PREVALENCE OF OVERWEIGHT AND OBESITY AMONG CHILDREN AGED 6-12 YEARS IN DODOMA AND KINONDONI MUNICIPALITIES

BY

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ABSTRACT

A cross-sectional study was conducted to determine the prevalence of overweight and obesity among 428 children aged between 6 and 12 years in Dodoma and Kinondoni municipalities. Anthropometrical and body composition measurements were taken for all respondents. Results showed that, the proportion of boys aged 6 - 9 years who were overweight and obese in Dodoma and Kinondoni municipalities ranged between 7.1 and 9.4 percent, while the proportion of overweight and obese girls of the same age in Dodoma and Kinondoni municipalities ranged between 5.8 and 10.2 percent. The proportion of overweight and obese boys aged 10 – 12 years in Dodoma and Kinondoni municipalities ranged between 3.1 – 6.4 percent, while prevalence of overweight and obese among girls of the same age in Dodoma and Kinondoni municipalities ranged between 1.6 and 8.6 percent. The mean fat mass and lean mass of boys aged 10 - 12 years in Dodoma and Kinondoni municipalities ranged between 10.3 and 20.8 percent, while the mean fat mass and lean mass of boys aged 6 - 9 years in Dodoma and Kinondoni municipalities ranged between 6.1 and 15.6 percent. For the girls aged 10 - 12 years, the mean fat mass and lean mass ranged between 9.3 - 24.6 percent. The study revealed further that, majority of school children of both sexes and age groups in both municipalities did not perform physical exercises. Children spent an average of one to two hours watching TV or listening to Radio programmes. There was generally high intake of non-nutritious, energy-dense snacks and drinks at school. It could be concluded that, the prevalence of overweight and obesity among boys and girls in the study was relatively lower than those reported elsewhere, however, the trend is rapidly increasing with change in lifestyles and urbanization.

DECLARATION

I, STELLA FUNGO do hereby declare to the senate of the Sokoine University of Agriculture that this dissertation is my own original work and that it has not been submitted nor concurrently being for a higher degree award in any other University.

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The above declaration is confirmed

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DEDICATION

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LIST OF ABBREVIATIONS

BMI	-	Body Mass Index
BIA	-	Bioelectric Impedance
FDA	-	Food and Drug administration
HAZ	-	Height –for –Age Z-score
HIV	-	Human Immune Deficiency Virus
ILSI	-	International Life Sciences Institute
MUAC	-	Mid Upper Arm Circumference
NCHS	-	National Centre Health Statistics
NHI	-	National Health Institute
SPSS	-	Statistics Package for Social Sciences
TFNC	-	Tanzania Food and Nutrition Centre
URT	-	United Republic of Tanzania
WAZ	-	Weight-for-Age Z-score
WHZ	-	Weight –for-Height Z-score
WHO	-	World Health Organization
NHANE	-	National Health and Nutrition Examination Survey

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Childhood obesity is currently a major health problem in many countries of the worldwide. Recent statistics show that, 16% of children between the ages of 6 and 11 years worldwide are overweight and that an additional 14.3% are at high risk of becoming overweight (Pierre *et al.*, 2003). Statistics also show that, prevalence of overweight continues to increase during the school age and adolescent stages (Musaiger, 2004).

In Tanzania, prevalence of obesity among men in urban areas is estimated at 30% while for women the prevalence is estimated at 28.6%. In rural communities, prevalence of obesity among men and women are estimated at 32.5 and 31.5%, respectively (Kyungu, personal communication, 2005). A study conducted in Dar es Salaam by Villamor *et al.* (2006) to determine prevalence of obesity in women of child bearing aged 14 - 42 years showed an upward trend from 3.6% in 1995 to 9.1% in 2004. Currently no studies on prevalence of overweight and obesity among children have been published in Tanzania.

Obesity has serious and dramatic implications for health because it leads to increased number of non-communicable diseases such as coronary heart diseases, hypertension, type II diabetes, sleep apnoea, orthopaedic problems, liver disease, asthma, cancer and osteoarthritis (NIH, 2007; WHO, 2003). In the short run, obesity has psycho-social effects on children whereby the social isolation and low self-

esteem of obese children lead to overwhelming feelings of hopelessness, giving a way to depression (Bowman and Russell, 2001; NIH, 2003; WHO, 2003). Obese children do less well in schools because of stress and anxiety. School-related anxiety interferes learning by creating a vicious cycle in which over-growing worry fuels the declining academic performance (Bowman and Russell, 2001; WHO, 2003). Excessive weight gain is a precursor to a wide variety of physiological aberrations that ultimately predispose the subject to morbidity and mortality later in life. Studies by Pierre *et al.* (2003) and Gill *et al.* (2000) *have* shown that, many adult diseases have their origin during childhood.

There are many reasons for childhood obesity. These include low level of physical activities and high calorie intake. A study by Epstein (1998) showed that, more than 65% of children between the ages of six and nineteen years eat a lot of fat and half of young people between the age of 12 and 21years do not engage in regular physical activities. Changes in lifestyle in which children lead sedentary life lead to low energy expenditure. Socio-economic condition has a significant effect on the levels of physical activity. Frequent use of cars is to facilitate movement rather than walking and lack of aerobic exercises contribute to low energy expenditure. Similarly, extensive use of electrical appliances such as television, video games and radios has made children spend much time watching TV, and listening to radio programs and playing electronic games and sports leads to low body activity. Lack of health awareness to both parents and children may also be linked to high prevalence of obesity (*Musaiger*, 2004).

1.2 Problem Statement

The aetiology of the development of childhood obesity and subsequent diseases is poorly understood, but is likely to be explained by alterations in the regulation of energy balance between energy expenditure and energy intake. There is an evidence suggesting that, reduced energy expenditure may be involved in the aetiology of childhood obesity (Goran, 1998). Obesity is an important causative factor in many major non-communicable diseases.

In children, serious physical complications associated with high weight and obesity includes cardiomyopath, pancreatitis orthopedic disorders, and respiratory disorders such as upper airway obstruction and chest wall restriction. Socially, most immediate consequences of overweight during childhood and adolescence are psychosocial. Obese individuals generally lead isolated social lifestyles; have poorer job prospects and lower self-esteem all of which subject them to depression (Joseph *et al.*, 1996). Stress and anxiety interfere with learning and make obese children do less well academically whereby school-related anxiety creates a vicious cycle in which the over-growing worry increases the declining academic performance (Joseph *et al.*, 1996).

These problems have been of public significance in developed countries. Similar trends however have been observed in developing countries especially among adults. In Tanzania, for instance prevalence of obesity among men in urban areas is estimated at 30% while for women the prevalence is estimated at 28.6%. In rural communities prevalence among men and women are estimated at 32.5 and 31.5%, respectively (Kyungu, personal communication, 2005). A study conducted in Dar

es Salaam by Villamor *et al.* (2004) showed that, the prevalence of obesity in Women of childbearing age between 14-42 years increased progressively from 3.6% in 1995 to 9.1% in 2004. There is evidence suggesting that, reduced energy expenditure may be involved in the aetiology of childhood obesity (Goran, 1998). Obesity is an important causative factor in many major non-communicable diseases later in life. Socially, most immediate consequences of overweight during childhood and adolescence are psychosocial. Obese individuals generally lead isolated social life; have poor job prospects and lower self-esteem, all of which subject them to depression (Joseph *et al.*, 1996). Stress and anxiety interfere with learning and make obese children do less well academically. School related anxiety creates a vicious circle in which the over-growing worry increases the declining academic performance (Bowman and Russell, 2001; WHO, 2003). Data from this study would be useful for health policy makers, planners, educators and other stakeholders in planning appropriate interventions and preventive measures targeting school children.

1.3 Research Objectives

1.3.1 General objective

To determine prevalence of overweight and obesity among children aged at 6 - 12 years in Dodoma and Kinondoni municipalities.

1.3.2 Specific objectives

i. To assess the anthropometrical measurements of children aged 6 -12years

ii. To assess the body composition of children aged 6 -12 years.

iii. To investigate the lifestyle behaviours which affect the nutritional status

of children namely pattern of food intake, physical exercises and use of leisure time of the children aged 6 -12 years.

iv. To compare the prevalence of overweight and obesity among children in the two study areas and determine factors that may play role in their health status.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Paediatric overweight and obesity are becoming an epidemic worldwide, indicating the need for formulating preventive programs and policies during a child's early years (Jouret et al., 2006). The proportion of the pre-school, school age, and adolescent population who are classified as overweight has increased dramatically over the past decade after remaining stable from the 1960s through late 1970s (Joseph *et al.*, 1997; Troiano *et al.*, 2000; Musaiger, 2004). A study by Troiano *et al.* (2000) showed that, a rapid change in the prevalence of overweight was unlikely to be due to genetic changes in the population. Much emphasis should be focused on the behavioural and environmental factors that may have contributed to increase in prevalence of overweight and obesity. Other studies (Troiano *et al.*, 2000; Bute, 2000; Pierre *et al.*, 2003) have indicated that, increased fatness in an individual or increased prevalence of overweight in a population can occur only as a result of a sustained positive energy balance, which occurs when energy intake exceeds energy expenditure.

Overweight and obesity lead to serious health consequences. Excessive weight gain is said to be a precursor for a wide variety of physiological aberrations that ultimately lead to morbidity and mortality (WHO, 2003). Raised body mass index is a major risk factor for chronic diseases such as, cardiovascular disease, type II diabetes, osteoarthritis, some cancers, hypertension, stroke, gall bladder disease, sleep apnoea, and other disorders (WHO, 2003; Kuczmarski and Flegal, 2000). In

order to avoid high morbidity and mortality rates that are approaching the levels of those in industrialized countries, steps to study and prevent obesity are necessary. If no quick steps are put in place to prevent high rates for morbidity and mortality due increased rates of overweight and obesity, there is a risk that the limited resources we have in our country will quickly be exhausted by the demand for treatment.

2.2 Definition of Overweight and Obesity

Overweight is defined as excess body weight. Body weight is reasonably correlated with body fat but is also highly correlated with height of an individual (Bellizzi and Dietz, 1999). Obesity is increases in body weight resulting from an excessive increase in body fat (Joseph *at al.*, 1996; Kuczmarski and Flegal, 2000) and is associated with excessive adipose fat tissue.

2.3 Anthropometric Indicators

Anthropometrical indicators assess the physical dimensions and the gross composition of the body (Weinsier and Morgan, 1993). These indicators are used throughout the world as the basis for assessing growth and nutritional status of individuals. Anthropometry is combined with other nutrition related information for assessment purposes. The most common anthropometric indicators used for assessing the nutritional status of children are weight for age z-score (WAZ), height for age z-score (HAZ), weight for height z-score (WHZ) and BMI for age, which is commonly used for assessing the nutritional status of children aged 10-18 years.

2.3.1 WAZ, HAZ WHZ Indicators

WA, HA and WH z-scores are classified according to WHO (1983) and expressed as percentiles or standard deviation scores. Growth charts, such as weight-for-age, weight-for-height and height-for-age chart are more frequently used to determine if children of less than 10 years are overweight or obese (Tienboon *et al.*,1992). These indicators are normally used to compare the nutritional status of the study sample with reference population of similar age and sex. These values describe how far the individual child in the study sample deviates from the reference population median (Nueman, 1998). The deviation beyond a particular cut-off value is often used to screen children for an intervention. Table 1 summarizes the reference z-score cut off points for children less than 10 years.

Table 1: WA, HA and WH Z-sore classification

WAZ, HAZ,WHZ Score	Inference
< -3.0	Severe
3.0 --2.0	Moderate
-1.0 SD-+2 SD	Normal
+2 SD-+3SD	Overweight
≥+3SD	Obese

Source: WHO (1983).

2.3.2 Body Mass Index for age

Body Mass Index for age is an index of weight-for-height that is commonly used to classify underweight, overweight and obesity in children aged 10 - 18 years and adults. It is defined as the weight in kilograms divided by the square of the height in

meters (kg/m^2). Use of BMI for age is not appropriate for infants and children less than 10 years because of their different rates of weight gain and height gain during development. In teenagers, BMI for age is used to assess underweight, overweight, and risk for overweight. Children's body fatness changes as they grow, girls and boys differ in their body fatness as they mature (Pietrobelli *et al.*, 1998; Tieboon *et al., 1992*). That is why BMI-for-age is gender and age specific. Children's body fatness changes over the years as they grow thus BMI are lower during the preschool years and increase during adulthood. Table 2 shows the classification of individuals according to BMI for age as adapted from WHO (2004).

Table 2: WHO (1995, 2000, and 2004) classification of underweight, overweight and obesity according to BMI by age

Nutritional status	BMI (kg/m^2)
Underweight	<18.50
Severe thinness	<16
Moderate thinness	16.00 - 16.99
Mild thinness	17.00 - 18.49
Normal range	18.50 - 24.99
Pre-obese/ Overweight	25.99 – 29.99
Obese	≥30.00

Source: Adapted from WHO (2004).

2.4 Causes of Obesity

The fundamental cause of obesity and overweight is an energy imbalance between calories consumed on one hand, and calories expended on the other hand. Global

increases in overweight and obesity are attributable to a number of factors, including a global shift in diet towards increased intake of energy-dense foods that are high in fat and sugars but low in vitamins, minerals and other micronutrients (WHO, 2004). Also, a trend towards decreased physical activities due to the increasingly sedentary lifestyles; television, video games and computers occupy vast amounts of their free time, at the expense of physical activity. According to the National Institutes of Health (2007), kids who most hours watch television have the highest prevalence of obesity. The fact that kids usually munch snack foods while watching television adds to the problem.

If the child is not involved in organized sports or after school playtime that involves cardiovascular exercise, it is important to add fitness to the family routine. Similarly changing modes of transportation and increasing urbanization have significant effect in the prevalence of overweight and obesity among school children (WHO, 2004). Genetically, family history plays part in determining whether the child will develop a serious weight problem. According to NIH (2007), 25 - 40% of children inherit the tendency towards overweight. Children, who come from a family of heavy people, where high-calorie food is readily available and exercise is not practiced, are more likely to become overweight.

2.4.1 Recommended daily intakes (RDIs)

Table 3 summarizes the recommended daily intake of energy and other nutrients for school children. The recommended daily intakes for boys and girls less than 10 years are the same for boys and girls, but these RDIs differ among girls and boys as they

grow. For school children above 10 years the RDIs for boys are generally higher than those for girls.

Table 3: Recommended energy and nutrient intakes for children of various age

Sex	Age	Energy (kcal)	Fat (g)	Protein (g)	Ca (mg)	Fe (mg)	Vit. A (IU)	Vit C (mg)
All	5-7	1820	30-71	30	800	8-10	400	**25**
All	7-10	1900	32-74	34	800	11	400	**45**
Boys	10-12	2120	35-82	48	800-1200	12	600	**45**
Girls	**10-12**	**1905**	**32-74**	**49**	**800-1200**	**11**	**600**	**45**

Source; WHO (1983) and National Academy of Sciences (2001).

2.5 Long- term and Short-term Effects of Overweight and Obesity

Overweight and obesity lead to serious health consequences. Risk increases progressively as BMI increases. The negative health consequences to overweight children are both physical and emotional. The primary effect of obesity is a much greater risk of developing heart disease later in life. Cardiovascular diseases kill about 17 million people worldwide each year, while type II diabetes and cancers which are also serious problems resulting from overweight children, have become global epidemics (Keller *et al.*, 2003; WHO, 2004). Other severe physical problems include sleep apnoea, orthopaedic problems, liver disease, asthma and osteoarthritis (NIH, 2007; WHO, 2003).

More damaging to the overweight kid in the short run are the psychological and social effects of obesity. The psychosocial effects of the obesity to children are low

self-esteem, stress, behaviour and learning problems. Normal weight children often tease or bully their overweight peers due to their nutritional high nutrition status. This situation subjects obese children into stress. Behaviour and learning problems are other psychosocial problems. Overweight children tend to have more anxiety and poorer social skills than normal weight children. Stress and anxiety interfere with learning whereby school-related anxiety creates a vicious cycle in which ever-growing worry increases declining academic performance. Social isolation and low self-esteem cause overwhelming feelings of hopelessness in overweight children. When children lose hope that their lives will improve, they are well on the way to depression (NIH, 2003). A depressed child may lose interest in normal activities, sleep more than usual or cry a lot. Depressed children may hide their sadness and instead appear emotionally flat (NIH, 2003).

Puberty stage is related to the BMI of the child. Girls with higher BMI at early age develop secondary characteristics earlier and tend to appear physically mature but mentally they are still immature. They practice acts, which don't correlate with the level of mental maturity. Children who mature earlier engage in sexual intercourse earlier, resulting in early-unexpected pregnancies while themselves and their parents are not socially and economically prepared to take care of the born babies.

2.6 Management of Overweight and Obesity

Overweight and obesity with their related chronic illnesses are preventable both at the individual and society level. The management of overweight and obesity in children should not be delayed until adulthood because it is even more difficult to

achieve lasting weight reductions (Bellizzi and Dietz, 1999). The main goal should be to work on the energy balance, a healthy ratio of calories consumed to calories expended. Childhood obesity should be managed with an intention to regulate body weight while ensuring adequate nutrition for growth and development. There should be limited energy intake from total fats and shift fat consumption away from saturated fats to unsaturated fats and also limited intake of sugars (WHO, 2003). The energy dense snacks should be replaced with more nutritionally sound choices as much as possible and put more emphasis on the consumption of fruits and vegetables, legumes, whole grains and nuts (WHO, 2003).

Ideally, the alleviation of obesity would also cause positive physiological and psychosocial changes (Epstein, 1998). To reduce the problem also attention should be placed on increasing physical activity level, which is central to tackling obesity in children (Carteson, 1997). Limiting television time leads indirectly to more exercise time and children should keep television watching to less than two hours a day. Sedentary behaviours such as playing video games and computer games and spending non-academic time listening to the radios programs and must be discouraged (NIH, 2003).

Physical exercise alone does not cause major weight loss, rather promotes changes in body composition by reducing adiposity and increasing muscle mass (Carteson, 1997). More physical activities and reduction in calorie intake may therefore be required for weight control. The best form of physical exercise is prolonged low intensity exercise, for example walking, vigorous activity exercise, which is a

physical activity that makes an individual puff and pant (WHO, 2004). These should be promoted especially for younger age groups for more immediate health benefits. Parents play an important role in preventing and managing child-hood obesity, as they are food providers and role models. Parents provide healthy meals and snacks and encourage regular exercises to their children (Gavin and Hassinks, 2005). In a similar manner, Governments, international partners, civil society, non-governmental organizations and the private sectors have a role in shaping healthy environments and making healthier diet options affordable and easily accessible by all people (WHO, 2003). This is especially important for the most vulnerable social groups in society, the children who have limited choices on the food they eat and the environments in which they live.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Areas

This study was conducted in two municipalities namely Dodoma municipality and Kinondoni municipality in Dar es Salaam. These areas were selected because previous studies have shown high prevalence of overweight and obesity among adults living in these urban communities. Since children, share part of the lifestyles where the adults live, it was logical to determine the prevalence of the same problem among children aged between 6 -12 years.

3.1.1 Dodoma municipality

Dodoma municipality is located within Dodoma region. It is one of the five administrative districts of the region. Other districts include Dodoma-Rural, Kondoa, Mpwapwa and Kongwa. The district has a total area of 2576 km^2 and a total population of 287 200m (URT, 2003). Much of the region is a plateau rising gradually from some 830 meters in Bahi Swamps to 2000 meters above sea level in the highlands north of Kondoa (URT, 2003). The main occupational activities include agriculture, business and arts.

3.1.2 Kinondoni municipality

Kinondoni municipal is one of the municipalities of Dar es Salaam city. Other municipalities include Ilala and Temeke. Based on the 2002 Population and Housing Census, Kinondoni municipality has a population of 1088567 people. The main

occupational activities in Kinondoni municipal include fishing, small and large-scale business, manufacturing and arts.

3.2 Study Design

This was a cross-sectional study in which children were randomly selected from classrooms. The study took place between January and March 2008. This study design was considered useful for descriptive purposes and for determination of the relationship between variables (Babbie, 1990).

3.3 Sampling Frame (Population) and Eligibility

The sampling frame for this study comprised of all children aged between 6 and 12 years living in the selected districts for at least three months prior to the study.

3.3.1 Inclusion criteria

All children aged between 6 and 12 years, living in the selected areas were eligible for inclusion into the study.

3.3.2 Exclusion criteria

All children with physical and mental impairment were excluded from the study. Likewise, children who had chronic illness such as type I diabetes, or those who have been diagnosed to be HIV+, were excluded from the study. Also children who were overweight or obese and were already in weight management programs were excluded from the study. Children in boarding schools were also excluded.

3.4 Sampling Technique

A purposive sampling technique was employed to identify the primary schools. Both private and public schools were selected from the study area. The schools in the urban settings were stratified into public and private. Boys and girls had equal chances of being selected into the sample. Using random sampling technique, six schools were selected from each category. At the selected schools, children were assigned random numbers. By random approach, about 46 children from each class were selected into the sample.

3.5 Sample Size

The sample will have a total of 428 as determined by Fischer *et al.*, (1991) formula where a random sampling technique was used to obtain the sample. The size of the sample was calculated from the following formula;

$$n = Z^2 . p . q / d^2$$

Where n= sample size, Z =1.96 for a confidence limit of 95%,

p =expected prevalence of obesity, d = relative precision

Calculation

Relative precision (d) =50%

Prevalence (P) = 28%

Confidence limit (z) =1.96

i.e $n = (1.96^2) . (1- 0. 28)/ (0.05^2)$

n= 428

3.6 Data Collection

3.6.1Construction of the questionnaire

A structured questionnaire was constructed to collect information form the subjects. The questionnaire had four sections. Section one solicited general information (raport), section two solicited the anthropometric informtion, section three focused on body composition information while section four solicited physical activities information and food consumption information.

3.6.2 Pre-testing of the questionnaire

During pilot study, two field assistants were recruited and trained. The assistants were form four graduates and were trained intensively on the procedures for collecting data. The constructed questionnare was pre-tested in two primary schools in Morogoro. One public primary school and one private primary school were involved in pre-testing of the questionnare.

3.6.3 Administration of the questionnaire

Two research assistants were recruited and trained as enumerators. The research assistants were form four graduates and were trained intensively on the procedures for administering the questionnaire. The questionnaire was administered to the study children during mid-morning recess or during mid-day break in order to avoid disruption of class sessions. Data were collected by face-to-face interview between the enumerator and respondent.

3.6.4 Anthropometric measurements

Measurements that were taken include height, weight, MUAC, fat mass and food portions.

3.6.4.1 Height

Height was determined by the use of length board and recorded to the nearest 0.1cm. Participants were asked to remove the shoes and step infront of the height board placed on flat floor with heels, buttocks, shoulders and back of the head touching the wall. The head was comfortably erect with the lower boarder of the orbit in the horizontal plane and external auditory meatus. The arms were hanging at the sides in a natural manner. The height was then measured and recorded in centimetres.

3.6.4.2 Weight

Weight was determined by the use of weighing scale and recorded to the nearest 0.1kg. Participants were asked to remove shoes and step on a zeroed digital bathroom weighing scale (Model H-2004, Hungury). Then the measurement was taken and recorded in kilograms.

3.6.4.3 MUAC

MUAC was determined by using a flexible, non stretchable tape and recorded to the nearest 0.1cm. The circumference was located and measured at the mid point between the tip of the acromion process of the scapula and olecranon process of the ulna of the left arm, while the respondent's arm was hanging at the side and relaxed. The measurement was taken and recorded in centimeters.

3.6.4.4 Body composition measurement

3.6.4.4.1 Body fat mass

Body fat mass was measured using bioelectrical impedence (BIA) machine (Model BF-350, America) and the results recorded in percentage. Respondent were required to remove shoes and sox and stand on the electrodes of the BIA machine containing saline solution.The machine was zeroed after every subject.

3.6.4.4.2 Fat free mass (Lean body mass)

Lean mass is measure of fat free mass. It can be obtained by substracting the proportion of fat mass from 100% (i.e Fat free mass (%) = 100% – percentage of fat mass).

3.6.4.5 Food composition

Food consumption pattern was determined by using a 24 hrs recall method, whereby children were asked to enumarate all food items and amounts consumed in the past 24 hrs. Energy and food nutrients including, protein, fat, carbohydrates, vitamin A and C and minerals such as calcium and iron in the diets were determined using Food Composition Table for use in East Africa (Temalilwa and Wageningeni, 1988).

3.7 Data Analysis

The data were compiled, coded and analysed using statistcal package for social science (SPSS) program version 11.5,where means, variances and frequencies were generated and t- test was employed to determine the statistical differrence among variables. Epi Info programe version 1.0 was used to compute WA, HA and HW z-scores that used to determine the nutritional status of the children.

3.8 Ethical Clearance

Permission was sought from the district authorities to conduct the research in the selected primary schools. Parents and teachers signed a consent form to affirm their willingness or willingness of the children under their jurisdiction to participate in the study.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the results and discussion of the findings. Results are grouped into four subsections, namely background information, anthropometric status, food consumption, life style behaviours and physical activities.

4.2 Background Information of the Children Under Study

4.2.1 Age and gender

Age and sex distribution of the studied children ranged between 6-12 years (Table 4).

Table 4: Distribution of the studied children by age and sex

Sex	Age	Respondents	Percent
Boys	6-9	60	40.0
	10-12	90	60.0
	Total	**150**	**100.0**
Girls	6-9	143	51.4
	10-12	135	48.6
	Total	**278**	**100.0**

Table 4 data indicate the age and sex distribution of the studied children. Out of 150 boys, 60 (40 %) were children under the age group 6-9 years while 90 (60 %) were children in the age group 10-12 years. Out of 278 girls interviewed, 143 (51.4 %) were in the age group 6-9 years while 135 (48.6 %) were girls in the age group 10 -12 years.

A study by Pietrobelli *et al.* (1998) showed that, children's body fatness changes over the years as they grow, especially during the preschool years. Girls and boys differ in their body compositions as they mature whereby girls' bodies tend to deposit more fat mass than those of boys who instead deposit more lean mass. Since girls deposit more fat than boys, they are more likely to be overweight or obese than boys.

4.2.2 Parents economic status

Table 5 summarizes the occupation of the parents and their major economic activities. Parental economic status is vital in determining the nutritional status of their children, since parents are the main food providers and the role models for the children (NIH, 2007). Data from this study revealed that, most parents; both males (53.3%, n = 150) and females (36%, n = 278) were wage employees followed by parents who were businessmen (24.0%, n = 150) and businesswomen (19.0%, n = 278). Occupations of other male parents were farming (5.3%, n = 150), petty trade (7.3%, n = 150), auto- mechanics (1.6%, n = 150), none (2.7%, n = 150), university student (0.1%), masonry (2%, n = 150), carpentry (2.0%, n = 150) and pastoral work (1.7%, n = 150). Occupations of the female parents were housewives (28.2%, n = 278), farming (3.6%, n = 278), petty trade (10.0%, n = 278), university student (0.4%, n = 278), tailoring (1.1%, n = 278) and painting (0.4%; n = 278).

A study conducted in Canada (Donalelle, 2001) showed that, children who lived in communities with high unemployment rates, low family income or low educational levels were at a greater risk of being overweight or obese.

Table 5: Parents occupation and their economic activities

Sex	Parent activity	Frequency	Percent
Boys	Farming	8	5.3
	Petty trade	11	7.3
	Wage employee	80	53.3
	Business	36	24.0
	None	2	1.7
	Auto-mechanics	4	2.6
	University student	1	0.1
	Masonry	3	2.0
	Pastoral work	2	1.7
	Carpentry	3	2.0
	Total	**150**	**100.0**
Girls	House wives	67	28.2
	Farming	10	3.6
	Petty trade	30	10
	Wage employee	100	36
	Business	53	19
	None	4	1.4
	University student	1	0.4
	Tailoring	3	1.1
	Painting	1	0.4
	Total	**278**	**100**

Kohrs et *al.* (1979) reported that, the proportions of adult women and men who were overweight as defined by BMI > 25 were inversely related to household income and education level. Families like those of office employees and the businessmen may have high income and afford to purchase nutritious foods, however due to poor education level and poor knowledge in nutrition may decide to purchase foods that are high in energy and low in essential nutrients. Since all members share the food purchased by the family, children are more likely to be affected by the high fat, high calorie foods than other members of the family. High economic status of parents may lead to sedentary life whereby families may own a car and use it more often to facilitate movements rather than giving the children an opportunity to walk, thus reducing their levels of physical activity. Also, availability of electrical appliances such as TV and radio sets in the high income families make children spend most of their leisure time watching TV, DVD or listening to radio programs. This inactive lifestyle conserves most of the energy they obtain from foods, which in turn is deposited in the body as fat tissue.

4.2.3 Contribution of parental care to overweight and obesity

Most children involved in the study (90.2%, n = 428) were living with their biological parents, while only 9.8%, (n = 428) were living with guardians. Parents have great influence on the nutritional status of their children since they are the food provider and the role models for the children. Parental monitoring lowers the number of non-nutritious food items chosen and the overall amount of energy taken (Jouret et al., 2006; Klesges, 1991). Dietary intake patterns within the family may contribute to the development of obesity among children and parents. It has been demonstrated

that, children of obese parents consumed a higher proportion of energy from fat than did children with none- obese parents (Kyungu, personal communications, 2005). A family history of overweight or diabetes influences much on the nutritional status of the children (Sardesai, 1997). Observation that obesity runs in families suggests that, some individuals may be predisposed to this disorder. It has been estimated that, two obese parents have 73% chance of having an obese child and the family that has one obese and one lean parent has 41.2% chance of having an obese child. A family with both lean parents have only 9% chance of having an obese child (Sardesai, 1997). Obesity status of the biological parents is therefore, a good predictor for the development of obesity in children (Kyungu, personal communications, 2005).

4.3 Anthropometric Status of the Children

4.3.1 Weight for age, weight for height and height for age z-scores

Anthropometric indicators used to assess the nutritional status of the children aged 6 - 9 were weight for age, height for age and weight for height- z-scores while BMI for age was used to assess the children aged 10 - 12 years. Anthropometric measurements assess the physical dimensions and the gross composition of the body (Weinsier and Morgan, 1993), and are used as the basis for assessing growth and nutritional status of individuals.

4.3.2 Weight for height z-score

Weight for age z-score is a physical measure for under-nutrition referred to as wasting. Children whose WHZ are < -3SD are classified as severely wasting while those whose WHZ lie between -3SD and -2SD are moderately wasting. Children

with WHZ between -2SD and -1SD are considered as mild wasted. Children whose WHZ lie between -1SD and +2SD are classified as normal whereas those lying between +2SD and +3SD are classified as overweight and children with WHZ >+3SD are classified as obese.

Table 6 present the summary of weight-for-height z-score (WHZ) for the boys and girls aged 6-9 years. Generally, the proportions of boys and girls aged 6 - 9 years who were classified as normal (-1SD - +2SD) in Kinondoni municipal were higher than those of boys and girls of the same age group in Dodoma municipal. Prevalence of obesity among boys and girls in Kinondoni municipal was higher ($p \leq 0.05$) than among girls and boys of the same age group in Dodoma municipal (Table 6). These data revealed that, the proportion of boys aged 6 - 9 years who were obese, normal and mildly wasted in Dodoma municipality were 9.4, 68.8 and 21.9 percent respectively, while the proportion of boys in the same age group who were obese, overweight, normal, mildly wasted and moderately wasted in Kinondoni municipality were 3.6, 7.1, 71.4, 10.7 and 7.1 percent, respectively.

The proportion of obese boys aged 6 - 9 years in Kinondoni municipality was lower (3.6%, n = 87) than the percentage of obese boys of the same age group in Dodoma municipality (9.4%, n = 128). Likewise, the proportion of boys 6-9 years who were classified as normal in Kinondoni municipality was slightly higher (71.4%, n = 87) than that of their counter parts in Dodoma municipality (68.8%, n = 128). The proportion of boys who were mildly wasted in Kinondoni municipality was lower (10.7%, n = 87) than that of their peers in Dodoma municipality (21.9%, n = 128).

There were no boys who were overweight or moderately wasted in Dodoma municipality. The proportion of girls (6 - 9 years) who were obese, overweight, normal, mildly wasted, moderately wasted and severely wasted in Dodoma municipality were 7.0, 5.8, 67.4, 14.0, 4.7 and 1.2 percent respectively, while the proportion of girls (6 - 9 years) who were obese, overweight, normal, mildly wasted and moderately wasted in Kinondoni municipality were 10.2, 10.2, 54.2, 22.0 and 3.4 percent, respectively. The proportion of obese girls (6 - 9 years) in Kinondoni municipality was higher (10.2%, n = 87) than that of their counterparts in Dodoma municipality (7.0%, n = 128). The proportion of overweight girls (6 - 9 years) in Kinondoni municipality was higher (10.2%, n = 87) than that of their peers in Dodoma municipality (5.8%, n = 87). Conversely, the proportion of normal weight girls (6 - 9 years) in Kinondoni municipality was lower (54.2%, n = 87) than that of normal weight girls of the same age group in Dodom municipal (67.4%, n = 128).

The proportions of mildly and moderately wasted girls (6 - 9 years) in Kinondoni municipality were higher than the proportions of girls of the same age group in Dodoma municipality (Table 5). There were no girls (6 - 9 years) who were severely wasted in Kinondoni municipality while in Dodoma municipality only 1.2% (n = 128) of the girls in the same age group were severely wasted. This prevalence of overweight and obesity among boys and girls in this study were relatively lower than those reported elsewhere (WHO, 2003). Prevalence of overweight and obesity among children aged 6 – 11 years in developed countries have been reported to be as high as to 16% (Musaiger, 2004).

Table 6: Distribution of the weight for height z- scores for the children aged 6- 9 years

Location/ Sex	WHZ-Inference	Respondents	Percents
Dodoma municipality			
Boys			
	Severe wasting	0	0
	Moderate wasting	0	0
	Mild wasting	7	21.9
	Normal	22	68.8
	Overweight	0	0
	Obese	3	9.4
	Total	**32**	**100**
Girls	Severe wasting	1	1.2
	Moderate wasting	4	4.7
	Mild wasting	12	14.0
	Normal	58	67.4
	Overweight	5	5.8
	Obese	6	7.0
	Total	**86**	**100.0**
Kinondoni municipality			
Boys	Severe wasting	0	0
	Moderate wasting	2	7.1
	Mild wasting	3	10.7
	Normal	20	71.4
	Overweight	2	7.1
	Obese	1	3.6
	Total	**28**	**100.0**
Girls	Severely wasting	0	0
	Moderate wasting	2	3.4
	Mild wasting	13	22.0
	Normal	32	54.2
	Overweight	6	10.2
	Obese	6	10.2
	Total	**59**	**100.0**

4.3.3 Weight for age z-score (WAZ)

Weight for age z-score is a physical measure which indicates the type of under-nutrition called under weight. Children whose WAZ are < -3SD are classified as severely underweight while those whose WAZ lie between -3SD and -2SD are moderately under weight. Children with WAZ between -2SD and -1SD are considered as underweight. Children whose WAZ lie between -1SD and +2SD are classified as normal whereas those lying between +2SD and +3SD are classified as overweight and children with WHZ >+3SD are classified as obese.

Table 7 data summarize the weight- for-age z-scores (WAZ) for the children aged 6-9 years. Generally, prevalence of overweight among both girls and boys in Kinondoni municipality was higher than that of their peers in Dodoma municipality. Conversely, prevalence of obesity among boys in Dodoma municipality was slightly higher ($p > 0.05$) than that of their counter parts in Kinondoni municipality. Prevalence trend for overweight and obesity among girls was similar to that of boys in both municipalities (Table 7). The proportions of obese, overweight, normal weight and mildly underweight boys (6 - 9 years) in Dodoma municipality were 6.3, 3.1, 68.8, and 12.5 percent respectively, while the proportions of obese, overweight, normal weight, mildly underweight, moderately underweight boys (6 - 9 years) in Dodoma municipality were higher (68.8%, n = 118) than that of boys of the same age group in Kinondoni municipality. (60.7%, n = 87).

Conversely, the proportion of mildly underweight boys (6 - 9 years) in Dodoma municipality was lower (12.5%, n = 118) than that of peers in Kinondoni

municipality (17.9%, n = 87). In Dodoma municipality there were no boys who were moderately or severely underweight (Table 7). The percent of obese, overweight, normal, mildly underweight, moderately underweight and severely underweight girls aged 6 - 9 years in Dodoma municipality were 2.3, 4.7, 75.6, 14.0, 4.7 and 2.3 respectively, while the percentages of obese, overweight, normal, mildly, moderately and severely underweight girls aged 6 - 9 years in Kinondoni municipality were 3.4, 8.5, 62.7, and 25.4 respectively. None of the girls in Kinondoni municipality was severely underweight.

The percentage of obese girls aged 6 - 9 years in Dodoma municipality was lower (2.3%, n = 118) than the percentage of obese girls of the same age group in Kinondoni municipality (3.4%, n = 87). The proportion of overweight girls aged 6 - 9 years in Dodoma municipality was lower (4.7%, n = 118) than that of overweight girls of the same age group in Kinondoni municipality (8.5%, n = 87). The percentage of normal weight girls aged 6-9 years in Dodoma municipality was higher (75.6, n = 118) than that of normal weight girls of the same age group in Kinondoni municipality (62.7%, n = 87). The proportion of mildly underweight girls aged 6 - 9 years in Dodoma municipality however, was lower (14.0%, n = 118) than that of girls of the same age group in Kinondoni municipality (25.4%, n = 87).

There were neither moderately nor severely underweight girls aged 6 - 9 years in Kinondoni municipal but for Dodoma municipal the percentages of moderately and severely underweight girls aged 6 - 9 years were 2.3 and 1.2, respectively. These data suggested that, prevalence of overweight among boys and girls involved in the study

was lower than the prevalence reported among children of the same age and sex in other countries. Example; in Eastern Mediterranean region, prevalence of overweight and obesity among school children (aged 6 – 15 years) was 12 and 25 percent, respectively (Musaiger, 2004).

4.3.4 Height for age z-score (HAZ)

Table 8 data summarize the distribution of height-for-age z-scores for the studied children. Height for age is a physical measure, which indicates linear growth of the child with age. It is also reflects chronic under nutrition referred to a stunting. Children whose HAZ are < -3SD are classified as severely stunted while those whose HAZ lie between -3SD and -2SD are moderately stunted. Children whose HAZ lie between -2SD and +3SD are classified as normal while those with HAZ > +3SD are classified as tall.

The proportion of boys aged 6 - 9 years with normal HAZ in this study was relatively high in both municipalities with Dodoma boys having the highest percentage (100%) of normal boys (Table 7). All boys (100%, n = 32) aged 6 - 9 years in Dodoma municipal had normal HAZ, while 92.6% (n = 27) of boys in Kinondoni municipal had normal HAZ. About 7% (n = 27) of boys aged 6 - 9 years in Kinondoni municipal were moderately stunted, while none of the boys in Dodoma municipal were moderately stunted. For the girls, prevalence of moderately stunted girls was 2.3% (n = 86) and 1.9 % (n = 122) in Dodoma and Kinondoni municipalities respectively. Proportions of girls with normal HAZ in both municipalities were 97.7% (n = 86) (Dodoma) and 98.1% (n=122) (Kinondoni).

Table 7: Distribution of weight for age z-scores for children aged 6- 9years

Location/Sex	WAZ inference	Respondents	Percent
Dodoma municipality			
		0	0
Boys	Severe underweight		
	Moderate underweight	3	9.4
	Mild underweight	4	12.5
	Normal	22	68.8
	Overweight	1	3.1
	Obese	2	6.3
	Total	**32**	**100.0**
Girls	Severe underweight	1	1.2
	Moderate underweight	2	2.3
	Mild underweight	12	14.0
	Normal	65	75.6
	Overweight	4	4.7
	Obese	2	2.3
	Total	**86**	**100.0**
Kinondoni municipality			
Boys	Severe underweight	0	0
	Moderate underweight	2	7.1
	Mild underweight	5	17.9
	Normal	17	60.7
	Overweight	2	7.1
	Obese	1	3.6
	Severe underweight	1	3.6
	Total	**28**	**100.0**
Girls	Severe underweight	0	0
	Moderate underweight	0	0
	Mild underweight	15	25.4
	Normal	37	62.7
	Overweight	5	8.5
	Obese	2	3.4
	Total	**59**	100.0

This prevalence was slightly lower than those of boys of the same age groups in the two municipalities (Table 8). The percentage of obese, overweight, normal and underweight boys (aged 10 - 12 years) in Dodoma municipality were 3.1, 6.3, 65.6 and 25.0, respectively while the percentage for obese, overweight, normal and underweight girls of the same age group in Kinondoni municipality were 0, 6.9, 63.8, and 29.3, respectively. In Kinondoni municipality, none of the boys aged 10 - 12 years were obese. The percentage of overweight boys aged 10-12 years in Kinondoni municipality was slightly higher (6.9%, n = 123) ($p > 0.05$) than that of boys of the same age group in Dodoma municipality while the proportion of boys aged 10 - 12 years in Kinondoni municipality who were underweight was higher (29.3%, n = 123) than that of their counterparts in Dodoma municipality (25.0%, n = 102).

The proportion of girls aged 10 - 12 years in Dodoma municipality who were obese, overweight, normal and underweight were 5.7%, 8.6%, 58.6% and 27.1%, respectively while the proportions of girls of the same age group in Kinondoni municipality were 1.6%, 4.8%, 66.7% and 27.0% (n = 102), respectively. The percentage of girls aged 10 - 12 years in Dodoma municipality who were obese was higher 5.7% (n = 102) than that of girls of the same age in Kinondoni municipality 1.6% (n = 123). Likewise the proportion of girls aged 10 - 12 years in Dodoma municipality who were overweight was higher 8.6% (n = 102) than that of girls of the same age group in Kinondoni municipality 4.8% (n=123). The proportion of girls aged 10-12 years in Dodoma municipality who were classified as having normal BMI for age was significantly lower 58.6% (n = 102) ($p < 0.05$) than their counterparts of the same age in Kinondoni municipality (66.7%, n = 123).

Table 8: Distribution of the height for age z-scores for children aged 6-9years

Location/Sex	HAZ inference	Respondents	Percent
Dodoma municipality			
Boys	Severe stunting	0	0
	Moderate stunting	0	0
	Mild stunting	0	0
	Normal	32	100.0
	Total	**32**	**100**
Girls	Severe stunting	0	0
	Moderate stunting	2	2.3
	Mild stunting	0	0
	Normal	84	97.7
	Total	**86**	**100.0**
Kinondoni municipality			
Boys	Severe stunting	0	0
	Moderate stunting	2	7.4
	Mild stunting	0	0
	Normal	25	92.6
	Total	**27**	**100.0**
Girls	Severe stunting	0	0
	Moderate stunting	1	1.9
	Mild stunting	0	0
	Normal	51	98.1
	Total	**52**	**100**

Meanwhile the proportion of girls aged 10 – 12 years in Dodoma municipality who were classified as underweight was equal (27.1%, n = 102) to that of girls of the same age group in Kinondoni municipality (27.0%, n = 123).

Prevalence of overweight and obesity among the children in this study was lower than that of the children of the same age group in developed countries (Musaiger, 2004; Pierre *et al.*, 2003). A study by Musaiger (2004) in Eastern Mediterranean region reported the prevalence of overweight among children aged 6-11 years to be 16% while Pierre *et al. (2003)* in US reported prevalence of overweight among children aged 6 - 19 years to be as high as 30%. In this study the prevalence of overweight among children aged 6 - 12 years ranged from 3.1 to 10.2% for both sexes in both municipalities. Majority of children aged 10 - 12 years were at pre-adolescent stage. This is the stage when children attain a rapid growth spurt, characterized by rapid linear growth.

In this stage also, many children start getting concerned about their own body images/ shapes and often adopt unhealthy food choices and meal practices. Children in this age group, especially girls tend to skip meals, eat very little food and snack on high fat, high sugar foods/drinks. Some children develop extreme food selection at this age leading to slender and unhealthy look (Cresswell, 1994). Table 10 summarizes the proportions of the children classified as overweight and/or obese in Dodoma and Kinondoni municipalities. The proportion of obese boys and girls aged 10 - 12 years were generally higher in Dodoma municipality than the proportion of obese boys and girls of the same age groups in Kinondoni municipality.

The prevalence trend for obesity among girls was similar to that of boys in both municipalities as classified by WAZ criterion (Table 10). The proportion of obese boys and girls in Dodoma municipality was similar to that of boys and girls in

Kinondoni municipality, by WHZ criterion. None of the boys and girls from both municipalities was classified as abnormally tall, using HAZ criterion. There were no boys (6 - 9 years) who were overweight in Dodoma municipality. The proportion of overweight girls (6 - 9 years) in Kinondoni municipality was higher (10.2%, n = 87) than that of their peers in Dodoma municipality (8.5%, n = 128).

4.3.6 Body composition

Table 11 data show the body composition parameters, namely mid upper arm circumference (MUAC), fat mass, lean mass and muscle strength for the studied children. The mean fat mass for girls was higher than that of boys for both age groups in both municipalities. Likewise, the mean MUAC for girls was higher than that of boys for both age groups (Table 11) in both municipalities. Conversely, lean mass was higher in boys than in girls for both age groups in both municipalities (Table 11). In this study, the mean fat mass for boys aged 6 - 9 years in Dodoma municipality was slightly higher (63.84%, n = 23) than that of boys of the same age group in Kinondoni municipality (32.20%, n = 28).

Likewise, the mean fat mass for boys aged 10 - 12 years in Dodoma municipality was slightly higher (64.43%, n = 31) than that of boys of the same age group (59.65%, n = 57) in Kinondoni municipality. The mean fat mass of girls aged 6 - 9 years in Dodoma municipality was slightly higher (65.08%, n = 69) than that of their girls counter parts aged 6 – 9 years in Kinondoni municipality (63.10%, n = 59).

Table 9: Distribution of BMI for age for children aged 10-12 years

Location/Sex	BMI inference	Respondents	Percent
Dodoma municipality			
Boys	Underweight	21	65.6
	Normal	8	25.0
	Overweight	2	6.3
	Obese	1	3.1
	Total	**32**	**100.0**
Girls	Underweight	41	58.6
	Normal	19	27.1
	Overweight	6	8.6
	Obese	4	5.7
	Total	**70**	**100.0**
Kinondoni municipality			
Boys	Underweight	37	63.8
	Normal	17	29.3
	Overweight	4	6.9
	Obese	0	0
	Total	**58**	**100.0**
Girls	Underweight	42	66.7
	Normal	17	27.0
	Overweight	3	4.8
	Obese	1	1.6
	Total	**63**	**100.0**

Also the mean fat mass for girls aged 10 - 12 years in Dodoma municipality was higher (69.19%, n=68) than that of girls of the same age group in Kinondoni municipality (60.73%, n = 61).

Table 10: Summary table of cut-off points for overweight/obesity

Criteria	Cut-off	Municipality			
		Dodoma		Kinondoni	
		Boys (%)	Girls (%)	Boys (%)	Girls (%)
Obesity					
WAZ	>+3SD	3.1 (n=128)	2.3(n=118)	3.6 (n=87)	3.4 (n=87)
WHZ	>+3SD	9.4 (n= 128)	7.2(n=118)	7.1(n=87)	10.2(n=87)
HAZ	>+3SD	0 (n=128)	0 (n= 118)	0 (n=87)	0 (n=87)
BMI /age	≥30 Kg/m^2	6.9 (n=128)	8.6(n=118)	6.3 (n= 87)	4.8 (n=87)
Overweight					
WAZ	+2SD-3SD	3.1 (n=128)	4.7(n=118)	7.1 (n=87)	8.5 (n=87)
WHZ	+2SD-3SD	9.4 (n=128)	5.8(n=118)	7.1 (n=87)	10.2 (n=87)
HAZ	+2SD-3SD	0 (n=128)	0 (n= 118)	0 (n=87)	0 (n=87)
BMI/age	≥25 Kg/m^2	6.3 (n=32)	8.6 (n=32)	6.9 (n=58)	1.6 (n=63)

For boys of both age groups, percent fat ranged from 32.20 – 64.43% higher than that the 25% that is used as a classic cut-off for obesity in boys. Likewise for girls in both age groups, percent fat ranged from 60.73 – 69.19%, higher than the 32% fat that is used as a cut-off for obesity in girls. The mean fat mass of the children aged 10 - 12 years especially girls, was significantly ($p < 0.05$) higher than that of the children aged 6 - 9 years. This could be due to the fact that children in this age group (10 - 12 years) were at puberty stage in which their bodies tended to deposit more fat.

Within these age groups, however, the mean fat mass for boys was lower than that of their girl counterparts because at puberty stage boys tend to deposit more lean mass than fat mass contrary to girls who deposit more fat mass.

4.3.6.2 Lean body mass (fat free mass)/grip strength

Grip strength reflects the strength of the muscle mass. Since the muscles are composed of protein, how strong the muscle is, reflects the protein status in the muscle. The higher the proteins content in the muscle the stronger the grip strength. Data from this study revealed that, the mean grip strength of boys aged 6 - 9 years in Dodoma municipality was higher (67.80%, n = 32), than that of their counterparts of the same age group in Kinondoni municipality (36.16%, n = 28). Likewise, the mean grip strength of boys aged 10 - 12 years in Dodoma municipality was slightly higher (41.29%, n = 32) than that of boys of the same age group in Kinondoni municipality (40.35%, n = 28) (Table 11).

Overall, the grip strength of boys was higher for boys in the age group 10 - 12 years than for boys aged 6 - 9 years (Table 11). This could be due to age difference in which the older boys had deposited more muscle mass than their younger counterparts. Likewise, the boys in the age group 10 - 12 years had higher mean grip strength values than girls of the same age. During puberty, boys develop more lean mass than girls who on the contrary develop more fat mass.

4.3.6.4 MUAC

In children, MUAC is useful for predicting mortality and nutritional changes both in long and short terms. Results of this study (Table 11) indicated that, the mean MUAC of boys aged 6 - 9 years in Dodoma municipality was lower (18.50 cm) that of boys of the same age group in Kinondoni municipality (19.50 cm). The Mean MUAC for Dodoma boys aged 10 - 12 was lower (21.56 cm) than that of boys of the same age group in Kinondoni municipality (22.10 cm). The mean MUAC of girls aged 6 - 9 years in Dodoma municipality was similar (20.28 cm) to that of girls of the same age group in Kinondoni municipality (20.29 cm) ($p > 0.05$). However, the mean MUAC of the girls aged 10 - 12 years in Dodoma municipality was slightly higher (22.44 cm) ($p > 0.05$) than that of girls of the same age group in Kinondoni municipality (22.36 cm).

4.4 Food Consumption

Table 12 summarizes the frequency of meal and snacks intake per day for children aged 6 - 9 and 10 - 12 years. Results of this study showed that the average meal intake for boys aged 6 - 9 years in Kinondoni municipality was 3.89 times per day, while for boys of the same age group in Dodoma municipality was 3.0 times per day. Meal intakes for boys aged 10 - 12 years in both municipalities were similar (3.9 times/day). Average meal intake for girls aged 6 - 9 years in Dodoma municipality was slightly higher (2.92 times/day) than that of girls of the same age group in Kinondoni municipality (2.71 times/day). The average meal intake for girls aged 10 - 12 years in Dodoma municipality was similar (2.97% times/day) to that of girls of the same age group in Kinondoni municipality (2.97 times/day). Boys were

taking more meals than girls for both age groups (Table 12). Large number of meals per day increases the amount of calories taken and if children are inactive, it can lead to overweight or obesity.

4.4.1 Mean dietary intake

Table 13(a) and 13 (b) present the average energy and nutrients intake for the studied children in both municipalities. The food composition levels were then compared with the daily-recommended intakes (WHO, 1983). Recommended daily intakes for boys and girls less than 11 years are the same but these RDIs differ among girls and boys as they grow. The average daily intake of both boys and girls in Dodoma municipality were slightly higher than those of their counterparts in Kinondoni municipality.

For both municipalities, boys had higher dietary intakes than girls (Table 13a and b). The average daily intakes of calories and nutrients for boys aged 6-9 years in Dodoma municipality were - calories (1895 kcal), carbohydrate (360.6 g), fat (42.9 g), protein (34.6 g), Ca (767.5 mg), Fe (8.8 mg), Vitamin C (30.9 mg) and Vitamin A (324 IU) while for boys aged 6-9 years in Kinondoni municipality the average intakes were calories (1890.7 kcal), carbohydrate (302.7 g), fat (45.9 g), protein (30.0 g), Ca (723.7 mg), Fe (7.9 mg), Vitamin C (25.7 mg) and Vitamin A (319.8 IU) (Table 13b). The mean daily intakes of energy and nutrients for girls aged 6-9 years in Dodoma municipality were - calories (1850.0 kcal), carbohydrate (326.4 g), fat (40.9 g), protein (28.3 g), Ca (726.8 mg), Fe (6.1 mg), Vitamin C (27.7 mg) and Vitamin A (340 IU) (Table 13a).

Table 11: Distribution of MUAC, fat mass, lean mass and muscle strength for the studied children

Location/Sex	Age (years)	Parameters	Respondents	Mean
Dodoma municipality				
Boys	6-9	MUAC (cm)	32	18.50
		Fat Mass (%)	23	63.84
		Lean mass (%)	32	67.80
	10-12	MUAC (cm)	32	21.56
		Fat Mass (%)	31	64.43
		Lean mass (%)	32	41.29
Girls	6-9	MUAC (cm)	86	18.72
		Fat Mass (%)	69	65.08
		Lean mass (%)	86	34.92
	10-12	MUAC (cm)	70	22.44
		Fat Mass (%)	68	69.19
		Lean mass (%)	70	30.87
Kinondoni municipality				
Boys	6-9	MUAC (cm)	28	19.50
		Fat Mass (%)	19	32.20
		Lean mass (%)	28	36.16
	10-12	MUAC (cm)	57	22.10
		Fat Mass (%)	57	59.65
		Lean mass (%)	57	40.35
Girls	6-9	MUAC (cm)	59	20.23
		Fat Mass (%)	50	63.08
		Lean mass (%)	59	36.92
	10-12	MUAC (cm)	62	22.36
		Fat Mass (%)	61	60.73
		Lean mass (%)	62	39.27

For the boys aged 10-12 years living in Dodoma municipality the daily intakes of calories and nutrients were calorie (2556.8 kcal), Carbohydrates (354.8 g),

Table 12: Frequency of meals and snacks intake (times) per day

Location/Sex	Age group (years)	Respondents	Mean
Dodoma municipality			
Boys	6-9	32	3.00
	10-12	32	3.97
Girls	6-9	86	2.92
	10-12	70	2.97
Kinondoni municipality			
Boys	6-9	28	3.89
	10-12	57	3.96
Girls	6-9	59	2.71
	10-12	62	2.97

fat (48.0), protein (41.3 g), Ca (900.8 mg), Fe (7.9 mg), Vitamin C (40.5 g) and Vitamin A (510 IU) (Table 13a) while intakes for boys of the same age group living in Kinondoni municipality were calorie (2387.9 kcal), carbohydrate (349.1g), fat (44.6 g), protein (37.8 g), Ca (889.9 mg), Fe (6.9 mg), Vitamin C (23.1mg) and Vitamin A (398.1 IU) (Table13b). Mean daily intakes for energy and nutrients for girls aged 10-12 years in Dodoma municipality were calorie (2000.4 kcal), carbohydrates (329.1g), fat (46.5g), protein (37.8 g), Ca (678.5 mg), Fe (10.7 mg), Vitamin C (31.9mg) and Vitamin A (319.8 IU) (Table 13a) while intakes for energy and nutrients for girls of the same age group in Kinondoni municipality were calorie (1246.6 kcal), carbohydrates (350g), fat (37.8g), protein (39.1g), Ca (596.4 mg), Fe (8.5 mg), Vitamin C (26.0 mg) and Vitamin A (402.5 IU) (Table 13b).

Results of this study indicated that, intake of energy and nutrients for boys were higher ($p < 0.05$) than that of girls. When the energy and nutrients taken were

compared with the recommended daily intakes (Table 3), both boys and girls of both age groups in both municipalities had adequate intake of fat, protein, energy and carbohydrate but inadequate intake of Ca, Fe, Vitamin A and Vitamin C (Table 13a and 13b).

Table 14 indicates the proportion of school children who took snacks at school. Snacks that were most commonly taken by the school children were chocolates, groundnuts, cakes, biscuits and sweets. Results from this study revealed that, majority of the school children in both age groups in both municipalities were taking snacks at school and only a handful of them were not taking snacks at school. However, more girls in both age groups were taking snacks than their boys' counterparts (Table 14).

The proportion of boys aged 6 - 9 years who took snacks at school in Dodoma municipality was higher (93.8%, n = 32) than that of boys of the same age group in Kinondoni municipality (92.9%, n = 28) while those who didn't take snacks were 6.3% (n = 32) and 7.1 % (n = 28) for Dodoma and Kinondoni municipalities respectively. Proportion of boys aged 10 - 12 years in Dodoma municipality who took snacks at school was 93.8% (n = 32) while in Kinondoni municipality was 89.5% (n = 57).

4.4.2 Intake of snacks

Children who did not take snacks at school were 6.3% (n = 32) and 10.5% (n = 57) for Dodoma and Kinondoni municipalities, respectively. A similar trend of snacks

Table13 (a): Average nutrients intake per day for boys and girls in Dodoma municipality

Sex	Age categories	Food nutrients	Respondents	Average intake
Boys	6-9	Calorie (kcal)	32	1895.5
		CHO (g)	32	360.6
		Fat (g)	32	42.9
		Protein (g)	32	34.6
		Ca (mg)	32	767.5
		Fe (mg)	32	8.8
		Vitamin A (IU)	32	324.0
		Vitamin C (mg)	32	30.9
	10-12	Calorie (kcal)	32	2556.8
		CHO (g)	32	354.8
		Fat (g)	32	48.0
		Protein (g)	32	48.3
		Ca (mg)	32	900.8
		Fe (mg)	32	7.9
		Vitamin A (IU)	32	510.5
		Vitamin C (mg)	32	40.5
Girls	6-9	Calorie (kcal)	86	1850.0
		CHO (g)	86	326.4
		Fat (g)	86	40.9
		Protein (mg)	86	30.3
		Ca (mg)	86	726.8
		Fe (mg)	86	6.1
		Vitamin A (IU)	86	401.9
		Vitamin C (mg)	86	27.7
	10-12	Calorie (kcal)	70	2000.4
		CHO (g)	70	329.1
		Fat (g)	70	46.5
		Protein (g)	70	48.9
		Ca (mg)	70	678.5
		Fe (mg)	70	10.7
		Vitamin A (IU)	70	454.7
		Vitamin C (mg)	70	31.9

intake was observed among girls in both municipalities (Table 13). Contemporary children's dietary habits have shifted away from healthy foods such as fruits,

vegetables, and whole grains to a much greater reliance on fast food, processed snack foods, and sugary drinks (Gavins and Hassink, 2005).

These foods tend to be high in fat and/or calories and low in essential nutrients especially the micronutrients. They thus increase the risk of children becoming overweight or obese. Fat and sugar scores consisted of the number of daily servings selected from the fatty foods group, and the sweet foods group, foods with added sugar and sugar-sweetened beverages, cereals, snacks and desserts. This implied that, when selecting snacks, girls tend to select those, which are both high in fat and sugar while boys tend to select those snacks that are high in sugar. Higher consumptions of snacks at schools by the studied children increased their calorie intake and the fact that most children did not engage in any physical exercise due to their sedentary life styles associated with watching TV and listening to radios/CDs for more than two hours, together increased the risk for them becoming overweight or obese and high morbidity rate at adulthood.

4.4.3 Soft drinks consumption

Table 15 summarizes the frequency of consumption of various soft drinks by the school children. This study revealed that, majority of the children were taking carbonated, sugared drinks especially sodas and fruit flavoured juices while only few children were not taking any of the soft drinks. A larger proportion of both boys (6 – 9 and 10 - 12 years) and girls (6 - 9 years) in Kinondoni municipality were taking soft drinks compared to their counterparts in Dodoma municipality (Table 15),

Table 13 (b): Average nutrients intake per day for boys and girls in Kinondoni municipality

Sex	Age group	Food nutrient	Respondents	Average intake
Boys	6-9	Calorie (kcal)	28	1890.7
		CHO (g)	28	362.7
		Fat (g)	28	45.9
		Protein (g)	28	30.0
		Ca (mg)	28	723.7
		Fe (mg)	28	7.9
		Vitamin A (IU)	28	319.8
		Vitamin C (mg)	28	25.7
	10-12	Calorie (kcal)	58	2387.9
		CHO (g)	58	349.9
		Fat (g)	58	44.6
		Protein (g)	58	49.4
		Ca (mg)	58	889.9
		Fe (mg)	58	6.9
		Vitamin A (IU)	58	398.1
		Vitamin C (mg)	58	23.1
Girls	6-9	Calorie (kcal)	59	1878.4
		CHO (g)	59	340.0
		Fat intake	59	36.3
		Protein (g)	59	38.3
		Ca (mg)	59	731.4
		Fe intake (mg)	59	4.1
		Vitamin A	59	340.3
		Vitamin C	59	22.5
	10-12	Calorie	62	1946.6
		CHO	62	350.0
		Fat	62	37.8
		Protein	62	49.1
		Ca	62	596.4
		Fe	62	8.5
		Vitamin A	62	402.5
		Vitamin C	62	26.0

however, consumption of soda among the older boys (10 - 12 years) in Kinondoni

Table 14: Intake of snacks at school

Municipalities	Sex	Age category (years)	Snacks intake	Respondents	Percent
Dodoma	Boys	6-9	Take snacks	30	93.8
			Don't take	2	6.3
			Total	**32**	**100.0**
		10-12	Take snacks	30	93.8
			Don't take	2	6.3
			Total	**32**	**100.0**
	Girls	6-9	Take snacks	82	95.3
			Don't take	4	4.7
			Total	**86**	**100.0**
		10-12	Take snacks	69	98.6
			Don't take	1	1.4
			Total	**70**	**100.0**
Kinondoni	Boys	6-9	Take snacks	26	92.9
			Don't take	2	7.1
			Total	**28**	**100.0**
		10-12	Take snacks	51	89.5
			Don't take	6	10.5
			Total	**57**	**100.0**
	Girls	6-9	Take snacks	56	94.9
			Don't take	3	5.1
			Total	**59**	**100.0**
		10-12	Take snacks	55	88.7
			Don't take	7	11.3
			Total	**62**	**100.0**

municipality was higher (90.4%, n = 208) than that their counterparts (10 -12 years) in Dodoma municipality (81.3%, n = 220). The proportions of girls (6-9 years) in Kinondoni municipality who were taking soda was 94.4% (n = 208) while in Dodoma municipality, the proportion was 78.7% (n = 220) ($p < 0.05$). Students who frequently took fruit flavoured juices or natural juices were 1.2 and 3.95%, respectively, in Kinondoni municipality while in Dodoma municipality consumption of fruit flavoured juices was 9.2% and natural juices was 11.2%. The proportion of girls (10 - 12 years) in Kinondoni municipality who were taking soda was slightly lower (72.3%, n = 208) than that of girls of the same age group (83. 6%, n = 220) in Dodoma municipality ($p > 0.05$) (Table 14).

From the study, the proportion of boys aged 6 - 9 years in Kinondoni municipality who were taking soda was higher (96.4%, n=208) ($p < 0.05$) than that of boys of the same age group (71.0%, n = 208) in Dodoma municipality. Likewise the proportion of boys aged 10 - 12 years in Kinondoni municipality who were taking soda were higher (90.4%, n = 208) than that of boys of the same age group (81.3, n = 220) in Dodoma municipality. The proportion of girls (6 - 9 years) in Kinondoni municipality who were taking soda were 94.4% (n = 108) while in Dodoma municipality the proportion was 78.7% (n = 220). Students who frequently took fruit flavoured juices or natural fruit juices were 1.2 and 3.9%, respectively in Kinondoni municipality while in Dodoma municipality consumptions were 9.2% (fruit flavoured juice) and 11.2% (natural fruit juices). Proportion of girls (10-12 years) in Kinondoni municipality who were taking soda was slightly lower (72.3%,n=208)

than that of girls of the same age group (83.6%; n=220) in Dodoma municipality (Table 15).

Research conducted by NCHS/NIH (1994) revealed that, beverages were one of the top contributors to energy appeared as one of the top contributors to energy intake for children and adolescents. According to Pierre *et al.* (2003), children's rate of consumption of soft drink has increased over the recent years, and now soft drinks provide about 188 kcal/day above the energy intake of non- soft drinks consumers. This in turn increases the risk of becoming overweight or obese and high morbidity rate at adulthood.

4.5 Lifestyle Behaviours of the Studied Children

4.5.1 Average time spent in watching TV

Table 16 summarizes the duration (hours) used by the studied children to watch TV. Out of 220 school children that were interviewed in Dodoma municipality, children in the lower age group (6 - 9 years) spent fewer hours in watching TV than those in the same age group in Kinondoni municipality. The proportion of children watching TV for various reasons times in Dodoma municipality were 52.2% (less than one hour) 17.8% (one hour), 9.9% (2 hours), 10.8% (more than 2 hours) and 9.3% (zero hours). In Kinondoni municipality, the proportion of children aged 6-9 years watching TV for various times were 31.0% (less than one hour), 11.5% (one hour), 8.0% (more than two hours) and 12.6% (zero hours). The proportions of school children aged 10 - 12 years who watched TV for less than one hour, one hour, two hours, more than two hours and zero hours in Dodoma municipality were 27.5, 34.3,

17.5% and 8.8 percent, respectively while children of the same age group from Kinondoni municipality who watched TV for less than one hour, one hour, two hours, more than two hours and zero were 18.5, 30.3, 37.0, 1.7 and 12.5 percent, respectively. A similar trend was observed for boys and girls of both age groups listening to radios and CDs in both districts (Table 17). Both girls and boys of both age groups spent a considerable amount of time listening to radios and CDs. The popularity of television, computers games, radios, CDs and video games translates into an increasingly sedentary lifestyle for many children.

Some children spent more than two hours per day watching television.This made the children inactive and also encouraged snacking (Gavin and Hassink, 2005). The time spent in watching TV or listening to radio has a significant impact on the level of physical activities of the individual. In this study, 40.2% (n = 428) of the children used an average of one hour daily to listen to radio programs, while 28% (n = 428) of the studied children spent an average of 2 hours daily watching TV, and more than 9.6% (n = 428) of the children spent the same amount of time listening to radio programs. A study by NHI (2007) showed that, limiting television time leads indirectly to more exercise time. NIH (2007) recommends that, children should be restricted from watching TV for more than two hours per day. In this study, only few children 5.4 % (n = 428) and 3 % (n = 428) were found to spend more than two hours in watching TV and/or listening to radio programs, respectively. According to NIH (2007), children who watch TV for many hours usually have the highest incidence of obesity. The fact that children usually munch some snacks while watching TV, this practice adds to the problem of excessive calorie intake.

Table 15: Soft drinks consumption by school children

Location/Sex	Age categories (Years)	Type of drink	Respondents	Percent
Dodoma Municipality				
Boys	6-9	Soda	22	71.0
		Sugar flavoured juice	5	20.8
		Natural fruits juice	3	5.0
		None	1	3.2
		Total	**31**	**100.0**
	10-12	Total	67	100.0
		Fruit flavoured juice	4	12.2
		Natural fruits juice	2	6.6
		Total	**32**	**100.0**
Girls	6-9	Soda	59	78.7
		Fruit flavoured juice	15	9.2
		Natural fruits juice	0	11.8
		None	1	1.3
		Total	**75**	**100.0**
	10-12	Soda	56	83.6
		Sugar flavoured juice	11	7.3
		Natural fruits juice	0	9.1
		Total	**67**	**100.0**
Kinondoni Municipality				
Boys	6-9	Soda	27	96.4
		Sugar flavoured juice	0	0.0
		Natural fruits juice	1	3.6
		Total	**28**	**100.0**
	10-12	Soda	47	90.4
		Sugar flavoured juice	3	5.6
		Natural fruits juice	2	4.0
		Total	**52**	**100.0**
Girls	6-9	Soda	56	94.9
		Sugar flavoured juice	1	1.2
		Fruit flavoured juice	0	0.0
		Total	**59**	**100.0**
	10-12	Soda	50	72.3
		Fruit flavoured juice	10	8.5
		Natural fruits juice	5	8.2
		None	5	11.0
		Total	**60**	**100.0**

In this study, only few children were not involved in watching TV (7.9%, n = 428) or listening to radio programs (23%, n = 428).

Table 16: Average amount of time spent in watching TV

Location	Time spent in watching TV (hrs)	Age groups (years)			
		6 - 9		10 - 12	
		Respondent	%	Respondent	%
Dodoma municipality	<1	58	52.2	28	27.5
	1	21	17.8	35	34.3
	2	20	9.9	25	17.5
	>2	8	10.8	5	11.9
	None	11	9.3	9	8.8
	Total	**118**	**100**	**102**	**100**
Kinondoni municipality	< 1	27	31.0	22	18.5
	1	10	11.5	48	30.3
	2	32	36.8	44	37.0
	<2	7	8.0	2	1.7
	None	11	12.6	3	12.5
	Total	**87**	**100.0**	**119**	**100.0**

This was due to the reason that, there were no TV or radio sets in their homes, otherwise they would have been similarly involved in TV watching and/or radio/CD listening.

Table 17: Average amount of time (hours) spent in listening to radio programmes and CDs

Location	Time spent in watching TV (hrs)	Age group (years)			
		6 - 9		10 - 12	
		Number	Percent	Number	Percent
Dodoma	<1	58	52.2	28	27.5
Municipality	<1	21	17.8	55	34.3
	<2	20	9.9	25	17.5
	>2	8	10.8	5	11.9
		11	9.3	9	8.8
	Total	**118**	**100.0**	**102**	**100.0**
Kinondoni	< 1	32	36.8	44	37.0
Municipality	1	17	19.5	35	29.4
	2	16	18.4	9	7.6
	> 2	2	2.3	3	2.5
	None	20	23.0	28	23.5
	Total	**87**	**100**	**119**	**100**

4.5.2 Distance travelled by the studied children to/ from school

Table 18 indicates the distance covered by children to and from school. In Dodoma municipality, most of the boys (46.9%, n = 32) in the age group 6-9 years stayed less than 0.5 km from the school while in Kinondoni municipality, only a few (7.1%, n = 28) of their peers stayed less than 0.5 km from school. A relatively higher percent (50.0%, n = 28) of the boys aged 6-9 years in Kinondoni municipality stayed in a distance of more than one km, and only a few boys (about 20%, n = 220) of the same age group in Dodoma municipality stayed more than one km. Overall, majority of school children in both Dodoma and Kinondoni municipalities stayed close to the schools (0 – 1 km) and only few pupils (about 20%) stayed more than one km from their schools (Table 18).

The distance that the child travels/walks to and from school every day and the mode of transport used influences greatly the level of physical activities. The longer the distance covered in walking the higher the level of physical exercise and vice-versa. Children who walk or bike to school daily subject their bodies into more physical exercise than those who go to school by cars or buses. Children who stay close to their schools should be encouraged to walk or bike to and from school than rather boarding cars or buses.

4.5.3 Mode of transport to/ from school

Table 19 shows the modes of transport to/from school for the studied children. It can be noted from Table 19 that, the modes of transport commonly used by the school children in both municipalities were private cars, public buses, bicycles and walking

on foot. Dodoma municipality, the proportions of boys aged 6 - 9 years who travelled to school on foot, private cars and public buses were higher ($p > 0.05$) than that of boys of the same age in Kinondoni municipality (Table 19).

The proportion of boys aged 6 - 9 years in Dodoma municipality who walked to school were 62.5 % ($n = 32$) while those who used private cars and school buses were 15.6 and 21.9 percent, respectively. The proportion of boys of the same age group in Kinondoni municipality who walked to school on foot were 56.5% ($n = 28$), while those who used private cars or public buses were 14.9 and 28.9 percent, respectively. A similar trend, whereby the majority of the children were walking on foot to school was also observed among girls and boys aged 10 - 12 years in both municipalities (Table 19).

In Dodoma municipality, the proportion of girls aged 6 - 9 years who walked to school on foot, rode bicycles, use private cars or used school buses were less than their peers in of the same age group in Kinondoni municipality ($p > 0.05$). The proportions of girls aged 6 - 9 years who walked to school on foot, rode bicycles, used private cars or school/public buses in Dodoma municipality were 37.2, 7.0, 8.1 and 47.7 percent, respectively while the proportion of girls of the same age group in Kinondoni municipality who walked to school on foot, used private cars, or boarded public/school buses were 41.5, 9.7 and 48.8 percent, respectively. In Dodoma municipality, the proportions of girls aged 10 - 12 years who went to school on private cars were similar to that of girls of the same age group in Kinondoni municipality (12.9%, $n = 57$).

Except for girls who went to school by public buses (30.0%), girls who went to school on foot and by bicycles in Dodoma municipality were fewer than their counterparts of the same age group in Kinondoni municipality (Table 19). The proportion of girls aged 10 - 12 years who went to school on foot, on bicycles and public buses in Kinondoni municipality were 54.8, 6.5 and 25.8 percent, respectively while girls in the same age group who travelled to school on foot and by bicycles were 53.7 and 3.4 percent, respectively.

Barbara and Russel (2001) recommended that, on workdays, children should engage in physical exercises for an average of 30 or more minutes. This can be a simple 30-minute walk to and from school. There is strong evidence to the suggestion that, a long-term, strict regimen of regular exercise and a moderate, low-fat diet can permanently sustain a lower weight (FDA, 1999). Vigorous physical activities for 10 minutes per occasion can be done by school children to promote cardio- respiratory fitness.

4.5.4 Common types of physical activities

Table 20 summarizes the common types of physical exercises undertaken by the studied children. Increased level of physical activities may help in controlling the weight by increasing the energy expenditure and thus maintaining the lean body mass (Barbara and Russel, 2001). Changes in lifestyle and socio-economic status have a significant effect on the levels of physical activities. With the availability of cars, the increase in the use of electronic appliances at home and at school, life has become more sedentary, and the pattern of doing physical exercises has diminished dramatically in most countries. Physical exercise is the activity least done during

leisure time in a typical day. In this study, majority of the children of both sexes and age groups were not involved in physical exercises. More than 95% (n = 86) of girls aged 6 - 9 years in Dodoma municipality did not do any physical exercise. A similar trend was observed for girls of the same age living in Kinondoni municipality (93.2%, n = 59). Likewise, more than 90% (n = 32) of boys aged 6 – 9 years in Dodoma municipality did not engage in physical exercise and this trend was echoed by their peers of the same age in Kinondoni municipality (85.7%, n = 28).

Table 20 summarizes the common types of physical exercises undertaken by the studied children. Increased level of physical activities may help in controlling the weight by increasing the energy expenditure and thus maintaining the lean body mass (Barbara and Russel, 2001). Changes in lifestyle and socio-economic status have a significant effect on the levels of physical activities. With the availability of cars, the increase in the use of electronic appliances at home and at school, life has become more sedentary, and the pattern of doing physical exercises has diminished dramatically in most countries. For girls aged 10 – 12 years in Kinondoni municipality, majority of the pupils (88.7%, n = 62) who did not engage in any physical activity similar to their counterparts of the same age group in Dodoma municipality (78.6%, n = 70). Generally, majority of the school children did not engage in any physical exercise and only handful pupils engaged in football, netball, handball, basketball, running, rope jumping, swimming, drama, singing and dancing (Table 20). Physical exercise develops physical fitness and health through strengthening musclesand cardiovascular system (Donalelle, 2001). Frequent and

Table 18: Distance covered by children to/from school

Location/Sex	Age	Distance covered (km)	Respondents	Percent
Dodoma municipality				
Male	6-9	Less than 0.5	15	46.9
		0.5-1 .0	12	37.5
		More than 1.0	5	15.6
		Total	**32**	**100.0**
	10-12	Less than 0.5	12	37.5
		0.5-1.0	12	37.5
		More than 1.0	8	25.0
		Total	**32**	**100.0**
Female				
	6-9	Less than 0.5	38	44.2
		0.5-1.0	30	34.9
		More than 1	18	20.9
		Total	**86**	**100.0**
	10-12	Less than 0.5	35	50.0
		0.5-1.0	20	28.6
		More than 1.0	14	20.0
		Total	**70**	**100.0**
Kinondoni municipality				
Male	6-9	Less than 0.5	2	7.1
		0.5-1.0	12	42.9
		More than 1.0	14	50.0
		Total	**28**	**100.0**
	10-12	Less than 0.5	18	31.0
		0.5-1.0	32	55.2
		More than 1.0	8	13.8
		Total	**58**	**100.0**
Female				
	6-9	Less than 0.5	1	3.2
		0.5-1.0	40	67.8
		More than 1.0	13	32.0
		Total	**53**	**100.0**
	10-12	Less than 0.5	16	25.8
		0.5-1 .0	31	50.0
		More than 1	15	24.2
		Total	**62**	**100.0**

regular physical exercises boost the immune system and prevent diseases such a

Table 19: Modes of transport to/from school

Location/Sex	Age group (years)	Mode of transport	Respondents	Percent
Dodoma Municipality				
Boys	6-9	Foot	20	62.5
		Car	5	15.6
		Public bus	7	21.9
		Total	**32**	**100.0**
	10-12	Foot	13	40.6
		Bicycle	1	3.1
		Car	1	3.1
		Bus	17	53.1
		Total	**32**	**100.0**
Girls	6-9	Foot	32	37.2
		Bicycle	6	7.0
		Car	7	8.1
		Public bus	41	47.7
		Total	**86**	**100.0**
	10-12	Foot	39	55.7
		Bicycle	1	1.4
		Car	9	12.9
		Public bus	21	30.0
		Total	**70**	**100.0**
Kinondoni Municipality				
Boys				
	6-9	Foot	15	56.5
		Car	5	14.9
		Public bus	8	28.6
		Total	**28**	**100.0**
	10-12	Foot	40	66.2
		Bicycle	1	5.8
		Car	10	17.5
		Public bus	6	10.5
		Total	**57**	**100.0**
Girls	6-9	Foot	28	41.5
		Car	14	9.7
		Public bus	17	48.8
		Total	**59**	**100.0**
	10-12	Foot	34	54.8
		Bicycle	4	6.5
		Car	8	12.9
		Public bus	16	25.8
		Total	**62**	**100.0**

heart diseases, type 2 diabetes and obesity. Aerobic exercises such as cycling, walking, running, hiking or playing balls, are good for increasing cardiovascular endurance. Anaerobic exercises such as weighing training, functional training or sprinting increase short term muscle strength and muscle mass while flexibility exercises such as stretching, improve the range of motion of muscles and joints (Donalelle, 2001). Parents should encourage children to engage in physical activities such as playing balls, running games, swimming, skating, and riding bicycles to help burn down excessive calories. The pupils should be guided to engage in modest activities which do not exhaust them. Most effective activities raise the heart rate moderately and cause mild sweating. The child should not become overheated, exhausted or severely short of breath (Gavin and Hassink, 2005).

Table 20: Types of physical exercises performed by the school children

Location/Sex	Age categories (years)	Exercise type	Respondents	Percent
Dodoma municipality				
Boys	6-9	Football	2	6.3
		None	29	90.6
		Body building exercise	1	3.1
		Total	**32**	**100**
	10-12	Football	8	25.0
		None	24	75.0
		Total	**32**	**100.0**
Girls	6-9	Football	3	3.5
		Netball	1	1.2
		None	82	95.3
		Total	**86**	**100.0**
	10-12	Football	8	11.4
		Basketball	2	2.9
		None	55	78.6
		Singing/dancing	1	1.4
		Netball	2	2.9
		Handball	1	1.4
		Jumping	1	1.4
		Total	**70**	**100.0**
Kinondoni municipality				
Boys	6-9	Football	3	10.7
		None	24	85.7
		Running	1	3.6
		Total	**28**	**100.0**
	10-12	Football	5	8.6
		None	47	81.0
		Running	5	8.6
		Drama	1	1.7
		Total	**58**	**100.0**
Girls	6-9	Football	3	5.1
		None	55	93.2
		Running	1	1.7
		Total	**59**	**100.0**
	10-12	Football	3	4.8
		None	55	88.7
		Running	1	1.6
		Singing / dancing	3	4.8
		Total	**62**	**100.0**

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Obesity and overweight have a profound effect on a child's life. It increases the child's risk of numerous health problems including chronic diseases such as heart diseases, hypertension, type 2 diabetes, some cancers, orthopaedic problems, liver diseases, sleep apnoea and asthma. Overweight and obesity also create emotional and social problems.

From this study it is concluded that the prevalence of overweight and obesity among boys and girls were relatively lower than those reported elsewhere, however, the trend is rapidly increasing with change in lifestyles and urbanization. Prevalence of overweight and obesity among children aged 6 – 11 years in developed countries has been reported to be as high as 30%, while that of developing countries is as low as 12% in Eastern Mediterranean region (Musager, 2004).

Factors that may have contributed to overweight and obesity among the school children aged 6 - 12 years in this study were physical inactivity and high intake of non-nutritious, energy-dense snacks and soft drinks such as sweets, cakes, soda, fruits flavoured juice. Long duration spent in watching TV or listening to radio programs (one to two hours daily) could have a significant impact on the level of energy expenditure of the children. It is therefore very important to make deliberate efforts to prevent overweight and obesity among children since the cost of managing this health problem is very high considering our low incomes and large number of

competing diseases such as malaria, HIV and other infections that must be addressed. Nutrition education at individual and community level to promote the best nutrition practices is thus very essential. Parents should encourage children to engage in physical activities such as playing balls, running games, swimming, skating, and riding bicycles to help burn down excessive calories, likewise, lifestyle behaviours that encourage inactivity among children should be discouraged.

5.2 Recommendations

Data from this study showed increased trend of overweight and obesity in children. There is therefore the need to take immediate actions to remedy the situation. Steps that can be taken to address this problem include:

- Provision of nutritional education at individual and community level to promote the best nutritional practices such as balancing energy intake and healthy weight. Also, creating awareness on causes and health risks associated with overweight and obesity including long and short-term effects, prevention and management of the conditions at individual level.

- Train the children to develop good eating habits and practices through promoting limited energy intake from fats, increasing consumption of fruit and vegetables, legumes, whole grains and nuts and limiting the intake of excessive sugars.

- Parents or guardians should limit children from watching TV or listening to radio programs or play computer games to less than 2 hours in a day. This

would lead indirectly to more physical exercises and other activities that may keep the children physically fit.

- Institutions, parents and communities should facilitate children to do physical exercises regularly, for at least 30 minutes per day. For weight control more vigorous exercise may be needed.

- The government should establish a national programme to control and prevent diet related chronic diseases. The program should be part of the national plan and should incorporate promotion of health lifestyles and physical education.

Implementation of these recommendations requires sustained political commitment and the collaboration of many stakeholders, public and private. Government, international partners, civil society and non - governmental organizations and the private sector should be mobilized to play roles in nurturing healthy lifestyle among children and support programs that enable school children to manage their weight in general. They should also support programs that make the public to access/afford healthier diet.

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APPENDICIES

Appendix 1: Questionnaire on prevalence of overweight and obesity for children aged 6-12 years in Dodoma urban and Kinondoni municipalities

Participant ID ..... Ward.....

Date of Visit..... District.....

SECTION A- GENERAL INFORMATION

1. Age ..... 2. Sex.....
3. School..... 4. Class.....

5. Parents economic activities

a) Father

i. Farmer

ii. Petty trader

iii. Office employee

iv. Businessman

v. Others

b) Mother

i. House wife

ii. Farmer

iii. Petty trader

Iv. Office Employee

v. Businesswoman

vi. Others

6. With whom are you living with?
   i. Parents
   ii. Guardian

SECTION B - ANTHROPOMETRIC MEASUREMENT AND BODY COMPOSITION INFORMATION.

7. Height (cm) ..... 8. Weight (Kg).....

9. MUAC (cm)..... 10. Fat mass (%).....

11. Grip strength (Kg).....

SECTION C - FOOD CONSUMPTION

13. How many times do you eat food per day?
    i. Once
    ii. Twice
    iii Thrice
    iv. More than thrice

14. What type of food do you normally take?

    i. Ugali
    ii. Rice
    iii. Potatoes
    iv. Bananas
    v. Green Vegetables
    vii. Meat
    viii. Fish
    ix .Beans
    x. Fruits

15. What did you eat in the past 3 days?

	DAY1	TYPE OF FOOD	PORTION	DAY 2	TYPE OF FOOD	PORTION	DAY 3	TYPE OF FOOD	PORTION
BREAKFAST									
LUNCH									
DINNER									
OTHERS									

16. Do you get lunch at school?
    I. Yes ii. No

17 .If Yes, What type of food do you usually take.

Type of food	How often in A week

18. Do you take snacks?
i. Yes ii No
If Yes which ones do you eat frequently.....

19. How often do you take the snacks per day?
i. Once

ii. Twice

iiI .Thrice

iv. More than thrice per day.

20. Do you take soft drinks?

i. Yes ii. No
If yes which ones do you take frequently?
i. Soda ii Juice

21. How often do you take the drinks per day?

i. Once

ii. Twice

iii. Thrice

iv. More than Thrice

SECTION D – PHYSICAL ACTIVITIES

22. What activities do you normally do at home before going to school in the morning?
    1 Exercise
    2 Watering the garden
    3 Washing utensils
    4. Mopping
    5. Cooking
    6. Environment cleaning
23. What type of activities do you normally do at school?

    1 Reading
    2 Writing
    3 Play
    4 School environments cleaning

24. What type of activities do you normally do in the evening when you are back from school
    1 Washing clothes
    2 Washing utensils
    3. Cooking
    4. Watching/
    5. Listening TV/Radio/DVD
    6. Play footballs
    7. Environment cleaning
    8. Sleep
25. How far is school from your home?
    i. Less than 0.5 Km

    ii. 0.5-1 Km

    iii. More than 1 Km

26. How do you go to school?

    i. On foot
    ii. On bicycle
    iii. By car
    iv. By bus

27. Do you have the following in your home?
    i. TV
    ii. DVD
    iii. CD
    iv. Radio cassette
    v. Car
    vi. Games like Super Nintendo
    Vii None

28. Are you restricted from watching TV or listening to radio programs?
    i .Yes ii. No
29. How much time do you spend watching/listening to.....per
    a) TV
       i. less than 1 hour
       ii. 1 hour
       iii. 2 hours
       iv More than 2 hours
       v. None

    b) CD/Radio cassette

       i. Less than 1 hour
       ii. 1 hour
       iii 2 hours
       iv. More than 2 hours
       v. None

30. What Play facility do you have at school?
    1. Football
    2. Basketball
    3. Bicycle
    4. Others

31. How often do you use these facilities?
    1. Daily
    2. Once weekly
    3. Twice weekly
    4. Thrice weekly
    5. .More than thrice
    6. None

32. Are you involved in any sport club/ Affiliation?

    i. Yes ii. No

33. If yes, which ones?
    1. Football
    2. Basketiball
    3. Others like
       i.....
       ii.....

34. What do you normally do in such health club/affiliation?
    i. Play
    ii. Sing
    iii. Act/Drama