EFFECTS OF TWELVE WEEK ROPE SKIPPING EXERCISE ON BODY FAT AND BMI OF OBESE CHILDREN IN PRIVATE SCHOOLS IN KANO METROPOLIS

BY

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A DISSERTATION SUBMITTED TO THE DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION, FACULTY OF EDUCATION, BAYERO UNIVERSITY, KANO, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS OF SCIENCE DEGREE (M.Sc.) IN PHYSICAL AND HEALTH EDUCATION (EXERCISE AND SPORTS SCIENCE)

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DECLARATION

The researcher is hereby declare that this work is the product of his own effort, undertaken under the supervision of Dr. A. I. Darki. The researcher also declares that to the best of his knowledge, this research work has not been presented and will not be presented elsewhere for the award of degree or certificate. All the sources of information herein have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent preparation of this dissertation by Ismaa'ila Tanko Birnin-Kudu (SPS/11/MHE/00040) was carried out under my supervision.

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APPROVAL PAGE

This research work has been examined and approved as meeting the requirements for the award of Masters of Science degree (M.Sc) in Physical and Health Education (Exercise and Sports Science).

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DEDICATION

This dissertation is dedicated to Abba Ismail's family.

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ABSTRACT

The study investigated the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in Kano Metropolis. In order to achieve the purpose of this study, three research questions were raised and also three hypotheses were tested. Pre-test, post-test, experimental and control group design method was adopted for this study. The population for the study comprised all obese pupils in private primary schools in Kano Metropolis, which was estimated to be around three hundred and eighty five (385). Purposive sampling technique was used to sample four private primary schools (2 experimental and 2 control group) while simple random sampling technique was used to select forty (40) participants (20 experimental and 20 control group) for this study. Hanson's weighing scale, skipping rope, whistle, stopwatch and ruler were used as the instrument for data collection. Descriptive statistics of mean and standard deviation was used to organize and describe the physical characteristics of the respondents while Analysis of covariance (ANCOVA) was used to test all the three formulated hypotheses at the 0.05 level of significance. The finding for this study indicated that twelve week of rope skipping exercise have significant effect on the body weight ($F = 31.037$, at $df=2$, $P< 0.05$). The finding for this study indicated that twelve week of rope skipping exercise have significant effect on the body BMI ($F=24.127$, at df 2, $P< 0.05$). The finding for this study also indicated that twelve week of rope skipping exercise have significant effect on the body percent body fat of obese pupils in privative schools in Kano Metropolis ($F = 51.019$, at df 2, $P< 0.05$). Based on these findings, it was concluded that rope skipping can be effective in reducing body weight, BMI and percent body fat of obese children. Therefore, all the three hypotheses tested were rejected. The implication of this finding is that if students in private schools in Kano Metropolis would be participating in physical activity, more effective results would be produce, thereby reducing obesity and overweight. However, it was recommended among others, that rope skipping exercise should be incorporated in the exercise programme of obese children in primary schools.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The problems of obesity has continued to rise at an alarming rate worldwide to such an extent that it has been described as a global pandemic and it has even replaced under-nutrition as the most common public health concern for infants and children (World Health organization, 2012). Although, obesity is rather complex, increased intake of fast foods, replacement of the traditional fiber diet with western diets rich in sugar and fats and the tendency for a more sedentary lifestyle with the advent of automobile and computers among others, are believed to contribute to this pandemic childhood obesity (Glanz & Salts, 2006).

According to Janssen, Craig, Boyce and Pickett (2004), overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. WHO (2012) defined overweight as Body Max Index (BMI) greater than or equal to 25 and BMI greater than or equal to 30 to be obesity. Obesity is a disease associated with the development of serious medical complications and increased mortality in adulthood. It is also a risk factor associated with cardiovascular diseases, atherosclerosis, diabetes and breast, colonic, endometrial and prostate cancers (Dietz, 1998). The scourge of childhood obesity is associated with some psychological problems like low self-esteem, feeling of inadequacy, anxiety, social dysfunction, depression and mood, thereby affecting the general personality of the children. Girls who are overweight or obese are prone to developing high-risk behaviors such as smoking and drinking of alcohol and are also less likely to engage in physical activities and exercise programmes that promote energy expenditure (Strauss, 2000).

In the United States of America (USA), the incidence of obesity in children and adolescent rose from 11% in 1984 to 25% in 1998, with Africa-American girls having a 50% greater prevalence than white girls (Troin & Flegal, 1998). Obesity in Canadian children aged

7-13 years has also doubled and tripled, respectively since 1998 (Wills, 2000). In the United Arab Emirates (UAE), recent research suggested that the prevalence of childhood obesity is increasing dramatically, already surpassing the high levels of obesity found among children and adolescents in the U.S.A and Europe (Wesyern & Smith, 2005; and Al-haddad, Bertis & Ghafar, 2005). In Nigeria, data on the prevalence of being overweight and of obesity are few and scattered. A study conducted in South-Western Nigeria by Omolola, Kara and Olayemi (2009) revealed that no adolescent is either overweight or obese among the rural dwellers. A report from a study conducted in Lagos, Nigeria pointed out that the overall prevalence rates of being overweight or obese in the urban and rural areas are 3.7% and 0.4% and 3.0% and 0.0%, respectively (Ben-Balsey, Oduwole & Ogundipe, 2007).

The prevalence rates of obesity and being overweight in a study carried out in Cross-Rivers, Nigeria, were 1.7% and 6.8%, female and male adults respectively (Victor, Maxwell & Wilfreds, 2008). Body composition methodology is based on assumption regarding the density of body tissues, concentrations of water and electrolytes, and biological interrelationship between body components and body tissue and their distribution among normal weight individuals. Similar assumptions do not exist for obese persons, whose metabolic and hormonal problems together with accompanying conditions that alter assumption and interrelationships underlying the validity of body composition methods in normal weight individuals (Moore, 1993).

In their study conducted on overweight and obesity among adolescents in Kano State, Nigeria, Yusuf, Mijinyawa, Musa, Gezawa and Uloko (2013), found that the prevalence of obesity and overweight were 0.84% and 1.98% respectively; with advancing age as a risk factor for both overweight and obesity. Multivariate logistic regression showed that the risk of overweight was almost two times higher with advancing age adjusted odds ratio of {1.79} with a P-value of {0.03} and C. I. {1.05- 3.09}, adjusted for gender and school type. They

concluded that the prevalence of overweight and obesity are low, and that advancing age is a risk factor for obesity.

According to Watts, Jones, Davis and Green (2005), childhood obesity has reached epidemic proportions worldwide and is associated with increased cardiovascular mortality and morbidity in adult life. The increase in fat mass in children and adolescents has occurred concomitantly with a decline in reported time for exercise. Evidence suggests that non-physically active children are more likely to become non-physically active adults and that encouraging the development of physical activity habits in children helps establish patterns that continue into adulthood. Also, dietary treatment of obesity is relatively ineffective in adults and it has been suggested that prevention of obesity in childhood and adolescence should emphasize increased physical activity rather than diet because of fears relating to the adverse effects of inappropriate eating patterns.

In some areas, overweight and obesity are problems for a segment of certain population. The problems are of concern not only from an aesthetic point of view, but also because excess weight has been recognized as the contributing factors in the development and severity of a number of chronic diseases, for instance, adults onset of diabetes and various kind of cardio-vascular diseases. Regular exercise can contribute to weight control in several ways. Perhaps the most obvious is that by increasing the body's energy needs, exercise increased the expenditure of calories, thus contributing to weight loss or to the avoidance of weight gain. Exercise usually must be combined with some form of dietary restriction in order to produce a large loss weight (Udoh, Fawole, Ajala, Okafor & Nwana, 1999).

The first problem to occur in obese children is usually emotional and psychological (Great Britain Parliament House of Common Health Committee, 2005). Childhood obesity however, can also lead to life threatening conditions including diabetes, high blood pressure,

heart disease, sleep disorder and cancer (Behm, 2009). Some of the other disorders include liver disease, early puberty or menarche, eating disorder, such as anorexia, bulimia, skin infection, asthma and other respiratory problems (Mayo clinic.com, 2010). Asthma severity is not affected by obesity; however, obese children are more likely to grow up to be overweight adults. Obesity during adolescence has been found to increase mortality rates during adulthood (Must, Jacques, Dallal, Bajema & Dietz, 1992).

It is not yet clearly understood that exercise in some way tends to regulate the mechanism that controls the appetite. Rather than causing an increased appetite, it seems that exercise affects the appetite in such a way that a more effective balance is established between food intake and energy needs. Again, through some mechanism not yet understood, recent investigations indicate that exercise contribute to weight control by increasing the basal metabolic rate, i.e., the rate at which metabolism occurs when one is in a resting state. Thus exercise increases caloric expenditure not only during, but also following exercise. Studies have reported an increase of 20 percent, give or take 2 percent, in the basal metabolic rate on the day after vigorous physical activity (Udoh, Fawole, Ajala, Okafor & Nwana, 1999).

It has been suggested that exercise is a promising intervention in obese children and adolescents (Watts, Jones, Davis & Green, 2005). Potential benefits include, but are not limited to, improvements in (1) cardiovascular fitness, (2) muscular strength and (3) vascular function. In addition, exercise may reduce body fat and increase lean body mass, thereby reducing the risk of overweight and obesity in adulthood and the subsequent premature morbidity and mortality associated with such (Singh, Mulder, Twisk, Van & Chinapaw, 2008). Udoh, Fawole, Ajala, Okafor and Nwana, (1999) pointed out that running, climbing, dancing, swimming and rope skipping are very good forms of exercise for controlling obesity and overweight.

Rope skipping is a simple and one of the most efficient forms of aerobic exercise. It helps the child to keep his body fit and healthy (Behm, 2009). Amao (2007) explains that rope is a primary tool used in the game of skipping, played majorly by children and women and other young adults where one or more participant jump over a rope that is swung so that it passes under their feet and over their heads. Minimum of three participants took part in turning and jumping the rope. They take turns, two of who turn the rope while one jumps. This is called long rope. Sometimes the later is played with turning rope, this form of activities is called double ditch and it is more difficult. Jump rope rhymes are often chanted in the beginning when the skipper jumps and ends when the skipper messes up. Frequent physical activity is an important behavior for individual and population health, with possible benefits such as preventing unhealthy weight gain (Ding, Wei, Shao-Ming, Jian-Bing, Wen-Qiang, Hao, You-Lin & Paolo, 2012).

Shenbagavalli and Mary (2014) conducted a study on the Effects of 8 Week Aerobic Training on Obese Men. Their finding indicated that 8 weeks aerobic training had significant effects on the body weight of obese men and also helped them to keep the heart healthy. The finding of Kam, Ping, Chung, Sung, Mu, Sophie, Christopher, Con, and David (2004) who conducted a study on the Effects of Rope Skipping Exercise on Obese Children, showed a significant decrease in body weight of obese children as well as improve in arterial endothelial function.

LeMura and Maziekas (2002) conducted a study on the factors that alter body fat, body mass index, and fat-free mass in obese children and adolescents. Their finding showed a significant decrease in the body max index of obese children and adolescents. They concluded that exercise is efficacious for reducing BMI on obese children and adolescents. More to that, the finding of Korsten (2007) who conducted a study on the effects of aerobic

exercise on obese children showed a significant decrease on the BMI and significant increase in the subjects' aerobic capacity.

Nevertheless, the finding of Sigal, Alberga, Goldfield, Prud'homme, Hadjiyannakis, Gougeon, Phillips, Tulloch, Malcolm, Doucette, Wells, Ma and Kenny (2014) who conducted a study on the effects of aerobic training, resistance training, on both percentage body fat and cardiometabolic risk markers in obese adolescents. They found a significant decrease in the percent body fat of the subjects in an experimental group. It is against this background that the researcher examined the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in the Kano metropolis.

1.2 Statement of the Problem

Obesity is a global health problem of children, adolescence and the elderly ones, which can lead to the development of type II diabetes, enhance risk factors for cardiovascular and related diseases, and are associated with increased risk for cancer and renal failure and as a results, at least 2.8 million people die each year as a result of being obese (WHO, 2012). Obesity has emerged as a major health problem in many countries. In 2005, there were an estimated 1.6 billion overweight adults worldwide, of whom 400 million were obese. Obese adolescents have a 70% chance of becoming obese adults. This increases to 80% if one or more parent is obese. More so, the most immediate consequence of obesity as perceived by children themselves is social discrimination (World Health Organization, 2013). Obesity is generally described as excess adipose tissue and excess body weight, but in some elderly persons there is occurrences form of sarcopenic obesity in which a preferential loss of muscle tissues and an increase in the percentage of body fat (Heber, Ingles & Ashley, 1996).

According to Yusuf, Mijinyawa, Musa, Gezawa and Uloko (2013), the first problem to occur in obese children is usually emotional or psychological. However, the problems of obesity among children in Kano metropolis can lead to life-threatening conditions including

diabetes, high blood pressure, heart disease, cancer, liver disease, early puberty or menarche, eating disorders such as anorexia and bulimia, skin infections, asthma and other respiratory problems. Also, obese children are more likely to grow up to be overweight adults and obesity during adolescence has been found to increase mortality rates during adulthood (Yusuf, Mijinyawa, Musa, Gezawa & Uloko, 2013). Although, the view of Schmidt (2012) indicated that regular exercise and proper nutrition can help reduce body fat as well as protect against chronic diseases associated with obesity.

The researcher observed that obese pupils in Kano Metropolis seem to suffer from teasing by their peers, some are harassed or discriminated against by their own family. Also obese children in Kano metropolis are inactive in their daily living, it is believed that obesity in children contributes to emotional disturbance, hypertension, lack of physical activities and other related diseases. It is based on this background that the researcher examined the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in the Kano metropolis.

In view of this, the following questions were raised to guide the study:

1) Does twelve week of rope skipping exercise have effect on body weight of obese children in private schools in Kano Metropolis?
2) Does twelve week of rope skipping exercise have effect on BMI of obese children in private schools in Kano Metropolis?
3) Does twelve week of rope skipping exercise have effect on percent body fat of obese children in private schools in Kano Metropolis?

1.3 Hypotheses

The following hypotheses were formulated to guide the study:

Major Hypothesis

There is no significant effect of twelve week rope skipping exercise on body composition of obese children of private schools in Kano metropolis.

Sub-Hypotheses

H_{O1}: There is no significant effect of twelve week of rope skipping exercise on the body weight of obese children in private schools in Kano metropolis.

H_{O2}: There is no significant effect of twelve week of rope skipping exercise on BMI of obese children in private schools in Kano metropolis.

H_{O3}: There is no significant effect of twelve week of rope skipping exercise on percent body fat of obese children in private schools in Kano metropolis.

1.4 Purpose of the Study

The purpose of this study was to examine the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in Kano metropolis, with the view to point out the effectiveness of rope skipping exercise in managing obesity.

1.5 Significance of the Study

It is hope that the findings of this study would be of great value in the following ways:

Create awareness to the parents and their children on the effect of exercise and rope skipping in particular, in the management of obesity.

Add to the existing body of knowledge on the effects of rope skipping exercise on obese children.

Encourage the community members and the schools authority to take appropriate steps in reducing the occurrence or prevalence of obesity through effective utilization of rope skipping exercise for the children.

1.6 Delimitation of the Study

The study was delimited to rope skipping exercises on body fat and BMI of obese children in private schools in Kano metropolis. This study was delimited to four private primary schools in Kano metropolis. It was further delimited to body composition indices of body weight, BMI and obese children between 7-11 years old in Kano Metropolis.

1.7 Limitation of the study

The findings of this study are interpreted in the light of a number of limitations. Given the demographic and rules diversity of the schools, the present study is not generalized to both public and private schools in Kano Metropolis. Genetic endowment could also account for the observed findings, but this was beyond the scope of the study. Finally, the children's socio-economic status was not evaluated as this could have given a clearer indication of their lifestyle, thus elucidating the findings.

1.8 Operational Definition of Terms

The following terms were operationally defined:

- **Children**: Pupil between the ages of 7-11 years in private schools in Kano metropolis.
- **Obesity**: A condition in which pupils in private schools in Kano metropolis has BMI of 30 and above.
- **Body Mass Index (BMI):** Is an indicator for excessive body weight (BMI equal to 30kg or greater than 30kg)
- **Overweight:** Refers to excessive weight among pupils in private schools in Kano metropolis.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This study investigated the effects of twelve weeks rope skipping exercise on body composition of obese children in private schools in the Kano metropolis. Literature related to this study was reviewed under the following sub-headings:

- Childhood obesity and overweight
- Causes of obesity
- Prevention and control of obesity
- Effects of obesity on health
- Health risks of obesity
- Body composition and assessment of obesity
- Aerobic exercises and obesity
- Rope skipping exercise
- Benefit of rope skipping exercise on body composition
- Summary
- Empirical studies on exercise training and childhood obesity

2.1 Childhood Obesity and Overweight

An overweight implies to a condition of excess weight in a human being. The term overweight is generally used to indicate the excess weight while obesity refers to excess fat. Being overweight means having more body weight than is considered normal or healthy for one's age or body build. On the other hand obesity is the condition of having an excess amount of fat. While an overweight person is carrying excess weight, he may or may not have excess accumulation of fat. Childhood obesity is a condition where excess body fat

negatively affects a child's health or well-being (Kopelman, 2005). As methods to determine body fat directly requires the use of sophisticated equipment which is costly, and need high sense of professionalism in Africa, the diagnosis of obesity is often based on BMI. Due to the rising prevalence of obesity in children and its many adverse health effects, it is being recognized as a serious public health concern (Leon & Marc, 2010). Body mass index (BMI) is acceptable for determining obesity for the children of two years of age and older (Deurenberg, Westrate & Seidell, 1991). The normal range for BMI in children varies with age and sex. The Centers for Disease Control (1998) defined obesity as a BMI greater than or equal to the 95th percentile. Yusuf, Mijinyawa, Musa, Gezawa and Uloko (2013) opined that childhood and adolescents' obesity is a global public health concern because of associated increased risk of cardiovascular diseases later in life.

According to Watts, Jones, Davis and Green (2005), childhood obesity has reached epidemic proportions worldwide and is associated with increased cardiovascular mortality and morbidity in adult life. The increase in fat mass in children and adolescents has occurred concomitantly with a decline in reported time for exercise. Evidence suggests that non-physically active children are more likely to become non-physically active adults and that encouraging the development of physical activity habits in children helps establish patterns that continue into adulthood. In their study on overweight and Obesity among Adolescents in Kano, Nigeria. Yusuf, Mijinyawa, Musa, Gezawa, Uloko (2013) found that the prevalence of obesity and overweight were 0.84% and 1.98% respectively; with advancing age as a risk factor for both overweight and obesity. Multivariate logistic regression showed that the risk of overweight was almost two times higher with advancing age adjusted odds ratio of {1.79} with a p-value of { 0.03} and C. I. { 1.05 - 3.09}, adjusted for gender and school type. They concluded that the prevalence of overweight and obesity are low, and that advancing age is a risk factor for obesity.

Childhood obesity (OB) has become a major public health problem, with increasing prevalence worldwide not only in industrialized countries, but also in developing countries including those in Africa. This situation undoubtedly presents a major public health challenge. OB has been defined as the accumulation of excessive adipose tissue to an extent that impairs physical as well as psychosocial health and well-being (Philip, 2004). Overweight (OW) and OB are associated with increased risks of cardiovascular disease (CVD), hypertension, diabetes mellitus and other chronic diseases (Cole, Bellizzi, Flegal & Dietz, 2000; Nieman, 2003). Dietz (1994) stated that the critical periods for the development of OB are infancy, early childhood and adolescence. OB is known to track from childhood to adulthood, and it often begins early in childhood. When this occurs, the chances for adult OB are three times greater than in children of normal body weight. Tracking studies have indicated that 70–80% of obese children and adolescents are likely to become obese adults (Nicklasen, Petzold & Schnohr, 2006), obese boys have a 78% likelihood of becoming obese adults and girls, 66% (Must, 1996).

Although OW and OB in both developed and developing countries show similar trends, different patterns exist from country to country. These patterns are sometimes inconsistent across national and regional boundaries. Studies have shown that Indian boys exhibit a higher prevalence of OB than girls (Ramachandran, Snehalatha & Vinitha, 2002). But in some African countries like Ethiopia, South Africa and Zimbabwe, BMI values of girls between five and 14 years were found to be slightly higher than those of boys (Medical Research Council of South Africa, 2006; Mascie-Taylor & Goto, 2007). This pattern is similar to reports from Britain and Australia (Taylor, Viner, & Booy, 2005; Sanigorski, Bell, Kremer & Swinborn, 2007).

In their study on Prevalence of Childhood and Adolescent Overweight and Obesity in Benue State, Nigeria, Danladi, Abel, Makama, Monyeki and Badamasi (2012) concluded that

girls in urban areas had higher prevalence of OW and OB than girls in rural settings. Among the boys, similar but less marked trends were found, except that the rural boys tended to be more OW on average than their peers in urban areas. In view of its public health significance, it is important to periodically evaluate the prevalence of weight disorders in children and adolescents so that appropriate preventative strategies can be instituted. Recent studies have demonstrated dramatic increases in the prevalence of OW and OB in youths worldwide (Wang & Lobstein, 2006; Dehghan, Akhtar-Banesh & Merchant, 2005; Bundred, Kitchiner & Buchan, 2001). For instance, in the United States, 25% of the children are OW and 11% obese (Dehghan, Akhtar-Banesh & Merchant, 2005), and OB is rated a second leading cause of preventable morbidity and mortality, surpassed only by smoking (Wang & Lobstein, 2006).

Prevalence of OW and OB among Greenlandic children and adolescents is 16.6% and 4.7%, respectively (Schnohr, Sorensen & Niclasen, 2005). Among South African children, prevalence rates are of 17.2–22.8% for OW and OB (Armstrong, Lambert, Sharwood, & Lambert, 2006). Opara, Ikpeme and Ekanem (2010) reported an OB rate of 11.3% among primary school children in Uyo, a state capital. While Musa, Lawal and Sarkin-Fawa (2002) documented an OW prevalence rate of 3.6% for male adolescents in Kano City, a state capital in Nigeria. Studies on OW and OB in Nigerian children have used different diagnostic criteria, but have highlighted the high prevalence of body weight disorders (Goon, Toriola & Shaw, 2009, 2011).

According to Udoh, Fawole, Ajala, Okafor and Nwana (1999), obesity and overweight is a nutritional disorder which is essentially due to the intake of energy being greater than the output. Obese children are likely to become overweight adults. Over-nourished babies increase the number of fat cells which stay with them for life. Some people put on weight more easily than others and also have greater difficulty in losing it when

dieting which may be due to a loss in the capacity to burn up extra fuel in the obese. They further stated that obesity tends to run in families, this could be due to heredity or family habits, but most overweight is certainly due to consuming more food than is needed by an individual. Adults as well as children may eat to compensate for lack of affection, boredom, inferiority feeling and other sources of unhappiness. The term overweight rather than obese is often used in children as it is less stigmatizing (Bessesen, 2008). In order to prevent or reverse obesity in children it is necessary to perform a population reassessment of the calorie intake as well as activity recommendation due to the sedentary lifestyle of children nowadays (Han, 2010). See table for a difference between obesity and overweight.

Table 2.1.1 Difference between obesity and overweight

Variables	Obesity	Overweight
Meaning	A bodily condition marked by excessive generalized deposition and storage of fat.	A condition in a person where the person weighs is over and above his normal weight according to his height, age and sex
Calculation set-point	BMI over 30. (BMI >30)	BMI (body mass index) is between 25 and 29.9
Risk factors	Coronary heart disease, high blood pressure, diabetes, hypertension.	Depression, high blood pressure.
Remedies/Treatment	Reduce calories, exercise and in extreme cases surgery	Exercise & Dieting.
Causes of Obesity and Overweight	Frequent eating of fast foods, stress, depression, hormonal imbalance, sedentary lifestyle	More intake of food than expended by the body, genetics increase energy intake & less expenditure
Occurrences	More than 300 million people are obese across the world	Around 1 billion people are estimated to be overweight across the globe
Geographically	More prominent and on the increase in North American, the United Kingdom, Eastern Europe, the Middle East, the Pacific Islands, Austria, Asia and china	Globally
In children	Around 5% of the 22 million obese children under five, are clinically obese worldwide	22million children under five are overweight worldwide.

Source: Han (2010).

2.2 Causes of Obesity

A person may be obese because of the following reasons: dietary intake, development factors, physical inactivity, medical factor, genetics SES and psychological factor. These and other factors could be addressed well, as causes of obesity (Miller, Rosenbloom & Silver-Stein, 2004). If medical term was set aside for this mixture of elements, the greatest risk factor for child obesity is the obesity of both parents. This may be reflected by the family's environment and genetics. Other reasons may also be due to psychological factors and the Childs body type (Cole, Bellizzi, Flegal & Dietz, 2006). Han, Lawlor & Kimm (2010) stated that, in 2008, a review on prevalence of obese in Asian primary school children, pointed that childhood obesity is likely the result of the interaction of natural selection favoring those with more parsimonious energy dense, cheap foods and less energy requirements in daily life.

Dietary as a factor to obesity:- The effects of eating habits on childhood obesity are difficult to determine. A three year randomized controlled study of 1,704 3rd grade children, which were provided with two healthy meals a day in combination with an exercise program and dietary counseling failed to show a significant reduction in percentage of body fat when compared to a controlled group. This was partly due to the fact that even though the children believed they were eating less their actual calorie consumption did not decrease with the intervention. At the same time observed energy expenditure remained similar between the groups. This occurred even though dietary fat intake decreased from 34% to 27% (Caballero, Clay & Davis, 2003). A second study of 5,106 children showed similar results. Even though the children ate an improved diet there was no effect found on BMI (Naders, Stone & Lytle, 1999). Also, calorie rick drinks and foods are readily available to children. Consumption of sugar laden soft drinks may contribute to childhood obesity. In a study of 548 children over a 19 month period the likelihood of obesity increased 1.6 times for every additional soft drink consumed per day.

McBride (2010) opined that, calorie dense prepared snacks are available in many locations frequented by children. As childhood obesity has become more prevalent, snack vending machines in school settings have been reduced by law in a small number of localities. Some research suggests that the increase in availability of junk foods in schools can account for about one-fifth of the increase in average BMI among adolescents over the last decade.

Eating at fast food restaurants is very common among young people with 75% of 7 to l2 grade students consuming fast food in a given week (Cole, Bellizzi, Flegal & Dietz, 2006). The fast food industry is also at fault for the rise in childhood obesity. This industry spent about US $4.2billion on advertisement aimed at young children. McDonald alone has thirteen websites that are viewed by 365,000 children and 294,000 teenagers each month. In addition, fast food restaurants give out toys in children's meals, which helps to entice children to buy the fast food. Forty percent of children ask their parents to take them to fast food restaurants on a daily basis in USA. To make matters worse out of 3000 combinations created from popular items on children's menus at fast food restaurants only 1/3 meet the recommended nutritional guidelines for young children (Han, Lawlor & Kimm, 2010). Caballero, Clay and Davis (2003) admits that whole milk consumption versus 2% milk consumption in children of one to two years of age had no effect on weight, height, or body fat percentage. Therefore, whole milk continues to be recommended for this age group. However, the trend of substituting sweetened drink for milk has been found to lead to excess weight gain. Dietary treatment of obesity is relatively ineffective in adults and it has been suggested that prevention of obesity in childhood and adolescence should emphasize increased physical activity rather than diet because of fears relating to the adverse effects of inappropriate eating patterns (Watts, Jones, Davis & Green, 2005).

Physical inactivity as a factor to obesity:- Physical inactivity of children has also shown to be a serious cause, and children who fail to engage in regular physical activity are at greater risk of obesity. Dietz (1998) point out that a study on the physical activity among of 133 children over a three week period using an accelerometer to measure each child level of physical activity. He discovered the obese children were 35% less active on school days and 65% less active on weekends compared to non-obese children. Physical inactivity as a child could result in physical inactivity as an adult. In a fitness survey of 6,000 adults, researchers discovered that 25% of those who were considered active at ages 14 to 19 were also active adults compared to 2% of those who were inactive at ages 14 to 19 who were now said to be active adults.

McBride (2010) stated that staying physically inactive leaves unused energy in the body, most of which is stored as fat. Also, study was conducted on l6 men over l4 day period and fed them 59% more of their energy required every day through fats and carbohydrates. He discovered that carbohydrate overfeeding produce 75-85% excess energy being stored as body fat and fat over feeding produced 90-95% storage of excess energy as body fat. 21.5% more children are likely to be overweight when watching of TV per day, 4.5% are more likely to be overweight when using a computer one or more hours per day, and unaffected by potential weight gain from playing video games. Furthermore, many children fail to exercise because they are spending time doing immobile activities such as computer usage, playing video games or watching television. Technology has a large factor on the children's activeness.

A randomized trial showed that reducing TV viewing and computer use can decrease age-adjusted BMI. Reduced calorie intake was thought to be the greatest contributor to the BMI decrease (Speiser, Rudolf & Anhalt, 2005). Technological activities are not the only household influences of childhood obesity. Low income households can affect a child's

tendency to gain weight. Over a three week period researchers studied the relationship of socio economic status (SES) to body composition in 194 children ages 11-12 they measured weight, waist birth, stretch stature, skin folds, physical activity, TV viewing and SES; researchers discovered clear SES inclines to upper class children compared to the lower class children (Kimm & Obarzanek, 2002).

Childhood inactivity is linked to obesity in the United States with more children being overweight at younger ages. In a 2009 preschool study, 89% of a preschoolers day was found to be sedentary while the same study also found that even when outside, 56 percent of activities were still sedentary. One factor believed to contribute to the lack of activity was little teacher motivation, but when toys, such as balls were made available, the children were more likely to play (Miller, Rosenbloom & Silverstein, 2004).

Genetics as a factor to obesity:- Kopelman (2005) stated that childhood obesity is often the result of interplay between many genetic and environmental factors. Polymorphisms in various genes controlling appetite and metabolism predispose individuals to obesity when sufficient calories are present. As such obesity is a major feature of a number of rare genetic conditions that often present in childhood. Prader- Willi Syndrome with an incident between 1 in 12,000 and 1 in 15,000 live births is characterized by food preoccupations which lead to rapid weight gain in those affected. In children with early onset of severe obesity (defined by an onset before ten years of age and body mass index over three standard deviations above normal), 7% harbor a single locus mutation (CDC, 1998).

One study found that 80% of the offspring of two obese parents were obese in contrast to less than 10% of the offspring of two parents who were of normal weight (Kopelman, 2005). Also the percentage of obesity that can be attributed to genetics varies from 6% to 85% depending on the population examined.

Socio-Economic Status as a factor to obesity:- Children's food choices are also influenced by family meals. One study discovered that four out of five parents let their children make their own food decisions. They also discovered that compared to adolescents who ate three or fewer family meals per week, those who ate four to five family meals per week were 19% less likely to report poor consumption of vegetables, 22% less likely to report poor consumption of fruits, and 19% less likely to report poor consumption of dairy foods. Adolescents who ate six to seven family meals per week, compared to those who ate three or fewer family meals per week, were 38% less likely to report poor consumption of vegetables, 31% less likely to report poor consumption of fruits, and 27% less likely to report poor consumption of dairy foods (Leon & Marc, 2010).

The result of a survey in the U.K published in 2010 implied that children raised by their grandparents are more likely to be obese as adults than those raised by their parents (Han, 2010). An American study released in 2011 found that more mothers do the work, and more children are likely to be overweight or obese as a result of inactive (Deurenberg, Weststrate & Seidell, 1991).

Developmental Factors:- Experts have long believed that aspect of a child's early development influences their weight in later life, now researchers writing in the British medical journal have high-lightened eight (8) key factors they believe increase the risk of obesity among the UK's children, their study involved 8,234 youngsters aged 7, plus a further sample of 909 children who were taking part in a large UK study, The children height and weight were measured and their body mass index (BMI), a measure of weight in relation to height was calculated. The researchers then came out with the following eight key factors that contribute to child obesity:

- Birth weight
- Obesity in one or both parents

- More than 8 hours spent watching television a week at the age of three
- A short amount of sleep, less than 10.5 hours a night at the age of 3
- Size in early life measured at 8-18 months
- Rapid weight gain in the first year of life
- Rapid catch of growth between birth to two years of age.
- Early development of body fitness in pre-school years at the age of 5-6

Breast Feeding:- Various developmental factors may affect rates of obesity. Breast feeding for example may protect against obesity in later life with the duration of Brest feeding inversely associated with the risk of being overweight later on (Bessesen, 2008). A child's body growth pattern may influence the tendency to gain weight and obese (Han, 2010).

Body Weight:- A child's weight may be influenced when he/she is only an infant. A nationally representative sample of US preschoolers found that infants whose early weight status was normal tended to retain a normal weight status and not to develop an unfavorable status at risk obese. In contrast, children who were overweight at an early age were more likely to be at risk or obese at later stage (Dietz, 1998).

Speiser, Rudolf and Anhalt (2005) reported that, a cohort study on 19,397 babies was conducted from their birth until age seven and discover that fat babies at four months were 1.38 times more likely to be overweight at seven years old compared to normal weight babies. Fat babies at the age of one were 1.17 times more likely to be overweight at age seven compared to normal weight babies.

Medical Illness:- Cushing is syndrome (a condition in which the body contains excess amounts of cortisol) which may also influences childhood obesity. McBride (2010) reported that two isoforms (protein that have the same purpose as other proteins, but are programmed by different genes) in the cell of 16 adults undergoing abdominal surgery. Also, the researcher discovered that one type of Isoform created Oxo-reductase activity (the alteration

of cortisone to cortisol) and this activity increased 127.5Pmol mg sup when the other type of isoform was treated with cortisol and insulin. The activity of the cortisol and insulin can possibly activate Cushing's syndrome. Hydrothyrodism is a hormonal cause of obesity, but it does not significantly affect obese people who have it more than obese people who do not have it. In a comparison of 108 obese patients with hypothyroidism to 131 obese patients without hypothyroidism, researchers discovered that those with hypothyroidism had only 0.077 points more on the calorie intake scale than did those without hypothyroidism (Han, Lawlo & Kimim, 2010).

Psychological Factors:- According to Dietz (1998), research surveyed of 1,520 children ages 9-10 with a four year follow up was conducted and discovered a positive correlation between obesity and low self-esteem in the four year follow up. They also discovered that decreased self-esteem led to 19% of obese children feeling sad, 48% of them feeling bored, and 21% of them feeling nervous. In comparison, 8% of normal weight children felt sad, 42% of them felt bored and 12% of them felt nervous. Stress can influence a child's eating habits.

Cole, Bellizzi, Flegal and Dietz (2006) tested the stress inventory of 28 college females and discovered that those who were binge eating had a mean of 29.65 point on the perceived stress scale, compared to the controlled group who had a mean of 15.19 points.

Cespedes (2011) stated that this evidence may demonstrate a link between eating and stress. Feeling of depression can cause a child to overeat researchers provided an in home interview to 9,374 adolescents, in grades seven through 12 are discovered that there was no direct correlation with children eating in response to depression of all the obese adolescents, 8.2% had said to be depressed, compared to 8.9% of the non-obese adolescents who said they were depressed. Antidepressants, however, seem to have very little influence on childhood obesity. Also, a depression questionnaire was administered to 487 overweight/obese subject and found that 7% of those with low depression symptoms were using antidepressants and

had an average BMI score of 44.3, 27% of those with moderate depression symptoms were using antidepressant and had an average BMI score of 44.3.

2.3 Prevention and Control of Obesity

The escalation of obese children is due to the upsurge of technology, increases in snack and portion size of meals and the decrease in the physical activity of children. If children were more mobile and less sedentary, the rate of obesity would decrease. Children should avoid spending time playing with the electronic devices and spend more time outside playing or exploring other options of physical activity. A study conducted by Cole (2006), on obesity as a host of other diseases, found that kids used electronic devices 3 or more hours a day had between a 17-44% increased risk of being overweight or a 10-61% increased risk obese. Cespedes (2011) viewed that parents have to recognize the signs and encourage their children to be more physically active.

Prevention of Obesity:

Obesity of mother predisposes the offspring to obesity by epigenetic, prenatal effects. "Prevention and awareness programs should target children as early as kindergarten with the involvement of parents (Reinehr & Wabitshch, 2011). Also, parents could change the diet and lifestyle of their offspring by offering appropriate food portions, increasing physical activity, and keeping sedentary behaviors at a minimum, this may also decrease the obesity level in children. Exclusive breast feedings is recommended in all new born infants for its nutritional and other beneficial effects (Cole, 2006). This condition is better prevented than treated. However, adequate physical activity is most important, but exercise must be planned and graduated. Many adults who are obese cannot safely perform very strenuous exercise due to cardio-vascular or orthopaedic complications, but obese children should be encouraged to be very active (Udoh, Fawole, Ajala, Okafor & Nwana, 1999). Exercise training improves cardiovascular fitness and muscular strength; however, it seems to have little effect on blood

lipid profile or blood pressure in obese young people. Importantly, recent studies have demonstrated that exercise training improves vascular endothelial function, an important surrogate measure that may predict future atherosclerotic risk in obese children and adolescents. Given that improvement in vascular function in these training studies occurred in the absence of changes in lipid fractions, haemodynamic variables or glucose metabolism, exercise appears to have a direct beneficial effect on the vasculature (Watts, Jones, Davis & Green, 2005).

Control of Obesity:

The safest and most effective way to lose weight in both cases is to reduce calories (balanced diet) and increase physical activity. In excesses cases of obesity a person can undergo surgery (Leon & Marc, 2010). There are no medications currently approved for the treatment of obesity in children olestra and sibutramine may however be helpful in managing moderate obesity in adolescence. Cespedes (2011) commented that Sibutramine is approved for adolescents older than 16 years. It works by altering the brains chemistry and decreasing appetite. Orlistat is approved for adolescent older than 12. It works by preventing the absorption of fat in the intestines (Must, Jacquel, Dallal, Bajema & Dietz, 1992).

2.4 Effects of Obesity on Health

The first problem to occur in obese children is usually emotional and psychological (Great Britain Parliament House of Common Health Committee, 2005). Childhood obesity however can also lead to life threatening conditions including diabetes, high blood pressure, heart disease, sleep disorder and cancer (Behm, 2009). Some of the other disorders include liver disease, early puberty or menarche, eating disorder, such as anorexia, bulimia, skin infection, asthma and other respiratory problems (Mayo clinic.com, 2010). Asthma severity is not affected by obesity; however, obese children are more likely to grow up to be overweight

adults. Obesity during adolescence has been found to increase mortality rates during adulthood (Must, Jacques, Dallal, Bajema & Dietz, 1992).

Obese children often suffer from teasing by their peers, some are harassed or discriminated against by their own family. Stereotypes abound and may lead to low self-esteem and depression (Janssen, Craig, Boyce & Pickett, 2004). Furthermore, a 2008 study has found that children who are obese have carotid arteries which have prematurely aged by as much as thirty years as well as abnormal levels of cholesterol. Thus, they are more at risk for adult health problems such as heart disease, type 2 diabetes, stroke, several types of cancer, and oestero-arthirsitc. According to an article in the New York Times, all of the health effects are contributing to a shorter lifespan of five years for these obese children. It is the first terms in two centuries that the current generation of children in American may have a shorter lifespan than their parents (Nytimes.com, 2005).

Udoh, Fawole, Ajala, Okafor and Nwana (1999) viewed that obese children can have the following effects:

1. An obese person is likely to appear unattractive to others. He has difficulty in getting clothes to fit. Obese children may become lonely, withdraw, immobile and backward.
2. Excess weight makes movement difficult, tiring and slow. Heaviness of the body increase the likelihood of having eventual ostesarthritis of the knees, hips and lumbar spine; also, flat-footedness and knock-knees result from obesity.
3. Fat in muscles interferes with the action of contracting muscle whose contraction should normally message the veins thus sending blood on its upward journey ti the heart. This interference may result in varicose vein.
4. Excess adipose tissue in the chest and under the diaphragm interferes with breathing and causes a tendency towards bronchitis.

5. Blood plasma in the obese frequently has a high level of cholesterol and this may account for a tendency to stone in the gall-bladder. Also, cholesterol may deposit in the linings of arteries, thereby narrowing their bore. This can damage organ whose blood supply is curtailed, e.g. the heart gets its nourishment and oxygen from the coronary vessels and diminished flow could contribute to heat failure. Obesity, no doubt, contributes in other way to disease of this organ.
6. Surgery is often difficult on an obese. On the average, the obese dies younger than others. Fat men are particularly liable to have circulatory disorder and diabetes (less true in women). Child labour is longer and more painful in the obese women and prenatal mortality risk increase if the mother is obese.

2.5 Health Risks of Obesity

Obesity is a major risk factor for serious health problem including coronary heart disease, systolic blood pressure, blood pressure, diabetes and hypertension. Though an overweight person also faces a risk of these problems but an obese is more susceptible to them. Obese people are at high risk of depression and other social problems. Obesity is an excess of body fat sufficient to shorten lifespan and make one susceptible to a greater amount of illness than would occur if the body weight were normal. Calories imbalance that results from lack of balance diet often develops from a combination of genetic and environmental factors. A combination of an excessive nutrient intake and a sedentary lifestyle are the main cause for the rapid acceleration of obesity (Leon & Marc, 2010).

Table 2.5.1: Health Risks of Obesity:

Systems	Condition/effect
Endocrine	Impaired glucose tolerance, diabetes mellitus, metabolic syndrome, hyperndrogensim, effect on growth and puberty and Null party
Cardiovascular	Hypertension, hyperlipidemia, increased risk of coronary heart disease as am adi;t. mi;;o gravity
Gastro intestinal	Nonalcoholic fatty liver disease, cholelithiasis, slipped capital femoral epiphysis (SCFE)
Musculoskeletal	Tibia vara (blount disease)
Psychosocial	Distorted peer relationships poor self-esteem, anxiety, depression
Respiratory	Obstructive sleep apnea, obesity hypoventilation syndrome
Neurologient	Idiopathic intracaranial hypertension
Skin	Furunculosis, intertrigo

Sources: Leon & Marc (2010).

2.6 Body Composition and Assessment of Obesity

Recent publications indicated that high prevalence of obesity is a recent phenomenon (Flegal, Carroll & Ogdenenet, 2002). However, Mellits & Check (1970) noted that they were spurred on the development of new body composition techniques as a result of concern for the high prevalence of obesity among children at that time.

Overview of Body Composition Methods:

Retailed aspect of body composition methodology, underlying theories and general applications are found in several excellent texts (Roche, Heymsfield & Lohman, 1996). Heymsfield, Lohman and Wang (2005) stated that interest in specific body composition

assessment methods should first consult these references. Body composition methodology is based on assumption regarding the density of body tissues, concentrations of water and electrolytes, and biological interrelationship between body components and body tissue and their distribution among normal weight individuals. Similar assumptions do not exist for obese persons, whose metabolic and hormonal problems together with accompanying conditions that alter assumption and interrelationships underlying the validity of body composition methods in normal weight individuals (Moore, 1993).

In addition, the application of body composition technology is limited among most obese adults and many older obese children because their bodies are too large for the available equipment. As a result, epidemiological and national obesity prevalence data are not completely based on actual measure of body fatness because of the difficulty of collecting such data during health surveys from sufficient numbers of obese individuals. It is also difficult to monitor and treat obesity without an easily acceptable assessment method or index and a references population.

Anthropometry:- Anthropometry is the study of human body measurement for use in anthropological classification and compares. The use of such data as skull dimensions and body proportions in the attempt to classify human beings into racial, ethnic, and national groups has been largely discrete, but are still used in physical anthropology (Ologies, 2008). It is also a study concerned with the measurements of the proportion, size and weight of the human body (Farlex, 2012).

Anthropometric measurements describe body mass, size, shape, and level of fatness. Body mass will be assessed with a balance scale (with underwear and no shoes) and height with a stadio-meter (without shoes). Body mass index (BMI) will be as body mass (kg) divided by height in meters squared (m^2). Three standard skin- folds (triceps, sub scapular, and abdominal) will be measured using a calibrated skin-fold caliper. Waist girth will be

measured at the horizontal plane at the level of the umbilicus (without clothing). All measurements will be run three times and the average will be reported. All skin-folds and waist girth will be measured by the same researcher (Lohman, Martorell & Roche, 2008).

De-Onis, Onyango, Vanden and Broeck (2004) stated that anthropometry is the science that defines physical measures of a person's size, form, and functional capacities. As applied to occupational injury prevention, anthropometric measurements are used to evaluate the interaction of workers with tasks, tools, machines, vehicles and personal protective equipment, especially in regard to determining degree of protection afforded against hazardous exposures, whether chronic or acute. It varies greatly between individuals and across populations for a variety of complex biological, genetic, environmental, and other factors. Due to methodological and practical problems, its measurement is also subject to considerable error in statistical sampling.

The average height in genetically and environmentally homogeneous populations is often proportional across a large number of individuals. Exceptional height variation (around 20% deviation from a population's average) within such, a population is sometimes due to gigantism or dwarfisms which are caused by specific genes or endocrine abnormalities. In the most extreme population comparisons, for example, the average female height in Bolivia is 1.422 m (4 ft. 8 in) while the average male height in the Dinaric Alps is 1.856 m (6 ft. 1 in), an average difference of 43.4 cm (17 inches). Similarly, the shortest and tallest of individuals, Chandra Bahadur Dangi and Robert Wadlow, have ranged from 1 ft. 9 in (0.53 m) to 8 ft. 11.1 in (2.72 m), respectively (Medical Research Council of South Africa, 2006).

Weight:- Human weight varies extensively both individually and across populations, with the most extreme documented examples of adults being Lucia Zarate who weighed 4.7 pounds (2.1 kg), and Jon Brower Minnoch who weighed 1,400 pounds (640 kg), and with population

extremes ranging from 109.3 pounds (49.6 kg) in Bangladesh to 192.7 pounds (87.4 kg) in Micronesia (Medical Research Council of South Africa, 2006).

Organs:- Limited research has shown that the adult brain size varies from 974.9 cm3 (59.49 cu in) to 1,498.1 cm3 (91.42 cu in) in females and 1,052.9 cm3 (64.25 cu in) to 1,498.5 cm3 (91.44 cu in) in males, with the average being 1,130 cm3 (69 cu in) and 1,260 cm 3 (77 cu in), respectively. The right cerebral hemisphere is typically larger than the left, whereas the cerebellar hemispheres are typically of more similar size. Size of the human stomach varies significantly in adults, with one study showing areas ranging from 520 cm3 (32 cu in) to 1,536 cm3 (93.7 cu in) and weights ranging from 77 grams (2.7 oz) to 453 grams (16.0 oz) (Medical Research Council of South Africa, 2006).

Weight and Height:- Weight is the obvious measure of obesity. Various scales are available for measuring weight. But these must be calibrated regularly. Persons with high body weights tend to have high amounts of body fats although this is not always true among the elderly with sarcopenic obesity, in whom stable or even low body weights occur with increased percent body fatness. Changes in weight reflect corresponding changes in body water, fat and lean tissue. However, weight is related to obesity because it is also related to stature, that is tall people are on average heavier than short people. Weight also increases with age in children (because of growth) and in adult (because of fatness). To overcome this lack of specificity weight is divided by stature squared to create the body mass index or BMI as a descriptive index of body habitués encompassing both the lean and the obese (Medical Research Council of South Africa, 2006).

Stature is also easily measured with a variety of wall mounted equipment that also needs to be calibrated regularly. In addition, methods are available for predicting stature when it cannot be measured for the handicapped or mobility impaired (Chumlea, Steinbaugh & Raughe, 2003).

Body Mass Index:- The advantage of Body mass index (BMI) as an index of obesity is the availability of extensive national reference data worldwide, it established relationship with levels of body fatness, morbidity, and mortality and it is highly predictive of future risk. The relationship of obesity as index of BMI with mortality has been revised for the US adult population. In the elderly, Sarcopenia cause a person of normal weight and BMI to become obese owing to an increased high percentage of body fat. BMI is also use in monitoring the treatment of obesity, but a weight change of about 3.5kg is needed to produce a unit change in BMI (Flegal, Graubard & Williamson, 2005).

An approximate measure of whether someone is over- or underweight, calculated by dividing their weight in kilograms by the square of their height in meters. The body mass index (BMI), or Quetelet index, is a measurement for human body shape based on an individual's mass and height. Body Mass Index (BMI) is a number calculated from a person's weight and height. BMI provides a reliable indicator of body fatness for most people and is used to screen for weight categories that may lead to health problems. It was devised between 1830 and 1850 by the Belgian polymath during the course of developing "social physics" it is defined as the individual's body mass divided by the square of their height-with the value universally being given in units of kg/rn^2. See table below:

BMI measurement table developed by Chumlea, Baumgartner and Garry (1992)**:**

BMI	$= \frac{\text{mass(kg)}}{(\text{height(m)})^2}$
	$= \frac{\text{mass(lb)}}{(\text{height(in)})^2} \times 703$ †

The BMI can also be determined using a table or from a chart which displays BMI as a function of mass and height using contour lines, or colors for different BMI categories. Such charts can easily allow two different sets of units of measurement to be used, which is often useful. It is used in a wide variety of contexts as a simple method to assess how much an individual's body weight departs from what is normal or desirable for a person of his or her height. There is however often vigorous debate, particularly regarding at which value of the BMI scale the threshold for overweight and obese should be set, but also about a range of perceived limitations and problems with the BMT (Chumlea, Baumgartner & Garry, 1992).

Abdominal Circumference:

Obesity is frequently associated with increased an amounts of intra-abdominal fat. A central fat pattern is associated with the deposition of intra-abdominal adipose tissue, but subcutaneous abdominal adipose tissue is involved with a relative increase in the ratio of abdominal circumstance (sometime incorrectly referred to as "waist" circumference) to the hip circumference is an early index describing adipose tissue distribution or fat patterning (Chumlea, Baumgartner & Garry, 1992). Ratio is greater than 0.85 represent a masculine or central distribution of fat. Most men with a ratio greater than 1.0 and women with a ratio greater than 0.85 are at risk for cardiovascular disease, diabetes, and cancers (Fujimoto, Newelimori's & Grote, 1991).

However, this ratio is an imperfect indicator of intra-abdominal adipose tissue and the use of the abdominal circumference alone provides much the same information (Pouliot, Despres & Lemieus, 1994). Persons in the upper percentiles for abdominal circumference are considered obese and at increased risk for morbidity, specifically type II diabetes and the metabolic syndrome and mortality (Nicklas, Penninx & Cesari, 2004).

Circumferences of other body segments such as the arm and leg are possible but there are little available reference data expected for the arm circumference. The calculation of fat

and muscle areas of the arm is not accurate or valid in the obese. Abdominal thickness is associated with levels of abdominal obesity because a large abdomen should be a thick abdomen (Lohman, Martorell & Roche, 1988). However, there is some inconsistency in standardizing this measurement; should it be taken standing or recumbent, from the small of the back, or from the top of a table when recumbent (Valsamakis, Chetty & Anwar, 2004).

Skin folds:- Skin folds measure substances fat thickness, but they are not very useful for the obese. Most skin fold calipers have an upper measurement limit of 45 to 55mm, which restricts their use to the "moderately" obese or thinner. A few skin fold calipers taken larger measurements, but this is not a significant improvement because of the difficulty in holding a large skin-fold, plus the additional problem of reading the caliper dials, all of which create additional errors. The majority of the available national references data is for triceps and sub scapular skin-folds, but the triceps is a sex-specific site and can reflect changes in the underlying triceps muscle rather than an actual change in body fatness. Skin folds are useful in monitoring of their small body size, and the majority of fat is subcutaneous even in obese children (Malina & Bouchard, 2009).

The statistical relationships of skin-folds with percent and total body fat are often not strong as that of BMI in both children and adults. Also, we do not know the real upper distribution of subcutaneous fat measurement because most obese children and adults have not had their skin fold measured (Roche, Siervogel & Chumlea, 2008).

Bioelectric Impedance Analysis:- Bioelectric impedance analyzers (BIAs) do not measure any biological quantity or describe any biophysical model related to obesity. Impedance index stature squared divided by resistance (52/R) at a frequency, most often 50KHZ, is an independent variable in regression equations to describe statistical associations based on biological relationships for a specific population, and as such the equations are useful only

subjects that closely match the reference population in body size and shape (Gray, Bray & Gemayel, 1989).

Also, BIA has been applied to overweight or obese samples in a few studies; thus the available BIA prediction equations are not applicable to overweight or obese children or adults. The ability of BIA to predict fatness in the obese is difficult because they have a greater proportion of body mass and body water accounted for by the trunk, the hydration of fat free mass (FFM) is lower in the obese, and the ratio of extracellular water (ECW) to intracellular water (ICW) Is increase in the obese (Kushner, Kunigk & ALspaugh, 1990).

BIA Volatility and its estimates of body composition are significant issues for normal weight individuals. BIA is useful in describing mean body composition for groups of individual limit its clinical application, especially among the obese. The large predictive errors with BIA render it insensitive to small improvements in response to treatment commercial BIA analysis contain all of the problems associated with this methodology (Sun, Chumlea, & Heymsfield, 2003). Recent BIA prediction equations have been published along with body composition mean estimated for non-Hispanic whites, non-Hispanic blacks, and Mexican American males and female from 12 to 90 years of age. These equations are not recommended for obese individuals or groups (Chumlea, Guo & Kuczmarski, 2002).

Body Density:- Hydro densitometry estimates body composition using measures of body weight, body volume, and residual lung volume. Historically, body density was converted to the percentage of body weight of fat using the two compartment models of Sin (Sin, 1961) or Brozek and coworkers, but more recently, a multi compartment model is used to calculate body fatness (Guo, Wisemandle & Tyleshevsk, 1997).

Body density is plagued with problem of subject performance because it is difficult if not impossible for an obese adult or child to submerge. Weight belts reduce bouncy, but not all aspect of performance. Air replacement devices are limited to adults who are

"moderately" obese at best. Regardless, most overweight child obese person are reluctant to put on a bathing suit and participate in body density measurements (Dempster & Atikens, 1995).

Total Body Water:- Total body water (TBW) is easy to measure because of does not required understanding or any real physical participation , but this method is limited in the obese. The major assumption is that FFM is estimated from TBW based on and assumed average proportion of TBW in FFM of 73% but this proportion ranges from 67% to 80% (Chumlea, Guo & Kuczmarski, 2002).

In addition, about 15% to 30% of TBW is present in adipose tissue as extracellular fluid, and this proportion increases with the degree of adiposity. These proportions tend to be higher in women than in men higher in the obese, and produce underestimated of FFM and overestimates of fatness. Variation in the distribution of TBW as a result of disease associated with obesity such as diabetes and renal failure, affect estimates of FFM and TBF further.

TBW is a potentially useful method applicable to the obese but there are details that need to be considered the several analytical chemical methods used to quantity the concentration of TBW and extracellular fluid have errors of almost a liter0. Equilibration times for isotope dilution in relation to levels of body fatness are unknown because, theoretically, it might and should take longer for the dilution dose to equilibrate in an obese person as compared with a normal weight individual. Also, a measure of extracellular space is necessary to correct the amount of FFM in an obese person. Such data could also be very useful in the treatment of end stage renal disease (Siri, 1961)

Dual energy X-ray Absorptiometry:- Dual energy X-ray absorptiometry (DXA) is the most popular method for quantifying fat, lean, and bone tissue. DXA is fast and user friendly for the subject and the operator, but the machine require regular maintenance and calibration.

DXA has inherent assumptions regarding levels of hydration, potassium content or tissue density in the estimation of fat and lean tissue, and this assumption vary by manufacturer (Roubenoff, Kehayias & Dawsonhughes, 1993).

DXA estimates of body composition are also affected by differences among manufacture in the technology, models and software employed, methodological problems, and intra and inter machine differences. These are physical limitation of bodyweight, length, thickness and width, and the type of DXA machine, that is pencil or fan beam. Most obese adults and many children are often too wide, too thick, and too heavy to receive a whole body DXA scans, although some innovative adaptations have been reported. Pediatric software is available for DXA and should be used according to the manufacturers' recommendation. DXA is convenient method of measuring body composition in much of the population, and it is currently included in the ongoing National Health and Nutrition Examination Survey [NHANES] (Roubenoff, Kehayias & Dawsonhughes, 1993).

The other imaging systems, such as computed tomography (CT) and magnetic resonance imaging are not practical for obese individuals. CT is able to accommodate large body sizes but has high radiation exposures and as such as inappropriate for whole body assessments, but it has been used to measure intra-abdominal fat. MRI is not able to accommodate large body sizes but has high radiation for whole body assessments, but it has been used to measure intra-abdominal fat. MRI is not able to accommodate large body sizes in many instances but can be used for whole body assessment. Both these methods require additional time and software to provide whole body quantities of fat and lean tissue (Tataranni & Ravussin, 1995).

Ethnic Differences in Body Composition:

Ethnic Differences in Body Composition and obesity are affected by differences in and associations with socio economic status, diet, utilization of health care and levels of

genetic admixture. These associations and effects in some ethnic groups may not be clear because the status of minority economic factors (Sun, Wu & Chumlea, 2002). African-American girls are fatter at earlier ages than white girls, they also have an earlier sexual maturation that has been linked to an early onset of obesity (Herman-Giddens, Slora & Hasemeier, 1993).

At the extremes of body fatness, there are more African-American women than non-Hispanic white women. These are limited body composition data for large samples of African, Hispanic, or Asian American and especially for the obese among these groups. The exception is that reasonably extensive anthropometric data are available for African, Hispanic and non-hispanic white Americans from the National Centre for Health Statistic in the NHANES (Fujimoto, Neweilmoris & Grote, 1991).

2.7 Aerobic Exercises and Obesity

Regular aerobic activities such as walking, bicycling or swimming can help a person live longer and healthier. However, the body responds to aerobic exercises during aerobic activity, it repeatedly moves large muscles in the arms, legs and hips you will notice quickly by body responses.

- Faster breathe and more deeply: This maximizes the amount of oxygen in your blood. Your heart will beat faster, which increases blood flow to your muscles and back to the lungs.
- Small blood vessels (capillaries) will widen to deliver more oxygen to the muscles and carry waste products such as carbon dioxide and lactic acid.
- The body will even release endorphins natural pain killers that promote an increased sense of well-being.

Regardless of age, weight or athletic ability, aerobic activity is good for the human body, as human body adapts to regular aerobic exercise and will get stronger and fitter. The following are ten (10) ways that state how aerobic activity helps the human body:

- Keeping excess pounds at bay.
- Ward off viral illness.
- Combined with health diet, aerobic exercise helps person to feel better and keep it off.
- Boosting mood.
- Reduce health risks.
- Stay active and independent.
- Manage chronic conditions.
- Strengthen the heart.
- Keep the arteries clear.
- Live longer (Source:- Healthy-lifestyle/fitness/in depth/aerobic-exercise art).

2.8 Rope Skipping

Skipping rope is played by children and many young adults, where one or more participants jump over a rope swung so that it passes under their feet and over their heads (WebMD, 2007). Rope skipping techniques include basic jump or easy jump, Alternate foot jump (speed step), Criss-cross, Side Swing, and Combination jumps (WebMD, 2007). It is cheap and portable and it burns more calories than one might think. Jumping rope is a great calorie burner. One has to run an eight minute mile to work off more calories than you would burn in jumping rope. Using the WebMD calorie counter to figure out how many calories you will burn for a given activity based on your weight and the duration of exercise. It strengthens the upper and lower body and burns a lot of calories. In a short time, but other considerations will determine if it's appropriate for an individual (WebMD, 2007).

2.8.1 Rope skipping as a form of aerobic exercise

Skipping may be used for cardiovascular workout in similarity to jogging or bicycle riding. This aerobic exercise can achieve a "burn rate" of up to 700 calories per hour of vigorous activities with about 0.1 calories consumed per jump (Tawney & Tawney, 2000). Ten minutes of jumping rope is roughly equivalent of running eight miles (Swain & Franklin 2006). Jumping rope for 15-20 minutes is enough to burn off calories from a candy bar Individual (Whalton, 2000). Also, women can participate in the exercise. Jumping rope techniques are relatively simple compared to many other athletic activities. Rope skipping is appropriate for a wide range of ages and fitness levels.

Amao (2007) explains that rope is a primary tool used in the game of skipping, played majorly by children and women and other young adults where one or more participant jump over a rope that is swung so that it passes under their feet and over their heads. The participant turning and jumping the rope are a minimum of three. They take turns, two of who turn the rope while one or more jumps. This is called long rope. Sometimes the later is played with turning rope, this form of activities is called double dutch and it is more difficult. Jump rope rhymes are often chanted in the beginning when the skipper jumps and ends when the skipper messes up. For a novice, a beaded rope is recommended because it holds its shape and easier to control than a light weight clothed or vinyl rope, on a 50 metres land space. In addition, the exercise surface is very important.

2.8.2 Steps of Jump rope for beginners include:

- Mimic the moves of jumping rope without the rope for about 30 seconds at a time to get correct form and build confidence.
- Jump while whipping the rope in one hand, alternating sides to enhance coordination.

- ❖ Step into the rope, one at a time. Moving forward and allowing the rope to go underneath each foot, one step at a time puts it all together.
- ❖ Start basic rope jump using both feet, landing on the balls of the feet.
- ❖ Split jump, Jump rope while alternately shifting each foot forward.
- ❖ Use a wood floor, piece of plywood, or an impact mat made for exercise.
- ❖ Alternate jumping with lower intensity exercise such as marching will enable one to jump for longer period and appropriately jump into a varied exercise routine.
- ❖ Do not jump on carpet grass, concrete or asphalt. The carpet reduces impact; the downside grabs the shoe and twists your ankle or knee (Aagaard, 2012).

2.9 Benefits of Rope Skipping Exercise on Body FAT and BMI of obese children

Rope Skipping is a simple and one of the most efficient forms of exercise. It helps the person to keep his body as fit and healthily (Behm, 2009). Benefits of rope skipping exercise on body fat and BMI of obese children include physical, psychological, health, economic and social benefits.

- **Physical Benefits:-** physical benefit such as building stamina, reduces weight, burn abdominal fat, improves appetite, strengthens muscles and bones, fights insomnia, prevents signs of aging and improves heart health.

Builds Stamina:- Rope skipping boosts the stamina and makes a person feel energetic and rejuvenated throughout the day. It increases your ability to carry out your daily activities. It stops the feeling lethargic and procrastinating things thereby increasing the efficiency.

Reduces weight:- Rope skipping speeds up metabolism and helps burn those extra calories in body. This helps to reduce the excess fat and achieve a lean body. Remember it is essential to burn more calories people consume (Behm, 2009).

Burn abdominal fat:- people have been trying hard to get rid of abdominal fat, then they should try rope skipping. Rope skipping for 30 minutes every day is an effective way to keep

the abdominal muscles firms and reduce the fat around your waist, hip and abdomen. Also rope skipping will helps to lose extra flabs, by combining it with a low-fat and healthy diet for best results (Behm, 2009).

Improves appetite:- If a person have poor appetite, rope skipping will help improve the appetite. After any form of exercise, there is need to repair the muscles and refuel them. The most important tip here is to eat food that makes the body feel full without consuming a large amount of calories. For this you need to choose healthier options eat a balance diet comprising fresh fruits and vegetables, lean protein, and high fiber food to sustain a person for a longer period of time. The rope skipping work out coupled with a healthy and nutritious diet will do wonders for the body (Behm, 2009).

Strengthens muscles and bones:- Rope skipping helps improve the strength, firmness, and flexibility of the muscles. It tones the muscles and improves the bone density especially in the spine and hip. This improves the overall flexibility of the body, thus preventing injuries and damage to the bones and muscles. Regular rope skipping can help reduce the risk of osteoporosis, fractures and cracked bones later in life. However, if already have a weak bone, there is need to take the advice of doctor before starting this form of exercise. Also, those, who are new to exercising or haven't exercised for a while, should consult their doctors before starting high impact exercise like rope skipping (Behm, 2009).

Fights Insomnia:- Besides keeping a person in good shape, rope skipping also helps to fight insomnia and sleep disorders. It relieves tension and helps to have good relaxation. If obese children rope skip regularly, it will help them get a sound and undisturbed sleep in the night .

Prevents signs of aging:- People who are forty (40) or above can engage in regular physical activities like rope skipping to keep them active. Apart from helping in losing weight and strengthening the bones and muscle, it regulates their metabolism and energy levels. As a result feels young and healthy.

Prevents infection and diseases:- Rope Skipping boosts up the immune system and stimulates the production of white blood cells and the cells that fight against bacteria in the body (Behm, 2009).

Improves heart health:- regular rope skipping strengthens the heart and minimizes heart attacks. It lowers the blood pressure and triglyceride levels, raises the HDL, and leads to improved oxygen intake.

- **Psychological Benefits:-** psychological benefit such as, building confidence, develops appositive attitude, cures depression and mood disorders, improve focus and concentration.

Builds confidence: When beginning to skip rope, start slowly and try to develop gradually. Then continue to do it on regular basis. Explore the body, set achievable targets, and try to reach the goals. This will help in overcome every obstacle and tremendously raise the confidence level. Not to mention the unwanted pounds lose. It will boost the self-esteem and improve the general health.

Develops a positive attitude:- When obese person perform any physical exercise, his body releases endorphins which creates a sense of euphoria and trigger a positive feeling in the body. It relieves the stress and fatigue and makes him feel happy and relaxed. It elevates his mood, makes him feel great, thus developing a positive attitude.

Cures depression and mood disorders:- In today's competitive world, work pressure, financial problems, and other issues can cause considerable amount of stress and anxiety which can lead to depression and other health concerns. Physical exercises are the best way to reduce depression. Rope skipping for 20-30 minutes in the morning is a great way to start a day fresh. Besides being physically active, rope skipping improves blood circulation, refresh the mind and uplift mood (Behm, 2009).

Improve focus and concentration:- Aerobic exercise like rope skipping improves the supply of oxygen rich blood to the brain and helps to function better. This sharpens the mind purpose, to focus better on memory, learning and develops mental toughness (Behm, 2009).

- **Health Benefits of Jumping Rope:-** Health benefits of rope skipping include:

❖ Strengthen cardiovascular, rehabilitation, and improve performance

❖ Help lose weight

❖ Help run and jump better

❖ keeps body healthy

❖ Reduced body fat mass

❖ Improved body composition

❖ Increased energy expenditure (Herndon, 2012; Miller, 2008).

- **Economic and Social Benefits of Skipping Rope:-** Economic and social benefits of rope skipping include:

❖ The exercise is easy to learn

❖ Inexpensive as you only need a rope.

❖ Fun and enjoyable (Herndon, 2012; Miller, 2008).

2.10 Empirical Studies on exercise training and Childhood Obesity

According to Dietz (1998), obesity is a disease process associated with the development of serious medicinal complications and increased mortality in adulthood. Obesity is also a risk factor associated with cardiovascular diseases, atherosclerosis, diabetes and breast, Colonic, endometrial and prostate cancers. Childhood obesity is associated with some psychological problems such as low self-esteem, feeling of inadequacy, anxiety, social dysfunction, depression and mood, all of which affect the personality of the children. Girls who are overweight or obsessed are prone to developing high-risk behaviors such as smoking

and drinking alcohol and are also less likely to engage in physical activities and exercises programme that promote energy expenditure (Strauss, 2007).

In the United States of America (USA), the incidence of obesity in children and adolescent rose from 11% in 1984 to 25% in 1998, with Africa-American girls having a 50% greater prevalence than white girls (Troino & Flegal, 1998). The united Arab Emirate (UAE), recent research suggested that the prevalence of childhood obesity is increasing dramatically, already surpassing the high levels of obesity found among children and adolescents in the U.S.A and Europe (Western & Smith, 2005); (Al-haddad, Bertis & Gafar, 2005). A study in South-Western Nigeria by Omolola, Karan and Olayemi (2009) reported no adolescent found to be either overweight or obese among the rural dwellers studied. Another study in Lagos, Nigeria, by Ben-Balsey, Oduwale and Ogundipe (2007), reported that overall prevalence rates of being overweight and of obesity in the urban and rural areas was 3.7% and 0.4% and 3.0% and 0.0%, respectively.

The issue of rope skipping as a method of fitness training is of great concern to the community. But little is known about the effects of rope skipping on the coordination ability of children. A study was conducted by Youlian-Hong and Chung (2004) on the effects in terms of EMG responses of eight weeks of rope skipping exercises on the coordination ability of school children. They used twenty male students. Form 5 schools. Those who did not have rope skipping experience were randomly recruited from a secondary school and formed paired exercise and control groups, in accordance with the Body Mass Index. The age, body height and body weight of the exercise group were 15.60±0.52 years, 173.83±5.05 cm and 59.93±5.73 kg, and for the control group 15.70±0.68 years, 170.28±6.05 cm and 55.20±6.49 kg respectively. The subjects in the exercise group took part in rope skipping for eight weeks, 5 times weekly, twenty minutes each time, and at an intensity that produced a mean heart rate of an estimated 75% of maximal oxygen uptake. The subjects in the control group did not

participate in any programmed exercise except the physical education courses for all students in the school. Two testing sessions were arranged for both groups: one week before and one week after the training program. In each session, the subjects were asked to perform rope skipping for 10 minutes at a rate which induced the heart rate of each subject to reach its maximal value. During testing, the remote EMG signals of eight muscles on the leg were detected and full-wave rectified. The duration of each muscle's contraction and the timing sequence of the contraction among different muscles were calculated for the supporting phase. T-tests were used to examine the differences in the data to be compared. The trained group showed significantly shorter duration in vastus medialis contraction than the untrained group ($P<.001$) (Youlian-Hong & Chung, 2004).

Also, the trained group showed a greater time gap in the muscle contraction between quadriceps (vastus medialis, rectus femoris and vastus lateralis) and tibialis anterior when jumping up, and between tibialis anterior (landing) and gastrocnemius (jumping). For the same intensity of exercise, a shorter working time for muscles results in less energy expenditure. Under the same frequency of rope skipping, greater time gaps between the consecutive contractions of muscles provide more resting time for the muscles and therefore save the energy expended. It was concluded that programmed rope skipping exercise improved movement coordination and reduce energy expenditure (Youlian-Hong & Chung, 2004).

Several studies have shown that the behavioral pattern in exercise and motor fitness of children has changed dramatically in the last two generations. Because childhood is a very important period of life, the promotion of physical activity (PA) has been identified as a major public health priority. Another study was conducted by Kuhnis (2011) to observe the fitness level and the importance of PA among 5th grade pupils in Liechtenstein. It was a cross-sectional study was carried out from March to June 2011. A total of 313 children (aged

11.8 ± 0.6 years) were randomly selected. PA and socio-demographic data were acquired with a short questionnaire, the motor fitness with a test battery, consisting of eight items. It was found that the physical performance of all the children is satisfactory, but with obvious deficits in coordination, flexibility and basic motor skills. Children's general fitness was significantly higher among those, who were members of sports clubs than non-members (P<.05). A high level of PA in free time was associated with better motor fitness (P<.001). According to other studies, the survey illustrates the controversial findings of a high participation in sports of school children in their free time activities but at the same time increasing motor disorders (Kuhnis, 2011).

Physical activity as a main factor in socialization has been teaches concept in different cultures. A study was conducted to determine the effect of rope skipping on social skills (SS) and academic performance (AP) on students of grade 4 in elementary schools. Participants were 84 students, randomly sampled among graded 4 students, in 4 educational areas, Shiraz, Iran. Accordingly, three control factors schools were randomly selected. Data collection occurred after and before performing rope skipping. The rope skipping exercise was performed for 45 minutes per week, in 12 weeks. Teachers completed the teachers' rating of social skills questionnaire (TRSSQ) about students. Academic performance was obtained from school lessons. The TRSSQ was based on subscales of non-social competence (NSC), social skill (SS) and peer relation (PR). It was consisted of 56 items designed to measure NSC with 30 items, SS with 30 items, and PR with l5 items. Each of the TRSSQ items was on a Likert scale. The AP was defined as a class point average and it was descriptive. The hypotheses were if there were any significant effects on AP and SS by rope skipping performance among elementary students. Paired sample t-tests were conducted for these hypotheses. The statistical analysis showed there were significant differences after and before

rope skipping in AP. It was concluded that performing rope skipping had significant effects on AP (Kuhnis, 2011).

Another study was conducted by John (2010) on how to assess the effectiveness of a school based physical activity programme during one school year on physical and psychological health in young schoolchildren. He uses cluster randomized controlled trial on 28 classes from 15 elementary schools in Switzerland randomly selected and assigned in a 4:3 ratio to an intervention (n16) or control arm (n=12) after stratification for grade (first and fifth grade), from August 2009 to June 2010. 540 children, of whom 502 consented and presented at baseline. Children in the intervention arm (n=297) received a multi-component physical activity programme that included structuring the three existing physical education lessons each week and adding two additional lessons a week, daily short activity breaks, and physical activity homework. Children (n=205) and parents in the control group were not informed of an intervention group. For most outcome measures, the assessors were blinded.

The primary outcome measures included body fat (sum of four skinfolds), aerobic fitness (shuttle run test), physical activity (accelerometry), and quality of life (questionnaires). Secondary outcome measures included body mass index and cardiovascular risk score (average z score of waist circumference, mean blood pressure, blood glucose, inverted high density lipoprotein cholesterol, and triglycerides). 498 children completed the baseline and follow-up assessments (mean age 6.9 (SD 0.3) years for first grade, 11.1 (0.5) years for fifth grade). After adjustment for grade, sex, baseline values, and clustering within classes, children in the intervention arm compared with controls showed more negative changes in the z score of the sum of four skinfolds (-0.12, 95 % confidence interval -0.21 to -0.03; P=0.009). Likewise, their z scores for aerobic fitness increased more favorably (0.17, 0.01 to 0.32; P=0.04), as did those for moderate- vigorous physical activity in school (1.19, 0.78 to 1.60; P<0.001), all day moderate- vigorous physical actiy (0.44, 0.05 to 0.82;

P=0.03), and total physical activity in school (0.92, 0.35 to 1.50; P=0.003). Z scores for overall daily physical activity (0.21,-0.21 to 0.63) and physical quality of life (0.42, -1.23 to 2.06) as well as psychological quality of life (0.59, -0.85 to 2.03) did not change significantly. A school based multi-component physical activity intervention including compulsory elements improved physical activity and fitness and reduced adiposity in children (John, 2010).

2.11 Summary

The review of literature covered relevant areas with convincing evidences with regards to the effects of twelve week rope skipping exercise on body composition of obese children in private schools in the Kano Metropolis. The review of related literature has revealed the concept obesity and overweight; obesity is one of the common disorders seen by health providers today. Obesity has been regarded as the most common musculoskeletal problem in the world, which affects people across various strata of the society from layman in the street to health care providers in the health institutions. On the other hand, an overweight implies a condition of excess weight in a human being. The term overweight is generally used to indicate the excess weight while obesity refers to excess fat.

Literature pointed out the causes of obesity; a person may be obese because of the following reasons: dietary intake, developmental factors, physical inactivity, medical factor, genetics, socio-economic and psychological factor. It also threw light on the prevention and control of obesity; parents could change the diet and lifestyle of their offspring by offering appropriate food portions, increasing physical activity, and keeping sedentary behaviors at a minimum, this may also decrease the obesity level in children. The safest and most effective way to control weight in both cases is to reduce calories (balanced diet) and increase physical activity. Effects of obesity on health were also reviewed; an obese person is likely to appear unattractive to others. Excess weight makes movement difficult, tiring and slow. Blood

plasma in the obese frequently has a high level of cholesterol and this may account for a tendency to stone in the gall-bladder. Also, cholesterol may deposit in the linings of arteries, thereby narrowing their bore. It further reviewed on the body composition and assessment of obesity; body composition methodology is based on assumption regarding the density of body tissues, concentrations of water and electrolytes, and biological interrelationship between body components and body tissue and their distribution among normal weight individuals.

It further reviewed on the aerobic exercises and obesity; regular aerobic activities such as walking, bicycling or swimming can help a person live longer and healthier. Rope skipping exercise as well as it benefit on body composition was also reviewed; rope skipping is a simple and one of the most efficient forms of exercise. It helps the person to keep his body as fit and healthily. Benefits of rope skipping exercise on body composition of obese children include physical, psychological, health, economic and social benefits. Lastly, literature revealed the empirical studies on exercise training and childhood obesity; Childhood obesity is associated with some psychological problems such as low self-esteem, feeling of inadequacy, anxiety, social dysfunction, depression and mood, all of which affect the personality of the children.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This study investigated the effect of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in Kano metropolis. This chapter describes the research design, the population of the study, the sample and sampling technique, data collection instrument, data collection procedure and data analysis.

3.1 Research Design

A pre-test, post-test experimental and control group design (scientific design) was used in this study. Obese children were assigned to experimental and control groups. Pre-test/post- test comparisons allow assessment of training effect between two groups. This is a common evaluative tool in training and education as its implementation is simple (Horteval & Weebly, 2009).

3.2 Population of the Study

The population of this study comprised all the obese pupils in the private primary schools in the Kano Metropolis, which were around three hundred and eighty five (385) (Kano State Private and Voluntary Institutions Board, 2015).

3.3 Sample and Sampling Techniques

Four private primary schools were used as the sample for this study. Simple random sampling technique was used to select 4 out of 39 registered private primary schools from the metropolis L.G.E.A. The procedure for sampling selection was as follows, the name of each school was written on a piece of paper, the pieces of paper were folded, mixed and shaken vigorously inside a container. Four research assistants represented the four schools by picking four of the folded papers one after another. The names of the school picked, formed the sampled schools for the study.

Ten (10) obese pupils were randomly selected in each of the four selected schools, from the volunteers, after satisfying the following criteria:

- Apparently healthy pupils
- Those with BMI>30
- Those that volunteers to participate in the exercise
- Those that are between the ages of 7 and 11 years old.

The children ages range between 7-11 years. The difference in the age range is in line with many authors such as Jone (1991) who affirmed that obese children are generally exposed to certain physical activities and these ages are less prone to injuries. According to Birbaun (2003), minimum of ten to twenty subjects are needed in an experimental study in order to achieve validity, hence this justifies the researcher's choice of using ten (10) obese pupils from each of the four selected private primary school in Kano metropolis totaling 40 obese pupils.

3.4 Data Collection Instrument

Data was collected using the following instruments; Hanson's weighing scale, Skipping rope, Whistle, Stopwatch, Ruler and calculator.

- **Hanson's weighing scale:-** It was used for measuring the body weight of the participants.
- **Skipping rope:-** It was used for skipping .
- **Whistle:-** It was used for blowing when starting and or stopping the exercise.
- **Stopwatch:-** It was used for recording duration of the exercise.
- **Ruler:** The ruler was kept in slide contact of the head and the point on the scale measurement was taken to the nearest centimeter to measure height of the participants.

- **Calculator:** It was used for calculating the participants' Body Mass Index (BMI) and percent body fat.

3.5 Data Collection Procedure

In order to collect the data, an introductory letter was collected from the head of Department, Physical and Health Education Department, Bayero University, Kano, which was taken to the schools proprietor in the selected private primary schools in Kano Metropolis, to seek for permission to conduct the study. After permission was granted, six research assistants were enlisted in the conduct of the research protocol.

Training Programmes: The following are the training programmes for this study

Research assistants:

The purpose and procedure of the study were fully explained to the research assistants. Two (2) research assistants were assigned to the control group while four of them were assigned to the experimental group. They were trained on how to measure the height of the pupils, 2 were trained on how to measure the weight of the pupils while other two were trained on how to measure the arms, waist, hips circumference of the pupils before the commencement of the exercise. All the 6 research assistance helped in communicating and conducting the test.

Rope skipping:

For the purpose of this study, rope skipping exercise was used, all the rope skipping exercise took place at the selected schools playground. All the participants were adequately informed about the procedure, protocol, benefits and the risk involved with the tests. An informed consent form was signed by the parents/guardians of the pupils. Pre-test was conducted a week before the exercise training programme while the 2nd measurement post-test was carried out a week after the completion of the programme. The procedure for the rope skipping exercise was as follows;

- Each training programme was preceded by a ten-minute warm up at a time to get correct form and build confidence.
- The participants jump while whipping the rope is in one hand, alternating sides to enhance coordination.
- The participants steps into the rope, one at a time. Moving forward and allowing the rope to go underneath each foot, one step at a time puts it all together.
- The participants start basic rope jump using both feet, landing on the balls of the feet.
- Split jump, Jump rope while alternately shifting each foot forward.

At the training programme, the following instruments were used for data collection; hanson's weighing scale, whistle, stopwatch, skipping rope, ruler and calculator were used throughout the programme. The training procedures were explained below:

Hanson's weighing scale:- The participants wearing game dress takes over the body weight measuring scale without any footwear and stand upright, the hands by the sides until the meter is balance and reading was taken by the research assistants in kilogram before the pupils could get down from the scale.

Whistle:- It was used for blowing, indicating when to start or stop the exercise

Stopwatch:- It was used for recording the duration of the exercise that is from the starting point of skip and to the end points.

Skipping rope:- It was used for skipping. The pupils were asked to jump the rope over which is being swung so that it passes under their feet and over their heads. Rope skipping techniques include easy jump, alternate foot jump (speed steps), criss-cross, side swing and combination jump (WebMD, 2007).

Ruler: The ruler was kept in slide contact of the head and the point on the scale measurement was taken to the nearest centimeter to measure height of the participants. The participants' remains relaxed, standing barefooted with the head erect and a ruler was placed on the head

and straight to the wall to determine the height in meter which was needed in calculating the BMI and the percent body fat of the participants.

Calculator:- A calculator was used for calculating the participants' Body Mass Index (BMI) and Percent Body Fat.

Body Max Index:- BMI is a number calculated from a person's weight and height therefore, the BMI of the participants was calculated using their height square divided by weight as presented in the table below:

BMI	$= \frac{\text{mass(kg)}}{(\text{height(m)})^2}$
	$= \frac{\text{mass(lb)}}{(\text{height(in)})^2} \times 703$ †

Percent Body Fat:- The percent body fat of the participants was taken after identifying their age, gender, a tape was used to determined their waist, hips, arms and neck circumference and a scale to measure their weight. Percent body fat was calculated using the following formula (1.5× BMI) – (0.70 × age) – (3.6 × gender). Male gender score is 1 while that of female is 0 as suggested by Horteval and Weebly (2009).

Training schedule:

For the purpose of this study, rope skipping training was carried out in 3 sessions, all the training was conducted on Tuesdays, Thursdays and Saturdays within the school playground, this means that the training programmes takes place 3 days per week. According to Wilmore (1983), at least, three sessions of training per week is recommended for a training programme. Rabin (2005) recommended that the exercise duration of 3 times per week is sufficient. Week 1-3 at 40-45 Maximum Heart Rate (MHR). Week 4-6 at 45-50 MHR

intensity, week 7-9 at 50-55 MHR intensity while Week 10-12 at 60-65% of the maximal heart rate, as illustrated in the table 3.4.1 below:

Table 3.5.1: table for the training programme:

Week(s)	Duration	Percent % maximal heart rate
1-3	3 times per week	40-45
4-6	3 times per weeks	45-50
7-9	3 times per weeks	50-55
10-12	3 times per weeks	60-65

3.6 Data Analysis

Descriptive statistics of mean and standard deviation were used to organize and describe the demographic information of the respondents while Analysis of Covariance (ANCOVA) was used to analyze the data collected from pre and post of the experimental and control groups at the 0.05 level of significance. ANCOVA was used in this study because ANCOVA usually adjust for initial differences so that the results more precisely reflect the effects of an intervention (Denis & Cheryl, 2008).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This study investigated the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in Kano Metropolis. The data collected for this study were statistically analyzed and presented in this chapter.

4.2 Results

Forty obese pupils participated in the exercise and the result found were used for analysis and presented in the table below.

Table 4.2.1: Descriptive Statistics of Pre & Posttest of the Variables:

Variables	Experimental		Control	
	Pre (n = 40)	Post	Pre (n = 40)	Post
	$\bar{x}$± S.D	$\bar{x}$± S.D	$\bar{x}$± S.D	$\bar{x}$± S.D
Weight	44.4850±5.75895	42.5800±6.29642	47.8750±2.97036	47.9600±2.98036
BMI	20.8950±2.58141	19.9250±2.72433	21.7350±1.70765	21.8550±1.72794
PBF	24.0250±4.80798	22.7000±4.91582	24.8700±3.53540	24.8950±3.62237

Table 4.2.1 is the descriptive statistics of pre and post of the variables. The table further indicates the significant difference in the mean scores of pretest and post test of the tested variables in the experimental and control groups of all the variables. This shows that 12 weeks rope skipping exercise has effects on the variables tested.

Hypotheses testing:

Sub-hypothesis I: There is no significant effect of twelve week of rope skipping exercise on the body weight of obese children in private schools in Kano metropolis.

Table 4.2.2: Summary of ANCOVA on the effect of twelve week of rope skipping exercise on the body weight of obese children:

Source	Type III Sum of Square	Df	Mean Square	F	P-value
Corrected Model	571.849	2	285.925	31.037	.001
Intercept	91.121	1	91.121	9.891	.003
Posttest weight	456.928	1	456.928	49.600	.001
Group	1.202	1	1.202	.130	.720
Error	340.855	37	9.212		
Total	86216.400	40			
Corrected Total	912.704	39			

df=2, F =31.037, P<0.05

ANCOVA was carried out to examine the effect of twelve week of rope skipping exercise on the body weight of obese children. The ANCOVA result indicates that F = 31.037, at df=2, P< 0.05. Hence, the null hypothesis tested is rejected due to the fact that twelve weeks of rope skipping exercise have significant effects on the body weight of obese children in private schools in Kano metropolis.

Sub-hypothesis II: There is no significant effect of twelve week of rope skipping exercise on BMI of obese children in private schools in Kano metropolis.

Table 4.2.3: Summary results of ANCOVA on the effect of twelve week of rope skipping exercise on the BMI of obese children:

Source	Type III Sum of Square	Df	Mean Square	F	P-value
Corrected Model	107.015	2	53.508	24.127	.001
Intercept	18.714	1	18.714	8.438	.006
Posttest BMI	99.959	1	99.959	45.073	.001
Group	2.383	1	2.383	1.075	.307
Error	82.056	37	2.218		
Total	18362.240	40			
Corrected Total	189.071	39			

df 2, F= 24.127, P<0.05.

ANCOVA was carried out to examine the effect of twelve week of rope skipping exercise on BMI of obese children. The ANCOVA result indicates that F=24.127, at df 2, P< 0.05. Hence, the null hypothesis tested is rejected due to the fact that twelve weeks of rope skipping exercise have significant effects on the BMI of obese children in private schools in Kano metropolis.

Sub-hypothesis III: There is no significant effect of twelve week of rope skipping exercise on percent body fat of obese children in private schools in Kano metropolis.

Table 4.2.6: Summary results of ANCOVA on the effect of twelve week of rope skipping exercise on the percent body fat of obese children:

Source	Type III Sum of Square	Df	Mean Square	F	P-value
Corrected Model	501.860	2	250.930	51.019	.001
Intercept	25.235	1	25.235	5.131	.029
Posttest PBF	494.720	1	494.720	100.586	.001
Group	9.163	1	9.163	1.863	.181
Error	181.980	37	4.918		
Total	24591.050	40			
Corrected Total	683.840	39			

df 2, F= 51.019, P<0.05.

ANCOVA was carried out to examine the effect of twelve week of rope skipping exercise on PBF of obese children. The ANCOVA result indicates that F = 51.019, at df 2, P< 0.05. Hence, the null hypothesis tested is rejected due to the fact that twelve weeks of rope skipping exercise have significant effects on the percent body fat of obese children in private schools in Kano metropolis.

4.3 Discussion

Discussions of results of the study are presented below according to formulated hypotheses as follows; body weight of obese children in private schools in Kano Metropolis, BMI of obese pupils in selected private schools in Kano Metropolis as well as the percent body fat of obese pupils in private schools in Kano Metropolis.

Sub-Hypotheses 1: There is no significant effect of twelve week of rope skipping exercise on the body weight of obese children in private schools in Kano metropolis.

The finding of this study revealed that twelve week rope skipping exercise has significant effect on the body weight of obese children in private schools in Kano Metropolis ($F = 31.037$, at $df=2$, $P< 0.05$). This finding is in line with the finding of Shenbagavalli and Mary (2014) who conducted a study on the Effects of 8 Weeks Aerobic Training on Obese Men. Their finding indicated that 8 weeks aerobic training had significant effects on the body weight of obese men and also helped them to keep the heart healthy. The current finding also support that of Kam, Ping, Chung, Sung, Mu, Sophie, Christopher, Con, and David (2004) who conducted a study on the Effects of Exercise on Obese Children. They found a significant decreased in body weight of obese children as well as improve in arterial endothelial function.

This current finding is also in agreement with that of Butler (2010) who found a significant weight loss of total body mass through an effort to improve fitness and health. Furthermore, Mayo Clinic (2005) asserted that weight loss occurs when an individual performed more aerobic exercise. The finding of this study is contrary with that of Kuhnis (2011) who conducted a study on the determinants of the fitness level and the importance of physical activities among 5^{th} grade pupils in Liechtenstein. He found that no obvious effect on weight reduction.

Sub-Hypotheses 2: There is no significant effect of twelve week of rope skipping exercise on the BMI of obese children in private schools in Kano metropolis.

The finding of this study revealed that there is significant effect of twelve week rope skipping exercise on the BMI of obese pupils in private schools in Kano Metropolis ($F=24.127$, at df 2, $P< 0.05$). This finding is in line with the finding of LeMura, and Maziekas (2002) who conducted a study on the factors that alter body fat, body mass index, and fat-free mass in obese children and adolescents. They found a significant decreased in the BMI of obese children and adolescents. They concluded that exercise is efficacious for reducing BMI on obese children and adolescents. The current finding also corroborates with that of Korsten (2007) who conducted a study on the effects of aerobic exercise on obese children. He found a significant decrease on the BMI and significant increase in the subjects' aerobic capacity.

The finding of this study further affirmed that of Shenbagavalli and Mary (2014) who found a significant effect of 8 weeks aerobic training on the body mass index of obese men. In their study on the prevalence of childhood and adolescent overweight and obesity in Benue State, Nigeria, Danladi, Abel, Makama and Badamasi (2012) found that 78.5% of obese children decrease their BMI, 18.3% were overweight and 3.2% remained obese. Benjamin, James, Nicholas and Michie (2011) reported that BMI Mean score of their subjects decreased from 34.03 to 32.26, with overweight/obesity prevalence decreasing by 3.7%.

The finding of this study is contrary with that of John (2010) who conducted a study on how to assess the effectiveness of a school based physical activity programme during one school year on physical and psychological health in young schoolchildren. His finding showed no significant changes in the body mass index and cardiovascular risk score. In contrary to this finding, the finding of Chen and Lin (2012) who conducted a study on Jumping Rope Intervention on Health-Related Physical Fitness in Students with Intellectual

Impairment; they found that 12-week jumping rope training have no significant influence on the BMI of students with intellectual impairment.

Sub-Hypotheses 3: There is no significant effect of twelve week of rope skipping exercise on percent body fat of obese children in private schools in Kano metropolis.

The finding of this study indicates that there is significant effect of twelve week rope skipping exercise on percent body fat of obese pupils in private schools in Kano Metropolis ($F = 51.019$, at df 2, $P< 0.05$). This finding is in line with the finding of Prabhakaran, Dowling, Branch, Swain and Leutholtz (2009) who conducted a study on the effect of 14 weeks of resistance training on lipid profile and body fat percentage in premenopausal women. They found a significant decrease on the percent body fat, as well as a strong trend towards a significant decrease in the low density lipoprotein (LDL) to high density lipoprotein (HDL) cholesterol ratio in the resistance exercise training group compared with their baseline values. The finding of this study also support that of LeMura, and Maziekas (2002) who conducted a study on the factors that alter body fat, body mass index, and fat-free mass in obese children. They found a significant decreased on the percent body fat of the obese children. They concluded that exercise is efficacious for reducing selected body composition variables in children and adolescents.

The current finding also confirmed that of Sigal, Alberga, Goldfield, Prud'homme, Hadjiyannakis, Gougeon, Phillips, Tulloch, Malcolm, Doucette, Wells, Ma and Kenny (2014) who conducted a study on the effects of aerobic training, resistance training, on both percentage body fat and cardiometabolic risk markers in obese adolescents. They found a significant decrease in the percentage body fat of the subjects in an experimental group. The finding of this study is contrary with the finding of Orhan, Kharazi, Akbar and Ercan (2012) who conducted a study on the effect of two training types on cardiorespiratory fitness and body fat of male and female students. Two groups (male and female) were assigned with

endurance exercises and two groups (male and female) were assigned with sprint exercises for 12 weeks, 3 sessions per week, and one hour per session. They found no significant effect on percent body fat.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This study examined the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in Kano Metropolis. To achieve the purpose of the study, three research questions were answered and also three hypotheses were tested. Related literatures were also reviewed. Pre-test, post-test, experimental and control group design method was adopted for this study. The population of the study comprised all obese pupils in selected private primary schools in Kano Metropolis with a population of three hundred and eighty five (385). Simple random sampling technique was used to select four schools and forty (40) participants from the selected schools. Data were collected using Hanson's weighing scale, skipping rope, whistle and stopwatch, ruler and calculator. For the purpose of analysis, data from forty (40) participants were analyzed. Analysis of Covariance (ANCOVA) was used to test all the three formulated hypotheses at the 0.05 level of significant. The finding of this study revealed that twelve weeks of rope skipping exercise have significant effect on the body weight of obese pupils in private schools in Kano Metropolis; twelve weeks of rope skipping exercise have significant effects on the BMI of obese pupils in private schools in Kano Metropolis; twelve weeks of rope skipping exercise have significant effects on the percent body fat of obese pupils in private schools in Kano Metropolis. Based on these findings, all the three hypotheses tested were rejected.

5.2 Conclusions

Based on the outcomes of this study, the following conclusions are drawn:

1) Rope skipping exercise has significant effects on the body weight of obese pupils in selected private primary schools in Kano Metropolis

2) Rope skipping exercise has significant effects on the BMI of obese pupils in selected private schools in Kano Metropolis.
3) Rope skipping exercise has significant effects on percent body fat of obese pupils in selected private schools in Kano Metropolis.

5.3 Recommendations

Based on the findings of this study, the following recommendations were made:

1) Urgent preventive strategies should be implemented in private primary schools in Kano Metropolis to raise the awareness about the health hazards of disordered body weight and obesity.
2) Pupils in private primary schools in Kano Metropolis should continue to engage themselves on rope skipping exercise that can have significant effects on their BMI.
3) Rope skipping exercise should be incorporated in the exercise programme of obese pupils in private primary schools in Kano Metropolis.

5.4 Recommendations for further studies

1) A similar study should be conducted to find out the prevalence of childhood and adolescent overweight and obesity in Kano State.
2) Similar studies should be carried out to cover both public and private primary schools in Kano State.
3) A study should be carried out to cover the secondary Kano state.

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APPENDIX

BAYERO UNIVERSITY, KANO

FACULTY OF EDUCATION,

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION

INFORMED CONSENT FORM

This is an experimental study designed to determine the effects of twelve week rope skipping exercise on body fat and BMI of obese children in private schools in Kano Metropolis.

Your child will perform a rope skipping exercise at certain interval. The exercise will be of specific intensity of about 40-45, 45-50, 50-55 and 60-65% Maximum Heart Rate. The exercise will be conducted 3 days per week, within the school playground whereby the participant is free to stop if having any feelings of dizziness or fatigue. Please do note that his/her weight, height, body max index, percent body fat, as well as the duration of the exercise will be taken as he/she perform. Please also note that there are likely going to be some changes occurring during and after the exercise. These might include abnormal or irregular heartbeat, fatigue and muscle pain, but be rest assures that after some times, it will return normal.

On the other hand, there are also going to be benefits coming out as a result of the exercise, which is the scientific basis of the exercise testing. If the participant has any question, he or she is free to ask for further clarifications.

INDEMNITY:

I have read this form and I fully understand the terms and conditions guiding the test procedures including any possible risk that might arise. I am hereby agree that my child should participate in this exercise.

Sign...…… Date……
(Parent/Guardian)

Sign…….. Date……
(Researcher)