NUTRITIONAL STATUS AND ASSOCIATED FACTORS AMONG ADOLESCENTS LIVING WITH HIV IN SHINYANGA MUNICIPAL COUNCIL, SHINYANGA

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Nutritional status and associated factors among adolescents living with HIV in Shinyanga municipal council, Shinyanga

By

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation entitled "**Nutritional status and associated factors among adolescents living with HIV in Shinyanga municipal council**" in (partial) fulfilment of the requirements for the degree of Master of Public Health of Muhimbili University of Health and Allied Sciences.

Dr. George PrayGod

(Supervisor)

Date: 29th October, 2021

DECLARATION AND COPYRIGHT

I, **Ambrose A. Asenga**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature: …… **Date: …….**

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DEDICATION

This work is dedicated to all adolescents living with HIV in Tanzania

ABSTRACT

Background

Nutrition is recognized as a prime indicator of the health of individuals. Adolescence is a period between 10 and 19 years of age. It is a critical part of development in the life cycle, and period of physical and emotional change as the body matures. Adolescent's nutritional status directly impact the adolescent's growth and health status. Nutrition status among HIV infected adolescents is the most crucial factor in ensuring ART success. Without good nutrition, ART adherence is unlikely, leading to avoidable HIV-related morbidity and mortality. Shinyanga is the second region in Tanzania with the highest HIV prevalence (6.2%) among young people aged 15 to 24 years as compared to a national average (3.7%). It is reported that, delay in growth and physical development among HIV infected adolescent has an intrinsic to infection i.e., these delays may be influenced by changes in nutrient absorption. This means that, HIV compromises the nutrition of adolescents and increases vulnerability to infection. Shinyanga has a history of being one of the regions in Tanzania with food shortages. The assessment of nutritional status among HIV infected adolescents in Shinyanga has not been comprehensively studied, despite of this region being the second region with the highest HIV prevalence among adolescents. This study aimed at assessing the nutrition status and associated factors with among adolescents living with HIV in Shinyanga municipal.

Objective

To determine the nutritional status and associated factors among adolescents living with HIV in Shinyanga Municipal Council.

Methods

An analytical cross-sectional study design was undertaken between the month of June and July 2020 in Shinyanga municipal council. A simple random sampling technique was used. Adolescents aged between 10 and 19 years old who were residents of Shinyanga municipal council and HIV infected attending Care and Treatment Centres from selected health centers were studied. Data collection tool was adopted from Nutrition and Consumer Protection Division questionnaire for Individual Dietary Diversity Score (IDDS). Data cleaning and analysis were conducted using Statistical Package for Social Sciences (SPSS) version 23

software. BMI was categorized by using WHO categorization of BMI for children and adolescents between 5- and 19-years z-scores. Nutritional status for adolescent was calculated using BMI for age and classified into four groups: thin, normal, overweight and obese. Descriptive statistics were summarized using frequencies and proportions for categorical variables while mean or median with standard deviation or inter-quartile range were used to summarize continuous variables. Multinomial logistic regression analysis was used to determine factors associated with nutritional status among HIV-infected adolescents. Relative Risk Ratio (RRR) and 95% CI were used to determine strength and direction of the association. The results were considered statistically significant at p-value < 0.05.

Results

A total of 158 adolescents living with HIV were studied. Majority of the adolescents (58.2%) were females, mean age of (16.5±1.4) years, living with parents (73.4%) with mean height and weight of (134.8±15.6) cm and (41.1±10.7) kg, respectively. Prevalence of thinness and overweight were more pronounced among males' adolescents compared to their females' counterparts (10.8% vs 5.5%) and (20.0% vs 13.3%); P=0.328, respectively. Adolescents who were not consuming specialized food products or micronutrients had higher prevalence of thinness (14.3%) as compared to those consuming these products. Adolescent whose mothers were self-employed and unemployed had lower risk of being thin [RRR=0.09, 95% CI 0.01, 0.63; *P*=0.02)] and [RRR=0.10, 95% CI 0.02, 0.63; *P*=0.01)], respectively as compared with adolescent whose mothers had formal employment. Adolescent who did not feel that they had lost weight in the past month had 3.31 times higher risk of being thin as compared to adolescents who felt they had lost weight in the past month [RRR=3.31, 95%CI 1.91, 11.8; *P*=0.08].

Conclusion

Stunting, overweight and obesity were prevalent in this population and differed across sex, parental occupation and nutritional factors. In addition, the level of thinness in this study was high indicating the need for early interventions among HIV infected adolescents in Shinyanga Municipal.

Recommendations

Further larger study is needed to confirm these results and explore factors associated with thinness among adolescent HIV-infected population in the Shinyanga region.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ACTG	AIDS Clinical Trial Group
ART	Antiretroviral Therapy
BMI	Body Mass Index
CD4	Cluster of Differentiation 4
CDC	Centre for Disease Control
CI	Confidence Interval
CTC	Care and Treatment Centers
FAO	Food and Agriculture Organization
HIV	Human Immunodeficiency Virus
IDDS	Individual Dietary Diversity score
MPH-DL	Masters of Public Health Distance Learning
MUHAS	Muhimbili University of Health and Allied Science
MUAC	Mid-Upper Arm Circumference
NBS	National Bureau of Statistics
PLHIV	People living with HIV
RRR	Relative Risk Ratio
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
THMIS	Tanzania HIV/AIDS and Malaria Indicator Survey
UN	United Nations
UNAIDS	United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
WHO	World Health Organization

DEFINITION OF KEY WORDS

Adolescent

Adolescent refers to an individual in the 10 to 19 years age group (WHO, 2018) https://www.who.int/southeastasia/health-topics/adolescent-health

HIV

HIV (human immunodeficiency virus) is a virus that attacks the body's immune system (CDC, 2020).

Nutritional status

Nutritional status is the physiological state of an individual, which results from the relationship between nutrient intake and requirements and from the body's ability to digest, absorb and use these nutrients (FAO, 2007). The term malnutrition indicates a bad nutritional status.

Malnutrition

Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. Malnutrition, in all its forms, includes undernutrition (wasting, stunting, underweight), inadequate vitamins or minerals, overweight, obesity, and resulting diet-related noncommunicable diseases (WHO, 2020)

Dietary patterns

Dietary patterns are defined as the quantities, proportions, variety or combinations of different foods and beverages in diets and the frequency with which they are habitually consumed (Sánchez-Villegas and Martínez-Lapiscina, 2017)

CHAPTER ONE

INTRODUCTION

1.1 Background

Nutrition is recognized as a prime indicator of the health of individuals (USAID, 2017). It is believed that the ultimate objective of nutritional assessments is the improvement of human health (Beghin, 2008). For many adolescents, inadequate quality and quantity of food are the prime determinants of nutrition problems (Baburam, 2011).

Adolescence is a period between 10 and 19 years of age (WHO, 2021). Approximately one-fifth of the world population is in this age group (Villamor et al., 2004). The adolescence period is a critical part of development in the life cycle, a time of physical and emotional change as the body matures (Tang, et al., 2009). Most adolescents tend to have a lower prevalence of infectious diseases than children under the age of 5 and a lower prevalence of chronic diseases than aging adults (Hoddinott, et al., 2002).

Malnutrition is a main threat to the health of people living with HIV (PLWHIV) (Oumer et al., 2019). Malnutrition is associated with elevated risk of illness and death amongst HIV infected adolescents (Rose, et al., 2014; Bachou, et al., 2006). Malnutrition results from inadequate food intake and utilization of nutrients as well as increased loss of nutrients. Inadequate intake could be due to food insecurity or HIV disease complications (Alemu, 2020). Globally, the overall number of HIV-related deaths fell by 30%, however deaths of adolescents due to HIV increased by 50% between 2005 and 2012 (WHO, 2013).

In 2016, 73% of new HIV infections among adolescents occurred in Africa. (UNICEF, 2017). Many African countries already have youthful populations - for example, 51% of the population of South Sudan are under the age of 18 (UNAIDS, 2013). It is estimated that the number of 10 to 24-year-old Africans is set to rise to more than 750 million by 2060. This means that, even if current progress is maintained, new HIV infections among young people are expected to increase. If progress stalls, the results could be devastating. Estimates suggest that as many as

740,000 additional adolescents could become infected between 2016 and 2030 (UNICEF, 2016).

Tanzania has about 9.9 million adolescents aged between 10 and 19 years old, representing almost 23 per cent of the total 2010 population (NBS, 2009). While most (98%) adolescents aged 15 to 19 years have heard about HIV and AIDS, fewer than half have comprehensive knowledge about how to prevent HIV infection. (Ibid).

In 2018, just under 24,000 young people in Tanzania became HIV-positive; roughly two-thirds of whom were young women (16,000 new infections among young women, compared to 7,600 among young men) (UNAIDS, 2019). In 2016/17, 3.4% of women aged 20-24 were living with HIV, compared to 0.9% of their male counterparts (Ministry of Health Tanzania, 2019).

HIV prevalence among young people aged 15 to 24 years is highest in Iringa (8.2%), Shinyanga (6.2%), Mbeya (6.1%), Mwanza (5.9%) and Dar es Salaam (5.3%) compared to a national average for this age group of 3.7%. In contrast, the regions of Arusha and Kilimanjaro, and Zanzibar show a virtual zero prevalence among young people 15 to 24 years.

There is no accurate data of nutritional status in Shinyanga, though a study by Ashimogo (2005) indicated that Shinyanga was one of the regions in Tanzania with food shortages. Another assessment by The National Food Security Division (2010/2011) established that 423,530 people in Tanzania or 6% of 7,638,550 (the estimated total population in 28 district councils in 12 regions) were likely to be generally food insecure between November 2010 and January 2011. This included Shinyanga region particularly Shinyanga Municipal Council, and Kishapu, and Meatu districts. Shinyanga has HIV prevalence of 6.5% (NBS, 2013) thus making it ideal for the study.

1.2 Problem statement

Adolescent's nutritional status directly impacts the adolescent's physical growth and development. Nutrition status among HIV infected adolescents is the most critical factor in ensuring ART success, because without good nutrition, ART adherence is unlikely, leading to avoidable HIV-related morbidity and mortality. Shinyanga is the second region in Tanzania with the highest HIV prevalence (6.2%) among young people aged 15 to 24 years as compared to a national average (3.7%) for this age group. HIV infection in adolescents increases energy requirements and may affect nutrition status if there is a reduction in food intake (Mahan et al., 2000). Furthermore, HIV infection is associated with growth and physical development delayed (Newll et al., 2003; Verweel et al; 2002), probably due to reduced nutrient absorption (Miller, 2003). These effects of HIV on nutrition status could increase the risk of other infections making HIV-infected adolescents unable to realize their full economic potential.

The assessment of nutritional status and associated factors among HIV infected adolescents in Shinyanga has not been comprehensively studied, thus hindering development of interventions to address malnutrition in HIV-infected adolescents. Therefore, this study aimed at assessing the nutrition status among HIV positive adolescents receiving care at the selected Care and Treatment Centers (CTC) and factors associated with nutritional status among adolescents living with HIV in Shinyanga municipal.

1.3 Research Questions

What is the nutrition status among adolescents living with HIV in Shinyanga Municipal Council?
What are the factors associated with nutritional status among adolescents living with HIV in Shinyanga Municipal Council?

1.4 Objectives of the study

1.4.1 Main objective

To determine the nutritional status and associated factors among adolescents living with HIV in Shinyanga Municipal Council.

1.4.2 Specific objective

1. To determine nutrition status among adolescents living with HIV in Shinyanga Municipal Council.
2. To determine factors associated with nutritional status among adolescents living with HIV in Shinyanga Municipal Council.

1.5 Significance of the study

Understanding the nutritional status and its associated factors among HIV infected adolescents will play a vital role in in achieving the WHO and United Nations – Sustainable Development Goals (UN-SDGs) targets specifically target three (3) in ensuring healthy lives and promote well-being for all at all ages. The information that will be obtained from this study will help in developing interventions for nutritional support among adolescents infected with HIV in Tanzania and specifically in Shinyanga Municipal Council.

1.6 Conceptual Framework

Malnutrition among adolescents living with HIV leads to faster disease progression and may be influenced by inadequate dietary intake. However, inadequate dietary intake is not just about the individual's social-economic status like income/occupation and source of food. This may also be affected by both individual and social factors such as age, gender and education and social factors such as marital status, nature of residence, ethnicity, and religion, taking of alcohol, smoking and number of people in household. Also, individual health related factors like ill health or being unwell, one's state of immunity reflected by CD4 cell counts and nutritional counselling/education received may directly affect dietary intake.

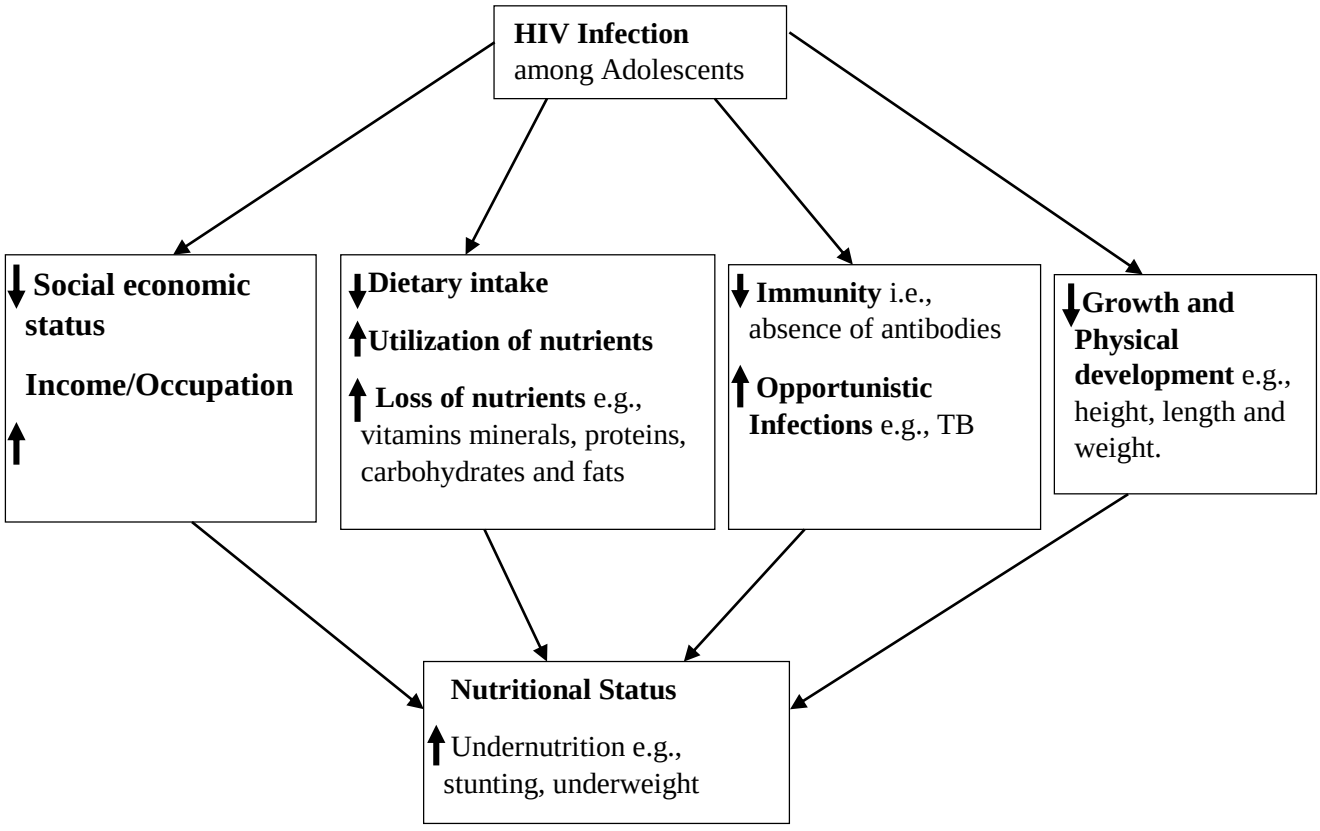

Figure 1: Conceptual Framework

2. CHAPTER TWO
LITERATURE REVIEW

1.7 Role of nutritional status on HIV infected adolescents

HIV-infected adolescents may develop feeding problems due to advanced HIV infection leading to insufficient consumption of nutrients. Economic issues leading to inadequate nutrient intake are a frequent contributor to malnutrition in many settings. These issues include a limited food supply, loss of household income or livelihood (such as farming) due to illness, and limited cooking and storage facilities. HIV infected adolescents may be too ill or uninterested to care for themselves. Depression in an adolescent can also lead to decreased appetite and poor nutrient intake(Lvers *et al.*, 2009)

1.1 Factors affecting Nutrition diversity of HIV positive adolescents

1.1.1 Socio-demographic factors

It has been found that older adults in Tanzania consume low food variety with inadequate dairy products, fruits, and vegetables, (35.2%, 59.3%, and 22.4%) respectively (Clausen et al, 2004). Another cross-sectional study among elderly respondents in Sharpeville, South Africa comparing low mean dietary diversity score of (3.41 +/- 1.34) and food variety score (4.77 +/- 2.2) with poverty parameters confirmed household food insecurity in this community (Oldewage-Theron and Kruger, 2008). However, an earlier study found that respondents in the older age group had a higher mean intake for all nutrients compared to their younger counterparts (Holcomb et al, 1995).

A study in Boston and Rhode Island (Woods et al., 2001) revealed that 25% -35% of the women had dietary intakes of less than 75% of the daily recommended intakes for vitamins A, C, E and B 6, and iron and zinc and male-headed households showed greater food security according to Kasie et al, 2017 (Kasie, 2017)

There are other social factors associated to nutrition status that have been established. Married individuals have been found to consume more servings of snacks/desserts, but fewer servings of alcoholic beverages than those who were unmarried (Deshmukh-Taskar, 2007). There is also evidence of an obvious difference in the dietary scores between the ethnic groups and religion. Muslim women have been found to have the lowest scores whereas Christian women had the highest (Savy et al, 2005). A large household size has been found to have a positive impact on food security and dietary quality (Toulmin, 2016). While there is indication from past studies that there is positive association between cigarette smoking and alcohol use, these show evidence of little relation between these habits and nutrient intake (Marian Fisher and Tavia Gordon, 20155).

1.1.2 Socio-economic factors

A number of cross-sectional studies assessing determinants of dietary diversity in adolescents have found that dietary diversity is associated with socioeconomic status (Torheim et al, 2004). Household income as a proxy indicator for socio-economic status has been found to be strongly associated with access to adequate food intake/food security (Sanusi et al, 2006). Food access that household members have is strongly associated with the control they have over household resources or income, particularly for women and their children (Linda Mayoux, 2006). Quantitative results from a US survey to establish the relationship between income and food insecurity indicated that lower income respondents were more likely to experience food insecurity (Nicholas T. Vozoris and Valerie S. Tarasuk, 2003).

1.1.3 Individual health-related factors

1.1.3.1 Ill health

Higher diet quality has been found to be less associated with barriers such as feeling sick and fewer problems related to illness or medications (Scott et al, 1998). In Abidjan, a cross-sectional study with 100 HIV-infected respondents at different stages of the infection showed that dietary intakes of HIV-infected respondents are worsened by clinical events such as anorexia, catabolism, chronic infection, fever, nausea, vomiting, diarrhea, mal-absorption, metabolic

disturbances, depression, and side effects of drugs and nutritional intakes are generally lower than recommended (Young, 1997).

1.1.3.2 Nutritional counselling and education

Studies on the effectiveness of nutritional counselling as an intervention to improve health outcomes for HIV-positive respondents have shown that nutritional counselling about protein dietary intake improved health and nutritional status of respondents allowing them to lead longer and better-quality lives especially in the absence of anti-retroviral therapy (Tabi et al, 2005). Dietary intake plays a critical role in maintaining optimal nutrition status and PLWHIV may be unable to choose and eat a varied diet if they do not possess adequate nutrition knowledge (Meyer, 1994).

1.1.4 Practices towards the role of nutrition

One of the factors that contribute to a healthy lifestyle is good dietary practices. When frequently consumed foods consist mainly of cereals and legumes and less of animal products, vegetables and fruits nutrient imbalance can cause micro nutrient deficiencies. Poor diet combinations synergized by risk factors such as inactivity can easily result to poor health. Current shifts in diets have been observed where more energy carbonated soft drinks together with refined grain products containing high fat and sugar are being increasingly consumed with less consumption of whole grain products and fresh fruits and vegetables (Hendrine et al., 2008). Future mothers need to watch their dietary patterns not only during pregnancy but also at least three months before conception. Studies with non-pregnant women of child bearing age have revealed the specific vitamins and minerals whose adequate intake is essential to a healthy pregnancy (Amadi et al, 2016). Good nutrition practices have been found to positively affect adolescent's nutritional status, menstruation, ovulation and the likelihood of conception as well as outcome of pregnancy (NAS, 1975). Nutrition habits and lifestyle choices may influence their ability to conceive and may be limited by malnutrition and food deprivation practices by women seeking sliming diets. For example, young women who diet excessively or in severe case of under-nutrition may develop amenorrhea (Torheim et al, 2003).

3. CHAPTER THREE
METHODOLOGY

a. Research design

An analytical cross-sectional study design was undertaken between the month of June and July 2020 to establish the nutrition status and associated factors among HIV infected adolescents in Shinyanga municipal council.

b. Study Area

This study was conducted in Shinyanga municipal council. Shinyanga region was selected because the rate of HIV prevalence (5.9%) is higher compared to other lake regions (Geita (5.0) Simiyu (3.9%) and Mara (3.6%) and there is an indication of food shortage in the region according to Ashimogo (2005). Shinyanga Municipal council is located in Shinyanga region in Northern Tanzania. It has a total population of y 161,391 with a total of 3 divisions and 17 wards (NBS, 2012). Approximately 20% of the population is represented by youth between 15-24 years. The study took place in 5 wards; Kambarage, Shinyanga Mjini, Old Shinyanga, Chibe, and Ibadakuli within Shinyanga municipal council. There are 34 dispensaries and 4 health centers in Shinyanga municipal council. HIV prevalence among young people aged 15 to 24 years in Shinyanga urban is 5.9% (UNICEF, 2011)

Figure 2: Map showing study area

Source: Tanzania Regions (2010)

c. Study population

The study population were adolescents aged between 10 and 19 years old who are resident of Shinyanga municipal council and HIV infected attending CTC from selected health centers.

d. Eligibility criteria

i. Inclusion criteria

Adolescents aged between 10 and 19 years old, who are resident of Shinyanga municipal council, and HIV infected attending CTC from selected health centers.

ii. Exclusion criteria

Adolescents having signs or symptoms of chronic diseases (cardiovascular diseases, diabetes) and/or using or had history of using medication that altered body composition (such as insulin, sulfonylurea and thiazolidinediones etc.) or nutritional status were excluded (Verhaegen and Van Gaal, 2000). Also, adolescents living with HIV who are admitted or seriously sick within selected health centers were excluded.

e. Sampling and sample size

i. Sample size calculation

The estimated sample size was calculated based on the estimated prevalence of adult malnutrition of 10.3% (Olalekan, 2008). A standard normal value (1.96) at 95% confidence interval with a 5% margin of error (e) was used to estimate the minimum sample size. The formula for estimating a single population proportion with specified absolute precision was used as shown below (Lwanga and Lemeshow, 1991)

$$n = \frac{Z^2{}_{\propto/2} PQ}{\varepsilon^2}$$

Where;

n = Desired sample size

$Z_{\alpha/2}$ = Standard normal deviation

P= Estimated proportion of the population with undernutrition. Prevalence of adult malnutrition in SSA was used as a proxy estimation of adolescents' malnutrition in Shinyanga (which is currently unknown).

Q = (1-P), which represents the estimated proportion of the population with adequate nutrition.

= Acceptable margin of error

$$n = \frac{1.96^2 * 0.103(1-0.103)}{0.05^2} = 158.27$$

A minimum estimated sample size was 158 adolescents.

ii. Sampling procedure

Random sampling technique was used. Shinyanga region was selected because it was the second region in Tanzania with the highest HIV prevalence among adolescents. Also, it was past reported as among region with food shortage in Tanzania. Specifically, Shinyanga municipal council was selected because the HIV prevalence among adolescent in Shinyanga region was more pronounced in urban as compared to rural settings. Five CTCs were randomly selected out of 12 total CTC available in Shinyanga municipal council using simple random sampling procedure by excel program. For each selected CTC, a list of all HIV infected adolescents expecting to attend clinic during the data collection period was generated. Probability proportional to size sampling was used to get a minimum expected number of adolescents to be enrolled from each selected CTC. A call was made a day prior the interview date by the appointed nurse to remind participants /participants' guardian about their clinic day and insist the participant not to miss the appointment. On the day of interview, participants who showed up at the CTC clinic and assented to take part in the study and their parent/guardian signed a consent to participate in the study were screened for eligibility and enrolled. Same procedures were repeated in each selected CTC visited and a total of 158 HIV infected adolescents were eligible, consented to participate in the study and respond to the questionnaire interviews.

f. Study Variables and Variable definition

i. Dependent variables

In this study the main outcome variable was Body Mass Index (BMI). Which is calculated as weight in kilograms (kg) divided by height in meter square (m^2). Each adolescent's height and weight were measured in the metric system, using standardized techniques. The Study assistant (s) measured the participant's height to the nearest 0.1cm and weights to the nearest 0.1kg while wearing light clothes and without shoes using a locally available Stadiometer and weighing scale (Heuer, Switzerland) respectively. Body Mass Index (BMI) was then calculated as the ratio of weight and height. The categorization of BMI for age was based as per WHO recommendations for 5 to 19 years to assess the nutritional status for adolescents (WHO, 2016).

ii. Independent variables

The independent variables include; age, sex, parents' education level, parents' marital status, patents' occupation, house ownership, living with parents and state of health and nutritional counselling, ART history, dietary diversity intake. Table 1 below show independent variables included in the study and their definitions.

Table 1: Independent variables and definitions

Variables	Option levels
Age in years	10-19 years
Sex	0=male, 1=female
Paternal education	0=No formal education, 1=Primary level, 2= Secondary level, 3=College/University
Maternal education	0=No formal education, 1=Primary level, 2= Secondary level, 3=College/University
Paternal Occupation	0=Formal employed 1=Self-employed 2=Unemployed
Maternal Occupation	0=Formal employed 1=Self-employed 2=Unemployed
Parents marital status	0=Married/Cohabiting 1=Single, 2= Divorced/Widowed
Parent House Ownership	0= No 1= Yes
Adolescent living with Parent	0=No, 1=Yes
Weight	In kilograms
Height	Measured in centimeters then converted into meters
BMI for age	WHO recommendations z scores
HAZ	Height for age z scores
Adolescent living with parents	1=Yes, 0=No
Adolescent lactating or pregnant	1=Yes, 0=No
Adolescent experiencing symptoms i.e., Diarrhea	1=Yes, 0=No
Adolescent that felt has lost weight	1=Yes, 0=No
Adolescent recently or soon start ART (<=6 months)	1=Yes, 0=No
Ever consumed micronutrients in the past month	1=Yes, 0=No
Ever received nutritional counselling	1=Yes, 0=No
Ever received nutritional counselling since ART	1=Yes, 0=No
Consuming fortified supplementary food	1=Yes, 0=No
Adolescent taking micronutrient supplements	1=Yes, 0=No
Consumed vegetables or fruits yesterday	1=Yes, 0=No
Adolescent consumed meat such as beef, pork yesterday	1=Yes, 0=No
Adolescent consumed any milk product yesterday	1=Yes, 0=No
Adolescent consume any food made with oil, fat or butter yesterday	1=Yes, 0=No
Referred to nutritional assessment and counselling	1=Yes, 0=No
Provided with specialized food product	1=Yes, 0=No
Provided with micronutrients supplements	1=Yes, 0=No
Referred to food security and livelihood services	1=Yes, 0=No
Dietary diversity scores	0=low (<=6 food groups), 1=Medium (7-9 food groups), 2= High (>=10 food groups)

g. Data collection methods

Interviews were used for data collection using a questionnaire. The study also included anthropometric measurement i.e., height and weight. A research team comprises of 3 researchers; one research officer and two research assistants.

i. Data collection tools

Data collection instrument was adopted from Nutrition and Consumer Protection Division questionnaire for individual Dietary Diversity Score (IDDS) (FAO, 2007). The AIDS Clinical Trial Group (ACTG) adherence questionnaire was also used as a guidance in assessing dietary intake diversity among HIV infected adolescents. The questionnaire included adolescent's information such as; age, sex, height, weight, living with parents, ART history, dietary diversity intake, state of health and nutritional counselling. Parental information such as; parents' education level, parents' marital status, patents' occupation and house ownership.

h. Validity and Reliability issues

Before field activities and data collection started, 3 days training was conducted to the research team. Research officer presented an overview of the study to research assistants and explained the aim of the study. At this time, research assistants went through consent forms and both English and Swahili questionnaires to understand the questions, their meaning and interpretations. Rehearsal among research assistant were done to each other from consent to the interviews. Pre-test of the tools and procedures were done in 3rd day of training to the nearby CTC clinic around Shinyanga town. After the pre-test, feedback was shared, challenges observed from the pre-test were explained and finalization of the tools were done. Additional to this, every evening of the day after field activities there was a debriefing meeting with research assistance to identify challenges, progress and how to improve the activity. Data quality check was also done by the research officer in collaboration with research assistants during field activities in every night. Team was also required to go through each filled question from the data collected to make sure data is complete and accurate. This was to ensure good quality of

the data (validity and reliability) to avoid unnecessary missing information because it was easy to correct them during field activities.

i. Data collection procedures

After sampling and confirming that the study participant met all inclusion criteria, their socio-demographic and consent for participating in the study were recorded. There were also 2 local nurse/doctors for each selected CTC clinic who helped in explaining purpose and methodology of the study to the adolescents and their guardians during data collection activity. Height and weight were measured at this time followed by an interview using questionnaire. The interviews were conducted in Swahili language. Consumption of food groups information was based on 24 hours recall and it was self-reported by the participants. Each food group eaten by a respondent was given a score of 1 and the total individual scores was computed. After completion of the administering of the questionnaire the study participants were then handed over the reports of anthropometrics measurement and nutritional status results. For those with abnormal results were referred regarding further investigations, treatment and nutritional modification at the responsible department.

i. Data Management and Analysis

Data was double entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSS) version 23 software. The cleaning processes was achieved through; checking for missing and abnormal values, checking for normalization of the continuous variables through histograms and normal plots, and renaming and categorization of the variables (based on the previous literature) for better interpretations. BMI was categorized by using WHO categorization of BMI for children and adolescents between 5- and 19-years z-scores (WHO, 2016)

Descriptive statistics were summarized using frequencies and proportions for categorical variables while mean or median with standard deviation or inter-quartile range were used to summarize continuous variables depending on their distribution respectively. Nutritional status for adolescent was calculated using BMI for age and was classified into four groups: thin, normal, overweight and obese. Adolescents were regarded as ‘thin’ whose BMI for age z-scores

was below -2 standard deviation (SD), BMI for age z-scores between -2SD to below 1SD were regarded as 'normal', BMI for age z-scores between 1SD to 2SD were regarded as 'overweight' and those with BMI for age z-scores above 2SD were regarded as 'obese' (WHO, 2016). Dietary diversity score was calculated based on food groups consumed. There were 17 food groups and each group was assigned 1 (if consumed) or 0 (if not consumed). The total scores were calculated by summing up responses across food groups for each individual. Average dietary diversity score of adolescents in this study (10.6) was calculated by taking sum of all total scores for all observations (1679) divided by total number of adolescents surveyed (158). A total score of at least 10 were categorized as high dietary diversity, between 7 and 9 as moderate dietary diversity and those below or equal to 6 were assigned as low dietary diversity (Krebs-Smith *et al.*, 1987). Since the outcome measure has four categories, the multinomial logistic regression analysis was used to determine factors associated with nutritional status of HIV infected adolescents. Selection of the factors to be included in the multivariate analysis were considered to those which were statistically significant with outcome variable in the crude analysis of multinomial logistic regression at p-value less than 0.2 (20%), based on the literature review and considering of the biological plausibility. Relative Risk Ratio (RRR) with their corresponding 95% Confidence Interval (CI) was used to determine strength and direction of the association. The results were considered statistically significant at p-value < 0.05.

j. Ethical Considerations

An ethical clearance number MUHAS-REC-07-2020-399 (Appendix 7.4) was granted from the Ethical Review Committee of MUHAS. Verbal consent was obtained from all participants before administering the questionnaire or obtaining measurements. The consent of participants less than 18 years was given by parents or guardians after participants provide assent. Both consents and structured questions was administered in local Swahili language. All participants were informed that there were no risks involved from adherence questions and were further explained that there are no direct benefits from participating in the research and no payment for participating in the study but will have a chance to measure their anthropometrics i.e., height

and weight to know their nutritional status. Participants were informed that they have right to refuse to participate or to withdraw from the interview any time they will feel to.

The study team ensured confidentiality by ensuring no name appeared in any written reports based on this study results. Also, before initiation of field work, data collectors were trained on privacy and breach of confidentiality by not sharing participants' information with other participants. No participant's name was used, instead unique identifiers were used.

3. CHAPTER FOUR
RESULTS

a. Sociodemographic characteristics of adolescents living with HIV in Shinyanga Municipal Council.

The socio-demographic characteristics of adolescents living with HIV in Shinyanga Municipal Council are summarized in **Table 2**. Majority of the adolescents (58.2%) were females with mean age of (16.5±1.4) years, living with parents (73.4%) with mean height and weight of (1.3±0.2) meter and (41.1±10.7) kg, respectively. Parental education was predominant by primary school level for both adolescents' mothers' (79.7%) and fathers' (55.1%). Fifty two percent of the adolescent's parents were married or cohabiting with vast majority of fathers being self-employed (81.6%) while more than half of adolescents' mothers were unemployed (53.8%).

Table 2: Socio-demographic characteristics of adolescents (14-19 years) living with HIV in Shinyanga Municipal Council (N=158)

Variable	n	%
Sex		
Male	66	41.8
Female	92	58.2
Adolescents' age in Years		
(Mean±SD)	16.5±1.4	
Maternal Education		
No formal Education	22	13.9
Primary level	126	79.7
Secondary level	10	6.4
Paternal Education		
No formal Education	20	12.7
Primary level	87	55.1
Secondary level	45	28.5
College/University	6	3.8
Maternal Occupation		
Formal Employed	7	4.4
Self Employed	66	41.8
Unemployed	85	53.8
Paternal Occupation		
Formal Employed	11	7.0
Self Employed	129	81.6
Unemployed	18	11.4
Parents marital status		
Married/Cohabiting	83	52.5
Single	42	26.6
Divorce/Widowed	33	20.9
Parents house ownership		
Yes	105	66.5
No	53	33.5
Adolescent living with parents		
Yes	116	73.4
No	42	26.6
Adolescents' weight in kg (Mean±SD)	41.1±10.7	
Adolescents' height in m (Mean±SD)	1.3±0.2	
Adolescents' height for age (HAZ) (Mean±SD)	-3.1±1.1	
Adolescents' body mass index for age (BAZ) (Mean±SD)	0.3±1.6	
Adolescents' body mass index (BMI) in kg/m^2 (Mean±SD)	22.8±6.0	

b. Nutritional status of adolescents living with HIV in Shinyanga Municipal Council.

The nutritional status of adolescents living with HIV in Shinyanga Municipal Council showed that 60.9% of the adolescents were normal, 7.7% were thin, 16.0% were overweight and 15.4% were obese.

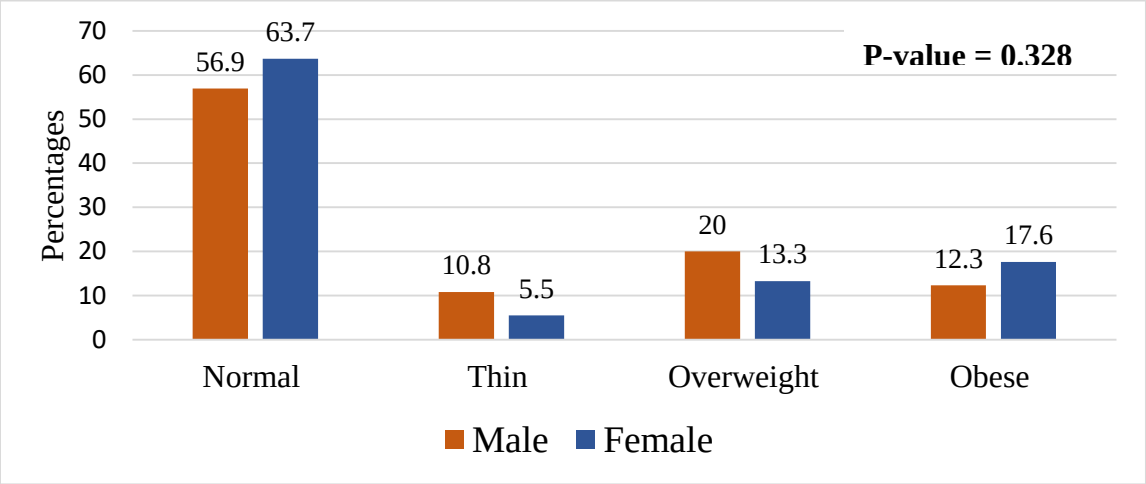

Figure 3: Nutritional status of Adolescents living with HIV by Sex

At least 60% of the adolescent's males and females were normal (56.9% vs. 63.7%). Prevalence of thinness and overweight were more pronounced among adolescents' male as compared to their female's counterparts (10.8% vs 5.5%) and (20.0% vs 13.3%), respectively. Unlike thinness and overweight, prevalence of Obese were higher among adolescents' female compared with male (17.6% vs. 12.3%). However, observed differences were not statistically significant (p-value = 0.328) (**Figure 3**).

i. Nutritional status of adolescents living with HIV by socio-demographic characteristics.

The nutritional status of adolescents living with HIV by socio-demographic characteristics are shown in **Table 3** below. There is significant evidence that the nutritional status of adolescents living with HIV differed across level of adolescents' mother occupation. More than half (57.2%) of adolescent living with HIV who had poor nutritional status (thin and obese) belongs to mothers who were formally employed (P=0.018). There is no statistical evidence that nutritional status of HIV infected adolescent differed across other socio-demographic characteristics in this study.

Table 3: Nutritional status of adolescents (14-19 years) living with HIV by socio-demographic characteristics in Shinyanga Municipal Council (N=156).

Variable	n	Normal (%)	Thin (%)	Overweight (%)	Obese (%)	χ^2-P value
Sex						
Male	65	56.9	10.8	20.0	12.3	0.328
Female	91	63.7	5.5	13.3	17.6	
Maternal Education						
No formal education	22	59.1	9.1	18.2	13.6	0.961
Primary level	124	60.5	8.1	16.1	15.3	
Secondary level	10	70.0	0.0	10.0	20.0	
Paternal Education						
No formal Education	20	65.0	5.0	20.0	10.0	0.975
Primary level	85	62.4	8.2	12.9	16.5	
Secondary level	45	55.6	8.9	20.0	15.6	
College/University	6	66.7	0.0	16.7	16.7	
Maternal Occupation						
Formal Employed	7	42.9	42.9	0.0	14.3	**0.018**
Self Employed	65	64.6	6.2	18.5	10.8	
Unemployed	84	59.5	6.0	15.5	19.0	
Paternal Occupation						
Formal Employed	10	80.0	0.0	10.0	10.0	0.658
Self Employed	129	58.1	7.8	17.8	16.3	
Unemployed	17	70.6	11.8	5.9	11.8	
Parents marital status						
Married/Cohabiting	82	59.8	11.0	12.2	17.1	0.569
Single	41	63.4	2.4	19.5	14.6	
Divorce/Widowed	33	60.6	6.1	21.2	12.1	
Parents house ownership						
Yes	103	56.3	8.7	18.4	16.5	0.418
No	53	69.8	5.7	11.3	13.2	
Adolescent living with parents						
Yes	115	60.0	8.7	18.3	13.0	0.314
No	41	63.4	4.9	9.8	22.0	

ii. Nutritional status of adolescents living with HIV by nutritional characteristics.

The nutritional status of adolescents living with HIV by nutritional characteristics are summarized in **Table 4** below. There is marginal significant evidence that nutritional status of adolescent differed between adolescent who ever received nutritional status since ART and those who were not. Adolescents who had not ever received nutritional counselling since ART had poor nutritional status (Thin, Overweight and Obese) – (66.7% vs 38.5%; P= 0.096) as compared to their fellow counter parts. Also, nutritional status of adolescent differed between those who felt had lost weight unintentionally in the past month as compared to those who did not i.e., Majority of adolescent who had poor nutritional status (thin, overweight and obese) belongs to those who did not felt has lost weight unintentionally in the past month (42.6% vs 36.3%; P=0.097) as compare to HIV infected adolescent who felt has lost weight unintentionally in the past month. Other observed differences of the nutritional status of adolescent living with HIV across levels of other nutritional characteristics included in this study were not statistically significant. **Table 4**.

Table 4:Nutritional status of adolescents (14-19 years) living with HIV by nutritional characteristics in Shinyanga Municipal Council (N=156).

Variable	n	Normal (%)	Thin (%)	Overweight (%)	Obese (%)	χ^2-P value
Experience symptoms in the past month i.e., diarrhea (n=155)						
Yes	7	85.7	0.0	0.0	14.3	0.472
No	148	59.5	8.1	16.9	15.5	
Participant felt has lost weight unintentionally in the past month (n=153)						
Yes	91	63.7	4.4	20.9	11.0	**0.097**
No	62	57.4	13.1	8.2	21.3	
Has the client recently or soon start ART (n=152)						
Yes	148	59.5	8.1	16.2	16.2	0.444
No	4	100.0	0.0	0.0	0.0	
Has the client consumed specialize food product/micronutrient						
Yes	142	62.7	7.0	14.8	15.5	0.360
No	14	42.9	14.3	28.6	14.3	
Ever received nutritional counselling						
Yes	8	62.5	0.0	25.0	12.5	0.772
No	148	60.8	8.1	15.5	15.5	
Ever received nutritional counselling since ART						
Yes	153	61.4	7.8	16.3	14.4	**0.096**
No	3	33.3	0.0	0.0	66.7	
Consuming fortified supplementary food						
Yes	12	58.3	8.3	8.3	25.0	0.733
No	144	61.1	7.6	16.7	14.6	
Taking micronutrients supplement						
Yes	12	58.3	8.3	8.3	25.0	0.733
No	144	61.1	7.6	16.7	14.6	
Consume vegetable or fruits yesterday						
Yes	34	64.7	5.9	14.7	14.7	0.951
No	122	59.8	8.2	16.4	15.6	

Table 4 (Continue): Nutritional status of adolescents (14-19 years) living with HIV by nutritional characteristics in Shinyanga Municipal Council (N=156).

Variable	n	Normal (%)	Thin (%)	Overweight (%)	Obese (%)	χ^2-P value
Consume meat such as beef, pork yesterday						
Yes	37	67.6	5.4	10.8	16.2	0.676
No	119	58.8	8.4	17.6	15.1	
Client consume any milk product yesterday						
Yes	19	57.9	5.3	10.5	26.3	0.515
No	137	61.3	8.0	16.8	13.9	
Client consume any food made with oil, fat or butter yesterday						
Yes	72	52.8	12.5	16.7	18.1	0.106
No	84	67.9	3.6	15.5	13.1	
Referred to nutritional assessment and counselling (n=154)						
Yes	6	83.3	0.0	16.7	0.0	0.587
No	148	60.1	8.1	16.2	15.5	
Provided with specialized food product (n=154)						
Yes	6	83.3	0.0	16.7	0.0	0.587
No	148	60.1	8.1	16.2	15.5	
Provided with micronutrients supplements (n=154)						
Yes	6	83.3	0.0	16.7	0.0	0.587
No	148	60.1	8.1	16.2	15.5	
Referred to food security and livelihood services (n=154)						
Yes	6	83.3	0.0	16.7	0.0	0.587
No	148	60.1	8.1	16.2	15.5	

c. Factors associated with nutritional status among adolescents living with HIV in Shinyanga Municipal.

Crude and adjusted factors of nutritional status among adolescent are summarized in **Table 5** below. Adolescent whose mothers were self-employed and unemployed had 90% lower risk of being thin versus normal weight [RRR=0.09, 95% CI 0.01, 0.63; *P*=0.02)] and [RRR=0.10, 95% CI 0.02, 0.63; *P*=0.01)], respectively compared with adolescent whose mothers were formal employed in the crude analysis. The association remained significant for mothers who were self-employed but was not observed among adolescents whose mothers were unemployed when other variables were adjusted in the model.

Adolescent who did not feel that they had lost weight in the past month were marginally significantly associated with being thin compared to those with normal weight in the crude analysis [RRR=3.31, 95%CI 1.91, 11.8; *P*=0.08]. However, this association was not sustained after adjustment for potential confounders. Additional in adjusted analysis, we found adolescents who did not feel that they had lost weight in the past month were about three times more likely to have obesity compared to those with normal weight [RRR=2.70, 95%CI 1.00, 7.30; *P*=0.05].

Adolescent living with HIV who did not consume any food made with oil, fat or butter a day before interview had 78% lower risk of being thin compared with those who consumed any food made with oil, fat or butter a day before interview [RRR=0.22, 95%CI 0.06, 0.87; *P*=0.03]. After adjusting for other factors, the association remained significant i.e., the risk of thinness among adolescent who did not consume any food made with oil, fat or butter yesterday were 83% lower compared to those who consumed any food made with oil, fat or butter yesterday [RRR=0.17, 95%CI 0.04, 0.77; *P*=0.02].

Adolescent who did not ever received nutritional counselling since ART had marginal significant higher risk in both crude and adjusted of being obese as compared to those who received counselling [RRR=8.55, 95%CI 3.74, 12.00; *P*=0.07] and [RRR=11.9, 95%CI 0.81, 17.3; *P*=0.09], respectively. Sex of the adolescent seemed to be insignificantly associated with the nutritional status in both analyses, however it was forced into the model as it is known to be among the profound classical confounders.

Table 5: Crude and adjusted multinomial logistic regression showing factors associated with nutritional status of adolescents (14-19 years) living with HIV (N=156).

	Thin		Overweight		Obese	
Variables	**RRR$^{\Phi}$(95%CI)**	**RRR¶(95%CI)**	**RRR$^{\Phi}$(95%CI)**	**RRR¶(95%CI)**	**RRR$^{\Phi}$(95%CI)**	**RRR¶(95%CI)**
Sex						
Male	1.00	1.00	1.00	1.00	1.00	1.00
Female	0.46 (0.13-1.54)	0.33(0.08-1.42)	0.58(0.24-1.43)	0.48(0.17-1.38)	1.28 (0.50-3.27)	0.86 (0.28-2.61)
Maternal Occupation						
Formal Employed	1.00	1.00	1.00	1.00	1.00	1.00
Self Employed	0.09(0.01-0.63) *	0.08(0.01-0.78) *	0.87(0.25-2.95)	0.09(0.02-0.53)	0.50(0.04-5.51)	0.35(0.03-4.30)
Unemployed	0.10(0.02-0.63) *	0.12(0.01-1.22)	0.46 (0.04-4.99)	0.87(0.07-6.10)	0.96(0.093-9.89)	0.81(0.07-9.36)
Participant felt has lost weight in the past month						
Yes	1.00	1.00	1.00	1.00	1.00	1.00
No	3.31(1.91-11.8) *	3.43(0.84-13.9)	0.44(0.15-1.27)	0.46(0.15-1.39)	2.15(0.85-5.43)	2.70(1.00-7.30) *
Client consume any food made with oil, fat or butter yesterday						
Yes	1.00	1.00	1.00	1.00	1.00	1.00
No	0.22(0.06-0.87) *	0.17(0.04-0.77) *	0.72(0.30-1.75)	0.57(0.22-1,48)	0.56(0.23-1.39)	0.47(0.18-1.28)
Ever received nutritional counselling since ART						

Yes	1.00	1.00	1.00	1.00	1.00	1.00
No	0.13(0.07-1.23)	2.64(1.01-6.85)	2.46(0.74-6.78)	0.73(0.12-4.15)	8.55(3.74-12.00) $^{\beta}$	11.9(0.81-17.3) $^{\beta}$

NOTE: Reference group for the outcome variable (nutritional status) is "normal weight";

ϕ = Crude Relative Risk Ratio; ¶= Adjusted Relative Risk Ratio; ⁎= Significant results at p<0.05;

d. Dietary pattern among adolescent living with HIV in Shinyanga Municipal

Dietary patterns of food groups consumed by adolescents are summarized in **Table 6** below. Most of the foods groups that were consumed by the adolescents includes; more than 94% of adolescent consumed spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea and other fruits. Ninety percent of adolescents consumed group of legumes, nuts and seed; eggs; milk and milk products; and around 82.9% of adolescents consumed cereals. Food groups that were less consumed includes organic meat (liver, kidney and heart) – 9.5%, red palm products (16.6%) and Flesh meat (beef, pork lamb, chicken) – 20.9%.

Looking on dietary diversity scores, majority of adolescents were categorized as high dietary diversity (77.2%) i.e., those who consumed at least 10 food groups out of 17 food groups. Only 0.6% were ranked as low dietary diversity (consumed less or equal to 6 food groups) **Table 6**.

Table 6: Dietary pattern among adolescent (14-19 years) living with HIV in Shinyanga Municipal (N=158)

Variables	n	%
% Of adolescents who consumed from the following food groups		
Cereals	131	82.9
Vitamin A rich vegetables and tubers	90	57.0
Other vegetables	117	74.1
Dark Green leafy vegetables (cassava)	79	50.0
Vitamin A rich fruits (mango, papaya)	83	53.0
Other fruits (wild fruits)	148	94.0
White tubers and roots	65	41.1
Organ meat – liver, kidney, heart	15	9.5
Flesh meat – beef, pork, lamb	33	20.9
Eggs	142	89.9
Fish	84	53.2
Legumes, nuts and seeds	142	89.9
Milk and milk products	142	89.9
Oils and Fats	114	72.2
Red Palm products	26	16.6
Sweets (Sugar, honey, chocolates)	119	75.3
Spices, Condiments, Beverage	149	94.3
Dietary diversity		
Low (≤ 6 Total score)	1	0.6
Medium (7 - 9 Total score)	35	22.2
High (≥ 10 Total score)	122	77.2

4. CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

a. Discussion

The present study evaluated the nutritional status and associated factors among adolescents living with HIV in Shinyanga Municipal Council. This study found that 7.7% of HIV positive adolescents were thin and 79.4% were stunted. This prevalence of undernutrition was high and falls short of the strategy to end all form of malnutrition and address the nutritional needs by 2030 (Lartey, 2015). Our prevalence of thinness (7.7%) is lower than what was reported in rural Dodoma (18%) among adolescent aged 10-19 years (Ismail *et al.*, 2020) and that of Tanga (21.1%) among children of 6 months to 14 years (Sunguya *et al.*, 2014) and Ethiopia (20%) among HIV positive adolescent on antiretroviral therapy (Shiferaw and Gebremedhin, 2020). Similar results were reported in Uganda (7.25%) among HIV positive adolescent aged 10-19 years (Darshit *et al.*, 2020) and in Brazil (7%) among adolescents aged 11years (Araújo *et al.*, 2010). The level of stunting in the current study was higher as compared to the studies done in Tanzania (Otis *et al*., 2015), Dodoma (21%), Tanga (21.1%), Uganda (25%) and Cambodia (46.6%) and Ethiopia (40.8%) as mentioned above. High level of stunting in the current study may be due to the setting of this study i.e., Shinyanga was one of the regions in Tanzania with food shortage (Ashimogo, 2005). Another possible explanation could be majority of adolescents in the present study were not referred to nutritional assessment and counselling, not provided with specialized food products, not provided with micronutrients supplements, and were not referred to food security and livelihood services. The variation of thinness and stunting in different studies might be due to the variable study settings, while our participants attended an urban clinic, some of the comparative studies involved a combination or only rural areas.

In the present study, prevalence of thinness and stunted were higher among adolescent males (10.8% and 91.7%) as compared to females (5.5% and 72.7%), respectively. The findings of this study show that male adolescents were at high risk of being both stunted and underweight compared with females, confirming the results of other studies which showed that boys were at

higher risk of malnutrition than girls throughout adolescence (Ismail *et al.*, 2020; Shiferaw and Gebremedhin, 2020)

Regarding factors associate with nutritional status; maternal occupation, adolescent felt has lost weight in the past month and adolescent who consumed any food made with oil, fats or butter yesterday were the significant factors associated with thinness among HIV positive adolescent in Shinyanga municipal. Adolescents belonging to self-employed mothers and who do not consume any food made with oil, fats or butter yesterday had significantly lower risks of being thin as compared to adolescents whose mothers were formally employed and those who consumed any food made with oil, fats or butter yesterday, respectively. This association was significant both in crude and even after controlling for other factors. Similar factor was reported in Brazil; maternal schooling is expected to have a strong influence on nutritional status among children and adolescents, since the mother is usually responsible for determining a child's diet (Hillesheim *et al.,* 2014). Maternal education was not associated with thinness nor stunting in the univariate and bivariate analysis in the present study hence was dropped in the regression analysis and were not reported.

Other studies have reported several factors associated with nutritional status and malnutrition among HIV positive adolescents in different settings however, some of them was not assessed in the current study and was reported as a limitation of this study. Adolescents who had attained secondary education and above were less likely to be malnourished which denotes the importance of education in nutrition care. This was reported in the studies done in Uganda, Kenya and India (Col and Kunwar, 2002; Abuya, Ciera and Kimani-Murage, 2012; Bbaale, 2014). However, this finding is inconsistence with the studies done in Dodoma and in Ethiopia. Adolescents' education level was positively associated with both thinness and stunting i.e., adolescents with secondary education levels have significantly higher thinness and stunting than adolescents with primary school levels. These results were reported by study in Dodoma Tanzania (Ismail *et al.,* 2020) and a study conducted in Ethiopia that reported that the highest grade completed by the adolescents was positively associated with thinness and stunting (Assefa, Belachew and Negash, 2015). This finding could be due to adolescents in secondary

schools spending much more time studying and less time engaging in other childhood activities than adolescents in primary school. More study time could give them greater access to foods and other nutritional benefits compared with primary school children who play most of the time and may miss opportunities for foods and other nutritional benefits. However, the present study did not asses level of education of the HIV infected adolescent, hence this was beyond the scope of this study.

In Cambodia, HIV positive adolescents who receiving ART for longer duration were reported to have protective factor against stunting (Yasuoka *et al.*, 2020). This finding was consistence to results of a study conducted in Thailand, which demonstrated that the younger the adolescent at ART initiation, the greater the effect on height growth velocity regardless of the ART regimen (Traisathit *et al.*, 2019). Again, the present study Adolescent who receiving ART was not significant in all stages of analysis and when forced in the model, the model fails to converged (to give out the results). This was associated with small sample size of the data and majority of adolescent (94.8%) were receiving ART hence the comparison group/cell was very small to give out the results.

Adolescents living with HIV who felt has lost weight in the past month in this study were only significant in the crude analysis of the regression analysis. Due to the small sample size, the present study had no enough power to demonstrate the association of many factors especially those relating to food groups and nutrients.

b. Strengths and Limitations

The strength of the study was the involvement of both in school and out-of-school adolescents, which is not common for many studies since out-of-school adolescents are difficult to access.

The findings of the study should be interpreted in consideration of its multiple limitations. Since we used a cross-sectional design, the study could not ascertain the temporal relationship between the various predictors of nutritional status.

The findings presented may not be generalizable to other Tanzanian adolescents regionally or nationally because only few town wards were involved in the study and were not selected probabilistically. In addition, the study may have benefited from a mixed-methods design in order to ascertain qualitative information about predictors of nutritional status, but this was not feasible.

Another limitation is the assumption used in the study to take the 24-hour recall period provided an indication of an adolescent's habitual diet. However, this effect was minimized by excluding respondents that had unusual dietary intake in previous 24 hours such as feasts at functions and celebrations. Also, the researcher excluded the very weak or very sick. This makes the study results less generalizable to all adolescents at different stages of ill-health.

The use of dietary diversity as a proxy for dietary quality may not be a specifically measure the recommended of nutrient intake. However, this was validated and found to adequately reflect nutrient adequacy. This study did not assess some important predictors of nutritional status including adherence to ART and actual intake of nutrient, Further, we could not separately present the prevalence of malnutrition according to the mode of HIV transmission (perinatally or sexually acquired) as such information was not collected in the study.

c. Conclusion

In conclusion, the findings highlighted a number of important issues related to HIV positive adolescent nutritional status in Shinyanga Municipal. The prevalence of stunting, overweight and obesity were high in this study and differ across gender, parental education and occupation. The low prevalence of thinness is alarming for early intervention among HIV infected adolescents in Shinyanga Municipal. On the other hand, adolescent who did not felt has lost weight in the past month and those who did not received nutritional counselling had significantly positively associated with poor nutritional status (Thin, Obese or Overweight). Overall, the current study suggests a need for interventions that are essential to mitigate the scope of nutritional status among adolescents in this and in similar setting.

d. Recommendation

Despite the fact that the dietary diversity score was high, the nutritional education provided by health care providers should be sensitized to encourage patients to increase diversity of dietary focusing on food groups which was observed to have low diversity among participants. These include flesh and organ meat, vitamin A rich foods, fruits and vegetables. This can be guided by conducting nutritional counselling to HIV infected adolescents.

The findings of the study should be interpreted with caution considering the use of cross-sectional design which is not suitable to show causal relationship between various predictors of nutritional status. A better-designed study with larger sample size and more-detailed information is needed to understand the association more fully.

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6. APPENDICES

a. Consent Form

Hello. My name is_____ I am working on behalf of Ambrose Asenga of MUHAS. I have been requested on his behalf to collect data on the topic "Nutrition status and associated factors among HIV infected adolescents in Shinyanga municipal council." This data is collected for academic purposes ONLY; to complete his master's degree in Public Health.

The main objective of this study is to assess the nutritional status and associated factors of HIV-infected adolescents in Shinyanga MC. You have been selected to participate in this discussion based on your status as one of the clients that attends the facility that has been in the sample study. The information collected will be only used for the purpose of academic.

I therefore ask you to take part in this exercise by providing information, which will be used in the objective of the study only. I would guarantee you that information will be confidential and only be used for academic purposes. If at any time you feel that you wouldn't continue to answer the questions, you can tell me and we will stop the exercise immediately. You do not have to answer any question you do not feel comfortable answering. You have the right to accept or refuse to participate in this study and your participation or refusal will not have any consequences to you personally or your family.

Please let me know if you have understood the aim of this interview and your rights to participate or not. *[INTERVIEWER PAUSE AND PROBE]*.

All participants in this survey are required to indicate their acceptance by signing that they have been informed and that they accept to participate. If you have questions after the survey, you may contact Mr. Ambrose Asenga Mobile 0717136221 or the MUHAS department who provided approval for us to conduct this survey.

(Please tick accordingly, and continue with the interview once the consent of the respondent is secured. If respondent refuses consent, thank him/her for his/her time and continue to next respondent.)

I agree I do not agree

Interviewee Signature…….

b. Food and Nutrition Questionnaire among Adolescents and Adults living with HIV

Guide to Screening for Food and Nutrition Services Among Adolescents and Adults Living with HIV

Figure 1. Sample Screening Questionnaire for Nutrition Services

NUTRITION SCREENING TOOL				
Date of screening (dd/mm/yy):	Name of staff person completing screening:			
Client name:	Sex (M/F):		Birthdate (dd/mm/yy):	
1. NUTRITION ASSESSMENT AND COUNSELING				
Is the client pregnant or lactating?		Y	N	*If the answer to any of these questions is "yes," refer the client to nutrition assessment and counseling.*
In the past month, has the client experienced symptoms including diarrhea, nausea, vomiting, thrush/mouth sores, anemia and lack of appetite that could be alleviated through diet?		Y	N	
In the past month, has the client felt that he or she has lost weight unintentionally?		Y	N	
Has the client recently started or will soon start ART?		Y	N	
In the past month, has the client consumed specialized food products or taken micronutrient supplements?		Y	N	
Does the client have any nutrition concerns or questions about his or her diet?		Y	N	
Has the client ever received nutrition counseling since testing positive for HIV?		Y	N	*If the answer to either of these questions is "no," refer to nutrition assessment and counseling.*
Has the client ever received nutrition counseling since starting ART?		Y	N	
2. PROVISION OF SPECIALIZED FOOD PRODUCTS				
Weight in kilograms (kg)	Height in meters (m)			For adults > 18 years of age *If BMI < 16.0, refer for treatment of severe malnutrition.* *If BMI ≥ 16.0 and < 18.5, refer for treatment of mild to moderate malnutrition.*
Body mass index (BMI) (weight in kilograms) ÷ (height in meters)²				
For adolescents 15-18 years of age BMI-for-age z-score				*If BMI-for-age < -3 SD, refer for treatment of severe malnutrition.* *If BMI ≥ -3 and < -1 SD, refer for treatment of mild to moderate malnutrition.*
For pregnant or post-partum women up to 6 months after delivery Mid-upper arm circumference (MUAC) in centimeters				*If MUAC < 19.0 cm, refer for treatment of severe malnutrition.* *If MUAC ≥ 19.0 and < 22.0 cm, refer for treatment of moderate malnutrition.*
3. MICRONUTRIENT SUPPLEMENTATION				
Is the client consuming fortified specialized food products designed for malnourished people or people living with HIV (PLHIV), such as ready-to-use therapeutic food (RUTF) or fortified supplementary foods?		Y	N	*If the client is not consuming either a fortified specialized food product or micronutrient supplement, refer for micronutrient supplementation (only if facility provides MN supplements routinely).*
Is the client taking a micronutrient supplement?		Y	N	
4. FOOD SECURITY AND LIVELIHOOD SERVICES				
Did the client or anyone in the household eat any of the following foods yesterday?				
Vegetables or fruits		Y	N	
Meat such as beef; pork; lamb; goat; rabbit wild game; chicken, duck or other birds; liver, kidney, heart or other organ meats; fresh or dried fish or shellfish; eggs		Y	N	
Cheese, yogurt, milk or milk products		Y	N	
Foods made with oil, fat or butter		Y	N	
If the client or anyone in the household did NOT eat any of the foods from the food groups above, why not?				*If the reason was inability to access or buy the foods, refer to food security and livelihood services.*
RESULT OF SCREENING				
Referred to nutrition assessment and counseling?		Y	N	
Provided with specialized food product?		Y	N	
Provided with micronutrient supplement?		Y	N	
Referred to food security and livelihood services?		Y	N	

c. Dietary diversity Questionnaire

DIETARY DIVERSITY QUESTIONNAIRE [1]

Please describe the foods (meals and snacks) that you ate yesterday during the day and night, whether at home or outside the home. Start with the first food eaten in the morning.
Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned.

Breakfast	Snack	Lunch	Snack	Dinner	Snack

[Household level: consider foods eaten by any member of the household, and exclude foods purchased and eaten outside of the home]
When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Question number	Food group	Examples	YES=1 NO=0
1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. ugali, nshima, porridge or pastes or other locally available grains*	
2	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrots, squash, or sweet potatoes that are orange inside + *other locally available vitamin-A rich vegetables (e.g. red sweet pepper)*	
3	WHITE TUBERS AND ROOTS	white potatoes, white yams, white cassava, or other foods made from roots	
4	DARK GREEN LEAFY VEGETABLES	dark green/leafy vegetables, including wild ones + *locally available vitamin-A rich leaves such as amaranth, cassava leaves, kale, spinach etc.*	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) , including wild vegetables	
6	VITAMIN A RICH FRUITS	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches + *other locally available vitamin A-rich fruits*	
7	OTHER FRUITS	other fruits, including wild fruits	
8	ORGAN MEAT (IRON-RICH)	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds	
10	EGGS	chicken, duck, guinea hen or any other egg	
11	FISH	fresh or dried fish or shellfish	

12	LEGUMES, NUTS AND SEEDS	beans, peas, lentils, nuts, seeds or foods made from these	
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	RED PALM PRODUCTS	Red palm oil, palm nut or palm nut pulp sauce	
16	SWEETS	sugar, honey, sweetened soda or sugary foods such as chocolates, candies, cookies and cakes	
17	SPICES, CONDIMENTS, BEVERAGES	spices(black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages OR *local examples*	
			YES=1 NO=0
Individual level only	Did you eat anything (meal or snack) OUTSIDE of the home yesterday?		
Household level only	Did you or anyone in your household eat anything (meal or snack) OUTSIDE of the home yesterday?		

[1] *FAO/Nutrition and Consumer Protection Division, version of May, 2007. Please acknowledge FAO in any documents pertaining to use of this questionnaire.*

[2] *This questionnaire may be used for any individual above the age of three years. For children under three, the dietary diversity questionnaire used in DHS surveys for young children is more appropriate.*

d. Ethical clearance approval

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

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IRB#: MUHAS-REC-07-2020-399

Ambrose A. Assenga,
MPH-Distance Learning,
School of Public Health and Social Sciences,
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED "NUTRITION STATUS AND ASSOCIATED FACTOS AMONG ADOLESCENTS LIVING WITH HIV IN SHINYANGA MUNICIPAL COUCIL. "

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from **31st August, 2020 to 30th August, 2021.** In case you do not complete data analysis and dissertation report writing by **30th August, 2021,** you will have to apply for renewal of ethical clearance prior to the expiry date.

Dr. Emmanuel Balandya
Ag. DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Public Health and Social Sciences, **MUHAS**