, on average, decrease with advancing age in men throughout adulthood, but a more modest decline occurs in women after the age of 50 (Penninx, 2003). According to Penninx (2003), in addition to decreasing levels with older age, variation in the distribution of hemoglobin concentration increases with age as well. This increased heterogeneity in haemoglobin concentration reflects the cumulative effects of interaction between intrinsic and extrinsic factors over the life course. Cleeland *et al.*, (2003) reported that, the prevalence of anemia is higher among women before age 65 and among men thereafter, implying that women are more susceptible to anemia at a younger age due to menstrual blood loss and childbearing iron loss, while men have a higher prevalence of anemia-related morbidity at an older age. Advancing age by itself is unlikely to lead to anemia. A study by Gabrilove (2000) showed that, the average haemoglobin levels remain stable between ages 60 and 98, suggesting that, anaemia in older individuals is due to the increased prevalence of co morbidity. Aging is associated with a progressive reduction in the functional reserve of multiple organs and systems, this association enhances the

susceptibility to insufficiency of failure of those systems in presence of stress. According to Gabrilove *et al.* (2001), the production of haemopoietic growth factors does not appear to reduce with age. Gabrilove *et al.* (2001) reported that, the production of erythropoietin appeared to be inadequate to correct the level of anaemia in a number of older individuals, but in at least some of these individuals, undiagnosed renal insufficiency might have been present.

Anaemia implies health problems. Chaves (2001) reported that, in addition to heralding an underlying disease, anaemia is by itself a cause of mortality, functional decline, cardiovascular and central nervous co morbidity, and increased risk of therapeutic complications. Also, Chaves *et al.* (2002) reported that, anaemia may adversely influence the management of older cancer patients receiving chemotherapy and radiotherapy by limiting the dose, the dose intensity, and the dose density of the treatment and thus preventing adequate cancer control. In addition, anaemia may increase the cost of treating cancer by causing prolonged disability and more frequent hospitalizations.

4.3.5 Distribution of haemoglobin status of inmates in the four prisons

Fig.14 shows that, Ruanda prison had the highest number of respondents with normal Hb level (53.0%, n=283, Hb 13-18g/dL for males and 12-14g/dL for females), followed by Butimba prison (29.0%, n=283), Segerea prison (13.8%, n=283) and Isanga prison (4.2%, n=283). Majority of inmates who were mildly anaemic came from Segerea prison (49%, n=392, Hb 10-12.9 g/dL for males and 10-11.9 g/dL for females), 18.4% (n=392) of cases came from Butimba prison, 17.8%, (n=392) from

Ruanda prison while 14.8% (n=392) of cases came from Isanga prison. Segerea prison also had the highest number of inmates who were moderately anaemic (47.1%, n=87; Hb7-10g/dL). Isanga prison had 30% (n=87) of moderately anaemic cases, Butimba had 11.5% (n=87) cases and Ruanda prison had only 2.7% (n=87) cases.

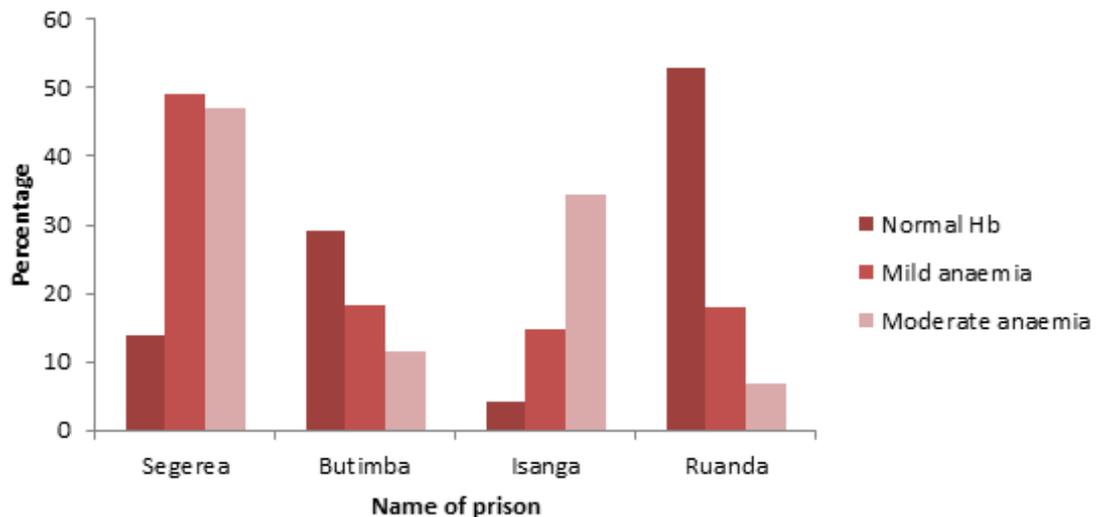


Figure 14: Haemoglobin status of inmates in the four prisons

4.4 Body Fat Mass Composition

4.4.1 General body fat mass composition of the respondents

Figure 15 shows the distribution of body fat mass composition of the inmates. Results showed that, 11.8% (n=768) of the respondents were under fat, 57.3% (n=768) had normal, healthy fat mass, 18.4% (n=768) were over fat while 12.5% (n=768) were obese. According to Gallagher *et al.* (2000), body fat mass composition is determined according to the age distribution and percentage ranges among females and males. In females, under-fat is diagnosed when it is between 0-21% at the age of 20-39 years, 0-23% at the age of 40-59 years and 0-24% at the age of 60-79 years. In males under

fat is diagnosed when it is between 0-8% at the age of 20-39 years, 0-11% at the age of 40-59 years and 0-13% at the age of 60-79 years.

Healthy, normal fat mass is detected in females when the percentage fat mass is between 21-33% at the age of 20-39 years, 23-34% at the age of 40-59 years and 24-35% at the age of 60-79 years.

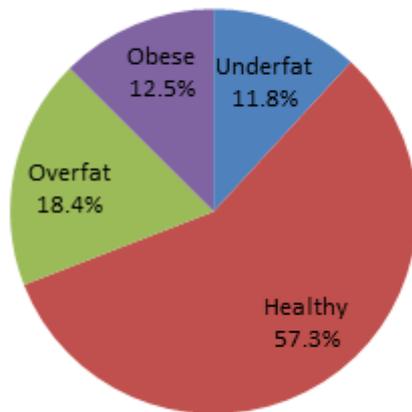


Figure 15: Body fat mass distribution among the inmates

In males, healthy normal fat mass is detected when the percentage fat mass is between 8 and 20% at the age of 20-39 years, 11-22% at the age of 40-59 years and 13-25% at the age of 60-79 years. Over fat is diagnosed in females when the body fat mass ranges between 33-39% at the age of 20-39 years, 34-40% at the age of 40-59 years and 35-42% at the age of 60-79 years. In adult males, over fat is diagnosed when the body fat mass composition ranges between 20-25% (20-39 years), 22-28% (40-59 years) and 25-30% (60-79 years). Obesity in adult females is detected when the body fat mass composition is >39% (20-39 years), >40% (40-59 years) and >42%

(60-79 years). In adult males, obesity is detected when it is >28% at the age of 40-59 years and >30% at the age of 60-79 years.

According to John *et al.* (2006), and Lines (2008), there is a growing tendency of inmates to become overweight and obesity in prison settings. Prevalence of over-fat and obese in this study was almost the same as the national prevalence of 18% and 12%, respectively. Under-fat indicates chronic energy deficiency (CED), over fat and obesity increases the risk of cardio-vascular diseases (FAO, 2004).

4.4.2 Body fat mass composition of HIV-infected and non-infected inmates

Fig.16 shows the body fat mass composition of the HIV-infected and non-infected inmates.

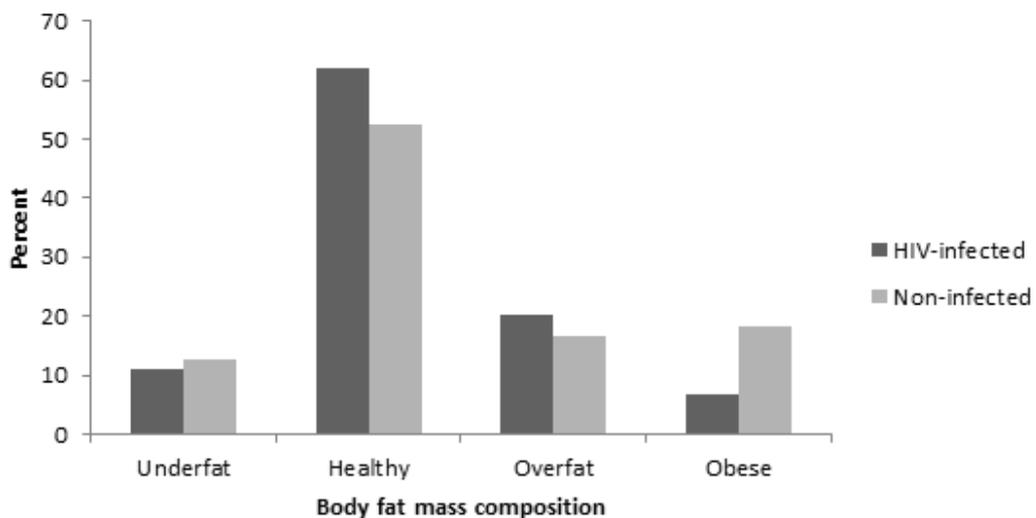


Figure 16: Body fat mass composition of HIV-infected and non-infected inmates

From the figure, majority of the HIV-infected and non-infected inmates were healthy (62%, n=440 of the HIV-infected and 52.6%, n=440 of the non-infected inmates).

Prevalence of over-fat inmates among the non-infected group was 16.7%, (n=141) while the prevalence of over-fat among the HIV-infected inmates was 20.1%, (n=141). 18.2 %, (n= 96) of the non-infected inmates were obese while 6.8% (n=96) of their HIV-infected peers were classified as obese. Prevalence of under fat inmates among the non-infected subjects was 12.8% (n=91), while for the HIV-infected inmates the prevalence of under fat was 10.9% (n=91). There was no significant difference ($p=0.2749$) in the body fat mass composition between the HIV-infected and the non-infected groups. Under-fat is associated with under-nutrition and it indicates the existence of chronic energy deficiency (CED) while over fat and obesity are associated with over-nutrition and they indicate the increasing risk to suffer from coronary and heart diseases, morbidity as well as mortality (FAO, 2004).

4.4.3 Distribution of body fat mass composition by gender

Figure 17 summarizes the distribution of body fat mass composition of the male and female inmates.

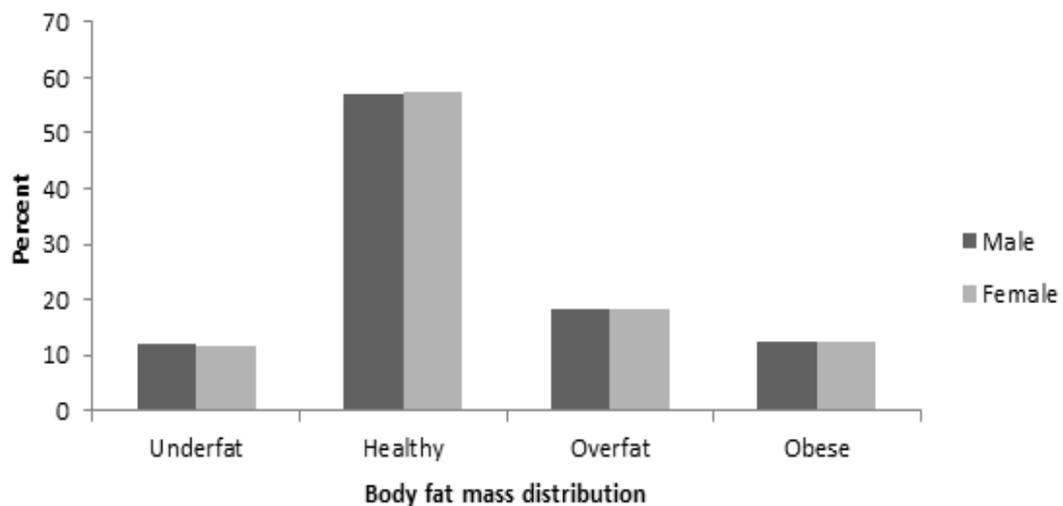


Figure 17: Body fat mass distribution among male and female inmates

The body fat mass composition of the male and female inmates was almost equal in all body fat mass categories. About 12% (n=91) of the male inmates were under fat while 11.2% (n=87) of the female inmates were under fat. On the other hand, 57.2% (n=440) of male inmates and 57.5% (n=141) of the female inmates were classified as healthy. Conversely, 18.4% of the male inmates and 18.2% (n=141) of the female inmates were over fat. Likewise, 12.4% (n=96) and 12.6%, (n=96) of the female inmates were obese. The body fat mass distribution between male and female inmates was therefore similar ($p=0.8021$).

It is well established that women generally have a higher percentage of body fat than men. A healthy range of body fat for women is 20-25%, and a healthy range of body fat for men is 10-15% (Blair, 2002). A body fat percentage over 20% for men or 30% for women is considered an indication of obesity. Body fat distribution varies among individuals and is a determinant of cardiovascular risk (Nagy, 2006). Some people carry more of their body fat in and around the abdominal area. This type of fat deposition is called android, and is most characteristic among males. The body type most common among females is the gynoid, which is characterized by fat stores in the hip and thigh region (Blair, 2002). According to Nagy (2006), the scientific explanation for the dramatic difference in body fat distribution between men and women are largely unknown, although differences in hormones, hormone receptors, and enzyme concentrations play a contributing role.

4.4.4 Distribution of body fat mass composition of the inmates by age

Fig. 18 shows the distribution of body fat mass among the age groups

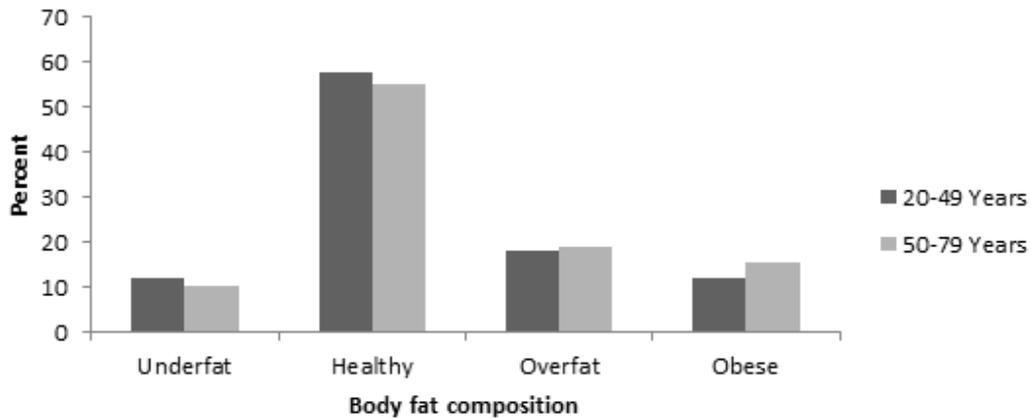


Figure 18: Distribution of body fat mass by age

The younger age group (20-49 years) was more under fat (12.1%, n=672) compared with the older age group (50-79 years) which had 10.4%, (n=96). Also the younger age group was healthier (57.6%, n=672) than the older age group peers (55.2%, n=96). In the over fat category, the older age group had more over fat (18.8%, n=96), than the younger age group which had 18.3%, (n=672). The older age group also was more obese (15.5%, n=96) than the younger age group (12.0%, n=672). This result supports several researches on the body fat mass composition in relation to age. Nagy (2006) reported that, as people get older, their muscles tend to shrink, and they tend to accumulate visceral fat. This implies that, body fat composition increases as age increase.

4.4.5 Distribution of body fat mass composition of the inmates in the four prisons

Figure 19 shows the distribution of body fat mass composition of the respondents in the four prisons involved in the study. Segerea prison had the highest number of respondents who were under fat (26.1%, n=91), followed by Butimba prison (5.5%, n=91), Ruanda prison (4.4%, n=91) and Isanga prison (1.0%, n=91). Butimba prison had the highest number of respondents who were healthy (78.6%, n=440) followed by Segerea prison (58.1%, n=440), Ruanda prison (54.4%, n=440) and Isanga prison (24.0%, n=440).

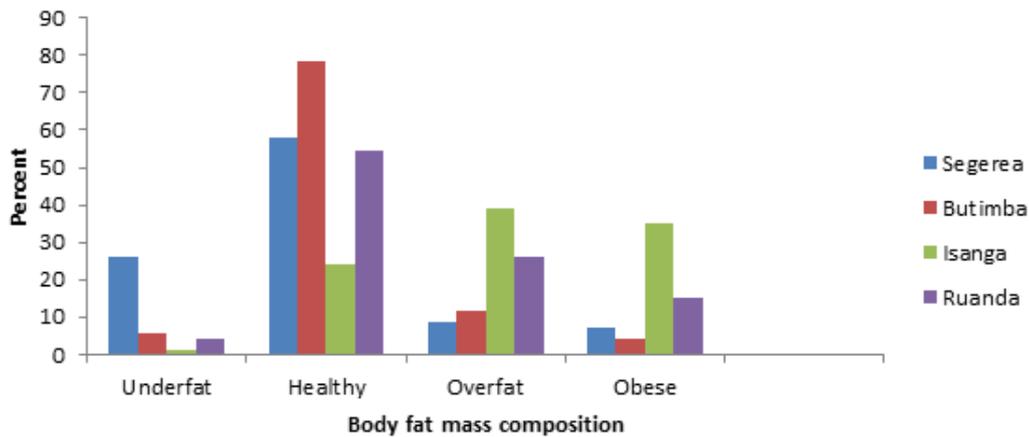


Figure 19: Body fat mass composition of the inmates in the four prisons

Isanga prison had the highest number of inmates who were over-fat (39.0%, n=141), followed by Ruanda prison (26.1%, n=141), Butimba prison (11.6%, n=141) and Segerea prison (8.8%, n=141). Isanga prison had the highest percentage of respondents who were obese (35.0%, n=96), followed by Ruanda prison (15.1%, n=96), Segerea prison had 7.0%, (n=96) while Butimba prison had 4.3% (n=96) of obese inmates. The disparity in body fat composition between the four prisons could

be due to disparity in physical activity, lifestyles, food environment, BMI, age and sex distribution among the four prisons and the disparity between the individual fat metabolisms.

Measuring body fat is important for health. Weight alone is not a clear indicator of good health because it does not distinguish between weight that comes from body fat and that come from lean body mass or muscle (Blair, 2002). Body fat is important for health since it is used for insulation, energy storage, hormone production and other functions. Keeping body fat under control and maintaining a healthy weight can help to prevent cardiovascular and other obesity related diseases (Ashley, 2000).

Cardio-vascular disease is the name given to all diseases that affect the heart and blood vessels and it include coronary heart disease, angina, heart attack and stroke (Rasmussen, 2009). Coronary heart disease is caused by a buildup of fatty deposits in the walls of the coronary arteries. Over time, the buildup causes the arteries to become narrower and narrower to the extent that the heart does not have enough oxygen to function properly. This causes pain known as angina (Braun, 2001). According to American College of Sports Medicine (2000), heart attack occur when the fatty deposit breaks away, a clot form and totally blocks an artery, causing the heart to starve of oxygen. A Stroke happens when the fatty material breaks off and blocks an artery that carries blood and oxygen to the brain. A stroke can also happen when the narrowing of the blood vessels causes an artery to rupture and bleed into the brain (Blatchford, 2005).

4.5 Dietary Information and Meal Patterns

4.5.1 Dietary intake

The dietary intake should contain appropriate amount of nutrients to meet the daily body requirements for energy, protein and fat. Table 5 shows the mean dietary intake of energy, protein and fat by the respondents.

Table 5: Mean dietary intake of energy, protein and fat by the respondents (N=768)

Diet	RDI		Mean Intake per day	
	HIV-infected	Non-infected	HIV-infected	Non-infected
Energy (kcal)	2100-2510	2100	3064	2817
Protein (g)	50-80	50-80	41.4	41.2
Fat (g)	-	-	50.1	50.7

The average energy intake of the respondents was higher than the WHO recommended daily allowance. Average protein intake of the subjects was lower than the recommended daily allowances. Higher intake of energy and low intake of protein could be a result of consumption of predominantly starchy foods and low intake of protein rich foods. These results are similar to findings by Akinlotan (2010), who observed that, average calorie intake of inmates was 4415 kcal while average intake of protein was 36g per day. A study conducted by Katharine (2012) also revealed high dietary energy intake above the recommended daily allowances among female prisoners.

Energy is required to sustain the body's various functions, including respiration, circulation, physical work, and maintenance of core body temperature (FAO, 2004). Energy balance in an individual depends on his or her dietary energy intake and energy expenditure. Imbalances between intake and expenditure result in gains or losses of body components, mainly in the form of fat and these determine changes in body weight (RCQHC and FAO, 2003). An adequate, healthy diet for prisoners must satisfy their needs for energy and all essential nutrients. Results showed that, respondents were taking more energy than the WHO recommended daily allowances. High intake of energy is beneficial, however, it increases the risk of the respondents to become overweight and obese which are dangerous to health.

Dietary protein is one of the most essential nutrients. Protein contributes to key body functions such as blood clotting, fluid balance, production of hormones and enzymes, vision cycle, cell repair, immune system, carrying iron to tissues, regulation of body metabolism and is important for muscle growth (FANTA and USAID, 2007). Results showed that, average protein intake of the respondents was lower than the WHO recommended daily allowance. This could be dangerous to health because when a person does not eat enough protein, the body begins to break down its muscles leading to weight loss and muscle wasting. Similarly, when a person does not eat sufficient carbohydrates the body will use its muscle protein for energy. Inadequate protein in the diet can lead to decreased energy, hair loss, blood and hormonal disorders, decreased body mass and impaired immune system (Piwoz and Preble, 2000).

Taking adequate amount of fat is essential for health. Apart from being a good source of energy, fat is also important as a carrier of fat soluble vitamins (A, D, E and K). However, excessive intake of fat has been associated with increased risk of overweight, obesity, coronary heart disease and certain types of cancers (NAS, 2005). Low fat diets are often low in cholesterol and higher in antioxidants and dietary fibre (FAO, 2004). Among inmates, there is no nutritional advantage to consuming high fat diets once essential energy and nutrient needs are met.

Adequate dietary intake of fats is essential to those inmates with HIV/AIDS. Dietary fat can affect the immune system by influencing substrate availability in the formation of cyclooxygenase and lipooxygenase products (Epstein, 2005). According to Epstein (2005), these products, in turn, act as lipid mediators in the control of the immune system. The cells of the immune system are highly dependent on cell membrane function for operations such as the secretion of lymphokines and antibodies, antigen receptors, lymphocyte transformation, and contact lysis. The importance of lipids in the maintenance of membrane integrity indicates that, they are potentially critical nutrients in the regulation of the immune function (Rice and Sacco, 2000).

4.5.2 Cereals, roots and tubers consumption

Cereals, roots and tubers form an important part of the diet. Cereals include maize, sorghum, millets, wheat, rice, barley and oats. Roots and tubers include cassava, sweet potatoes, yams, taro and Irish potatoes. Cereals, roots and tubers provide the

body with energy (Gillespie, 2001). Table 6 shows the frequency (times/week) of consumption of cereals, roots and tubers by the inmates in the four prisons.

Table 6: Frequency (times per week) of consumption of cereals and tubers by the respondents (n=768)

Intake per week (times)	Maize meal		Rice		Wheat		Cassava		Sweet Potatoes	
	NO.	%	No.	%	No.	%	No.	%	No.	%
Zero	44	5.7	458	59.6	514	66.9	767	99.9	766	99.8
One	0	0.0	16	2.1	1	0.1	1	0.1	1	0.1
Two	2	0.3	5	0.7	1	0.1	0	0.0	1	0.1
Three	3	0.4	2	0.3	1	0.1	0	0.0	0	0.0
Four	1	0.1	4	0.5	0	0.0	0	0.0	0	0.0
Five	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0
Six	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Seven	717	93.4	282	36.7	25	32.8	0	0.0	0	0.0
Total	768	100.0	768	100.0	768	100.0	768	100.0	768	100.0

Results showed that, 93.4% (n=768) of the inmates consumed maize meal every day of the week. Only 5.7% (n=768) of the inmates did not consume maize meal for the whole week. Majority of the inmates (59.6%, n=768) did not consume rice for the whole week and only a small proportion (36.7%, n=768) were able to eat rice seven days per week. Likewise, majority (66.9%, n=768) of the inmates did not eat any wheat product per week and only a few (32.8%, n=768) were able to eat wheat product daily. Consumption of tubers (cassava and sweet potatoes) was rare as majority of the respondents did not eat the foods at all (Table 6).

According to TFNC (2007), cereals are very important for PLHA because they provide the body with energy. However, consumption of only one staple food for a long time without diversifying with other types of foods can lead to malnutrition (Dolan *et al.*, 2007). According to Sokwawele (2007), 23 inmates died in Chikurubi prison in Zimbabwe from an outbreak of pellagra and many more were ill from the outbreak which resulted from prolonged consumption of maize meal alone. Roots and tubers are high in carbohydrates, calcium and vitamin C, but low in protein (FAO and WHO, 2002). As staple food, however, they are inferior to cereals because they consist of about two-thirds water and have much less protein, as well as lower contents of minerals and vitamins. They usually contain less than 2% protein, whereas cereals contain about 10% (FAO, WHO and UNU, 2005).

4.5.3 Consumption of pulses, meat and meat products

The consumption of pulses such as beans and peas, nuts such as ground nuts and cashew nuts and foods of animal origin such as meat and meat products, fish and eggs is important for health since they provide the body with protein which is used for rebuilding dead and new body cells (WHO, 2005). Table 7 shows the frequency of consumption of pulses, meat and fish by the respondents per week.

Table 7: Frequency (times per week) of consumption of pulses, meat and meat products by the respondents (n=768)

Intake per week (times)	Beans		Beef		Milk		Fish		Groundnuts	
	No.	%	No.	%	No.	%	No.	%	No.	%
Zero	29	3.8	428	55.7	402	52.3	733	96.2	767	99.9
One	0	0.0	297	38.7	4	0.5	16	2.1	0	0.0
Two	0	0.0	28	3.6	97	12.7	1	0.1	0	0.0
Three	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Four	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Five	5	0.7	0	0.0	0	0.0	0	0.0	0	0.0
Six	7	0.9	0	0.0	0	0.0	1	0.1	0	0.0
Seven	727	94.6	15	2.0	265	34.5	9	1.2	1	0.1
Total	768	100.0	768	100.0	768	100.0	768	100.0	768	100.0

Results showed that, 94.6% (n=768) of the inmates consumed beans every day in a week, while 3.8% did not consume beans. Regarding beef consumption, 38.7% (n=768) of the inmates consumed only once per week while 55.7%, (n=768) of the inmates did not consume at all. According to NBS (2010), beef consumption is not common in the general population in Tanzania. NBS reported that, 54% of the households in Tanzania did not consume beef in the previous week of survey, 19% ate only once and 15% ate it twice. Only 12% of the households managed to consume beef more than three times in the past week of the survey. NBS (2010) reported that, in Tanzania mainland beef is mainly consumed in the urban (60%), compared to rural (33%) communities. About 34.5% of the inmates consumed milk daily, while 55.7% of the respondents did not have access to milk at all. Consumption of fish and peanuts was very low (Table 7). In the general population, fish consumption also is low.

According to NBS (2010), only 26% of households in Tanzania Mainland consumed fish more than three times per week.

Foods of animal origin are useful complements to most diets, especially to prisoners whose diets are based on carbohydrate-rich staple foods such as maize (Giacomini, 2000). Meat, fish, eggs, milk and dairy products provide protein of high biological value, which is often a good complement to the limiting amino acids in plant foods (FAO, 2003). These products are also rich in other nutrients. Iron from meat and fish (haeme iron) is readily absorbed and enhances the absorption of iron from common staple foods (non-haeme iron) such as rice, wheat and maize (WHO, 2005). However, foods of animal origin are relatively expensive and not within the purchasing power of prisons in Tanzania. Prisoners in wealthier and industrialized countries consume large quantities of these foods and thus high intake of fat, especially saturated fat, which increases the risk of heart disease and obesity (NAS, 2005).

4.5.4 Consumption of fruits and vegetables

Fruits such as paw paws, mangoes, oranges and pineapples are good sources of vitamins and minerals. Also vegetables such as sweet-potato and cassava leaves provide the body with vitamins and minerals (FANTA, 2005). The foods called vegetables also include some fruits such as tomatoes and pumpkins, leaves such as amaranth and cabbage, roots such as carrots and flowers such as cauliflower. Table 8 shows the frequency of consumption per week of fruits and vegetables by the inmates.

Table 8: Frequency (times per week) of consumption of fruits and vegetables by the respondents per week (n=768)

Intake per week (times)	Paw paws		Oranges		Pineapples		Amaranth		Chinese	
	No.	%	No.	%	No.	%	No.	%	No.	%
Zero times	764	99.5	469	61.1	763	99.3	555	72.3	530	69.0
One times	4	0.5	283	36.8	1	0.1	117	15.2	27	3.5
Two times	0	0.0	4	0.5	0	0.0	14	1.8	10	1.3
Three times	0	0.0	6	0.8	2	0.3	6	0.8	23	3.0
Four times	0	0.0	2	0.3	0	0.0	2	0.3	144	18.8
Five times	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3
Six times	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Seven times	0	0.0	4	0.5	2	0.3	74	9.6	31	4.0
Total	768	100.0	768	100.0	768	100.0	768	100.0	768	100.0

The results show that, consumption of fruits and vegetables was generally very low. The most consumed fruits were oranges while the most consumed vegetables were amaranth and Chinese spinach. Only 36.8% (n=768) of the inmates managed to get fruits every day in a week. Paw paws and pineapples were fruits that were least consumed. Regarding consumption of vegetables, only 18.8% (n=768) of the inmates were able to eat Chinese Spinach four times a week while 15.2% (n=768) of the inmates consumed amaranth once a week. The low consumption of fruits and vegetables by inmates is due to their unavailability in prisons.

Vegetables are important part of the diet. They are all rich in carotene and vitamin C and contain significant amounts of calcium, iron and other minerals. Their content of B vitamins is frequently small. They usually provide only a little energy and very

little protein (Piwoz and Preble, 2000). An increase in the consumption of green leaves and other vegetables to inmates could play a major part in reducing vitamin A deficiency, which is often prevalent in PLHA, and could contribute to lessening the high prevalence of anaemia among prisoners as observed in this study. Consumption of vegetables was highest in Ruanda prison, thanks to the availability of vegetables in their gardens. This was reflected in the Hb status of their inmates who had the highest proportion of normal Hb status (Fig. 14). Increased vegetable consumption would also supply additional calcium and vitamin C which would prevent scurvy and also assist in healing of ulcers and wounds that are common among inmates.

The main nutritive value of fruits is their content of vitamin C, which is often high. Some fruits also contain useful quantities of carotene. Fruits usually contain very little fat or protein and usually no starch (Seumoet *al.*, 2003). Fruits, like vegetables, contain much unobservable residue, mainly cellulose. The citrus fruits, such as oranges, lemons, grapefruits, tangerines and limes, contain good quantities of vitamin C but little carotene (Lwanga, 2001). High intakes of fruits and vegetables reduce the risk of coronary heart disease and some cancers (Piwoz and Preble, 2000).

4.5.5 Fats and oil consumption

A diet very low in fat tends to be unpalatable and dull. It is difficult to cook a really good meal without any fat or oil, although the desired amount is largely a matter of habit and taste (AED, 2004). Fats and oils such as ghee, butter, coconut oil, margarine, sunflower and palm oil provide energy and increase palatability of foods. Also, fats and oils enhance absorption of fat soluble vitamins (A, D, E and K) (WHO,

2005). Table 9 shows the trend of consumption of fats and oil among the respondents per week.

Table 9: Frequency (times per week) of consumption of fat and oils by the respondents (n=768)

Intake per week (times)	Animal fat		Vegetable oil	
	No.	%	No.	%
Zero	748	97.4	63	8.2
One	1	0.1	7	0.9
Two	1	0.1	1	0.1
Three	0	0.0	0	0.0
Four	0	0.0	0	0.0
Five	0	0.0	0	0.0
Six	0	0.0	0	0.0
Seven	18	2.4	697	90.8
Total	768	100.0	768	100.0

Vegetable oil accounted for 90.8% (n=768) of the fat and oil consumed by the inmates. Animal fats were rarely consumed as only 2.4% (n=768) of the inmates consumed the fat or oil daily. According to PEPFAR (2006), fats and oils are components of essential fatty acids which are used to build body cells. However, fats and oils should be taken only in a moderate amount since high consumption is associated with increased risk of chronic non communicable diseases such as diabetes, coronary heart diseases and hypertension (WHO, 2002).

The fat consumed in human diets is often divided into two categories: visible fat such as cooking oil and invisible fat such as the oil naturally present in cereals and

legumes (AED, 2005). However, fats are relatively expensive, so the diets of poorer people or people in institutions such as prisons are often low in fat (NAS, 2005). Fat is important because it provides more than twice energy per gram compared with carbohydrate or protein. Fats and oils also assist in the absorption of fat soluble vitamins A, D, E and K (WHO, 2005).

Fats contain a variety of fatty acids. Fats derived from animals such as butter and lard usually contain a high proportion of saturated fatty acids and are solid at room temperature. Fats derived from vegetable products such as groundnuts and sun flower contain more unsaturated fatty acids and are usually liquid at room temperature (oils) (Giraldo, 2003). Our study showed that 90.8% of the inmates were taking vegetable oils, which were rich in unsaturated fat acids and therefore their risk for coronary heart disease could be lower (Verger, 2003).

4.6 Food Adequacy in Prisons

Table 10 summarizes the responses of the inmates regarding food adequacy in prison.

Table 10: Food adequacy in prisons (n=757)

Response	No. of respondents	Percent
No	135	17.7
Yes	622	81.6
Total	757	99.3

According to the results, 81.6% (n=757) of prisoners reported that the food served in the prisons was adequate. Only 17.7 %, (n=757) of inmates reported that the food served in the prisons was not adequate. Food adequacy may affect the health of

an individual and especially those living with HIV/AIDS (FANTA, 2006). According to Piot *et al.* (2001), food inadequacy leads to increased risk of malnutrition and successibility to opportunistic infections. In a situation where food and meals intake are restricted such as in prisons, nutritional requirements may be difficult to meet (John *et al.*, 2006).

4.7 Digestion Problem Among the Respondents

Table 11 summarizes the responses of the inmates regarding digestion problems in the prisons.

Table 11: Responses of the inmates regarding digestion problems (n=758)

Digestion problem	No. of respondents	Percent
Yes	484	63.0
No	274	35.7
Total	758	100.0

About 63.0% (n=758) of the respondents had digestion problems while 35.7% did not have such problems. According to Piwoz and Preble (2000), digestive problems are those conditions which make the process of eating and digestion of food, absorption and utilization of nutrients difficult such as fever, oral thrush, heartburn, constipation, nausea and vomiting. According to Akinlotan *et al.* (2010), food plays a major role in the life of prisoners, poorly designed meal, inadequate portion sizes, lack of variety and poorly cooked foods can contribute to digestion problems and other serious health conditions. According to WHO (2003), digestion problems may be reduced by

the application of good eating practices, proper cooking of foods and choosing food ingredients.

4.8 Special Diet for HIV-infected Respondents

Good nutrition for PLHA is important because it helps to strengthen the immune system and thus decreasing vulnerability to opportunistic infections. Maintaining good nutrition also helps to reinforce the effectiveness of medicines taken by the individual including anti-retroviral drugs. It also enhances tolerance, safety and adherence to ART. It is important to ensure that PLHA get proper nutrition to strengthen their immune system and complement the drug treatment. Table 12 summarizes the responses of the HIV-infected inmates regarding whether they were provided with special diets to support their health or not.

Table 12: If the HIV-infected respondents were given special diet (N=384)

Given special diet	No. of respondents	Percent
Yes	365	95.1
No	19	4.9
Total	384	100.0

Majority of the PLHA (95.1%, N=384) were given special diets. The special diets given were fresh milk, cooked rice, bread, beef, green vegetables and salads depending on the availability in the prison setting. Maintenance of good nutrition among HIV/AIDS subjects improves their quality of life and survival (FANTA,

2001). According to FAO (2005), adequate nutrition is important for the health and survival of PLHA because they are at high risk of malnutrition and mortality due to the extra demands imposed by HIV-related infections. Provision of a diet that is healthy and nutritionally balanced and acceptable to PLHA is a factor which must be considered in any food service providers (John *et al.*, 2006). According to Harrison *et al.* (2006), presence or absence of some nutrients or excess of some nutrients in the diet of HIV-infected prisoners may have effect on their anti-social behaviors or nutritional status.

4.9 Water Availability in Prisons

4.9.1 Sources of water in prisons

The source of drinking water is an indicator of whether it is suitable for drinking. Sources that are likely to provide water suitable for drinking are identified as improved sources. These include a piped sources within the dwelling, yard, or plot, a public tap, tube well, or borehole, a protected well, and a spring or rainwater. Table 13 summarizes the information regarding the sources of water used in the surveyed prisons.

Table 13: Sources of water in the surveyed prisons (n=763)

Water source	No. of respondents	Percent
Public water supply	537	69.9
Protected wells/springs	225	29.3
River/canal	1	0.1
Total	763	99.3

Majority of the inmates (69.9%, n=763) used water from public water supply systems. Protected wells and springs accounted for 29.3% of the water consumed in prisons while only 0.1% of the inmates used water from rivers and canals. Although public water supply is a good source of water in prisons, however, it is not reliable due to repeated cut offs caused by water rationing. Increasing access to improved drinking water is one of the Millennium Development Goals that Tanzania along with other nations worldwide has adopted (United Nations General Assembly, 2002). Good sources of drinking water in prisons are important to prevent water-borne and water-related diseases which are relatively high among inmates (WHO, 2005). Sources of water expected to be relatively free of these diseases are piped water, protected wells, and protected springs. Other sources such as unprotected wells, rivers or streams, ponds, lakes, or dams are more likely to carry disease-causing agents and water from these sources must be treated before use (WHO, 2007). Treatment of water used in prisons can improve the quality of drinking water and thus reduce the water-borne, water-related diseases (WHO, 2005).

4.9.2 Water scarcity in prisons

Water scarcity in prisons can lead to serious health problems such as skin infections, trachoma, diarrhoeal diseases and cholera. Table 14 summarizes the responses of the inmates regarding water scarcity in the surveyed prisons.

Table 14: Water scarcity in the surveyed prisons (n=763)

Water scarcity	No. of respondents	Percent
Yes	660	85.9
No	103	13.4
Total	763	99.3

Majority of the inmates (85.9%, n=768) reported that, there were times when there was water scarcity in prisons. Most of the prisons depended on the public water supply systems (Table 13), which were not reliable due to water cut-offs caused by water rationing. Lack of water in congested population like in prisons even for a single day may pose dangerous health problems such as diarrhoeal diseases and cholera. Water scarcity also can lead to consumption of contaminated foods, which in turn can cause food related infections (WHO, 2003). According to FANTA (2001), PLHA particularly those with low CD4 cell counts, need to drink adequate amount of clean and safe water to avoid waterborne diseases.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Although there were small proportions of inmates who were overweight, obese and underweight, the nutritional status of majority of the prisoners was generally good. The nutritional status of the HIV-infected prisoners was similar to that of the non-HIV infected peers. Anaemia is a major health problem in prisons; more than a half of the prisoners were anaemic. Over fat and obesity are alarming health problems in prisons. There were disparities among prisons, gender and age group based on nutritional status, haemoglobin levels and body fat mass composition. The dietary intake of the prisoners provided energy above the WHO (2002) recommended daily intake for the people of the same age and sex. Protein intake was below the WHO (2002), recommended daily intakes. Only a handful of the prisoners experienced frequent digestion problems. Water scarcity was a problem in most of the prisons.

5.2 Recommendations

There is need for nutrition intervention to improve the nutritional status of prisoners especially those who are undernourished, overweight, obese and anaemic.

Prison authority should;

- put effort on the establishment and improvement of prison gardens where fruits and vegetables can be grown for consumption by the prisoners.

- put effort on the construction of deep wells to ensure reliable supply of water in prisons
- promote the consumption of foods rich in protein and micronutrients such as ground nuts, legumes and lentils
- ensure that, foods are properly prepared and cooked to reduce the digestion problems
- put emphasis on more studies concerning the health of prisoners.

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- 10. How many meals do you take per day? Tick one.
a) One b) Two c) three d) four e) Five
- 11. Are you provided with special diet?
a) Yes
b) No
- 12. Mention the special diet you are given
a).....d).....
b)..... e).....
c)..... f).....
- 13. Are there food shortage times in prison?
a) Yes
b) No
- 14. Where does the prison get water?
a) Public water supply
b) wells/springs
c) river/canals
- 15. Are there times when water is scarce?
a) Yes
b) No
- 16. Which are your major problems in daily life?
a) Frequent ill
b) Little food
c) Poor or inadequate water supply
- 17. Do you have any digestion problems?
a) Yes
b) No
- 18. If yes to the above problem mention
a) -----
b) -----
c).....
d).....

Section C. Anthropometric measurements

- 19. Weight (kg).....
- 20. Height (meter).....
- 21. BMI.....

Section D. Body composition measurements

- 22. HB level (g/dL).....
- 23. Fat mass (%)