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The association of school food environment with eating habits of school going adolescents in Tanzania

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Certification and Declaration

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ABSTRACT

Background: Adolescence is a stage of particular nutritional vulnerability. Lifestyle choices particularly eating habits, at this stage determine the occurrence of obesity and diet related non-communicable diseases in present and later life. It is a stage where there is potential of altering the current rising trend of obesity and NCDs. Schools have been pointed among the environments that influence adolescents eating habits. However in Tanzania there are no studies that have been conducted to examine how the school food environment affect or influence the eating habits of adolescents.

Objective: This study examined the association of the school level variables with the dietary intake outcomes of school going adolescents in Morogoro municipal in Tanzania.

Study design: A cross-sectional study design was used.

Methodology: 83 students were randomly selected from 3 secondary schools. Questionnaires were used to measure school food environment, and a 24-hour recall on two non-consecutive days was used to collect information on dietary intake, also anthropometric measurements to assess nutritional status. One way ANOVA and Kruskal-Wallis test were used to compare food and nutrients intake between schools. A multilevel mixed effect linear regression model was used to measure associations of school level variables and dietary outcomes from 24hr recall.

Results: Low fruits and vegetable intake, high snacking and soft drinks consumption, and breakfast skipping habits were revealed among respondents. Number of food stores was associated with high intake of snacks (P=0.009) and intake of soft drinks (P=0.011). Number of snack places at school was inversely related with fruits intake (P=0.013). There was significant difference in carbohydrate (P<0.001), fat (P=0.04) and protein (P=0.03) intake between schools.

Conclusion: Adolescents' eating habits and nutrition is a topic that needs attention in Tanzania. Schools can be an effective environment to improve and impart health eating habits among school going adolescents. There is a need to develop school food policy and modify physical food environment in schools to support healthy eating behaviours.

Key words; adolescents, eating habit, school food environment

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Dedication

I would like to dedicate this research to every individual, organization and agency participating in the fight against unhealthy lifestyles, obesity and non-communicable diseases.

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ACRONYMS

BMI	Body Mass Index
FAO	Food and Agriculture Organization
NCDs	Non Communicable Diseases
TDHS	Tanzania Demographic Health Survey
WHO	World Health Organization

Chapter 1: Introduction

This chapter presents an overview of the study. The current situation of adolescent eating habits has been discussed with regard to background, the justification and motivation of the study, as well as the study objectives.

1.1 Background

Adolescents' dietary intake is a topic of concern at the moment because of its association with development of Non-communicable diseases (NCDs) in later life. The prevalence of NCDs such as diabetes, cardiovascular diseases and cancer is increasing in the world today as a result of prolonged exposure to unhealthy lifestyles; where by unhealthy eating habit is one of them. In the year 2008, 63% of deaths worldwide were attributable to NCDs. The burden of diseases due to diet related diseases is increasing and expected to rise by 2030 especially in low and middle income countries (WHO, 2011). Poor adolescent nutrition is an important determinant of development of these chronic diseases in adulthood. Majority of adolescents are known to have poor eating habits, defined by high intake of sugar, salt, fat and calories, also meal skipping habit especially breakfast (Seliske, et al., 2013). Adolescence marks a very potential stage for prevention of these chronic diseases.

Adolescents' eating habit is the outcome of many influencing factors linking together. These influencing factors are categorized into two, which are individual and environmental factors (Story, et al., 2002). Individual factors are the ones that affect a person direct and considered to be internal such as attitudes, beliefs, taste and preferences, and knowledge. Environmental factors are most likely to affect whole population which includes food policies, availability and accessibility, community settings, media and information environment.

Environmental factors are very important in shaping eating habits of adolescents and other individual groups as well. They are of greater interest since they are likely to alter and modify individual behaviour, whether in positive or negative way. External factors tend to affect majority of the population and individual may lack control over it. Some of the common food environment includes schools, restaurants and food store.

School food environment is regarded as a very important factor in influencing eating habits of school going adolescents. Adolescents spend most of their time in school; hence they are likely to be affected by school food environment and policies (Kubik, et al., 2003). School is the place where they are most likely to learn and adopt new habits. When school environment is well organized it can be an ideal place for promotion of health lifestyle. Nevertheless, school environment can also be a source of unhealthy lifestyles when necessary measure to control food environment are not taken. Increasing the prevalence of obesity and non-communicable nutrition related diseases in the world has brought up the need for more research on present food environment and its impacts on eating habits (Mckinnon, et al., 2009).

Recently, there is an obvious shift in eating habits in many places in the world; these rapid changes are the results of change in lifestyle due to urbanization, socio and economic development which affect food environment. There is an increase in fast foods, eating out, snacking and high intake of sweetened beverage (Moreno, et al., 2010). Change in dietary intake pattern is characterized by shifting consumption to more energy dense food instead of traditionally plant based food. The emerged dietary pattern increases the risk of developing obesity and non-communicable diet related diseases such as cardiovascular diseases and diabetes.

Nutrition transition has also been observed in African countries, the dietary pattern has changed to more westernized diet characterized by high energy dense foods. Prevalence of overweight, obesity, diabetes and cardiovascular diseases is increasing in these countries as a result of unhealthy diet and lack of physical activity (Vorster, et al., 2011). The condition is growing worse in African countries as there is still a serious battle over under nutrition. Under nutrition and micronutrient deficiencies (hidden hunger) are still the biggest nutrition problems in Africa. To date, the efforts made have not succeeded to eliminate these problems completely. These situations so far give rise to the so called double burden of disease, now additional efforts are needed to eliminate both over and under nutrition since none of the two can be ignored (Vorster, et al., 2011; Adeboye, et al., 2012).

1.2 Rationale of the study

Tanzania is not excluded from the double burden of disease. The prevalence of under nutrition is still very high, while overweight and obesity prevalence is highly noticeable (FAO, 2008). Tanzania Demographic Health Survey (TDHS) 2010 reported that 11.3% of women aged from 15 – 49 years have BMI less than 18.5kg/m^2 (underweight) and 21.2% have BMI higher than 25 kg/m^2 which defines overweight and obesity. So far these data signifies the prevalence of both under and over nutrition in Tanzania (NBS Tanzania & ICF Macro, 2011). Also the TDHS report showed, 17.6% of adolescent girls are underweight (BMI < 18.5 kg/m^2) and 9.1% are overweight and obese (BMI >= 25 kg/m^2) (NBS Tanzania & ICF Macro, 2011).

In Tanzania a substantial volume of nutrition research has been conducted. Nevertheless very few or none of this research has been directed to address nutrition issues in adolescent boys and girls. Most nutrition research involves children under five and maternal aged from 15 to 49 years who are known to be most vulnerable groups. Adolescents are the neglected group in most research simply because they are regarded as least vulnerable and susceptible to diseases in comparison to the other mentioned groups.

This study aims to bring insight to nutritionists, researchers, policy makers and other nutrition stakeholders on the field of school food environment in Tanzania secondary schools as well as eating behaviours of school going adolescents. It is a pilot study that intends to convey the idea of school food environment and adolescents' nutrition in Tanzania. Also to pave a way for more research since few research studies focused on this arena so far. The study assesses how the current school food environment is associated with the eating habits of the Tanzania students considering the co-existence of over and under nutrition among adolescents. The study measures the school food environment in terms of number and type of food services available (stores, canteens, food vendors), food options offered (snacks, fruits, vegetables, soft drinks, main meals) and school food policies available. Moreover, to study the eating habits of school going adolescents by looking at daily energy intake, nutrients intake, food groups commonly consumed both at school and home, and the overall meal pattern as well.

1.3 Study objectives

1.3.1 General objective

The general objective of this study is to examine the association of school food environment and eating habits of Tanzanian school going adolescents.

1.3.2 Specific objectives

- To examine the current food environment in schools,
- To assess the dietary intake of school going adolescents,
- To assess the contribution of school foods on energy intake,
- To assess nutritional status of school going adolescents in the study area using anthropometric measurements.

Chapter 2: Literature review

This chapter reviews the literature on various topics related to the study. Major topics discussed include eating habits of adolescents, and the influencing factors, also food environment and how it can be measured. In this chapter also findings from similar studies have been reviewed.

2.1 Eating habits of adolescents

Eating habit can be defined as the way individual or group of people eats, what they eat, how they eat and when, it includes meal frequency, diet composition and food choices. An individual eating habit develops over time and results from interplay of various factors (Larson & Story, 2009). Eating habits are the determinant of an individual or group nutritional status and the risk factor for chronic diet related diseases.

Most studies show that adolescents have poor eating habits that do not meet their recommended dietary guidelines (Story & Stang, 2005). Adolescents' diets are characterized by high intake of fat, sugar, salt, sweetened beverage, high calories and less intake of fruits and vegetables. Meal skipping, mainly breakfast, eating fast food and unhealthy snacking are also associated with adolescents' poor eating habits (Moreno, et al., 2010). Most of the information on adolescents' dietary intakes was collected from developed countries, mostly United States and Europe. Adolescence is a stage of particular nutritional vulnerability (WHO, 2005); poor nutrition at this stage of life has an impact later in life (Reilly & Kelly, 2011). Adolescents' nutrition is important for immediate and future health of a person. Current eating habits are predictors of future health outcome of an individual. For example high fat intake during adolescence is associated with high risk of heart diseases in adulthood; an obese adolescent is also likely to become an obese adult and, low intake of calcium during this stage is associated with lower bone mass and osteoporosis for women in later age (Story, et al., 2002). Therefore it is imperative to invest in adolescents' health for future growth of health adults.

2.2 Why adolescent health is important

Adolescents' health is crucial all over the world and of concern in developing countries. Adolescents make up approximately 20% of world population according to WHO report on

adolescents. The adolescent population is predicted to increase more rapidly in Africa than other developing countries (WHO, 2005).

Tanzania is a country where almost 50 % of its population is below 17 years of age, and adolescents (10 to 19 years) account for 23 % of the whole population (UNICEF, 2011) (NBS Tanzania & ICF Macro, 2011). This fact makes adolescence a very crucial stage in altering the unhealthy lifestyle behaviour that lead to development of NCDs. Unhealthy eating habits and lack of physical activity are major causes of overweight and obesity, which is an intermediate risk factor for NCDs such as diabetes, cancer and cardiovascular diseases. NCDs mainly results from improper lifestyles that expose a person to the risk of developing diseases. The burden of NCDs have increased recently, In the year 2008 NCDs account for 27% of all death in Tanzania (WHO, 2011).

Adolescence is the stage in the lifecycle where there is still a chance to correct childhood nutrition faults and to introduce healthy habits that can last throughout the entire life of an individual. In other words it is a window of opportunity to reverse the current NCDs trend and prevent it from increasing by 2030. Health of adolescents is crucial for economic development of the country as it can help to break the NCDs – poverty cycle. Chronic diseases reduce working efficiency hence lead to low productivity which results in decreased family earnings. Decreasing family incomes and increasing health care cost for people with chronic diseases drive most of families into poverty as well as the whole country (Alleyne, et al., 2013) (Mariachiara Di Cesare, et al., 2013). Prevalence of NCDs has a negative impact not only at individual or household level but also at the national level. It is a barrier for government efforts to eradicate poverty as it increase burden in the whole health system. Poor adolescent nutrition is a risk for the overall development of Tanzania as a low income country. Investing on adolescent health for earlier prevention of chronic diseases is a wiser option for low income countries since diagnosis and treatment of NCDs might not be affordable due to poor resources. Poor resources are the reason as to why most of death due to NCDs occurs in low and middle income countries than high income countries (Alleyne, et al., 2013).

2.3 Factors influencing eating habits

2.3.1 Models and theoretical explanations of influencing factors

Various models and theories have been developed to explain individuals' behaviour and factors affecting or influencing various habits in the society. These models are useful and have been adopted to explain eating behaviours of an individual or a group of people and its influencing factors. Applications of some of models and theories of behavioural change were found useful in understanding various issues pertaining to eating behaviour (Williams, 2011). To better impart behavioural change in the society, these theories are worthy taken into considerations. They are useful in formulating public health interventions and policies that aims at improving eating behaviour of the population. There is no single theory or model that is sufficient enough to completely understand human behaviour, but different theories and models can be adopted depending on the situation in hand (Glanz, 2008).

The social ecological model

The social ecological model is a commonly used model that explains multiple levels of influence on a person eating habit (Robinson, 2008). The model explains individual behaviour as an outcome of individuals' perspective, social and physical environment. These factors have been described in the model as levels of influence and they are categorized into five groups which are Intrapersonal, interpersonal, organizational (institutional), community and public (Robinson, 2008).

These levels of influences have been grouped into various categories, with "individual" and "environmental factors" being the two main categories (Story, et al., 2002). Current literature has different ways of classifying environmental factors. In most cases factors that do not fall within individual category are considered as environmental, but this is not always so. Some separate social factors and policies from environmental factors. So far all these categories of environmental factors in the literature can be considered as levels of environmental influences on eating habit. Generally, they are external factors that have an effect on an individual eating habit. It is important to understand the effect of these factors since they affect everyone in the society.

Story & Stang (2005) described factors influencing eating habit using a conceptual model, which grouped these levels of influence into three categories, being Individual (intrapersonal), Environmental and Macrosystems.

2.3.2 Intrapersonal factors

Intrapersonal factors are also known as individual or endogenous factors; which includes personal knowledge, taste and preference, personality traits, beliefs, and attitude. Intrapersonal influences can further be grouped into biological, psychosocial and behavioural factors (Story, et al., 2002). These are proximal factors that affect individual directly without having impact to the whole population. In the study carried out on adolescent living in rural Greece, knowledge and body image perception were identified as among the individual factors that influence eating behaviour (Bargiota, et al., 2013). In a qualitative study carried out by Fitsgerald et al., (2010) found that some personal factors such as taste , preferences, texture and smell of food had more influence on adolescents food choices regardless of their nutrional knowledge.

2.3.3 Environmental factors

As explained above, there are various ways to categorize environmental influences. In this section the level of environment influences have been discussed in terms of social environment (interpersonal), macro systems, and physical environment which includes community, organizational and public influences from social ecological model. These factors are very crucial as they interact with intrapersonal factors to influence the individual behaviour (Larson & Story, 2009). Even with high individual awareness and motivation to change, changes will not be possible if the environment does not accommodate or support the changed behaviour (McAlister, et al., 2008).

Social environment (interpersonal)

Social environment is built up as a result of social interaction between an individual and other people, or social groups in the society. Interpersonal influence includes inspiration from peer groups, parental influences and that of, friends and role models. The impact of social interaction on eating behaviour is constructed on support from other members, existing social standards and role modelling (Story, et al., 2002). There are many studies that have shown association between

social environment and adolescents eating behaviours. Mothers as role models or key players in home food environment have been found to positively associate with adolescents eating behaviour, although the influence differs based on gender (Campbell, et al., 2007). Social environmental factors such as parental behaviour, and peer influences were associated with breakfast habits of Europeans adolescents in the HELENA study conducted by Hallstrom et al., (2011). In another study adolescents intake of fruits and vegetables was associated with availability of healthy foods in their homes (Ding, et al., 2012).

Physical environment and macro-systems

The physical and macro level are important factors in influencing eating habit (Popkin, et al., 2005). They have indirect influence on an individual eating habit. It explains influences at macro level which tend to affect the whole population rather than one person in the society. This category includes community settings, organizational and public environment. Macro-systems' influences include policies, media and advertisement, food availability and distribution at higher level. Physical environment focuses more on food available within the surrounding. These are also regarded as community settings which consist of school, work, restaurants, shopping malls, vending machines and food store.

2.4 Food environment

The food environment is an emerging complex concept that is becoming common in the field of nutrition, it explains all external aspects that determines or influences what an individual eat, when and how. Home environment, food policies, organizational and work places policies, media and information environment are all included in the definition of food environment according to Glanz. The definition of a food environment excludes individual or internal factors such as person's knowledge, attitude, believes and perception (Glanz, 2009). The interest in this arena has increased due to rise in the prevalence of obesity and nutrition related chronic diseases (Mckinnon, et al., 2009). Food availability, accessibility, acceptability and affordability are essential elements of food environment (Caspi, et al., 2012).

Food environment sometimes called "nutrition environment" has been classified into four main categories; community, consumer, organizational and information environment. Glanz, et al.,

deveoped a conceptual model helps to understand food environment and the ways it is influenced by policies at macro level, or how the environment influence individual variables such as eating habits (Glanz, et al., 2005).

The review of Mckinnon et al., (2009) categorized food environments based on physical environment. The categories include restaurant, food store, school, and worksite environment. According to Glanz (2009) these categories all fall under organizational environment. Despite this, a substantial number of researchers use these categories of food environment.

Measures of food environment

Increased interest in environment effects on food choices and consumption came up with another question of how the particular environment can be measured to better classify it as healthy or unhealthy food environment. There is rise in number of research that intend to measure food environment, but up to now it is still unclear how this environment can be quantified and conceptualized (Moore, et al., 2008).

Food environment measures have been grouped into major two parts instruments and methodologies. Instruments are standardised tools which are used for measuring observed or supposed food environment. Main instruments used includes questionairre or interview, checklist, market basket and inventory. The type of instruments used mainly depend on the food environment to be assessed.

Interviews or questionairre contains a set of questions that used to evaluate the environment. It is the commonly used instrument especially in assessment of school or worksite food environment (Mckinnon, et al., 2009). Self reporting or recording by reporter can be used to collect information.

Checklists include a list of foods that meet certain pre determined criteria to be assessed example health or unhealthy food. Presence of the foods in the list indicate definite food environment. Market basket is similar to checklist as it also contains pre determined list of foods that makes a diet, it is more used in food store assesments. The two instruments are mostly used in assessment of food quality, affordability in terms of cost and availability (Mckinnon, et al., 2009).

Methodologies used in measuring food environment are mainly four which are menu analysis, sales analysis, nutrient analysis and geographical analysis. Exept for geographical analysis, remaining three methodologies used to assess food availability and nutrients content of various foods. To perform sales analysis data from sale, receipt and food stores informations are used (Mckinnon, et al., 2009).

Geographical analysis used to measure available food stores, super markets, fast food outlets and restaurants within certain geographical area, this method operate at the macro level (Charreire, et al., 2010). It also measure food accessibility within the sorrounding area in terms of distance , store density and diversity (Caspi, et al., 2012). Methods used in geographical exposure assesments include Geographical Information System, surveys and store audits (Caspi, et al., 2012). It is the most used methodology in measuring food environment according to the review conducted by Mckinnon, et al., 2009 and (Charreire, et al., 2010).

2.5 School food environment

Many researchers identified school food environment as one of the strong factors influencing eating habits of school going adolescents. It is a very important influence since adolescents spend quite a number of hours in school, and about 19 – 50% of the total daily energy intake can be obtained from food consumed at school (Story, et al., 2009). Also a systematic review on out of home eating found that the percentage total energy intake from out of home foods to be higher among school children up to 83% of total energy, and school being the potential source of out of home foods (Lachat, et al., 2012). It is a place where they are likely to learn and develop certain ways of life. School food environment can shape eating habits to more healthy or unhealthy habits depending on the policies and food available is schools. A systematic review conducted on effectiveness of school interventions in prevention of obesity among children and adolescents, reported that school interventions are likely to improve dietary intake of adolescents in middle and low income countries (Verstraeten, et al., 2012). Similar findings were reported by Bourdeaudhuij et al., (2011) on their sytematic review within HOPE project carried out in Europe.

A substantial body of research carried out especially in developed countries showed there is strong association between school food environment and adolescent food choices and consumptions. A study carried out by Kubik et al., showed association between unhealthy eating habits of adolescents and presence of vending machines, á la carte progams and snacks in school environment. Intake of sweetened beverage and snacks was found to be high among the schools with more vending machines than those with fewer (Kubik, et al., 2003). Similar results on the effect of food environment has been reported by Seliske et al., (2013), in their study results indicated strong relationship between retail food environment and lunch time behaviour of the students. Also school policies have been found to influence eating pattern of students. A Study showed that, existence of school policies on foods sold at school or operating hours of vending machine are associated with low intake of snacks among students (Neumark-sztainer, et al., 2005)

Although there are many studies that reported association between food environment and consumption of various foods, some research brought forward conflicting results. Van der Horst, et al., in their study found there is little association between higher snacks availability in school environment and high snacks consumption. Association was positive when related to personal cognition (Van der Horst, et al., 2008).

Chapter 3: Methodology

This chapter describes the study area, study design, sampling procedure, and the methodologies used for data collection, data entry and analysis.

3.1 Study area

The study was conducted in Morogoro municipal which is located in Morogoro region in Tanzania. It is one among six districts of Morogoro region, and is highly urbanized compared to other districts in the region and has a total area of 260 km^2. Morogoro municipal is 169 km away from Dar es Salaam, the largest commercial city in Tanzania. According to the 2012 census the district has a population of 315, 866 of whom 151,700 are men and 164,166 are women. Morogoro municipal district is divided into 19 wards, among which three wards were involved in the study (NBS, 2013).

Morogoro municipal is multicultural in nature with people from various ethnic backgrounds. It is among the fast growing urban centres of the country, and has a high population growth rate. Economic activities are diversified but agriculture is still an important economic activity in the region (UN-HABITAT, 2009).

3.2 Study design

Data were collected using a cross-sectional study in the period of July to August 2013.

3.3 Sampling framework

The sample frame included school going adolescents, both boys and girls aged 14 to 19 years, who were enrolled in secondary schools in Morogoro municipal. Non-school going adolescents were excluded in this study since their eating behaviours are not influenced by school environment.

3.4 Sampling method

Random sampling was used to obtain three secondary schools from the list of 23 public secondary schools in Morogoro Municipal. A total of 83 students were randomly selected from the selected school.

3.5 Data collection

Data were collected using different techniques. Questionnaires were used to collect data on school food environment, face to face interviews were conducted to collect information on dietary intake as well as demographic data, and lastly anthropometric measurements were taken from all respondents.

3.5.1 Construction of a school food environment questionnaire

A questionnaire was constructed to collect data on school food environment (**Appendix 1**). School level variables measured were availability of food policies in school, number of food store, cafeteria, restaurant and food vendors available within school area, and specific food that are sold/ available within school compound and if there are any rules and regulations on food available. The questionnaires were translated into Swahili language.

3.5.2 Pre-testing the questionnaire

The questionnaire to assess school food environment was pre-tested on one secondary school before the actual data collection. Some minor adjustments were made after it and related to the terms of arrangement to allow easy and clear understanding of questions. Additionally some questions were added to provide more details.

3.5.3 Administration of questionnaire

In each school, the school food environment questionnaires were administered to a group of students and at least one responsible teacher mostly second master so as to complement information obtained from. The group of students was supervised by a researcher throughout the filling process for further clarification of the questions, when needed. Afterward all the

information obtained from the students and teacher were compiled into one questionnaire for each school by a researcher.

3.5.4 Dietary intake

Face to face interviews were conducted to collect data on dietary intake and general demographic information of respondents. The interview was carried out using Swahili language. General information collected included age, date of birth, sex, name, class level and amount of money spend for buying food at school. A 24-hour recall was conducted where a respondent was asked to recall all foods and drinks consumed in the past 24 hours. Information collected during the recall were; specific food eaten, time taken, the recipe, amount consumed (portion size), place of preparations, and place of consumptions **(Appendix 2)**. The interview was conducted twice for every respondent on two non-consecutive school days. The days of the interview were preceded by normal school days since the study intended to obtain data on school foods consumption. The interview days were planned based on students' schedule, at the same time the difference between the day of the first and second interview was considered.

Portion size estimation

Various techniques were used to estimate portion sizes. Household measure was one of the techniques used to estimate the portion sizes. In this method utensils of known volume were used, included a plate, bowl, saucer, glass, cup, table spoon, teaspoon, and saving spoon. These were used to aid in portion size estimates of food items such as cereals, grains, drinks, vegetables and sauces.

Also pre weighed grains of various weights (100g, 200g, and 250g) wrapped in polythene bags were used to estimate portion size of foods such as stiff porridge (*ugali*). This technique was used together with household utensils available to get clear estimate of portion size.

Portion size of foods available within school compounds were obtained by actual weighing the foods using a food weighing scale. Average portion size was computed for every food item and used as a standard school portion size. Examples of some food items weighed were fried cassava pieces, donut-African, spicy potato balls (*kachori*), locally packed crisps and *bhajia*.

To estimate the portion size of some countable food items such as egg, banana, orange, etc., the portion size database from the Tanzania Food composition table was consulted (Lukmanji, et al., 2008). It helped to estimate portion sizes by using pre estimated average portion of some food items which are frequently consumed by Tanzanians.

Data entry

Lucille software for food intake was used to enter dietary intake data from 24-hour recall (Ghent University, Belgium, www.foodintake.ugent.be). The data was then transferred to Stata statistical software for further analysis. From the two recalls average intake per person per day was calculated and used for analysis.

Outcome variables

From the 24-hour recall the main outcomes measured were total daily energy consumed, percentage energy consumed from different meals per day, percentage energy contributed from fat, protein and carbohydrate, total fruits and vegetable intake per day, and daily total weight consumed from different food groups.

A total of ten food groups were adopted from Tanzania food composition table (Lukmanji, et al., 2008). The food groups were made by placing together all food items with similar nutritional properties or biological specification. These food groups were:

- Cereals and cereals products; such as rice, maize, wheat ,
- Roots, tubers and banana; such as cassava, plantains and potatoes,
- Pulse seeds and nuts,
- Meat, poultry (including eggs) and fish,
- Fruits,
- Vegetables,
- Dairy and dairy products,
- Oils and fats; including food items that are concentrated in fat and oils such as margarine, butter,
- Soft drinks; including all flavoured drinks, carbonated drinks,

– Miscellaneous; this group included food such as sugar, honey, black tea, alcoholic drinks and sauces.

3.5.5 Anthropometric measurements

In order to assess nutritional status of the respondents, anthropometric measurements i.e. weight and height were taken.

Weight (kg) was measured using electronic weighing scale, respondents were asked to remove shoes and heavy objects if there was any before the measurement was taken. The respondent was asked to stand upright on weighing scale with arms hanging on sides, and then the weight was measured and recorded to the nearest of 0.1kg.

Height (cm) was measured using length board, were respondent was asked to stand straight on the length board with the back of the heels touching the board. The height was measured and recorded to the nearest 0.1cm.

Anthropometric data together with demographic data such as gender, date of birth and date of interview were entered in the WHO AnthroPlus version 1.0.4 software. WHO AnthroPlus is the software used to aid the application of WHO growth references 2007 for children and adolescents aged 5- 19 years (Onis, et al., 2007). Based on the data entered, the software generated age of respondents in months, height for age, and BMI for age and gender specific. **Table 1** shows classification of BMI for age for children aged 5-19 years according to WHO recommendation.

Table 1: Body Mass Index for age cut-offs for children ages 5-19years

Classification	BMI for age
Severe thinness	< - 3SD
Thinness	< - 2 SD
Normal	> - 2SD and < = +1SD
Overweight	> +1SD and < +2SD
Obesity	> +2SD

Source: Adapted from 2007 WHO references; SD = Standard Deviation

3.6 Data and statistical analysis

Statistical analysis was conducted using Stata version 10.1 statistical software. Descriptive statistics such as mean, median, standard deviation, interquartile range and frequencies were calculated. Summary statistics of the outcome variables from the 24-hour recalls such as total daily energy consumed, percentage energy consumed from different meals per day, percentage energy contributed from fat, protein and carbohydrate, total fruits and vegetable intake per day, and daily total weight consumed from different food groups were produced.

Two sample T-test was used to compare the mean intake of total energy, energy from different meals (lunch, dinner, snacks, and breakfast), nutrients and food groups among boys and girls, also fasting and non-fasting students. Assumptions for normality of both boys and girls were checked using Shapiro-Wilk test and QQ plot, as well as assumption for equal variance. When assumptions were not fulfilled Wilcoxon Rank Sum Test was used to compare mean intakes. The Wilcoxon Rank Sum test was used for comparison of mean intake of fruits, fat, and protein.

One way ANOVA was used to compare mean energy from snacks and mean energy consumed from food vendors. To compare mean food and nutrient intake from the three schools a new dataset was created which included foods and nutrients which were consumed at school only. Kruskal-Wallis rank a non-parametrical test was used to compare median intake of all food groups since the assumptions for a One-way ANOVA were not fulfilled.

To associate dietary intake outcome and school level variables multilevel mixed effects model regression was used, were school was treated as a random effect. The model was adjusted for confounders, which were age, sex and the amount of money spend for food at school. This model has been used as it takes into account variation between schools, which is not the same between independent variables. The following assumptions were checked;

1. Normality of residual using QQ plot,
2. Residual variability constant by plotting a graph of residual versus independent variable (predictor),
3. Model pattern assumption using scatterplot of the dependent variables versus fitted value of independent variables.

Chapter 4: Results

4.1 School food environment

Table 2 presents the characteristics of the 3 public schools that participated in the study. These schools shared most of their characteristics. None of the schools had food policy or school food program. Students relied on foods sold in the school since they were not allowed to buy foods outside or go out of the school compound during school hours.

Food vendors were the most important food suppliers in these schools, and students mostly consumed food sold by food vendors. In this context, food vendors were considered people who sell foods and drinks to students that are not prepared within school area. Snacks were the most sold food items in schools by majority of food vendors as well as in shops and canteen. Only one school (Kolahill) had a food vendor who sold fruits, as for the other two schools there were no source of fruits within the compound. Vegetables were sold in school canteens as a portion of main meals. Two schools Moroseco and Kihonda had canteens which offered main meals served with vegetables, also snacks and soft drinks were retailed in canteens.

Table 2: School characteristics as reported by students and teacher

	Moroseco	**Kihonda**	**Kolahill**
Students	(n =25)	(n= 28)	(n=30)
Food Policy	No	No	No
Food program	No	No	No
Campus rule	Closed campus	Closed campus	Closed campus
Food store/shop	4	1	0
Canteen	1	1	0
Food vendors	>6	>6	>6
Food sold in school			
Snacks	Yes	Yes	Yes
Fruits	No	No	Yes
Vegetable	Yes	Yes	No
Main meals	Yes	Yes	No
Soft drinks	Yes	Yes	Yes

(n = sample size, number of students interviewed)

4.2 Respondents' characteristics

Participants' characteristics are presented in **Table 3.** A total of 83 students were interviewed from 3 selected schools. Participants' age ranged from 13 to 19 years, with mean age of 15.6±1.4 years. Result shows money given to students for food ranged from 0 to 1000 TZS, with the average of 370±206 TZS per day (1 EURO = 2200 TZS). 13.3% of students reported to not receive any amount of money to buy food at school from their parents or guardians.

Data were collected in the month of July up to August 2013 which was Ramadan season for Muslims. Therefore 21.7% of students who participated in the study were practicing different meal pattern, in particular fasting during day-time.

Table 3: Participants' characteristics

Characteristics	Mean ± SD	**n**	**%**
Gender			
Male		40	48
Female		43	52
Age (years)	15.6 ± 1.5		
Weight (kg)	51.2 ± 8.0		
Height (cm)	157.8 ± 8.5		
BMI (z-scores)	-0.08 ± 0.9		
Money for food		72	86.6
Amount spend on food (TZS)	370 ± 206.3		
Fasting		18	21.7
Class			
Grade I		25	30.1
Grade II		28	33.7
Grade III		11	13.3
Grade IV		19	22.9

4.3 Nutritional status of the respondents

From the results most of the students had normal BMI for age as shown in **Table 4**. However, prevalence of overweight (> +1SD) was observed among the respondents as well. None of the respondents fall on the categories of severe thinness (< -3SD) and obesity (> +2SD). The mean BMI of male students was lower compared to female students (P=0.03). There was no

statistically significant differences when mean BMI was compared between students who fasted and who did not (*P*=0.56).

Table 4: Nutritional status of respondents based on WHO growth reference

BMI classification	n	%
Underweight/Thinness	2	2.4
Normal	74	89.2
Overweight	7	8.4

4.4 Dietary intake of adolescents

4.4.1 Consumption of food groups

Cereals were the food group that was consumed in largest quantity (485g±149.6) on a daily basis (**Table 5)**. Majority of students reported the intake of cereals during the days of recall. Fruits, vegetables and dairy were the food groups which were consumed in a very low quantity. About 46% and 40% of the students (n=83) did not consume any fruits and vegetables at all during the recall days, respectively. Even for those who consumed fruits and vegetables the amount consumed was very low with mean intake of 77.5g±113.5 for fruits and 47g±70.7 for vegetables. Dairy and dairy products were the least consumed food groups as results showed 86% of the students interviewed did not consume them on the days of recall.

Table 5: Overall food groups consumption.

Food groups	All students (n=83)	
	Mean	SD
Cereals (g)	485.0	149.6
Roots (g)	179.2	126.0
Fruits (g)	77.6	113.5
Vegetables (g)	47.0	70.7
Meat, fish, poultry (g)	101.9	86.5
Pulses (g)	103.3	86.8
Dairy (g)	30.8	95.9
Miscellaneous (g)	232.7	188.0
Soft drinks (ml)	104.4	149.7

There was difference in intake of some food groups between fasting and non-fasting students (**Table 6**). Fasting students had a significantly lower intake of cereals (*P*=0.005) and pulses (*P*=0.009), but they had higher intake of fruits (*P*<0.001), with mean of 162.5g per day compared to non-fasting. There were no significant differences in intake of the remaining food groups observed.

For non-fasting students the consumption of food groups was compared based on gender. There was no strong evidence to conclude statistically significant differences in intake of food groups between male and female students at 5% level of significance.

Table 6: Average food groups consumption per day.

Food groups	**Non-fasting (n=65)**		**Fasting (n=18)**		*P*
	Mean	**SD**	**Mean**	**SD**	
Cereals (g)	507.3	139.5	404.5	371.9	<0.01
Roots (g)	172.3	121.1	204.2	143.3	0.35
Fruits (g)	54.1	68.9	162.5	185.7	<0.001
Vegetables (g)	52.0	74.4	28.9	53.2	0.22
Meat, fish, poultry (g)	110.3	90.7	71.6	62.5	0.046
Pulses (g)	115.0	90.0	61.1	59.1	<0.01
Dairy (g)	33.6	103.2	20.8	64.3	0.62
Miscellaneous (g)	241.7	194.0	200.4	165.9	0.41
Soft drinks (ml)	111.7	160.0	77.8	104.3	0.4

SD = Standard Deviation, P = p value

4.4.2 Daily nutrients intake

The mean energy and nutrients intake for all school going adolescents during recalls are presented in **Table 7. Table 8** presents energy intake (kcal) and average nutrients consumed per day, and comparison of intake between fasting and non-fasting students. With regard to energy and nutrients intake, the non-fasting students had significantly higher intake of energy, protein, fat, saturated fat and sodium compared to fasting students.

There was no significant differences when total energy intake (*P*=0.84), carbohydrate (*P*=0.80), fat (*P*=0.79) and protein (*P*=0.59) intake were compared between male and female students. This comparison was only for non-fasting students.

Subsequently, percentage energy contribution of macronutrients was computed. Carbohydrates contributed about 57% of total energy consumed, and 32% of total energy came from total fat and 11 % from protein.

Table 7: Overall energy and nutrients intake

Nutrients	All (n=83)	
	Mean	**SD**
Energy (kcal)	1912.8	550.6
Carbohydrate (g)	281.4	69.9
Protein (g)	50.8	24.2
Fat (g)	66.7	33.1
Saturated fat (g)	43.8	23.0
Sugar (g)	51.3	25.3
Cholesterol (mg)	45.7	52.1
Sodium (mg)	467.9	428.9
Calcium (mg)	408.1	366.0

Table 8: Average nutrients intake per day.

Nutrients	Non-fasting (n=65)		Fasting (n=18)		*P*
	Mean	**SD**	**Mean**	**SD**	
Energy (kcal)	2007.9	557.2	1569.4	366.1	<0.01
Carbohydrate (g)	287.9	73.9	258.1	47.9	0.11
Protein (g)	54.1	24.2	38.9	20.8	0.02
Fat (g)	72.5	32.8	45.8	26.1	<0.01
Saturated fat (g)	46.9	22.8	32.8	20.5	0.02
Sugar (g)	49.8	26.7	56.6	19.5	0.32
Cholesterol (mg)	49.1	55.4	33.4	36.5	0.30
Sodium (mg)	517.5	464.3	288.9	178.9	0.04
Calcium (mg)	437.9	381.8	300.6	286.0	0.16

With regard to meal pattern (**Table 9**), dinner contributed higher percentage of total daily energy consumed. Breakfast contributed 13.6% of the total energy intake on daily basis. However, the percentage energy from snacks was higher (22.2%) than energy from breakfast. 26% of non-fasting students did not consume breakfast during recall days. Male students had significantly higher energy from lunch and significantly lower energy from snacks compared to female

students. As for the rest of meals (breakfast and dinner) the energy contributions were comparable between males and females. **Figure 1** presents percentage energy contribution of meals from the 3 participated schools.

Table 9: Energy (kcal) contribution from meals

	Mean	SD	%	*P**
Breakfast	274.4	239.5	13.7	0.63
Lunch	548.5	259.1	27.3	<0.001
Dinner	738.1	284.2	36.8	0.57
Snacks	446.3	339.5	22.2	0.046

P* = Comparison of mean intake based on gender using a t test

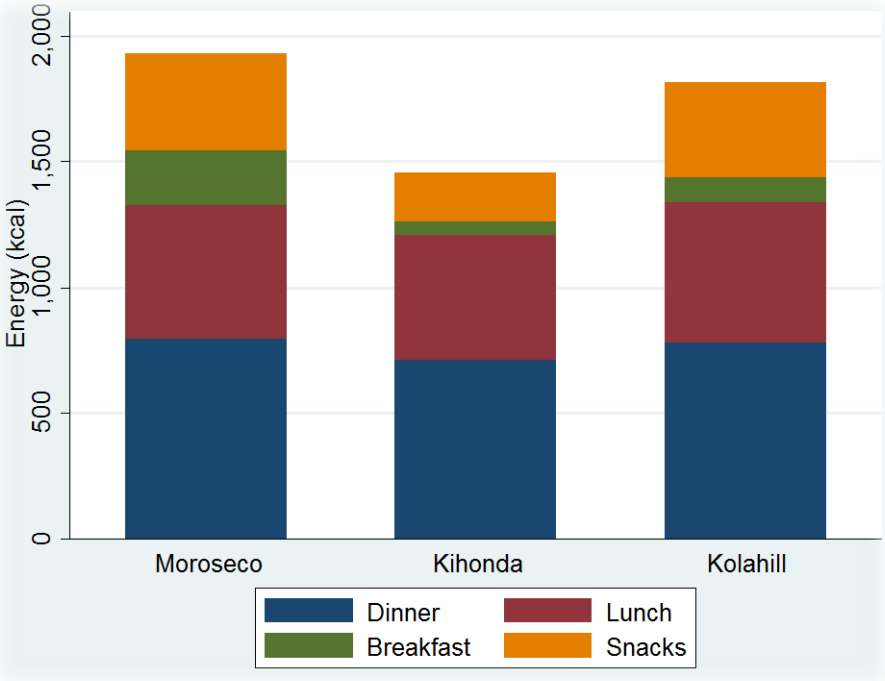

Figure 1: Energy contribution based on meals

4.5 School foods intake

4.5.1 Energy intake from school foods

Foods consumed in school contributed on average 25% of daily energy. Among all students, 68% reported consumption of school foods during recalls. However, there were also a number of students (n=8) who did not consume school foods on the days of recall, apart from those students who were fasting (n=18). Most of the foods consumed at school were snacks rather than main meals such as breakfast and lunch. Main meals especially dinner and lunch were still consumed at home by most of the students. **Table 10** presents mean energy and nutrients intake from school foods, and comparisons between the 3 schools.

Food vendors contributed about 77% of total energy consumed from school foods, and the remaining 23% was from food purchased from shops and canteen.

The mean total energy and energy intake from snacks were compared between the 3 schools. There were no differences in total energy (P=0.15) and energy intake from snacks (P=0.07). **Figure 2** presents box plot of energy intake from snacks per schools. However, Kihonda had significant lower intake of energy from food vendors (P=0.005) compared to the other schools.

Table 10: Mean energy and nutrients intake from school foods.

Nutrients	n=57		*P*
	Mean	SD	
Energy (kcal)	495.1	243.7	0.16
Carbohydrate (g)	59.2	33.0	<0.001
Protein (g)	9.3	8.2	0.03
Fat (g)	23.7	16.2	0.04
Saturated fat (g)	15.9	11.1	0.01
Sugar (g)	13.3	11.3	0.49
Cholesterol (mg)	7.1	28.9	0.51
Sodium (mg)	66.4	191.4	0.34
Calcium (mg)	66.1	57.5	0.01

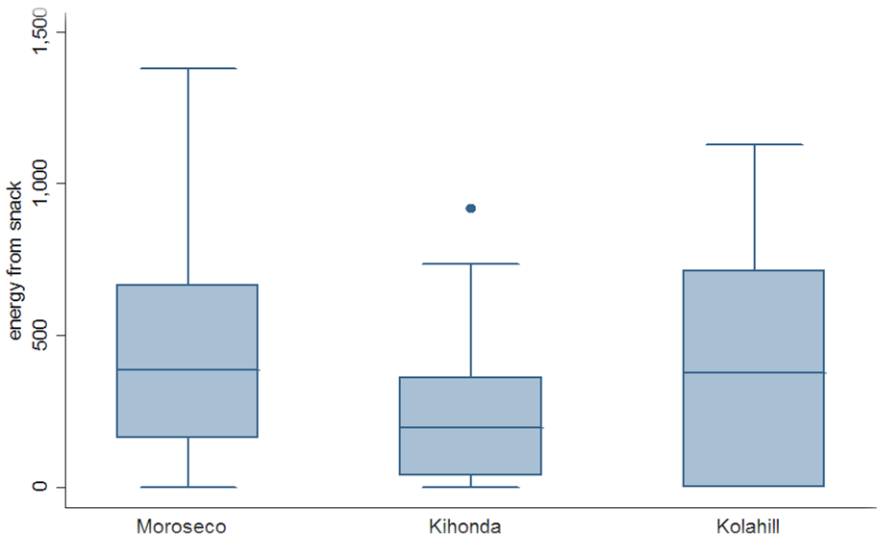

Figure 2: Box plot for energy (kcal) intake from snacks

4.5.2 Daily intake of food groups in schools

Figure 3 and **Figure 4** present food groups consumption based on total weight and energy contribution, respectively. Root and tuber was the mostly consumed food group in schools with mean intake of 149g, followed by soft drinks with a mean intake of 86.6ml (**Table 11**). The most common food items from roots and tuber group were fried cassava, sweet potatoes and Irish potatoes. Dairy products and vegetables were the least consumed food groups in school.

When the median intake of food groups was compared among schools there were no statistically significant differences in consumption of these food groups. The only statistically significant difference was found on cereals consumption (P=0.01).

Table 11: Percentage of total daily weight from food groups consumed in school, and differences in median food groups intake between schools by Kruskal-Wallis test

	n=57		%	*P*
	Mean	**SD**		
Cereals (g)	35.9	49.9	11.0	0.01
Roots (g)	149.0	127.4	45.6	0.06
Fruits (g)	4.5	23.7	1.4	0.74
Vegetables (g)	1.4	7.4	0.4	0.83
Meat, fish, poultry (g)	13.4	44.4	4.1	0.51
Pulses (g)	8.5	27.7	2.6	0.65
Dairy (g)	1.2	9.2	0.4	0.95
Miscellaneous (g)	26.8	68.6	8.2	0.47
Soft drinks (ml)	86.6	119.9	26.5	0.10

n= number or students who consumed school foods during recalls.

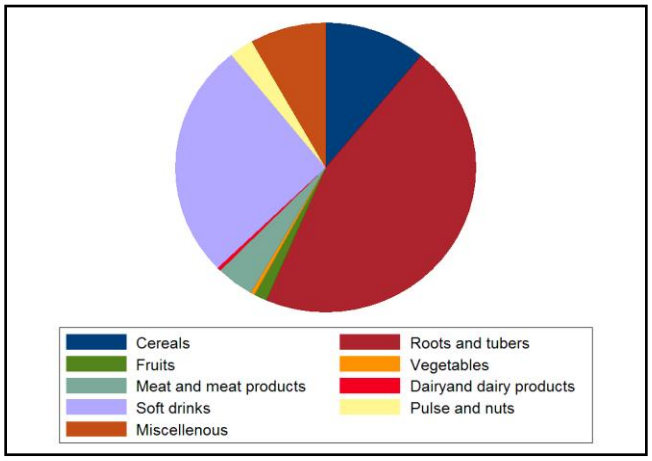

Figure 3: Food groups' consumption based on weight contribution

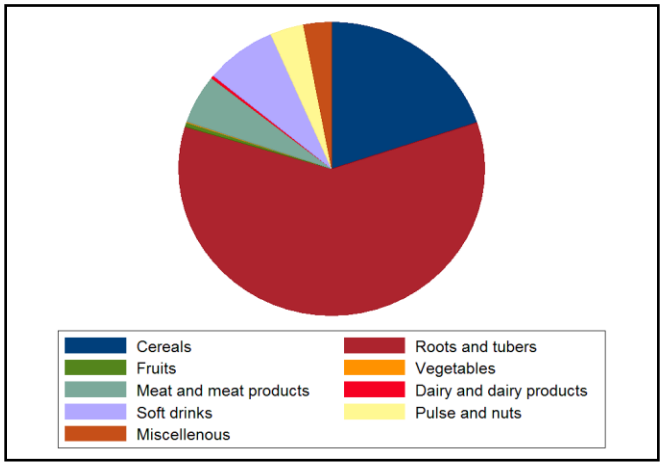

Figure 4: Food groups' consumption based on energy contribution

4.6 Association of school level variables and eating habit of school going adolescents

Statistically significant associations were found between some school level variables and eating habit in school. Positively associations were found between number of food stores and the intake of energy from snacks and soft drinks consumptions. The intake was high in school with many food stores than the others. Also fruit intake was related to number of snack places available. As snack places increase the consumption of fruits in school decreased (**Table 12).**

Unexpectedly, negative associations were found between total number of snack places and some outcome variables from 24-hour recalls which were total energy intake from snacks and total energy consumed in school. Also there was negative association between total number of soft drink places and soft drink intake, and number of fruit vendors was negatively related with fruit consumptions in school. No significant relationship was found between the school level variables and vegetable intake at school.

Table 12: Association of school level variable and eating habits of adolescents

	Snacks		**Fruits**		**Vegetables**		**Soft drinks**		**Energy**	
	Coef.	p	Coef.	p	Coef.	p	Coef.	p	Coef.	p
No. of snack places	-254.7	0.012	-5.7	0.013	1.42	0.086			-20.9	0.18
No. of stores	323.7	0.009					576.7	0.011		
No. of canteen					-3.15	0.370				
No. of fruit vendors			-27.5	0.014						
Total soft drink places							-328.6	0.012		

Coef = coefficient, *p* = p value; derived from multilevel mixed effect model adjusted for age sex and money spend for food.

Chapter 5: Discussion

Some associations were found between various school level variables and the eating habits of school going adolescents. The findings show intake of snacks and soft drinks increase as the number of food stores in schools increase. Also low fruits intake was associated with increase in number of snack selling places. There were significant differences in nutrients consumed from school foods between the 3 schools specifically with respect to carbohydrate, protein, fat, saturated fat and calcium. No statistically significant differences were found in energy and food groups consumed at school between the 3 schools regardless of the differences in food environments. The difference in dietary intakes was observed between non-fasting and fasting students. The non- fasting students had significantly higher intake of energy, protein, fat and sodium than the fasting group. Consumption of cereals, meats, and pulses were still significantly higher in non-fasting students, however higher intake of fruits was found in fasting students. Energy, nutrients and intake from different food groups were comparable between male and female students. However, there was a significant difference with respect to the energy contribution from meals (breakfast, lunch, dinner and snacks). In comparison to energy contribution from all other meals, breakfast contributed the lowest energy. Generally, there was high consumption of snacks among respondents. Female students however, had higher energy intake from snacks compared to male students. Also energy from lunch was higher in males than females. With respect to nutritional status most respondents had normal BMI; though mean BMI for male students was significantly lower compared to females.

5.1 School food environment

Absence of food policies and regulations that control the food offered in schools indicated the lack of concern among school administrators on issues regarding to food environment in school. The food environments in the schools that participated in this study were not controlled to give a student access to healthier foods. Students were more exposed to snacks and sweetened beverage, which were sold by food vendors. Most of the snacks sold were energy dense rich in carbohydrates and fat, also fruits flavoured sweet beverage. The finding shows that most of these foods sold were from the same food groups which mostly were root and tubers, and even used the same methods of preparation which was frying. There was no much diversification on food

offered in schools. Fruits and healthy dairy products such as milk and yoghurt were not commonly found in schools. Proper complete meals with vegetable portion were offered in schools with canteens only. However, these canteens were not commonly used by students as they regarded the foods in the canteens as expensive, and most of the time canteens were used by teachers and other school staffs. Food vendors had fewer operating hours in schools compared to food stores and canteens. Food stores and canteens operated from morning until after class hours, but food vendors brought their food items during break time and some after classes. Nevertheless, operating hours of these food services did not real influence students' food options as in these public schools students were not allowed to purchase their foods before break time, which was the time when all food services operates. Unfortunately, there were no studies conducted in Tanzania on school food environment that the findings from this study could be compared with.

5.2 Eating habits of adolescents

The eating habits of school going adolescents in the study, was not very different from finding of other studies (Story & Stang, 2005). Like most of the studies show, fruits and vegetable intake in adolescents is very low compared to the WHO/FAO recommendation of at least 400g per day (WHO, 2003). The total amount consumed per person per day both at school and home could hardly meet the daily requirements. Low intake of these food groups at school could be due to their unavailability. In these schools the students did not have an option to buy fruits even when they wanted to because there were no fruits sold around. In this study, fruits were sold in one school, where the food vendor sold only one type of fruits which was Mangoes. That did not give students a lot of options when it comes to fruit intakes. Still there is more to be explored concerning adolescents fruits intake since their total intake during recalls was not sufficient even when both home and school intake were combined (mean of 77g per day). Low total intake of fruit indicated it was not only about the school environment but also home environment had a role to play in the total daily intake of fruits. At least there were some students who reported to consume fruits in school which was brought from home during the days of recall. This was reported in Kihonda secondary were there were no fruits sold at school. More studies can be done to examine factors influencing fruit and vegetable intake among adolescents. In promotion

of healthy eating habits, fruits and vegetables are very essential food groups because of their benefit in prevention of NCDs such as gastrointestinal cancer and cardiovascular disease and lowering of the prevalence of obesity (Radhika, et al., 2008).

High snacking habit has been found to be common among school going adolescents. This finding is supported by other studies conducted on adolescent snacking habits, however mostly of these studies were conducted in United States (Piernas & Popkins, 2010) (Larson & Story, 2013). As shown in the results, snacks contributed a high percentage of energy among all the foods consumed in schools. It was a common habit practiced by adolescents particularly girls during recalls, which exposed them to high energy foods with less of other nutrients. Probably it will not be possible to make adolescents quit snacking habits but the effort should be on the provision of healthy snacks in schools. This indicates that schools have to intervene to be able to control what is offered to students in schools. Together with snacks, intake of sweet fruit flavoured beverage was observed in schools. Although not all students consumed soft drinks during recalls as results show, high amount was consumed by students who reported intake of these drinks. Most of the opted soft drinks were empty calorie, which included soda and flavoured drinks. A number of flavoured drinks were locally made by food vendors and there was nothing nutritious added to it but water, fruit flavour and a lot of sugar. Snacks and sweet drinks play a major contribution in daily energy intake for some students. There are some students who are exposed to more than what is required in a day. These habits in school are more likely to affect the intake of other healthy foods after school time as they end up being satisfied with unhealthy snacks.

This study as well reveals breakfast as the most skipped meal of the day. A number of students came to school without taking breakfast during recall days. Some of those who had breakfast in their recalls, they still had poor breakfast such as black tea with sugar and a piece of boiled cassava. Breakfast skipping and inadequate breakfast seemed to be a problem considering the importance of breakfast in reducing obesity risks (Koletzko & Toschke, 2010) and also in improving overall nutrient profile (Matthys, et al., 2007). To improve this situation for school going adolescents something should be done both at school and home food environment. For the students who stay far from their schools, being able to get to school on time could be one of the reasons that they skip breakfast. Also there could be other reasons as well explains why

breakfast is the mostly skipped meal among the school going adolescents such as household food insecurity etc.

A number of students fasted during data collection due to Ramadan season. Those students had different meal pattern as they abstained from consumption of any food or drink during day-time. The differences in dietary consumption between non-fasting and fasting students were found as revealed in the results. Fasting students had lower intakes of energy and macro nutrients which were expected since their meal pattern was changed. Also they had higher intake of fruits compared to non-fasting students. High fruits intake for fasting students could be influenced by family meal and food diversification as they are common practiced during Ramadan.

Dietary intakes were not compared based on BMI, as majority of the students had normal BMI. However, comparisons based on gender shows mean BMI for male students was slightly lower than for females. Overweight was as observed among few respondents, but this finding already portray the existence of overweight problem among school going adolescents. This group of students are more likely to fall into obesity when exposed to unhealthy food environment.

5.3 Association between school food variables and eating habits

An association was found between number of food stores available and the average intake of soft drinks and energy from snacks. The intake was high in schools where there were many food stores. Most of carbonated beverage and fruit flavoured drinks were sold in food stores and canteens, not by food vendors, this probably explains why there was positive association with soft drink intake. Although snacks were mostly sold by food vendors the intake was higher in schools with food stores and this could be explained by the difference in the type of snacks sold by food vendors and in food stores. The types of snacks available in food stores were mostly industrially processed such as biscuits, and industrial made crisps. These might increase the consumption as they added up to the pool of snacks variety.

The number of snack places was negatively associated with fruits intake at schools. This was predictable since snack places found in the participating schools basically sold unhealthy snacks rather than fruits. Fruits were not likely to be sold by snack vendors could be due to their

perishability or lack of fruits market. Lack of fruits supply by vendors in schools explains the reason for low intake of fruits when there are many snack places.

There were unpredictably negative associations between the number of snack places and the energy intake from snacks, also between number of fruit vendors and fruit intake, and between total drink selling places and the intake of soft drinks. These results nevertheless were quite similar with the results from comparisons of means intake of energy from food vendors. The intake of energy from food vendors was lower in Kihonda secondary school, which had more snack places and soft drink places than Kolahill secondary which had fewer. These results indicated the presence of other unidentified confounding factors that affected the intake regardless of the school food environment, which was beyond what this study could explain.

In general, there were not many significant differences observed on the foods and energy intake of the students from the three schools despite of their differences in the school variables. The significant differences were found in carbohydrates, fat and protein intakes. Since the 3 schools had comparable intake with regard to food groups consumed at school, the differences in nutrients intake could be due to cooking methods or ingredients used in food preparations.

5.4 Study limitations

The demographic variables such as family social economic status, nutrition knowledge, parental influences etc. were not taken into consideration in the study which might have a confounding effect on the results of the study. The confounders affect the results as they mask the effect of the interested school level variables on dietary outcomes.

Chapter 6: Conclusion and recommendations

Adolescents' eating habits and nutrition is a topic that needs attention in Tanzania. Schools can be an effective environment to improve and impart health eating habits among school going adolescents. There is a need to develop school food policy and modify physical food environment in schools to support healthy eating behaviours. Schools have an important role to play when it comes to eating habits of the students in schools. Better food environment will help students to meet their daily requirements of nutrients and foods intake. There is a potential to improve the eating habits of adolescents through regulating school food environment. More of attention is needed on adolescents' nutrition in Tanzania as there is a chance to change and improve dietary habits that will help in the fight against obesity and NCDs in present and later life.

In the course of this research the huge knowledge gap have been observed with regard to issues related to adolescents eating habits and nutrition in Tanzania. More research should be done in Tanzania to provide enough evidence on the importance of school environment on shaping eating habits of the students.

Based on this study, the potential areas for further research are identified. Firstly, similar study should be conducted on a large scale where the influences of both school level variables and demographic variables on dietary outcomes can be examined. This is important to obtain the generalizable results for adolescents in Tanzania.

Meanwhile research is lacking on adolescents eating behaviours in Tanzania. There is a need to examine the influence of various food environments important for adolescents such as home and to assess the influence of individual factors such as nutritional knowledge and attitude.

More studies should be conducted to measure school food environment in Tanzania. It is a field that has not been addressed yet. With respect to school environments, the differences between public and private schools food environment should be studied. Research should also look at differences in urban schools and rural schools to examine how the different environment affects their dietary behaviour.

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Appendices

Appendix 1: School Food Environment Questionnaire

Name of School:

School ID:

Part 1: Food Policy

1. Do you have food policy in the school? Yes [ ] No [ ]
2. Do you have school food programs? Yes[ ] No [ ]
3. Are there some foods which are not allowed to be sold at school surroundings? Yes No[ ]
   If yes name them……
4. Are students allowed to buy/ eat any food during class hours? Yes [ ] No [ ]
5. Are students allowed to go out of school compound during break time? Yes[ ] No[ ]
6. Are students allowed to buy food outside the school during school hours? Yes[ ] No[ ]

Part 2: Food environment

a. Food services available in school and operating hours

	None	1-2	3-5	6+
Food store/ shops				
Food vendors				
School canteen/ cafeteria				

Operating hours

	Full time	Break time	Before class	After class
Food store				
Food vendors				
School Canteen/ cafeteria				

b. Types of foods available in school per food services

	Canteen	Food store	<2 food vendors	3-5 food vendors	>6 food vendors
Main meals					
Snacks					
Soft drinks					
Vegetable					
Fruits					

c. List of foods available in school environment

	List foods available
Main meals	
Beverages	
snacks	
Fruits	
Vegetables	

7. How do you consider the price of food sold around the school environment?
    a. Expensive
    b. Fair
    c. Cheap
8. What do you consider to be the most expensive foods? (List)
    -
9. What do you consider to be the least expensive foods? (List)
    -

Part 3: Perception

10. How do you perceive food environment in the school?
    Health Unhealthy

11. Do you think nutrition and food safety is priority in your school?

    Disagree Agree

Appendix 2: Survey questionnaire

General information	
ID No.	Date of the interview:
Interviewer name:	School name:

Demographic Data	
Sex: F ( ) M ( )	
How old are you?	Date of Birth:
Which grade/class are you in?	
Does your parent/guardian give you money to buy food at school? Yes ( ) No ( ) How much?	How much money do you normally spend on food every day?

Adolescents 24h Dietary Recall Form

ID No:	Interview date:	Day of the week:
Respondent name:	Interviewer name:	
Did you experience any form of sickness yesterday? Yes ( ) No ( )	Did you receive any food supplements the day before? Yes ( ) No ( ) Name:	
Was yesterday a typical normal school day for you? Yes ( ) No ( )	Was there anything special or different that changes your daily food intake e.g. festival, fasting? Yes ( ) No ( )	
Weight (kg)	Height (cm)	

Time	**Food/ drinks**	**Recipe**	**Amount**	**Place of preparation**	**Place of consumption**

Appendix 3: Informed Consent Form for school going Adolescents

Part I: Information

Purpose of the study: The study aims at understanding how school food environment affect the eating habit of school going adolescents. This study will bring insight on the role of school food environment on students eating habit hence will be useful for various stakeholders such as nutritionists, policy makers in effort to improve adolescent's nutrition and fighting chronic diseases that are the results of prolonged poor eating habit.

What will be done: This research involves face to face interview with adolescents aged 14 to 19 years. For every participant interview will be conducted twice on non-consecutive school days. On both interview days the participant will be expected to give clear and detailed information on foods and drinks consumed for the past 24 hours. The interview can take 20 to 30 minutes depending on the list of food and details needed. Also measurement of weight and height will be taken for every participant; the measurements will be used for assessment of nutritional status of participants.

Participation: Firstly, you should be aware that your participation in this study is completely voluntary. You are not obliged to participate in this study if you do not want to. Participation should be out of your own will. You have the right to withdraw from the research at any point if you feel like you are no longer comfortable with the process. With drawing from this study will not affect in anyway your relationship with teachers and school administration, being part of this study is not considered as your responsibility as a student and not in relation with your academic or discipline issues.

Confidentiality: The information corrected is completely confidential and they will only be used for academic purpose and not otherwise. Your names will not appear on the questionnaire only your ID number. The researchers only will have access of your full name and your ID in case they need to trace back some information from you. Individual information will not be disseminated under any circumstances to school administrators and teachers as well.

Risk involved: There are no risks involved in participating in this research

Part II: Agreement

I undersigned ……. declare that I have read and understood the information above. I am completely aware of the purpose of the research and what is expected from me as a participant. I agree to participate in this study willingly without being forced, also I am aware that I can withdraw any time when I feel uncomfortable and information I give will be treated with confidentiality.

Signature and date