ASSESSMENT OF DIET QUALITY AND DIETARY DIVERSITY OF OVERWEIGHT AND OBESE ADULTS IN MOROGORO MUNICIPALITY, TANZANIA.

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ABSTRACT

Obesity is a condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy. It is one of the most serious public health problems of the 21st century. This study was carried out to determine diet quality and dietary diversity among overweight and obese adults aged 40 years and above working in public and private institutions in Morogoro Municipality. A cross sectional study was conducted in which data were collected once to determine the diet quality and dietary diversity in 288 individuals. Dietary diversity was determined by using a validated 24 hours recall method. Anthropometric measurements of weight and height were measured by using Salter scale and stadiometer, respectively, while waist and hip circumferences were measured by using non-stretchable tape measure. Structured questionnaire was used to collect social-economic and demographic information of the subjects. Data were coded and analyzed by IBM Statistical Product for Service Solution (SPSS) program, version 20. Results showed that, prevalence of overweight was higher (P =0.005) among males (41%, n = 118) than females (22.1%, n = 64) while prevalence of obesity was higher (*P* = 0.005) among females (26.7%, n = 77) than males (10.1%, n = 29). The average dietary diversity score for the study sample was 5.51 ± 1.056 and no significant association was observed between Dietary Diversity Score (DDS) and Body Mass Index (BMI) of the respondents (P = 0.280). Dietary quality score of the subjects using Diet Quality Index-Revised (DQI-R) was low since they were related to high fat consumption, low fruits and vegetable intakes, and low iron and calcium intakes. There was a strong association (P = 0.000) between diet quality index and BMI of the respondents. Most of the participants in the study (> 80%) had daily energy intakes ranging from 1634.73 to 3598.00 kcal. The average energy intake for both males and females was 2318.18 kcal. Despite most subjects being literate, majority of them were not

aware of dietary diversity, diet quality and the health problems that could result from poor dietary diversity. It was concluded from the study that overweight and obesity together with unhealthy eating practices may play a major role in the future risk for cardio vascular diseases, therefore should be discouraged, also dietary diversity should be encouraged but limiting diets that offer a greater variety of energy-dense foods because could increase food intake and body weight. It was recommended from the study that people should be encouraged to eat healthier foods that are high in energy and nutrients from different food groups such as fruits, vegetables, and or non-refined grain. While discouraging the practice of eating highly refined foods, high sugar confectionery foods such as cakes, biscuits and high fat and low fibre foods.

DECLARATION

I, Nyamizi Njile Katunge, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

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The above declaration is confirmed by

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Prof. Theobald C. E. Mosha Date

(Supervisor)

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DEDICATION

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LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS.

BMI	Body mass index
CHO	Carbohydrate
cm	Centimeter
CVD	Cardio vascular diseases
DDS	Dietary Diversity Scores
DQI	Diet Quality Index
DQI-R	Diet Quality Index – Revised
DGI	Dietary Guideline Index
FAO	Food and Agriculture Organization
FFQ	Food frequency questionnaire
FVS	Food Variety Scores
HDDS	Household Dietary Diversity Score
HEI	Healthy Eating Index
IDDS	Individual Dietary Diversity Scores
kcal	Kilocalorie
kg	Kilogram
LDL	High Density Lopoprotein
mg	Milligram
m	Meter
NBS	National Bureau of Statistics
RDA	Recommended daily allowance
SPSS	Statistical Product for Service Solution
URT	United Republic of Tanzania
USA	United States of America
wc	Waist circumference

WHO	World Health Organization
WHR	Waist to Hip Ratio

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Overweight and obesity are conditions in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems (Suman *et al*., 2010). Overweight and obesity are considered a multivariate syndrome which can negatively affect the whole body functioning (WHO, 2005). They were previously common in highly developed countries, but in recent years progressive increase is noticeable in developing countries including Tanzania (Ziraba *et al*., 2012). It is a leading but preventable cause of death worldwide, with increasing prevalence in adults and children. It is one of the most serious public health problems of the 21st century (Swinburn *et al*., 2011).

World Health Organization (2000) defines obesity as a condition of abnormal and excessive fat accumulation in adipose tissue to the extent that, health may be adversely affected (WHO, 2000). Overweight and obese have become a serious epidemic health problem, estimated to be the fifth leading cause of mortality at global level (Yang *et al*., 2012). Worldwide prevalence of obesity has more than doubled between 1980 and 2014 (WHO, 2015). In 2014, more than 1.9 billion adults, aged 18 years and above were overweight. Of these, over 600 million adults were obese. Overall, about 39% of adults aged 18 years and over (38% of men and 40% of women) are overweight (WHO, 2015).

Diet quality refers to the nutritional adequacy of an individual's nutrient requirements and how closely this aligns with national/international dietary guidelines (Ruel, 2003; Kant, 1996).

Scores or indices of diet quality are being increasingly used in research as proxies for nutrient intakes, due to their low burden for researchers and respondents. Diet and nutrition play important roles in maintaining health and preventing diseases. This is especially important for adults where proper nutrition plays a crucial role in helping them maintain good health and functioning of different body systems (Steyn *et al.*, 2004).

Dietary diversity has long been recognized by nutritionists as a key element of high-quality diets. Dietary diversity, which is defined as the number of different food groups consumed over a given reference period, has been identified as a potentially useful indicator which provides information about the individual or household nutrients intake. Dietary diversity in populations can serve as a simple but effective indicator of various parameters that affect the nutritional status of people (Hillbruner and Egan, 2008; Steyn, 2006). Dietary diversity therefore is usually quantified by the number of nutritious food groups compared with the number of different food items known as food variety (Clausen *et al.*, 2005; Ruel, 2003). Additionally, with the current recognition that dietary factors are associated with increased risks of chronic diseases, dietary recommendations promote increased dietary diversity along with reducing intake of selected nutrients such as fat, refined sugars and salt.

A diverse diet increases the probability of nutrient adequacy among adults and leads to positive health outcomes such as reduced complications of diabetes, incidence of several cancers and all-cause mortality. As dietary factors are associated with increased risk of chronic diseases, local and international dietary recommendations promote increased dietary diversity but limiting saturated fats, refined sugar and salt (Ruel, 2003).

Lack of dietary diversity is however, a major nutritional concern among deprived people from the low income countries. Changing from a monotonous diet to one with varied food

types has been shown to improve energy and nutrient intakes in people from developing countries. The demographic and economic transition that many developing countries are undergoing is producing important changes in diet and lifestyle behaviors that greatly impact on disease risks (Jayawardena *et al*., 2013).

Despite nutrient deficiencies being major concerns in the developing countries, recent nutrition transition and changes in the physical activity patters, diet related metabolic problems has emerged as alarming public health problems in many developing countries, especially among urban dwellers. Nutritional status is considered an outcome of biological processes that involve food utilization while dietary diversity ensures adequate nutrient intakes among various social groups (Steyn *et al.*, 2006). Furthermore, while inverse relationships have been found between dietary diversity and chronic non-communicable diseases (Azadbakht *et al*., 2006), dietary diversity has a direct relationship with favorable nutritional status (Steyn *et al.,* 2006). It is not surprising that, eating a variety of foods, across and within major food groups has been recommended in most dietary guidelines (Jeanene *et al*., 2006), since it is associated with a number of improved outcomes such as nutrient adequacy, anthropometric indices and improved hemoglobin concentrations (Swindale and Bilinsky, 2005).

1.2 Problem Statement.

Overweight and obesity are worldwide phenomena that have reached in both developed and developing countries, contributing to the development of chronic diseases such as diabetes, cardiovascular diseases and cancers (Ilana and Rosely, 2011).

Most of the world's population lives in countries where overweight and obesity kill more people than underweight (WHO, 2014). According to Field (2001), overweight and

obesity contribute to many comorbidities and even death. In Tanzania, increased prevalence of excessive weight is noted among all age groups, in both genders (Bray, 2004). This has been associated with nutrition transition in food choices from our local diet to Western food patterns and changes in lifestyles. Sedentary lifestyles have grown over the past decade due to urbanization and rapid technological advancements. It has been shown that, at least 60% of the world's population does not undertake sufficient physical activity to gain health benefits (WHO, 2002).

Dietary diversity has been used to reflect the quality of the diet, and it has been associated with better health outcomes, especially with regard to issues of underweight among children. High diet diversity is associated with increased intake of fiber and vitamins and also, increased variety contributes to high calorie consumption (Jayawardena *et al.*, 2013).

In Tanzania, nutrition transition is also affecting the health of the people. For example in Morogoro region, prevalence of overweight and obesity among adult females and males is as high as 25% (Nyaruhucha *et al*., 2003). Development of various diseases caused by obesity and over-weight reduces life expectancy and shortens lifespan by three to seven years for an individual aged 40 years with a BMI of 30 kg/m^2 or more**.** Many studies on overweight and obesity have focused on either investigating the prevalence or comparison of prevalence rates between the people in urban and rural areas, and not on assessing the quality of their diets and how do they diversify them.

1.3 Justification of the Study

Overweight and obesity are on the rise in Tanzania and might reach epidemic proportions in the near future. Like the other public health challenges, overweight and obesity should be tackled and prevented early as stipulated in the WHO Global strategy on diet, physical

activity and health (WHO, 2013). In Tanzania, due to rapid urbanization, nutrition problems namely under-nutrition and over-nutrition have been reported. Despite the initiatives implemented by the Government and other stakeholders, still nutrition problems have declined only slightly (NBS, 2011).

Assessment of dietary patterns of overweight and obesity among adults has not been sufficiently studied and knowledge in this area is still limited. This study therefore was designed to fill this gap by investigating diet quality and dietary diversity among overweight and obese adults in Morogoro Municipality. Findings from this study will be useful to nutritionist, health workers, and policy makers in planning appropriate intervention programs to address the problem of over-nutrition in the study area.

1.4 OBJECTIVES

1.4.1 General objective

To assess diet quality and dietary diversity of overweight and obese adults in Morogoro municipality, Tanzania

1.4.2 Specific objectives

Specific objectives of the study are to**:**

i. Assess nutrition knowledge of the respondents.
ii. Determine energy and nutrients intake of the respondents using a three past 24 hours recall method.
iii. Determine the individual dietary diversity by assessing the usual food groups consumed by the respondents.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Diet

Diet is a meal while a balanced diet is a meal that provides all the nutrients required for optimal growth in the right proportions to promote optimal growth. Balanced diet provides the correct amount of all nutrients without excess or deficiency to maintain health (Dangour, 2010)**.** Furthermore, a balanced diet is one that gives our bodies the nutrition needed to function properly. In order to get good nutrition, we should obtain majority of our daily calories and nutrients from whole grains, lean proteins, fresh fruits and vegetables. A complete diet is a meal that contains food components from all the seven major food groups namely carbohydrates, fibre, fat, protein, minerals, vitamins and water. Complete diet plays an important role in prevention of chronic diseases such as diabetes, cardiovascular diseases and cancers (Willet, 2004). Many studies have been done to assess the overall diet and categorize individuals according to the extent to which their eating behaviour is healthy (Gil *et al.,* 2015).

2.2 Diet Quality

To quantify overall diet quality, several indices have been developed to assign scores to individuals based diet records. The most popular indices are the Diet Quality Index (DQI) (Patterson *et al.,* 1994) and the Healthy Eating Index (HEI) (Kennedy *et al*., 1995). The DQI was first developed as a sixteen-point scale (zero being the best score and sixteen the worst) (Patterson *et al.,* 1994). The lower (i.e. better) DQI scores were associated with higher vitamins and minerals and lower fat intake among American adults (Patterson *et al.,* 1994).

Other studies have focused on the relationship between DQI and various health outcomes (Nkondjock and Ghadirian, 2007; Fung, 2005; Seymour, 2003; Alexandre and Dubois, 2000). The Diet Quality Index developed in 1998 was updated by Haines *et al.* (1999) to reflect changes in nutrition guidelines in the U.S. resulting in the "revised" DQI or DQI-R. The new index was a 100-point scale with 100 being a perfect score, thus improving interpretation and making it more users friendly.

2.2.1 Diet quality indices

The use of diet quality indices has become widespread and often used to determine valid dietary guidance. Indices allow evaluation of the total diet in relationship with selected nutrients intake, compliance with dietary recommendations and chronic disease risks. Diet quality indices consist of a combination of foods or nutrient components that together represent dietary guidelines (Waijers *et al.*, 2007; Newby and Tucker, 2004; Kant, 2004).

The use of index-based dietary patterns is one way to address the complexity of diet, while at the same time evaluating the effectiveness of current dietary guidelines to prevent chronic diseases (Arvaniti and Panagiotakos, 2008). Studies using dietary indices have found associations with nutrient adequacy, biomarkers of disease, premature mortality, cardiovascular diseases and certain forms of cancers (Reedy, 2008; Fung, 2006).

Diet quality indices have been derived by applying a scoring system to dietary intakes assessed by a variety of measures, including food frequency questionnaires (FFQ) and 24 h recalls. Indices are constructed by assigning higher scores within sub-scales based on more frequent or higher intakes of foods, nutrients, or both (Kant, 1991). Generally, there are two types of diet quality scores. These are either food-based or nutrient-based. A food-based diet quality index considers the number of foods or food groups consumed in a

given period and assigns points based on diversity or frequency of intake. Nutrient-based scores require the dietary intake record to be analysed first in order to derive nutrient intakes the form which the diet quality scores can be calculated (Waijers, 2007).

According to Ruel (2003) and Kant (1991), no consideration is usually given to the sources or intakes of nutrients. Food-based scores rely on food consumption data only, because they can be scored quickly, but they typically have a limited food list and may not fully reflect overall variety of foods consumed. This may be particularly for some population sub-groups, such as specific ethnic groups where food items may not have been included in the original FFQ food list. In comparison, nutrient-based scores require the dietary intake record to be analysed first in order to derive nutrient intakes, the form which the diet quality scores can be calculated. For this reason nutrient-based scores may be preferable for clinical settings and education purposes as they are more adapted to this purpose (Waijers *et al.*, 2007; Kant, 1991). Given differences in food supply, consumption patterns and nutrition recommendations, diet quality indices should be country-specific because each country has its own foods which are only available to the particular country.

2.2.1.1 Ten components involved in the diet quality index

The Diet Quality Index is one example of such a measurement approach, designed to assess conformity of the diet with U.S. dietary recommendations (Drewnowski *et al.*, 1997). It was designed based on the recommendations made in *Diet and health: Implication for reducing chronic diseases risk committee,* (1989*).* The ten equally weighed items included in this index are (1) that the diet contains less than 30 percent of energy from fat; (2) less than 10 percent of energy from saturated fat; (3) less than 300 milligrams of cholesterol per day; (4) 2-4 Servings of fruits per day; (5) 3-5 Servings of vegetables per day; (6) 6-11 Servings of grains per day; (7) Calcium intake, AL (Average intake) for

age, (8) Iron intake, % RDA for age; (9) Dietary diversity; (10) Dietary moderation. Diet Quality Index-Revised scores range from 0 to 10 for each component, for a highest possible diet quality score of 100. According to the method of Haines *et al*. (1999), total fat, saturated fat, and cholesterol components are calculated as a percent of total energy and are categorically scored as 0, 5, or 10, and the remaining components are scored as continuous variables from 0 to 10, proportional to the recommended range of intake.

According to Dietary Recommendation for Fruits and Vegetable (2010), fruits and vegetable intake is as follows: 1 servings; 1 Cup of raw leafy vegetables, half cup of other vegetable, raw or cooked, 1 medium apple, Banana, orange, pear, half cup of chopped, canned or canned fruits, quarter cup of dried fruits, three quarter cup of 100% fruits or vegetable juice. Weight reference; 1 Cup of raw leafy vegetables = 56 g, half cup of cooked or chopped raw vegetables = 84 g.

Table 1: **Recommended daily allowances for macro and micro-nutrients (included in the DQI-R) for adults**

	Age category (years)			
Nutrients	**19-50**		**51± Above**	
	M	F	M	F
Calcium (mg)	1000	1000	1200	1200
Iron (mg)	8	18	8	8
Fat (g)	<65	<65	<65	<65
Cholesterol (mg)	<300	<300	<300	<300
Saturated fat (mg)	<20	<20	<20	<20

2.3 Estimated Calorie Needs per day by Age, Gender, and Physical Activity Level (PAL)

Table 2: Average daily energy requirement (kcal)

Age (years)	Male			Female		
	Sedentary	**Moderate**	**Active**	**Sedentary**	**Moderate**	**Active**
40-45	2200	2600	2800	1800	2000	2200
46-50	2200	2400	2800	1800	2000	2200
51-55	2200	2400	2800	1600	1800	2200
56-60	2200	2400	2600	1600	1800	2000
61-65	2000	2400	2600	1600	1800	1800

Table 3: Physical activity level of people with different occupations

Physical Activity level (PAL)	*Examples of Occupation*
Sedentary	Office workers, salesperson, lecturers, hotel attendants
Moderate	School workers, electricians, professional drivers
Active/heavy	Athletes, dancers, construction workers

2.4 The Role of Food Diversity in Diet Quality Scores

Diet diversity is a major element in determining the degree to which food and/or nutrient intakes by individuals and/or populations are adequate (Fernandez *et al.,* 2000). Kuhnlein and Receveur (2007) recognized that, whenever North American dietary patterns comprised more diverse food items or groups dietary quality increased. Although many studies emphasize this idea, they employ a wide variety of methods to incorporate it in the particular indexes they build up (Guenther *et al.,* 2014). Many studies also highlighted that, various food sources contributed differently to food diversity: for instance, products

taken from animals were not equal to those from plants in terms of nutrient densities; i.e. one animal food serving gave more nutrients than comparable amount of plant food. Foote *et al*. (2009) perceived this difficulty in providing a clear meaning to dietary variety that could be based on food codes, food groups or food ingredients (from composite mixed dishes). Dietary quality is also assessed with a close look at added sugars, cholesterol, saturated fat and sodium (i.e. nutrients that need limited consumption), which had a weak association with dietary variety, yet statistically significant. It was also agreed that, nutrient adequacy could be achieved by consuming at least a half-serving per day of diverse foods from the twenty-two Food Guide Pyramid subgroups. In their study on ways to measure food variety in relation to dietary quality, Murphy *et al*. (2009) insisted in using fifteen vitamins and minerals (i.e. vitamins A, C, E, B6, and B12, and thiamine, riboflavin, niacin, folate, calcium, phosphorus, magnesium, iron, copper, and zinc) that had established in order to characterize the concept of diet quality.

In their analysis of the Australian diet with the dietary guideline index, McNaughton *et al*. (2008) limited dietary diversity to food groups they considered to be the core of the diets, i.e. fruits, vegetables, meat/protein, dairy, and cereals. Within each core food group was interpreted as the proportion of core foods minimally eaten once per week as a proportion of the total amount of core foods listed on the food-frequency questionnaire. The score was the summation of points (out of two) given to core food groups individually.

It has been advanced that, promoting food variety could push people to over-consumption (Mirmiran *et al*., 2006), especially in regard to nutritional factors that have undesirable effects. Individuals could see food variety as a ‘healthy’ way to increase the number of food items they can eat and forget to limit their choices to their energy requirements and balance. This showed again how difficult it was to create dietary scores that capture the

idea of healthy/balanced eating patterns, i.e. food patterns that are adequate in terms of nutrient density/adequacy, macronutrient proportionality, moderation of less healthy items and food variety.

2.4.1 Measuring dietary diversity

Dietary diversity score is created by summing either the number of individual foods or food groups consumed over a reference period. This may constitute a simple count of food groups that a household or an individual has consumed over the past 24 hours. Calculation is slightly different if used at household or individual level and carries different meanings. Household dietary diversity score (HDDS) reflects, in a snapshot, the economic ability of a household to consume a variety of foods. Its increase is associated with socio-economic status and household food security (Hoddinot and Yohannes, 2002). Individual dietary diversity score (IDDS) aims to capture nutrient adequacy. Many studies in different age groups have shown that, an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet. Dietary diversity scores have also been positively correlated with increased mean micronutrient density adequacy of complementary foods. The population-level dietary diversity is the mean dietary diversity score and a measure of distribution of the scores (FANTA, 2006).

2.4.2 Dietary diversity at the individual level

The dietary diversity questionnaire can be used to collect information either at household or individual level. The decision on which level to collect information depends on the purpose and objectives of the survey. If assessment of the nutrient adequacy of the diet is of primary concern, it is best to collect information at the level of the individual. Another important consideration for the choice between household and individual is the frequency of meals/snacks purchased and consumed outside the home. If meals/snacks are purchased

and consumed outside the home on a regular basis by one or more family members, administering the questionnaire at the individual level is more appropriate as it is not possible to capture accurately meals/snacks purchased and eaten outside the home when assessing at household level (FAO, 2010).

2.4.3 Dietary diversity and health

Diverse diet increases likelihood of meeting nutrient requirements. The association of dietary diversity to longevity and reduced rates of chronic degenerative diseases such as cardiovascular diseases, diabetes and cancers for men and women has been documented by Kant *et al*. (1995). A handful of epidemiological studies uphold the conventional wisdom embodied in dietary guidelines concerning the benefits of a varied diet (Tucker, 2001). For example, in a study of 42,254 American women (mean age, 61 years) those who consumed a greater number of recommended foods had a decreased risk of mortality (Kant *et al*., 2000). Women in the highest quartile (median variety scores of 15) had an odds ratio of dying in a five and a half year period of 0.69 in comparison to the lowest quartile (variety score of 7). In an Italian study, dietary diversity, most strongly in vegetables and fruits, was associated with reduced incidence of stomach cancers (Le Vecchia *et al*., 1997).

This coincides with the recognized relationship of the benefits of Mediterranean diets in the reduction of risk for chronic degenerative diseases related to fruit and vegetable consumption. Drewnowski *et al*. (1996) showed that, while French diets were higher in fats than those in the USA, and therefore lower in indices of dietary quality, overall diversity likely accounts for their recognized benefits. Few data exist to support the contribution of dietary diversity to health in developing countries. Dietary diversity has been linked to improved anthropometry in children 1-3 years in Kenya (Onyango *et al*.,

2012). In Mali, Hatløy *et al.* (2001) demonstrated a strong correlation of dietary diversity of fruits and vegetables with overall nutrient adequacy and with specific nutrient intake such as vitamins A and C. Among different studies, inconsistent measurements of dietary diversity by indices of the number of individual foods as well as numbers of quality foods makes comparisons and general conclusions difficult. Key to future work in this area is development of common methodologies for measuring dietary diversity. Nonetheless, the suggestion that diversity in fruits and vegetables contributes to nutrition and health is consistently supported.

2.5 Factors Influencing the Development of Overweight and Obesity

Overweight and obesity are influenced by a number of factors including hereditary tendencies, environmental and behavioral factors, ageing and pregnancies. Obesity is not always simply a result of overindulgence in highly palatable foods or a lack of physical activity as is often mistakenly thought. Dietary factors and physical activity patterns strongly influence the energy balance equation and they are also the major modifiable factors (EUFIC, 2006; WHO, 2000).

2.5.1 Co-morbidities of overweight and obesity

Overweight and obesity are independent risk factors for premature death, but are also strongly associated with a number of other serious medical conditions (WHO, 2000). These people are susceptible to diabetes and Cardio vascular diseases and have increased risk of several major health risks especially women at post-menopausal state i.e. breast cancers and endometrial cancers (Schlenker and Long, 2007). Obese/Overweight are independent risk factors for diabetes and insulin resistance among different populations, for each increase of one unit of BMI, the risk of diabetes increases by 12%. The distribution of fat around the trunk region or central obesity is also a strong risk factor for

diabetes (Jamison *et al.*, 2006). Waist circumference (WC) and waist-hip ratio (WHR) are considered a good estimate of body fat, especially internal fat deposits and likelihood of developing weight-related disease. Health professionals often use BMI and waist circumference together to assess overweight and obesity and assessing risk of cardiovascular disease and diabetes. These measures are independent of height and muscle mass, have emerged as important predictors of risk of obesity related diseases and are very useful indicators of excess body fat and increased health risk. Measurements of waist circumference and waist-hip ratio are relatively simple and easier to calculate. It has been reported that WC and WHR showed significant association with myocardial infarction as compared to BMI (Yusuf *et al*., 2005; Welborn *et al*., 2003).

Type 2 diabetes is three times more likely to develop in an obese person than in a non-obese person. Furthermore, a person with Type 2 diabetes often has central obesity. Central body fat cells appear to be larger and more insulin resistant than lower body fat cells. Diabetes and hyperlipidaemia are strongly associated with excess weight especially in the abdominal region. Considerable evidence has suggested that, excessive weight gain is the most common cause of arterial hypertension (Yang *et al.*, 2012). Prevalence of obesity-hypertension is higher in urban areas compared to the rural and peri-urban areas owing to changes in lifestyles (dietary habits and physical activity). A study done in Tanzania, (Njelekela *et al.*, 2002), concluded that, urban population in Tanzania had higher mean BMI and blood pressure and higher prevalence of obesity and hypertension than the rural populations. Similar findings were reported by Sodjinou *et al.* (2008) in a Beninese urban adult population.

Obesity is also associated with psychosocial problems, among them stigma and depression. A study by Murphy *et al*. (2009) revealed that, among the subjects who had

experienced a major depressive episode, obese persons were five times more likely than the non-obese subjects. Depression leads to over-eating hence more weight gain. Overall, obese people are three times more likely to die than their lean counterparts. High BMI is strongly associated with elevated blood pressure and risk of hypertension, higher total cholesterol and LDL-cholesterol levels. Overall risks for cardio vascular diseases and stroke therefore increase substantially with weight gain and obesity (Swinburn *et al.,* 2011).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

Morogoro Municipality is one of the fastest growing urban centres in Tanzania. It is located about 190 km West of Dar es Salaam. It is situated on the slopes of Uluguru Mountains and covers an area of 260 km² (UN-HABITAT, 2009). It lies at the crossings of Longitudes 37 º 40 º East of the Greenwich Meridian and Latitude 60 º 49 º South of Equator. Morogoro Municipality has a population of 315 866 on the ratio of 52.15% (164 166) women and 47.85% (151 170) men, and a population growth rate of 4.7 % per annum (NBS, 2011).

The Municipality which constitutes the Morogoro urban district is one of the seven districts of Morogoro Region. Other districts are Kilosa, Kilombero, Ulanga, Morogoro Rural, Gairo and Mvomero. The Municipality has one division which is sub-divided into twenty nine (29) administrative wards namely; Bigwa, Kichangani, Kihonda, Kilakala, Mzinga, Mlimani, Kingolwira, Mafiga, Mazimbu, Mbuyuni, Boma, Mji Kuu, Mji Mpya, Mwembesongo, Sabasaba and Sultan Area. Others are Kiwanja cha Ndege, Uwanja wa Taifa, Chamwino, Kihonda Magorofani, Lukobe, Mafisa, Tungi, Mkundi, Mindu, Magadu, Kauzeni, Kingo, and Luhungo (NBS, 2011). About 10% of the current populations are civil servants employed by institutions and industries while 50% of the population depends on the agricultural sector as a major economic activity (UN-HABITAT, 2009).

The main agricultural cash crop grown in the Municipality is sisal while food crops include maize, rice, vegetables and fruits. The main income-generating activities include

livestock keeping, mining, charcoal making and petty businesses. Municipality's average per capital annual income is estimated to be 130000 Tanzanian shillings (UN-HABITAT, 2009). The main ethnic groups are Waluguru, Wasagara, Wakaguru, Wandamba and Wapogoro. Average daily temperature is 30 ^{o} C $\pm$ 5 ^{o} C. The highest temperatures occurs in November, December and January during which the mean maximum temperatures read 33 ^{o} C $\pm$ 5 ^{o} C while the minimum temperatures are in June, July and August when the average temperatures drop down to 16 ^{o} C $\pm$ 5 ^{o} C. The mean relative humidity is 66% and drops down to 37% during the dry season. The average total annual rainfall ranges from 821 mm to 1505 mm. March to May is the time for long rains while short rains occur between October and December of each year (NBS, 2011).

3.2 Study Design

This study was cross – sectional in design. This design was chosen because it entails collection of data on a number of cases at a single point in time. The design also is simple, less costly in terms of time, finance and human resources.

3.3 Sampling Frame

The study population was comprised of all adults aged 40 years and above working in public and private institutions in Morogoro Municipality. Inclusion criteria were adult men or women at age 40 years and above, who were overweight (BMI = 25-29.9) or obese (BMI = 30 and above) were eligible for this study. Exclusion criteria: Normal weight people, with (BMI less than 25), those who had chronic diseases and mental problems were excluded from the study. Likewise, those who refused to participate in the study were excluded.

3.4 Sampling Techniques

Public institutions in Morogoro Municipality namely Sokoine University of Agriculture, Mzumbe University, Morogoro Regional Commissioner's Office, Morogoro District

Council, Morogoro Municipal Council, Regional Treasury Office - Morogoro, Energy and Mineral Office – Morogoro region, Mafiga Secondary School and Mafiga Health Centre and a private institution namely Jordan University were selected purposely to participate in the study. Adults from these institutions were screened to determine their nutritional status. Those with BMI = 25-29 (Overweight) and BMI greater than 30 (Obese) were selected for further investigation. Cluster/Multistage sampling technique was employed so as to get as diverse a sample as possible in the municipal.

Ten institutions were purposely chosen as named above for being involved in the study. In which different departments were identified from each institution. Thereafter at least five adults from each department in the institution were selected at random, thus getting a representative number of adults from each department. For example, at Sokoine there were a total of 10 departments that were chosen at random out of 31 and five adults were randomly selected from each of these departments giving out a total of 50 subjects from SUA also it was done effectively to avoid taking more than one department from the same college/school/faculty. The number of respondents who participated from each institution varied depending on the capacity and eligibility factors. The distribution of the subjects sampled from each of the public and private institutions is summarized in Table 4.

Table 4: Sample distribution from various institutions

Respondents working places (institutions)	Number of subjects	Percent of total
Municipal Council	51	17.7
Regional Office	36	12.5
District Council	12	4.2
Energy and Mineral Morogoro Region	14	4.9
Finance Morogoro Region	30	10.4
SUA	50	17.4
Mzumbe University	40	13.9
Jordan University College	29	10.1
Mafiga Secondary	16	5.6
Mafiga Hospital	10	3.5
Total	**288**	**100**

3.5 Sample Size

Sample size was determined by using statistical power analysis (Chow *et al*., 2003) using the following equation:

$N = Z^2 * P (1-P) / d^2$

Whereby; N = Estimated sample size (when population is greater than 10 000)

d = Degree of accuracy desired (precision level) (acceptable error 0.05 or 5%)

P = Prevalence of Overweight and Obesity in Morogoro (25% overweight and obese in Morogoro) (Nyaruhucha *et al*., 2003).

Z = Confidence interval (1.96 two tailed)

Calculation

$N = 1.96^2 \times 0.25 (1-0.25) / 0.05^2 = 288$

Therefore the sample size for this study was 288 adults.

3.6 Data Collection

Data were collected in two steps.

Step1. Screening to identify those who were overweight and obese and those identified with BMI less than needed were dropped.

Step 2. Assessment of dietary quality and diversity among overweight and obese respondents.

3.6.1 Construction of a questionnaire, pre-testing and administration

A structured questionnaire was constructed to collect information on individual dietary diversity and dietary quality. The questionnaire was divided into five sections. Section A solicited personal information, section B solicited information on meal composition for the past 24-hours, section C solicited information about different types of food groups consumed based on individual dietary diversity scores, section D solicited information

about nutrition awareness, dietary quality and dietary diversity while section E solicited information on anthropometric measurements of the respondents.

Before data collection, the questionnaire was pre-tested among 20 adults at the National Seed Quality Testing Centre, Morogoro. This was done to check the validity and effectiveness of the questionnaire and the equipment used. Two enumerators were trained on how to administer the questionnaire, proper use of the equipment and proper recording of information.

The pre-tested questionnaire was administered to the subjects at the various institutions by face-to-face interview through office visits during morning hours. The individual Dietary Diversity Score (IDDS) was used to collect the information on the usual foods consumed by the respondents, where respondents were required to describe the foods (meals, drinks and snacks) consumed in the previous 24-hours starting with the first food or drink eaten during the morning, also respondents were asked to provide as much information as possible about portion size, method of cooking and all details of food consumption.

3.7 Measurements Taken and Tools

3.7.1 Height

Height of the respondents was measured by using stadiometer (length board). Respondent was required to remove his/her shoes and step before a stadiometer placed on a flat floor with his/her heels, buttocks, shoulders and back of head touching the wall of the stadiometer. The head of the respondent was comfortably erected with the lower border of the orbit in the same horizontal plane as the external auditory meatus, the arms were hanging at the sides in natural manner. The headpiece was then lowered gently crushing the hair making contact with the top of the head. The height was read and then recorded to the nearest 0.1 cm.

3.7.2 Weight

Weight was measured by using SECA (Model: 874 1021659, Made in Germany) weighing scale. The scale was checked and set to zero before measuring the weight. An individual was required to take off his/her shoes and stand straight on the scale. The weight was read from the scale and recorded to the nearest 0.1kg.

3.7.3 Waist circumference

Waist circumference was measured while the respondent was standing erect and abdomen relaxed with arms on the side but lifted a bit from the body. Feet were put together and weight distributed over the legs. Then the waist circumference was measured using non-stretchable tape and recorded to the nearest 0.1cm.

3.7.4 Hip circumference

Hip circumference was taken at the widest part of the buttocks using a non-stretchable tape and recorded to the nearest 0.1cm.

3.7.4.1 Waist to Hip Ratio.

W: H ratio was calculated from the relationship:

$$\text{W: H ratio} = \frac{\text{Waist (cm)}}{\text{Hip (cm)}}$$

3.7.5 24-hour dietary recall

Individual dietary intake was taken three times a week (two week days taken on Wednesday and one weekend day taken on Monday). Standard measurement utensils were used e.g. plate, cup and spoon were used during the interview, in order to estimate the actual amount of food taken by each individual. Digital kitchen scale /volume measures

were used to determine approximate amount of foods and beverages consumed by individuals in grams and milliliters within the past 24 hours. Recorded amounts of foods and ingredients were converted to their gram equivalents using the Tanzanian Food Composition Table (Lukmanji *et al*., 2008). Nutrients determined were total fat, saturated fat, iron and calcium. Nutrients were determined as percent of RDA.

$$\text{Dietary intake} = \text{Total } \frac{\text{intake}}{\text{RDA}} \times 100$$

3.7.6 BMI calculation

The BMI was calculated from the relationship:

$$\text{BMI} = \frac{\text{Weight in (kg)}}{\text{Height in (m)}^2}$$

3.8. Data Analysis

Descriptive statistics such as frequencies, percentages, means and standard deviations were analysed as well as correlation analysis, using the IBM Statistical Product and Service Solutions (SPSS) for Windows version 20.0 (SPSS, Inc, Chicago, IL, USA). Excel for Windows program was used to analyze dietary patterns of the respondents.

3.9 Ethical Consideration

The purpose of this study was explained to the respondents. Those who accepted to participate in the study were required to fill in a consent form to affirm their willingness to participate. To ensure confidentiality of the respondents, no real names were used and all respondents were identified by numbers. Permission to conduct the study was obtained from Morogoro Region health authorities.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic and Demographic Characteristics of the Respondents

4.1.1 Sex of the respondents verses BMI

The results showed that, 51% (n = 147) and 49% (n = 141) of the respondents were male and female subjects, respectively (Table 5). Most of the subjects 89.9% (n = 259) involved in the study were public servants working with the government while 10.1% (n = 29) were employed in the private sector (Table 4).

4.1.2 BMI and gender of the respondents

In the current study, it was observed that, overweight was twice as common in men 41% (n = 118) as in women 22.2% (n = 64). Conversely, obesity was twice as common in women 26.7% (n = 77) as in men 10.1% (n = 29). This observation was similar to findings by Brown and Siahpush (2007); Tjepkema (2006) and Johnston *et al.*(2004) who reported that, distribution of overweight and obesity is gender-specific, with men being more likely than women to be overweight and women being more likely than men to be obese.

Huot *et al*. (2004) reported that, rural and suburban living was associated with increased risk of overweight in men, but at the same time urban living was associated with increased obesity risk in women. Among obese respondents 15.3 % (n = 44) said they had no overweight/obese history in their family and 21.5% (n = 62) said yes in having history of overweight/obese. This indicated that not only heredity factor can play a role in being overweight/obese, but other factors including hereditary tendencies, environmental and behavioral factors as well as ageing play an important role (EUFIC, 2006; WHO, 2000).

This may also reflect the gender difference in overweight risk, in our study whereby men were more likely than women to be overweight while women were more likely than men to be obese. There was a strong (p = 0.000) association between BMI and the sex of the respondents (Table 5).

4.1.3 Age and BMI

Table 5 also shows that, most of the respondents 36.8% (n = 106) were in the age group 40 - 45 years, whereas 23.6% (n = 68) were aged 46 - 50 years. Results indicated that, 19.15%, 15.6% and 4.9% were aged 51 - 55, 56 - 60 and 61 - 65 years respectively. This study showed that, no significant association existed between age and BMI (p = 0.121). This implied that the state of being overweight/obese was not strongly influenced by age, implies that even people of young age can have high BMI.

Cihangi (2004) stated that, association between obesity and age can be explained, in part, by a decrease in physical activities with age in both men and women. Some age-related changes involve a gradual decline in function that is due to biological senescence. For example, aging is generally associated with more body fat and reduced muscle mass. Reduced muscle mass has been directly linked with lowered muscle strength, lowered maximal aerobic capacity, and decreased bone density in elderly adults. According to Nyaruhucha *et al*. (2003), the problem of being obese appears to be increasing more rapidly among children compared to adults. Therefore the problem starts at a very young age and this could be caused by several factors such as hormones, high adipose cell count, heredity, defective metabolic mechanism, large fat cell, brown fat, lack of physical exercises and over-eating. The most common and main cause is however, the consumption of calories in excess of the normal body requirements (Meeuwsen, 2010).

Table 5: **Socio-economic and demographic characteristics of the respondents**

Variable	Overweight No (%)	Obese No (%)	Total No (%)	$\chi 2$ No (%)	d.f No (%)	p-value No (%)
Education level						
Certificate	43 (14.9)	26 (9)	69 (24)	5.567a	4	0.234
Diploma	66 (22.9)	35(12.1)	101(35.1)			
Bachelor	28 (9.7)	23 (8)	51(17.7)			
Master	24 (8.3)	17(5.9)	41(14.2)			
PhD	21 (7.3)	5 (1.7)	26 (9)			
Sex						
Male	118 (41)	29(10.1)	147 (51)	37.649[a]	1	0.000
Female	64 (22.2)	77(26.7)	141 (49)			
Age (years)						
40-45	61 (21.2)	45(15.6)	106(36.8)	7.292[a]	4	0.121
46-50	42 (14.6)	26 (9)	68(23.6)			
51-55	33 (11.5)	22(7.6)	55(19.1)			
56-60	35 (12.1)	10 (3.5)	45(15.6)			
61-65	11 (3.8)	3 (1)	14(4.9)			
Income	35(12.2)	24(8.3)	59(20.5)	2.888[a]	3	0.409
100000 to 400000	50(17.4)	36(12.5)	86(29.9)			
450000 to 700000	59(20.5)	30(10.4)	89(30.9)			
750000 to 1000000	38(13.2)	16(5.6)	54(18.8)			
> 10000000						

4.1.4 Education level and BMI of the respondents

Most of the subjects in Table 5 had Diploma education (35.1%; n = 101). The percent of overweight and obese subjects in this education level were (22.9%; n = 66) and (12.1%; n = 35), respectively. Few respondents (9%; n = 26) had Ph.D. degrees in which the percent of overweight and obese were (7.3%; n = 21) and (1.7%; n = 5) respectively. Results revealed that, most of the subjects had either gone to College or University. Kruger *et al*. (2005) reported that, education attainment can lead to acquisition of a different lifestyle which may have either positively or negatively impact on body weight. There were no significant association (p = 0.234) between the levels of education and BMI of the subjects (Table 5).

4.2 Waist - Hip Circumference of the Respondents

4.2.1 Waist circumference of men and women

Waist circumference (WC) is strongly linked to obesity-associated health risks in men and women. In this study majority of female respondents (82.98%; n = 117) were having

abdominal obesity compared to male subjects (13.6%; n = 20). Meanwhile, only 1.42% of female subjects were normal compared to 55.1% of males. Lean *et al.* (1998) suggest that a waist circumference of 94 cm for men and of 80 cm for women should be considered as cut offs for limiting weight gain, whereas a waist circumference of 102 cm for men and of 88 cm for women should be considered as cut offs for reducing weight. The relation of obesity-associated risk factors with BMI and waist circumference, particularly the cut offs at which the risk associated with a given waist circumference corresponded to the cut offs for BMI are 25 and 30 kg/m^2. These corresponding cut offs suggest that a waist circumference of 90 cm for men and of 83 cm for women, equivalent in risk to a BMI of 25units, may represent an action level for limiting future weight gain, whereas a WC of 100 cm for men and of 93 cm for women, equivalent in risk to a BMI of 30 units, may suggest the need for risk reduction and weight loss (Zhu *et al.*, (2012).

Table 6: Waist circumference of men and women

Variable	Classification/cut off points		No. of respondents	Percent
Male	Obese	> 102cm	20	13.6
	Overweight	≥94cm -<102cm	46	31.3
	Normal	< 94cm	81	55.1
Total			**147**	**100**
Female	0bese	>88cm	117	82.98
	overweight	≥80cm -<88cm	22	15.6
	Normal	<80cm	2	1.42
Total			**141**	**100**

4.2.2 Waist to hip ratio of both males and females

Table 7 shows, most women were obese (39.9%) compared to male (3.1%) while only (4.2%) of female were normal compared to (40.3%) of male. This implies that, females were more likely to develop abdominal obesity compared to males. Huxley *et al.* (2010)

concluded that there was convincing evidence that measures of general obesity (E.g. BMI) and measures of abdominal adiposity (E.g. waist circumference, waist–hip ratio and waist–height ratio) are associated with cardio vascular disease risks.

Abdominal obesity measured by waist circumference or waist-to-hip ratio (WHR) is an important potential risk factor for chronic diseases such as hypertension, lipid and glucose concentrations, with abdominal adiposity (measured by waist hip circumference or WHR) than with overall adiposity (as measured by BMI) (Dalton *et al*., 2013). Individuals with a similar BMI can vary considerably in their abdominal-fat mass, with premenopausal women typically having half the abdominal-fat mass of men (Janssen *et al.,* 2014). For this reason, a measure of obesity that takes into account the increased risk of obesity-related illness because of the accumulation of abdominal fat is desirable.

Table 7: Waist to Hip ratio of the respondents

Category	WHR Classification	Status	No. of respondents	Percent
Female	≤ 0.8	Normal	12	4.2
	> 0.8 - ≤ 0.85	Excess fat	14	4.9
	> 0.85	Obesity	115	39.9
Male	≤ 0.95	Normal	116	40.3
	> 0.95 - ≤ 1.0	Excess fat	22	7.6
	> 1.0	Obesity	9	3.1
Total			**288**	**100**

4.4 Nutrition Education of the Respondents (Including the Knowledge about Diet and Dietary Diversity).

Studies done by Kobe (2006) and Uddin *et al*. (2008) revealed that, knowledge plays an important role in public health. Table 8 shows that, 40.6% (n = 117) of the respondents had no knowledge about diet. In addition, majority of the subjects (52.1%, n = 150) had no knowledge about complete diet. On defining poor diet, 49% (n = 141) of the subjects

failed, 25% (n = 72) defined poor diet as one containing all nutrients in proper quantities, while 26% (n = 75) defined poor diet as a diet rich in fat and carbohydrate only. Researchers have indicated that, individuals with greater nutrition knowledge are more likely to eat healthier diets (Ball *et al*., 2006; Turrell and Kavanagh, 2006; Wardle *et al*., 2000). On the other hand, nutrition knowledge and diet quality are negated by research advocating that, nutrition knowledge alone is not sufficient to influence healthy dietary behaviours (Darmon and Drewnowski, 2008; Drewnowski and Specter, 2004; Worsley, 2002).

Skipping meals usually compelled individuals to snack repeatedly in order to suppress their hunger (Leidy, 2013). Our study showed that, most of the subjects (64.9%; n = 187) (Table 8) ate at least once every 8 hours, implying that, most of them took only an average of two meals per day. They took snacks and soft drinks mostly as compensation during lunch or dinner. What makes the difference in the effect of snacking on weight gain was probably the amount of energy provided by the snacks (Bo *et al*., 2014) and the compensation (if any) which is made in the energy intake in the subsequent meals and snacks (Whybrow *et al*., 2007).

In this study, 73.6% (n = 212) of the respondents did not have a clear understanding of the quality diet, only 28.5% (n = 82) of them reported quality diet as a diet rich in different food varieties from several food groups at proper quantities. About 3.1% (n = 9), of the respondents reported quality diet as a diet rich in protein foods such as fish, meat and eggs while 2.4% (n = 7), of the respondents reported quality diet as a diet without any fat or oil. About 1.0% (n = 3) of the respondents reported quality diet as a diet rich in carbohydrate foods only. Access to and availability of healthy foods at home have been associated with better diet quality (Ding *et al*., 2012 and Patrick *et al*., 2005). On the

contrary, access to unhealthy food outlets, such as fast food restaurants and convenience stores, can lead to excessive intake of high energy, sugar, and saturated-fat, which have been linked to increased prevalence of overweight and obesity (Laska *et al*., 2010; Fulkerson *et al.*, 2011).

In this study, 75% (n = 216) of the respondents had never heard about diet diversity. In addition, 80.2% (n = 231) of all respondents did not know the health benefits of diverse diets and they also did not know problems that could result from poor dietary diversity (Table 8). According to Ruel (2003), people with poor dietary diversity are more likely to develop obesity and Type 2 diabetes. With regards to dietary factors that were associated with increased risk of chronic diseases, nutritional advice promoted dietary diversity and reduced intake of non-healthy food items such as fat, salt and refined sugars.

The current study showed that, the subjects' level of knowledge about nutrition and dietary diversity was poor regardless of the high level of education they had. This lack of knowledge about nutrition could be related to exposure to different training curricula. In addition, respondents' prepared or purchased food without knowing if the food was good for their health or not, simply because they did not have knowledge about nutrition and dietary diversity (Table 8).

Table 8: Nutrition education of the respondents

Variable	Frequent	Percent
Do you eat fruits and vegetables often?		
Yes	275	95.5
No	13	4.5
If yes, how many times do you eat fruits and vegetable per day?		
1-2 times	217	(75.3)
3-4 times	71	(24.7)
More than	4	0
Do you understand the term "diet?"		
Yes	1 71	59.4
No	117	40.6
Which of the following is a poor diet?		
Diet containing all nutrients in a proper quantity	72	25
A diet rich in fat and carbohydrate only	75	26
Do not know	141	49
Do you understand the term "Diet quality"		
Yes	7 6	:6.44
No	212	3.6
Which of the following could be a high quality diet?		
A diet rich in different food varieties from several food groups at a proper quantity	82	28.5
A diet rich in protein food, like fish, meat and eggs	187	64.9
A diet without any fat or oil	9	3.1
A diet rich in carbohydrate foods	7	2.4
Do you understand what diet diversity is?		
Yes	72	25
No	216	75
Which of the following are the healthy benefit of a diverse diet?		
High appetite	216	75
Rapid bodyweight increase	1	0.4
Enough sleeping	15	5.2
A healthy immune system, Heart healthy, Vision health	56	19.4
Among the following healthy problems, which category do you think could results from poor dietary diversity?		
Overweight or underweight	231	80.2
Bilharzia or malaria	56	19.4
Typhoid or fever	1	0.4
Which of the following healthy problems are linked to being overweight or obese?		
Depression, trouble sleeping, Asthma	13	4.5
Heart disease, High blood pressure, Diabetes Infertility and Arthritis	275	95.5

4.5 Nutrients and Energy Intake (Diet Quality)

4.5.1 Food composition tables

The Tanzania Food Composition Tables (Lukmanji *et al*., 2008) were used for converting the amounts of food and beverages measured from a 24-hours dietary recall into nutrition parameters. The items involved were energy, fat, saturated fat, cholesterol, calcium and iron.

4.5.2 Macro-nutrients intake of the respondents

4.5.2.1 Energy intake

Table 9 shows that, majority of the male respondents (55.1%, n = 81) had excess energy intake/day while 40.1% (n = 59) of the male respondents met their RDA for energy. Only 4.8% (n = 7) of the male respondents did not meet their RDA for energy.

Majority of the female respondents (95.7%, n = 135) had energy intake exceeding their RDA. Only 3.5% (n = 5) of the female respondents were not able to meet their RDA for calories. The Average energy intake for male and female respondents was 2318.18 kcal, range 1634.73 – 3597.00 kcal.

The study indicated that, majority of the male (55.1%) and female (95.7%) respondents had energy intake exceeding the RDA, Pierre *et al.* (2005**)** revealed that, one of the most basic risks associated with high calorie intake was development of overweight and obesity. Also as the body weight increases, the body became larger in size due to fat accumulation, as fat accumulates around the extremities (peripheral parties of the body) and cholesterol accumulates on the inside the wall of the blood vessels, as the blood vessels become narrowed the heart must work even harder to push blood through narrowed pipes and high blood pressure develops as a result. High blood pressure

increases the risk of heart failure, along with heart attack and stroke (Swinburn *et al.*, 2011). Only a small portion of the subjects had energy intake below the recommendation. Though uncommon, negative energy balance can lead into health problems such as wasting and loss of muscle mass.

Table 9: Energy intake of the respondents by sex

Age in group (years) Energy intake (Male)	Average intake (kcal)	RDAs (kcal)	Intake as % RDAs	Respondents below RDA$_S$	% Below RDA$_S$	Met RDA	Respondent who met RDA	Respondent in Excess of RDA$_S$	% respondent in excess RDA$_S$
40-45	2349.8	2200	106.8	2	1.4	20	13.6	30	20.4
46- 50	2359.8	2200	107.3	1	0.7	12	8.2	15	10.2
51-55	2198.0	2200	99.9	1	0.7	16	10.9	15	10.2
56-60	2348.0	2200	106.7	3	2.0	10	6.8	15	10.2
61-65	2344.0	2000	117.2	0	0.0	1	0.7	6	4.1
Total				**7**	**4.8**	**59**	**40.1**	**81**	**55.1**
Energy intake (Female)									
40-45	2242.5	1800	124.5	28	19.9	0	0	26	18.4
46- 50	2288.3	1800	127.1	14	9.9	3	2.1	23	16.3
51-55	2327.2	1600	129.2	8	5.7	0	0	16	11.3
56-60	2322.9	1600	145.1	7	5	0	0	11	7.8
61-65	2455.7	1600		1	0.7	0	0	4	2.8
Total				**58**	**41.1**	**3**	**2.1**	**80**	**56.7**

4.5.2.2 Fat

Table 10 shows that, majority of the subjects (52.6%, n=152) exceeded the recommended daily allowance for fat. About 47.24% (n = 136) of the respondents met their RDA for fat (<65 mg). Fat makes a meal less bulky and helps the absorption of fat soluble vitamins such as Vitamin A, D, E and K. However, too much fat can lead to overweight and obesity. Findings by Jayawardena *et al.* (2013) showed that, excess fat in the diet increases calorie intake and introduces detrimental effects into our bloodstream that threatens our health and longevity. Consuming more than 20 to 30% of calories from fat increases weight gain, obesity and may lead to other unhealthy chronic conditions (Tenens *et al*., 2009).

4.5.2.3 Saturated fat

Table 10 shows that, 60.5% of the respondents were taking more than 20 mg of saturated fat in their diet per day while 39.5% took less than 20 mg/d of saturated fat as recommended (RDA < 20 mg). Saturated fat is a type of fat that comes mainly from animal products, such as meat and dairy products. Out of the various food groups consumed by the respondents, meat was the most food consumed in the group of flesh, organ meats, poultry and fish. Consumption of high amount of meat and their products could results into higher intake of saturated fat. Individuals who consume large amount of saturated fat are at a high risk of developing Type 2 diabetes as well as heart diseases (Mokhtar *et al.*, 2001).

Table 10: Macro-nutrients intake of the respondents

Age group	Average intake	RDAS (mg)	Intake in % RDAS	No. of respondents who Met RDAs	% who met RDAs	No. of respondent Excess RDAS	% Excess RDAs
Saturated fat (g)							
40-45	21.0	<20	105	45	15.6	61	21.2
46-50	22.7	<20	88.5	26	9	42	14.6
51-55	19.0	<20	95.0	22	7.6	33	11.5
56- 60	19.3	<20	96.5	10	3.5	35	12.2
61-65	16.0	<20	80.0	11	3.8	3	1.0
Total				**114**	**39.5**	**174**	**60.5**
Fats (g)		RDAs (mg)					
40-45	75	<65	115.3	45	15.6	61	2 1.18
46- 50	68	<65	104.6	20	6.94	48	16.66
51-55	70	<65	107.6	30	10.42	25	8.68
56-60	64	<65	98.4	35	12.2	13	4.51
61- 65	63	<65	96.7	6	2.08	5	1.73
Total				**136**	**47.24**	**152**	**52.76**
Cholesterol (mg)		RDAs (mg)					
40-45	356	<300	118.6	35	12.2	71	24.6
46-50	332	<300	110.6	18	6.3	50	17.3
51-55	319	<300	106.3	22	7.6	33	11.4
56-60	284	<300	94.66	29	10.1	16	5.6
61-65	315	<300	105	6	2.1	8	2.8
Total				**110**	**38.3**	**178**	**61.7**

4.5.2.4 Cholesterol

Table 10 shows that, 61.7% of the respondents were taking more than 300 mg/d of cholesterol in their diet per day while 38.3% were taking less than 300 mg/d as recommended. Cholesterol comes from two sources. Our body (specifically in the liver) makes all the cholesterol we need. The rest come from foods like animal source. For example, meat, poultry and full-fat dairy products contain cholesterol (called dietary cholesterol). Out of the nine food groups consumed by the respondents, meat was the food most commonly consumed in the group of flesh, organ meats, poultry and fish followed by oils and fat. Cholesterol circulates in the blood, and as blood cholesterol levels rise, it cause greater risk of developing heart diseases as well as increased in body weight (Ozturk *et al*., 2012).

4.5.3 Micro-nutrients intake of the respondents

4.5.3.1 Calcium

Results in Table 11 show that, there was high percent of male (58.4%) and female (77.3%) respondents, failing to meet the recommended calcium intake of 1000 mg/d (age of 19-50 years) and 1200 mg/d for age 51+ years. Calcium is required in higher amount per day as the age increases. Results of this study indicated that, large proportion of the respondents failed to meet the recommended calcium intake per day as their diet lacked dairy products, which are a good source of calcium. Table 10 indicates that, consumption of milk and dairy products was poor with only 22.2% of the respondents consuming it per day. Adults are vulnerable to calcium deficiency, largely because their bodies change with advancing age, which increases the demand for calcium.

4.5.3.2 Iron

Result in Table 11 show that, most male (64.62%, n = 95) and female (66.67%, n = 94), subjects had low iron intake and only (35.38%, n = 52) of males and (33.33%, n = 47) of the females were able to meet the RDA for iron (Table 11). This could be a result of consuming inadequate amount of iron-rich food groups. Inadequate intake of iron may lead to iron deficiency anemia (Faber and Wenhold, 2007).

Table 11: Micro-nutrients intake by the respondents

Iron (mg)	Average intake	RDAs (mg)	Intake in % RDAs	Met RDAs	% met RDAs	Below RDAs	% Below RDAs
Male (Age group years)							
19-50	4.0	8	50.0	29	19.73	52	35.37
51+	5.0	8	62.5	23	15.65	43	29.25
Total				**52**	**35.38**	**95**	**64.62**
Female (Age group years)							
19-50	8	18	44.4	27	19.15	67	47.52
51+	4	8	50.0	20	14.18	27	19.15
Total				**47**	**33.33**	**94**	**66.67**
Calcium (mg)							
Male (Age group years)							
19-50		1000	62.42	33	22.5	48	32.6
51+		1200	75.0	28	19.1	38	25.8
Total				**61**	**41.6**	**86**	**58.4**
Female (Age group years)							
19-50		1000	86.7	32	22.7	62	65
51+		1200	68.0	19	13.7	28	76
Total				**52**	**67**	**89**	**77.3**

4.6 Food Types and Feeding Practices of the Respondents

4.6.1 Food groups

4.6.1.1 Cereals

Table 12 shows distribution of cereals consumed by the respondents. The most consumed cereals were maize (maize meal) and rice. This implied that, respondents' diet was

predominantly based on cereals. Observation from this study was similar to that reported at national the level, whereby more than 60% of the diets in Tanzania were reported to be cereal-based (NBS, 2011), with low energy and nutrient density (URT, 2010). A study in Sri Lanka also found similar results where cereal-based foods were the most consumed diets (Wolever and Mehling, 2003). Consumption of carbohydrate is linked to increased risk of diabetes (Mohan *et al.*, 2009). Wolever, and Mehling (2003) recommended that, dietary intake of carbohydrate-based foods should be minimal, since diets based on carbohydrates raise the plasma glucose, triglycerides and non-esterified fatty acids leading to insulin resistance.

Table 12: Consumption of the various foods groups by respondents

Food groups	No. of respondents	Percent	Mean	P value
Starchy staples	288	100	1	-
Legumes, Nuts and Seeds	240	83.3	0.83	0.913
Other Fruits	48	16.7	0.17	0.690
Other Vegetables	143	49.7	0.50	0.750
Oils and Fats	289	96.9	0.97	0.913
Vitamin A rich Fruits and Vegetables	247	85.8	0.86	0.509
Meat, Fish, Poultry and their products	265	92.0	0.92	0.604
Eggs	59	20.5	0.20	0.648
Milk and dairy products	64	22.2	0.22	0.629

4.6.1.2 Vitamin A rich fruits and vegetables and other vegetables

Table 12 data indicated that, consumption of vitamin A rich fruits and vegetables was high (85.8%). According to Sharma (2003), there was high consumption of vitamin A rich fruits in urban individual since its consumption rate was more than 50%. Findings by Wolever and Mehling (2003), also found that, fruit consumption among rural population in Sri Lanka was also low compared to consumption levels in urban population.

4.6.1.3 Other fruits and vegetables

Consumption of other fruits and vegetables is summarized in Table 12. Only 16.7% and 49.7% of the respondents consumed other fruits and vegetables, respectively. Observation in this study was similar to that documented in Morogoro region by Ngasongwa (2007). According to Ngasongwa (2007), the rate of vegetables and fruits consumption in Morogoro Region was 17.9% while at national level was 36.5%. However, fruit and vegetables are not consumed on the same occasion and, therefore, might not replace the same type of food in the diet. Vegetables are mainly consumed during meals as a side dish (relish) or instead of staple foods or meat, whereas fruit are consumed instead of energy-dense snack or desserts. Individuals who eat high quantities of fruit and vegetables also tend to eat less meat, especially processed meat, saturated fat, and refined carbohydrates, all of which have been positively associated with weight gain and high BMI (Swinburn *et al.*, 2011).

4.6.1.4 Flesh, organ meats, poultry and fish

The results of this study showed that, dietary intake of meat and their products among individuals was high (92%) (Table12). Meat group was the most common protein food source that had high score and meat itself was highly consumed by most subjects. It was also reported that, meat was high in energy and fat content which was associated with high risk of overweight and obesity (Wang and Beydoun, 2009). A similar study by Amelia *et al.* (2012) showed that, people in urban areas of Zanzibar had more diverse diets and were eating more protein foods from sea sources. Fish and sea foods are good sources of high quality protein, vitamins and minerals such as iron, zinc and selenium (Sharma, 2003).

4.6.1.5 Eggs

Table 12 showed that, consumption of eggs was generally poor (20.5%). Eggs were mostly consumed in fried form mixed with fried potatoes and usually taken as a fast food.

According to Ngasongwa (2007), consumption of fast foods is more often due to occupation and time constraints, as many people do not have time to prepare full meals. This observation was similar to that reported by Foote *et al.* (2009) who stated that, frequent consumption of fast foods including fried foods e.g. potato chips has been reported to cause overweight and obesity.

4.6.1.6 Legumes, nuts and seeds

It was revealed from this study that, the most frequently consumed foods in the legumes, nuts and seeds group were common beans, cowpeas and soybeans (Table 12). Common beans were the major legumes consumed by the subjects. Consumption of legumes (83.3%) as a source of protein was also high similar to the consumption of animal protein sources (92%). Low consumption of this food group limited the intake of plant protein, B-vitamins and dietary fibre. Bazzano *et al*., (2001) reported an inverse relationship between legume intake and risk of cardiovascular diseases. They reported that legume consumption of four times or more per week, compared with less than once a week, was associated with a 22% lower risk of coronary heart disease and 11% lower risk of cardiovascular diseases.

4.6.1.7 Milk and milk products

This study showed that, there was poor consumption of milk and milk products (22.2%; n = 64) (Table 12). This poor consumption of milk and milk products appeared to be replaced by calorically sweetened beverages (Popkin, 2006). City and urban dwellers often demand diets high in fats and refined Carbohydrates (CHOs) and low in fibre. The amount which the subjects consumed was dependent on income levels (Kurwijila, 2000). Low consumption of milk and milk products can lead to calcium and vitamin D deficiency especially in adults whose nutritional needs for Ca and vitamin D increase with age.

4.6.1.8 Oils and fats

Consumption of oil and fat was generally high (96.8%). Dietary intake of fat and oils group by the respondents is summarized in Table 12. Studies by Friel *et al.* (2003) reveled that, consumption of oil and fats among individuals increased with rising levels of income. High fat foods such as animal products have high proportion of saturated fatty acids, which are associated with cardiovascular diseases. High fat diets tend to be energy dense and thus weight promoting. Similar observation on intake of fats was reported by Mohan *et al.* (2009) who stated that, excessive use of plant and animal based fats elevate the blood lipids thereby increasing the risk of heart diseases and other illnesses. Fats and oils, however, should therefore be consumed sparingly. Fat is an essential nutrient for absorption and transporting fat soluble vitamins (Wildman and Miller, 2004). When people consume too little or too much fat or a large amount of a certain type of fat, health can be compromised. According to Whitney *et al.* (2007), consumption of fats and oils below 20% of calorie intake increases the risk of inadequate intake of essential fatty acids.

4.6.2 Diet diversity

Diet diversity is usually measured by summing the number of foods or food groups that contribute to the overall diet of an individual consumed over a reference period of time (FAO, 2007). The reference period usually ranges from one to three days, but seven days are also often used, and periods of up to 15 days have been reported (Drewnowski *et al*. 1997). Diet diversity in terms of food groups predicts diet quality better than the one which is based on individual food nutrients (Ruel, 2003).

Diversity, however, is just one component of overall dietary quality and may not, in itself, ensure achievement of all dietary goals. Dietary diversity is usually measured by quantifying the number of individual foods, hereafter referred to as the food variety score

(FVS) and the number of food groups used as the food group diversity score (FGDS), usually calculated for a reference period of time (Ruel, 2003) e.g. three days for this study. The common food groups used are (1) Starchy staples, (2) Legumes, Nuts and Seeds, (3) Other Fruits, (4) Other Vegetables, (5) Oils and Fats, (6) Vitamin A rich Fruits and Vegetables, (7) Meat, Fish, Poultry and their products, (8) Eggs and (9) Milk and dairy products.

Table 13 data indicated that, majority of the respondents (67%; n = 193) could be classified as having a medium dietary diversity score (consuming 4–5 food groups), followed by high dietary diversity (31.6%; n= 91) (consuming 6–9 groups) and low dietary diversity (1.4%; n = 4) (consuming 0–3 food groups). In this study, only three of the respondents consumed all nine food groups during the three days data collection period. Overall, a variety of 48 different food items were consumed by all study subjects, from all the nine food groups. The average dietary diversity score for all the respondents was 5.51 which implied that, the dietary diversity among the studied sample was medium. Dietary intake of more than five food groups per day, as was the case in this study indicated adequate intake of micronutrients in the body (Gina *et al.*, 2007).

Table 13: Dietary diversity score for the nine food groups

Dietary diversity score	Frequency	Percent
Lowest dietary diversity(0-3 food groups)	4	1.4
Medium dietary diversity(4-5 food groups)	193	67.0
High dietary diversity (6-9 food groups)	91	31.6
Total	**288**	**100.0**

4.7 Correlation between Various Factors

4.7.1 Nutritional status and dietary diversity

The BMI was correlated with the Dietary Diversity Score (DDS), for the consumption of foods from the various food groups (Table 13). No significant correlation was found between Dietary Diversity Scores and BMI in this study ($p = 0.280$). This was consistent with previous findings by Savy *et al.* (2008). Other studies have established significant relationship between DDS and nutritional status of subjects at different age groups (Savy *et al.*, 2008; Steyn *et al.*, 2006; Arimond and Ruel, 2004). BMI is regarded as an outcome of energy balance, with particular reference to weight. While DDS was associated with adequate macro and micronutrients intakes (Kennedy *et al*., 2007 and Steyn *et al*., 2006), portion size has been shown to be a stronger predictor of adequate nutrient intakes (Kennedy *et al.*, 2007; Azadbakht, 2005), highlighting its importance in establishing the contribution of each food to the overall diet quality.

Different studies have shown inconsistent results e.g. Vandevijvere *et al*. (2010) did not find relationship between DDS and BMI among either men or women. Torheim and colleagues (2004) did not find strong association between DDS and the nutritional status of adults. Conversely, Savy *et al*. (2005) found significant association between dietary diversity scores and women's nutritional status, measured as BMI or body fat percentage. In contrast, Azadbakht and Esmaillzadeh, (2010) found an inverse association between DDS with obesity and abdominal adiposity in young females. In the study done by Keding *et al.* (2012), when food diversity increased, the additional foods were often sugar, beverages (black tea), or animal products. Black tea, a very common drink in Tanzania, is taken mostly with a large amount of sugar in it, and both food groups ''tea'' and ''sugar'' were consumed to a great extent by the study subjects resulting in high BMI.

Consumption of vegetables and fruits has been associated with reduced incidence of stomach cancer (Le Vecchia *et al.,* 1997). This coincided with the recognized relationship of the benefits of Mediterranean diet in the reduction of risk for chronic degenerative diseases when fruits and vegetables are consumed generously. Similarly, Drewnowski *et al.* (1996) showed that, while French diets were higher in fats than those in the USA, and therefore lower on the indices of dietary quality, their diversity however likely accounts for their recognized benefits. WHO/FAO (1996) recommended that, developing countries should also start implementing measures of dietary quality that capture both problems of nutrient deficiency and dietary excess and over nutrition (WHO/FAO, 1996). This was in recognition of the fast pace at which the nutrition transition is taking place in developing countries as a result of rapid economic development and urbanization.

4.5.2 Nutritional status and diet quality

BMI was correlated with the Diet Quality Index score (DQI-R), for the consumption of foods from the various food groups (Table 14). There was significant correlation ($p = 0.000$) between the quality of diet and the nutritional status of the respondents. These findings were consistent with the work of Savy *et al*. (2005), who observed in Burkina Faso that, diet quality and nutritional status of respondents were strongly correlated. This relationship suggests that, the quality of diets of respondents somehow determined their nutritional status since high quality diets play an important role in the nutritional status of individuals (Nti *et al*., 2012). In the contrary, Nti *et al*. (2012) reported a, negative correlation between the quality of diets of respondents and their nutritional status.

Table 14: Mean scores and daily intakes components for the total Diet Quality Index Revised (DQI-R)

Total DQI-R index component and recommendation	Score (0-100)	Point scored	Nutritional status	
			Overweight	obese
Total fat, ≤ 30% of energy intake[1]	≤ 30% = 10,	55(19.1)	48	7
	> 30% and ≤ 40% = 5	112(38.9)	92	20
	> 40% = 0	121(42.0)	42	79
Saturated fat , ≤ 10% of energy, 10% intake	≤ 10% = 10	80(27.8)	69	11
	>10% and ≤ 13% = 5	100(34.7)	71	29
	> 13% = 0	108(37.5)	42	66
Dietary cholesterol, < 300 mg/d	≤ 300% = 10	92(32)	62	30
	>300% and ≤ 400% = 5	100(34.7)	70	30
	> 400% = 0	96(33.3)	50	46
2-4 servings fruits/d Recommended servings [2]	≥ 100% = 10	70(24.3)	59	11
	≥ 50% and < 100%= 5	73(25.3)	61	12
	< 50%=0	145(50.3)	62	83
3-5 servings vegetables/d, % recommended servings [2]	≥ 100% = 10	0(0)	0	0
	≥ 50% and < 100%= 5	98(34.0)	80	18
	< 50%= 0	190(66.0)	102	88
6-11 servings grains/d % recommended servings [2]	≥ 100% = 10	10(3)	6	4
	≥ 50% and < 100%= 5	201(69.8)	147	54
	< 50%= 0	77(24.7)	29	48
Calcium intake, % Al for Age [3]	≥ 100% = 10	78(27.1)	64	14
	≥ 50% and < 100%= 5	57(19.8)	50	7
	< 50%= 0	153(53.1)	68	85
Iron intake, % RDA for age [4]	≥ 100% = 10	59(20.5)	51	8
	≥ 50% and < 100%= 5	110(38.2)	88	22
	< 50%= 0	119(41.3)	43	76
Dietary diversity	≥ 6 = 10	91(31.6)	56	35
	≥ 4 and < 6 = 5	193(67.0)	125	68
	< 3 = 0	4(1.4)	1	3
Dietary Moderation	≥ 7 = 10	58(20.1)	49	9
	≥ 4 and < 7 = 5	166(57.6)	110	56
	< 4 = 0	58(20.1)	23	41

Key for Table 14

1 Total DQI-R score is out of a highest possible score of 100, individual component scores range from 0 to 10.

2 Values presented % of recommended servings, recommendations are 3 servings of fruit, 4 servings of vegetables, and 9 servings of grains for a 2200-kcal/d diet.

3 Values are presented as % of the adequate intake. The AI is 1000 mg/d for male/female aged 19–51 years and 1200 mg/d for male/female aged 51+ years.

4 Values are presented as % of (RDA). The AL is 8 mg/d for male/female aged 19–51 years and 8 mg/d and 18 mg/d for male/female aged 51+ years.

4.8 Diet Quality Score by Using DQI-R

Table 14 shows the data obtained from the 24 hour recall method that was used to complete the distribution of scores for the total Diet Quality Index Revised (DQI-R). Ten equally weighed items included in this index were (1) diet contained less than 30% of energy from fat, (2) less than 10% of energy from saturated fat, (3) less than 300 milligrams of cholesterol per day, (4) 2 - 4 servings of fruits per day, (5) 3 - 5 servings of vegetables per day, (6) 6 - 11 servings of grains per day, (7) calcium intake, average intake for age, (8) iron intake % RDA for age, (9) dietary diversity and (10) dietary moderation.

Diet Quality Index-Revised scores range from 0 to 10 for each component, for a highest possible diet quality score of 100. According to the method of Haines *et al*. (1999), the total fat, saturated fat, and cholesterol components were calculated as a percentage of total energy and were categorically scored as 0, 5 or 10, whereby 0 means lowest score while 5 means medium score/average and 10 means highest score/recommended.

Most of the subjects (42%, n = 121) in (Table 14), consumed total fat greater than 40% of the energy intake, with 0 point score (lowest point) in the DQI. Proportion of saturated fat and dietary cholesterol that were in the medium/average group with 5 point score were 34.7% each. For dietary diversity, majority (67%) of the respondents could be classified as

having medium dietary diversity score with 5 points (consumed 4 - 5 different food groups/day). This study revealed that, few respondents (3%, n = 10), met the recommended 6 - 11 servings of grains/day with 10 points. On average, an individual should consume not less than 6 servings of grains/day.

These results contradict the findings by Haines *et al*. (1999), who reported that, individuals participating in a survey of food intake had higher DQI-R score since their fat consumption was low with higher consumption of fruits and vegetable, iron and calcium. This implied that, most of the subjects in this study had low DQI-R score with the average score of 0 points in fruits and vegetable intake. Majority did not take more than 3 servings of fruits/vegetable per day as recommended. Low levels of iron and calcium intake below the RDA were also observed (41.1% and 53.1%, respectively) (Table 14).

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Despite of high literacy level of the subjects involved in this study, results showed that knowledge of the subjects about nutrition was not adequate. Majority of the subjects were not aware about diet, dietary diversity and diet quality as well as the health problems that could result from poor dietary diversity. On average dietary diversity score was 5.51 ± 1.056 food groups. This indicated that, dietary diversity of the subjects was medium. It has been reported that, when food diversity increase, the additional foods were often sugar, beverages, or animal products and processed foods. No significant association was observed between DDS and BMI (P = 0.280). Prevalence of overweight was twice as common in men (41%, n = 118) as in women (22.2%, n = 64) while obesity was twice as common in women (26.7%, n = 77) as in men (10.1%, n = 29). The mean BMI mean for males was 28.25 kg/m^2 while for females was 31.15 kg/m^2. Most females (39.9%, n = 115) had abdominal obesity compared to males (3.1%, n = 9) while only (4.2% n = 12) of females were normal compared to males (40.3%, n = 116). Females were therefore more susceptible to chronic diseases compared to males. Low consumption of milk, fruits and vegetables and over consumption of meat and meat products, sweets and sugar, fats and oils, and processed foods may have contributed to high prevalence of overweight and obesity.

Dietary quality of the subjects was poor because there was excessive calorie supply, especially from fat and saturated fat. There was also insufficient intake of dietary fiber and vegetables, fruits, grains, and legumes.

Overweight and obesity together with unhealthy eating practices may play a major role in the future risk for CVD among the subjects. There was a significant association between the BMI and the quality of the diet consumed by the respondents.

5.2 Recommendations

i. Dietary diversity, diet quality and healthy eating practices need to be given first priority in the community. Undertaking nutritional advocacy and publicity to people will not only increase their dietary diversification but also help to reduce the rate of over nutrition among all age groups.

ii. People should be encouraged to eat healthier and nutrient dense foods from different food groups such as fruits, vegetables, and or non-refined grains (complex carbohydrate) while discouraging the practice of eating highly refined foods, high sugar confectionery foods such as cakes, biscuits and high fat, low fiber foods.

iii. Dietary diversity should be encouraged but limiting diets that offer a greater variety of energy and nutrient-dense foods that could increase the quality of the diet and hence the body weight.

iv. Further research should be undertaken to investigate association between over-nutrition among adults and individual dietary diversity scores.

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APPENDICES

Appendix 1: Questionnaire

QUESTIONNAIRE FOR DIET QUALITY AND DIETARY DIVERSITY OF OVERWEIGHT AND OBESE ADULTS IN MOROGORO MUNICIPALITY

Instructions: Please fill in the blanks or circle the number bearing the correct answer where applicable.

1. Questionnaire number……

2. Date of interview ……

3. Name of the institution……

SECTION A: PERSONAL INFORMATION

4. Age of interviewee (in years) …….....

5. Sex of interviewee 1. Male 2. Female

6. What is your highest education level?.....

7. Occupation of the interviewee……..

8. Income level of the respondent

1) 100000/= to 400000/= 2) 450000/= to 700000/= 3) 750000/= to 1000000/=
4) More than 10000000/=

9. Does Overweight/obesity run in your family?

1. Yes 2. No

10. Describe your lifestyle

1) Sedentary 2) Active 3) Moderate 4) Extremely active

10. Are you currently doing anything to improve your health or lose weight?

1) Yes (Continue with question 11) 2) No (Continue with question 12)

11. If yes have you tried one of the following strategies?

1) Eating healthier foods 2) Watching portion size

3) Doing more Cardio exercise (Like running, Walking, Biking) 4) Dieting

5) Other (Specify……)

12. If you want to get healthier and in better shape, what, if anything, do you feel is holding you back?

1) Stress 2) My busy schedule 3) Lack of support from Friends and Parents

4) Money (Because gyms, healthy foods etc. are expensive)

13. Do you eat in response to?

1) Anger 2) Sadness 3) Frustration 4) Boredom

5) All of the above

14. How frequent do you eat

1) Every 2 hours 2) Every 4 hours 3) Every 6 hours 4) Every 8 hours

15. Do you eat fruits and vegetables Often?

1) Yes 2) No

16. If yes, how many times do you eat fruits and Vegetables per day?

1) 1–2 2) 3 – 4 3) More than 4

17. Do you eat fried foods?

1) Yes 2) No 3) Sometimes

18. If yes or sometimes which types of fried foods do you prefer?

1) Fried meat 2) Potato chips 3) Fried banana

19. How many times do you eat meat and meat products in a week?

1) Once 2) Twice 3) More than twice 4) None

20. How many times do you eat fish in a week?

1) None 2) Once 3) Twice 4) More than twice

21. Do you take snacks?

1) Yes 2) No 3) Sometimes

22. If YES or sometimes, what type of snacks do you prefer…

23. Do you take soft /hard drinks?

1) Yes 2) No

24. If yes which one do you take frequently?

1) Soda 2) Juice 3) Fruit punch 4) Others (specify)

25. How often do you take the drink per day?

1) Once 2) Twice 3) More than twice

SECTION B: ASSESSMENT OF MEAL COMPOSITION OF THE PAST 24-HOURS.

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink of the morning. We will be estimating the amount you had. Feel free to mention both foods and beverages made from even local/wild sources. Describe in detail. List one food per line

Meal time (as determined by respondent)	Name of food or dish consumed: List one food/dish per line	Ingredients used	Amount(g/ml)
Breakfast			
Mid-morning Snack			
Lunch			
Mid-afternoon Snack			
Dinner			
Night Snack			

SECTION C: IDENTIFY DIFFERENT TYPES OF FOOD GROUPS CONSUMED BASED ON INDIVIDUAL DIETARY DIVERSITY SCORES

Record the food groups based on the information given by the respondent. For any food groups not mentioned, ask the respondent if a food item from this group was consumed or not.

S/No.	Food group	Example	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, porridge or pastes	
2	WHITE ROOTS AND TUBERS	White potatoes, white yam, white cassava, or other foods made from roots	
3	VITAMIN A RICH VEGETABLES AND TUBERS , AND OTHER VEGETABLES	Pumpkin, carrot, squash or sweet potatoes that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper). Dark green/leafy vegetables, including wild forms + locally available vitamin A rich leaves such as amaranth, cassava leaves, spinach. other vegetables (e.g. tomato, onion, eggplant) + other locally available	
4	DARK GREEN LEAFY VEGETABLES VITAMIN A RICH FRUITS AND OTHER FRUITS	Ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried Peach and 100% fruit juice made from these + other locally available vitamin A rich fruits. other fruits, including wild fruits and 100% fruit juice made from these	
5	FLESH MEATS AND ORGAN MEAT	Liver, kidney, heart or other organ meats or blood-based foods. beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	
6	EGGS	Eggs from chicken, duck, guinea fowl or any other egg	
7	FISH AND SEAFOOD	Fresh or dried fish or shellfish	
8	LEGUMES, NUTS AND SEEDS	Dried beans, dried peas, lentils, nuts, seeds or foods made from these (eg. peanut butter)	

9	MILK AND MILK PRODUCTS	Milk, cheese, yogurt or other milk products	
10	OILS AND FATS	Oil, fats or butter added to food or used for cooking	
11	SWEETS	Sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
12	SPICES, CONDIMENTS, BEVERAGES	Spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	

SECTION D: NUTRITION AWARENESS ABOUT DIETARY QUALITY AND DIETARY DIVERSITY

26. Do you understand the term "diet" i). Yes ii). No

27. Do you understand what complete diet is term? i). Yes ii). No

28. Which of the following is a poor diet?

    i. Diet containing all nutrients in a proper quantity

    ii. A diet rich in fat and carbohydrate only

    iii. Do not know

29. Do you understand the term "diet Quality" i). Yes ii). No

30. Which of the following could be a Quality diet?

(i) A diet rich in different food verities from several food groups at a proper quantity

(ii) A diet rich in protein foods; like fish, meat and eggs

(iii) A diet without any fat or oil

(iv) A diet rich in carbohydrate foods

31. Do you understand what diet diversity is? i) Yes (go Qn 30) ii) No

32. Is there any health benefit to diversify the diet? i) Yes (go Qn 31) ii) No

33. Which of the following are the health benefits of a diverse diet?

    i. Rapid bodyweight increase

    ii. Enough sleep

    iii. A healthy immune system, Heart health, Vision health

34. Among the following health problems, which category do you think could result from poor dietary diversity?

    i) Overweight or underweight ii). Bilharzia or malaria

    ii) Coughing iv). Typhoid or Fever

35. Which of the following health problems are linked to being overweight or obese?

    i. Depression, Trouble sleeping, Asthma

    ii. Heart disease, High blood pressure, Diabetes

iii. Infertility and Arthritis

36. Are you aware that saturated fats (e.g. animal fats), refined sugars and salts should be taken in limited amount in our daily dietary intake? i) Yes ii). No
37. Are you aware that consumption of fruits or vegetable enhances satiety? i). Yes ii). No

SECTION E: ANTHROPOMETRIC MEASUREMENTS OF THE RESPONDENT

Now, I am going to take weight, height, waist and hip measurements. Please feel comfortable and please cooperate with me to facilitate this.

i) Weight [ ]kg

ii) Height [ ]cm

iii) Waist [ ]cm

iv) Hip [ ]cm

W: H ratio……

Thank you very much for your time, participation and cooperation in this research.

Would you like to participate in other researches like this?