EFFECTS OF AEROBIC TRAINING ON BODY COMPOSITION AND CARDIORESPIRATORY FUNCTIONS OF OBESE AND NON-OBESE ADOLESCENTS IN NUMAN, ADAMAWA STATE, NIGERIA

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DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION,
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JUNE, 2015.

DECLARATION

The researcher here by declares that this thesis titled **Effects of Aerobic Training on Body Composition and Cardiorespiratory Functions of Obese and Non-obese Adolescents in Numan, Adamawa State, Nigeria** was written by me and that it is a record of my own research work. This research work has not been submitted in any previous way for a higher degree. All quotations and sources of information used have been duly acknowledged in the references.

Christopher, Julius Jikoshiafuro
June, 2015.

CERTIFICATION

This thesis titled **Effects of Aerobic Training on Body Composition and Cardiorespiratory Functions of Obese and Non-obese Adolescents in Numan, Adamawa State, Nigeria** meets the regulations governing the award of Master of Science (M.Sc) degree in Exercise and Sport Science, Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to God Almighty who gave me the enabling grace to embark on this programme and to my beloved wife Mrs Homtapwa E. Julius (Gift) for her patience throughout the period of my sojourn at Ahmadu Bello University, Zaria.

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Christopher, Julius Jikoshiafuro.

ABSTRACT

This study was carried to assess the effect of jogging body composition and cardiorespiratory functions of obese and non-obese adolescents in Numan, Adamawa state. Obesity is a health hazard of epidemic proportion in most developed and developing countries around the world and in Nigeria in recent years. World Health Organization estimated that 35% of adult populations in industrialized and developing nations are obese and Nigerian Health care system is rated one of the lowest five in the world. Research design, population, sample and sampling techniques, research instruments, procedure for data collection, training protocol, and statistical techniques were used as methodology in this study. The population for this study comprised of 570 male and female students of Junior Secondary Schools in Numan metropolis. Using the stratified sampling technique, 88 students were screened and a total of 80 students successfully completed the training programme by gender and ages of 12, 13, 14 and 15 years. Data collected from the pre, mid, and post training programmes, were analyzed using the Statistical Package for Social Science (SPSS) at the Institute of Agricultural Research (IAR), Ahmadu Bello University, Zaria. The descriptive statistics of mean, standard deviation and standard error of means was used to analyse the body composition and cardiorespiratory variables. The repeated measure ANOVA 16.0 version was used to analyse the data to determine the effect of jogging on the subject body composition and cardiorespiratory variables, and the t-test was used to analyze the data for gender. The findings revealed that regular jogging had significant effect on body composition variables (%BF of obese males). Regular jogging had significant effect on cardiorespiratory variables of obese and non-obese male and female adolescents in Numan Metropolis of Adamawa State, Nigeria. From the results obtained, the researcher came up with the recommendations which if adhered to will help alleviate or minimize obesity. Physical Education for children already in existence in school curriculum should be seriously re-emphasized and stressed. Regular assessment of physical fitness status of adolescents in Nigerian schools by Exercise Scientist should be emphasized so as to be able to prescribe exercise programmes to meet fitness needs and standard.

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ABBREVIATIONS

AAHPHERD: American Alliance of Health, Physical Education, Recreation and Dance

ACSM: American College of Sport Medicine

ADA: American Dietetic Association

ANOVA: Analysis of Variance

CHD: Coronary Heart Disease

NIH: National Institute of Health

MVPA: Moderate to vigorous physical activity

PA: Physical Activity

SPSS: Statistical Package for Social Sciences

USDHHS: United State Department of Health and Human Service

WHO: World Health Organization

%BF: Percent Body Fat

BMI: Body Mass Index

BW: Body Weight

HR: Heart Rate

SBP: Systolic Blood Pressure

DBP: Diastolic Blood pressure

$VO_{2MAX:}$ Maximal Oxygen Consumption per kilogram body weight per minute

JSS: Junior Secondary School

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1.9 OPERATIONAL DEFINATION OF TERMS

Technical terms used in this research are defined below in their operational sense to avoid inconsistency and confusion.

a. JOGGING: This can be defined as a form of aerobic activity embarked upon by the subjects which entails running at a slow or leisurely pace to cover a given distance.

b. AEROBIC ACTIVITY: This is a physical activity of low to moderate intensity that depends on aerobic energy process for generating ATP jogging requiring free oxygen intake.

c. TRAINING: This the act of subjecting or exposing an individual or group of people to a physical activity programme for a period of time to produce favourable effect on the body.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Obesity is a health hazard of epidemic proportion in most developed and developing countries around the world in recent years. The World Health Organization (WHO 1988), estimated that 35% of adult populations in industrialized and developing nations are obese. Obesity is a state of excess body fat, commonly assessed using body mass index (BMI), a ratio of weight (kg) to height (m^2), and a BMI of 30kg/ m^2 is considered obese (WHO, 2000) and (Werner and Sharon, 2007). Therefore, physical activity has a role in managing this epidemic called obesity. Sorof, Lai Turner, Poffenbarger and Portman (2004) presented a longitudinal data from the Muscatine Study in children between 7 and 18 years which revealed that adult blood pressure is correlated with childhood blood pressure and body size. As such, it was noted that obesity was the most important factor affecting blood pressure distribution among youths. More recently, a study of school children between 8 and 13 years of age revealed that the prevalence of elated blood pressure was higher among obese children (Urrutia-Rojas., Egbuchunam., Bae., Menchaca., Bayona, Rivers *et al* 2006). Chiolera, Madeleine, Gabriel, Burner, Paccaud and Bovet (2007) observed that in a rapidly developing country, both systolic and diastolic blood pressure was strongly associated with his or her BMI in boys and girls between the ages of 5 and 16 years.

In recent years, several countries have recognized the importance of regular physical exercise in preventing cardiovascular diseases risk factors like atheroscholoresis, hypertension, osteoporosis, osteoarthritis, low back pain, obesity, overweight, type II diabetes and other lipid profiles and in promoting the quality of life and life span of its

citizens (United State Department of Health and Human Services, 1996). Exercise, a phenomenon that exists from creation targeted at treating diseases has suffered neglect due to negative perception that exercise is for the healthy individuals. This phenomenon starts gaining acceptance in the 20th century. However, it could be seen as an example that, Hippocrates in 1849 wrote that "in a word, all part of the body which were made for active use, if moderately used and exercised at the labour to which they are habituated, becomes healthy, increase in bulk and bear their age well, but when not used, and when left without exercise, they become diseased, their growth is arrested and they soon become old".

Aerobic exercise of moderate intensity has been recommended with particular reference to jogging as the type of aerobic exercise for this research (Werner *et al*., 2007), with minimal training contraindication. Jogging is a form trotting or running at a slow or leisure pace targeted at increasing the fitness status with less stress to the body. It helps to burns calories which help keep the body lean. However, exercise scientist and health fitness professionals have maintained that regular physical activity for preventing disease and premature death and in maintaining a high quality of life has recently received recognition (Haruna, 2000).Regular aerobic physical activity therefore leads to a significant cardiovascular risk reduction by improving lipid profile, especially in children and adolescents who exhibit unfavourable baseline lipid and lipoprotein concentrations (Kang, Gutin, Barbeau, Owens, and Lemmon 2002). Therefore, the study was targeted at assessing the effects of jogging on percent body fat, body mass index, blood pressure, heart rate and maximal oxygen consumption of obese and non-obese adolescents in Numan, Adamawa state, Nigeria.

1.2: Statement of problem

The incidence of obesity among adolescents is a growing modern health epidemic in many developing nations of the world. Cathy, and Sinnott (2011) states that the World Health Organization concludes that "obesity among adolescents and youths is one of the most serious public health challenges of the 21st century" as presented in 2010. It has been estimated that by the year 2020, non-communicable diseases will account for approximately three quarters of all deaths in the developing world (WHO, 1999). In the forefront of these non communicable diseases are obesity, type 11 diabetes and cardio respiratory diseases. In Nigerian society fatness is erroneously said to be associated with good living and that lean body on the other hand is associated with hardship. Emmanuel, (2002) opined that chronic diseases resulting from obesity and overweight are the major causes of death and disability world wide. Inactivity is associated with increase in obesity, body fat, body weight, abnormal fat and deterioration in lipid profiles of adolescents. Time spent engaging in sedentary activities also increases with age and is associated with obesity, atherosclerosis and cardiovascular disease (Kohit, Obert, Holloszy, 1992; Ryan, Nicklas, 1995; Schoenbom, 2002; Calle, Thun, Petreli, Rodriquez and Heath, 1999).

Body compositional changes, including the regional distribution of body fat, are large during puberty transition. The hormonal regulation of the growth spurt in adolescents and the alterations in body composition depend on the release of gonadotropins, leptin, the sex-steroids, and growth hormones. It is very likely that interactions among these hormonal axes are more important tan there main effects, and that alterations in body composition and regional distribution of body fat actually are signals to alter the neuroendrocrine and peripheral hormone axes. These process are merely magnified during pubertal development but likely are pivotal all along the way from fatal growth

to the aging process (Alan., Rogol., James., Roemmich., Pamela, and Clark, 2002). The changes in body composition and cardiorespiratory variables of adolescents could be detrimental to health which could transcend to adulthood later in life.

More so, due to the fast growing incidence of cardiovascular diseases risk factors like obesity, hypertension, diabetes, and overweight, and stress related diseases among adolescents in Numan that are related to unhealthy lifestyle, the researcher sees it as a health challenge that needs urgent intervention . However, the concurrent reduction of multiple risk factors due to various exercise regimes has not been adequately investigated on Nigerian population. More so, to the researcher's best of knowledge, base on the literature search, no study has been conducted on the effects of jogging on body composition and cardio respiratory functions of obese and non obese male and female adolescents in Numan metropolis.

There is a substantial body of research and broad clinical practice on nutritional aspect, but not much has been written about practical physical activity recommendations in the treatment and management of obese youths in Nigeria. Aerobic training like jogging has been proposed as one of the most effective intervention strategies for curbing cardiovascular disease risk factors among adolescents even though the findings are inconsistent (Sillanpaa, Hakkinen, Punnonen, Hakkinen, and Laaksonen, 2009). Active lifestyle involving participation in moderate to vigorous physical activity has been shown to decrease the severity of cardiovascular disease risk (Dikki, 2001).

More so, there has been insufficient research evidence regarding the association between physical behaviour and obesity status among adolescents, especially in Numan, Nigeria. This study therefore, was conducted in order to find out the effects of 8 weeks jogging on body composition and cardio respiratory function of obese and non obese adolescents in Numan, metropolis.

1.3: Research Questions

The study attempts to answer the following research questions.

i. Would there be any effect of jogging on body composition and cardiorespiratory functions of obese and non obese adolescents?

ii. Can jogging cause any modification on obese and non obese male and female adolescents after 8 weeks training session?

1.4: Purpose of the study

The purpose of the study was to determine the effect of aerobic training on:

i. Percent body fat (%BF) of obese and non-obese adolescents in Numan, Adamawa state.

ii. Heart rate (HR) of obese and non-obese adolescents in Numan, Adamawa state.

iii. Blood pressure (SBP and DBP) of obese and non-obese adolescents in Numan, Adamawa state.

iv. Maximal oxygen Consumption (VO_2 max) of obese and non-obese male and female adolescents in Numan, Adamawa State.

1.5: Hypotheses

The following major and sub- hypotheses were tested to guide the conduct of this study.

1.5.1: Major Hypothesis

There are no significant effects of jogging on body composition and cardio respiratory function of obese and non-obese male and female adolescents in Junior Secondary Schools of Numan, Adamawa State.

1.5.2: Sub Hypothesis

i. There is no significant effect of jogging on percent body fat (%BF) of obese and non-obese male and female adolescents in Junior Secondary Schools of Numan, Adamawa State.

ii. There is no significant effect of jogging on body mass index of obese and non-obese male and female adolescents in Junior Secondary Schools of Numan, Adamawa State.

iii. There is no significant effect of jogging in blood pressure of obese and non-obese male and female adolescents in Junior Secondary Schools of Numan, Adamawa State.

iv. There is no significant effect of jogging on maximal oxygen Consumption (VO_2max) of obese and non-obese male and female adolescents in Junior Secondary Schools of Numan, Adamawa State.

v. There is no significant effect of jogging on obese and non-obese male and female adolescents in Junior Secondary Schools of Numan, Adamawa State.

1.6: Significance of the study

The results from this investigation would provide valuable information on the responses of obese and non-obese adolescents to jogging.

The result would also provide beneficial information to physical education specialists, and coaches on how obese and non-obese male and female adolescents respond to jogging.

Fitness experts would benefit from the result in the administration of planned physical activities for the improvement of health- related fitness of adolescents.

The general populace of Numan would be more enlightened on the valuable nature of regular jogging in the prevention of cardio respiratory diseases and to understand the inherent dangers in sedentary lifestyles.

Furthermore, the study would contribute to the existing body of knowledge in the areas of physical fitness of youths, especially to the obese and the application of different training programmes to achieve the desired goals.

1.7: Delimitation of the study

This study is delimited to the following:

i. Male and female obese and non-obese adolescents age 12-15 years in Junior Secondary Schools in Numan metropolis of Adamawa State.

ii. The aerobic training mode used for this research work was jogging.

iii. The training duration was eight weeks.

iv. Each training session lasted for 45 minutes, three times per week on alternate days

v. Effects of jogging body composition (%body fat, and body mass index,) and cardiorespiratory function (blood pressure, heart rate and maximal oxygen consumption) of the clients.

vi. Training intensity maintained at 55-60 % HRmax.

1.8: Limitations of the study

i. Differences in the dietary and lifestyle pattern affect the variable being studied. Though, the dietary habit of the subjects was not controlled due to the facts that they were not camped in a confined environment, they were advised to maintain their diet since they are within the same location, it was assumed that their dietary patterns did not differ significantly.

ii. As training progressed, some of the subjects lost interest due to fatigue and stress. To arose their interest and reduce the dropout rate, some results of the test were discussed with them and they were given the opportunity to ask questions. This helped to boost their interest.

iii. Inadequate literature on obesity among youths was also one of the limitations of this study because most of the studies conducted were on adult obesity.

CHAPTER TWO

2.0: REVIEW OF RELATED LITERATURE

2.1: Introduction

Evidence from recent research has suggested that high levels of adiposity do not represent an impediment to achieving a high aerobic capacity in overweight and obesity or lead to a high energy cost of sub-maximal exercise in obese compared to non-obese youths (Goran, Fields, Hunter, Herd and Weinsier 2000; Rowland, Bhargara, Parslow and Heptulla 2003; Bar-or 2003). Blood pressure is lower in youths than in adults at rest and during sub maximal exercise, but increases progressively later in life.

Although, there is evidence suggesting that obese adolescence do not have impaired maximal aerobic functions, very little is known about their non -steady- state VO_2 dynamics. Slower VO_2 kinetics will lead to a larger requirement for non-aerobic energy, hastening fatigue, which has implications for the ability of obese youths to perform activity. (Whipp 1997). In this chapter, available related literatures on the research topic were reviewed. The review was carried out on the following sub-topics;

2.2 Body composition variables of adolescents;

2.2.1 Percent body fat (%BF),

2.2.2 Body mass index (BMI),

2.3 Cardio respiratory variables in adolescents;

2.3.1 Blood pressure (systolic and diastolic blood pressure),

2.3.2 Heart rate (HR),

2.3.3 2.3.3 Maximal Oxygen Consumption (VO_2max),

2.4 Effects of Jogging on;

2.4.1 Body Composition,

2.4.2 Cardiorespiratory response to intermittent jogging,

2.5 Adolescents participation in physical activity;

2.5.1 Recommended daily levels of physical activity for adolescents

2.6 Exercise prescription for adolescents

2.7 Summary

It has been identified that obesity during childhood is a major health problem in the United State. Pediatric obesity commonly presages adult obesity (Whitaker, Wight, and Pepe, 1997). It is associated with the development of weight-related comoroid conditions and increased morbidity and mortality (Must, Jacques, Dallal 1992, Kuczmarshki, FlegaL, Campbell, Johnson 1994; Must, 1996). Decreased physical activity and a sedentary lifestyle have been implicated as factors in the development of pediatric obesity (Goran, Cower, Nagy, and Johnson 1998). Aerobic exercise is widely accepted and used in the management of obesity. However, there is little information regarding how clinicians should evaluate cardio respiratory fitness in children and also adolescents who are overweight (Epstein, Coleman Myers 1996; Epstein, Goldfield 1999).

2.2 Effect of jogging on body composition of adolescents

Body composition is generally considered to be a health related component of physical fitness which can also be considered as a component of metabolic fitness. Body composition can then be referred to as a relative percentage of muscles, fat, bone and other tissue of the body (Gutin et al, 1998). It is associated with various health

problems which lead to increases in obesity and overweight that is evident in both sexes and the trends being consistent across all ages and socio economic class.

2.2.1 Effect of jogging on percent body fat (%BF) of adolescents

The direct effects of the obese state on heart function, and the means by which excessive body fat might negatively affect cardiac health during the growing years, however, has received less attention. It is well-recognized that cardiac mass and chamber dimensions are increased in the obese adult, which is reflected in a greater resting stroke volume and cardiac output (Alpert and Alexander, 1998). Given sufficient duration and/or severity of obesity, this hyperkinetic state is supplanted by increasing evidence of systolic and diastolic myocardial dysfunction, which may progress to overt clinical heart failure (Alpert, 2001). This cardiomyopathy of obesity appears to be independent of the adverse cardiac effects of coronary artery disease, hypertension, and sleep apnea commonly observed in adults with marked obesity. The cause of this myocardial dysfunction is unclear, but chronic volume overload, insulin resistance, autonomic changes, and local metabolic derangements have all been implicated as possible etiologic factors. Similar information is beginning to emerge regarding the effects of adiposity on cardiac health of children and adolescents. These data indicate trends of diminishing ventricular function in youth related to level of obesity; however, overt myocardial dysfunction is rare, and reserve capacity with exercise is generally preserved. It is the purpose of this review to summarize these reports which have addressed the effects of obesity on cardiac size, function, and reserve capacity (“cardiovascular fitness”) in the paediatric age group. Given the marked rise in obesity in youth, an understanding of the pathophysiological implications of these effects early in the lifespan is clearly important. Such information

underscores the urgency of preventive efforts and serves to help define specific management strategies.

Gutin et al. (1998) reported that among 62 children ages 7 to 13 years, percent body fat correlated negatively with lower mid-wall ventricular shortening fraction (r = -0.37). Mensah et al. (1999) found a significant negative association between mid-wall shortening fraction and central adiposity in black (but not white) subjects in a group of 15-year old subjects. Chinali et al. (2006) found a significantly lower left ventricular ejection fraction in 14-20 year old obese subjects (BMI >95th percentile) compared to a non-obese group.

Becoming obese is an anabolic event. Besides the obvious accumulation of excessive body fat, the obese child is characterized by an increase in lean body mass, acceleration of linear growth, enhanced skeletal maturation, and advanced sexual development (Forbes, 1977). An expanded circulatory system reflects this somatic growth, with increased plasma volume, hypertrophy of myocardial fibres, and cardiac chamber enlargement. Friberg et al., (2004); and Koehler et al., (1997); States echocardiography studies, supplemented by recent MRI investigations, have consistently indicated similar anatomic features in obese children and adolescents. Larger, thicker hearts are seen in obese subjects compared to non obese youth (Mehta et al., 2004; Rabbia et al., 2003). In these studies, those with mild-moderate obesity typically demonstrate approximately 15-20% greater values of cardiac mass (related to body height or surface area) than lean youth. Although comparisons are treacherous, the magnitude of these differences is somewhat less than the 20-40% described in studies of obese adults (presumably reflecting differences in duration of obesity) (Alpert and Alexander, 1998).

2.2.2 Effect Aerobic jogging on body mass index (BMI) of adolescents

Kono et al. (1994) reported a correlation coefficient of r = 0.60 between adiposity and left ventricular mass normalized for height in 6-year old males, while, Rowland and

Dunbar (2007) found a correlation of r = 0.59 between body mass index and left ventricular end diastolic dimension in a group of early adolescent females with a BMI range of 14-63 kg·m-2. The average dimension was 44 mm in those with a BMI of approximately 20 kg·m-2 compared to 52 mm with a BMI of 42 kg·m-2. In the only study which has assessed cardiac features relative to duration of obesity, Rabbia et al. (2003) found that a group of 13 year old obese children had a greater average heart mass than non-obese. However, they could find no significant difference in left ventricular mass among three groups of the obese children with <4, 4-7, and >7 years duration.

Rowland and Dunbar (2007) found a progressive decline in left ventricular shortening fraction with increasing BMI in 39 young adolescent females (r=-0.47). Between a BMI of 20 and 60 kg·m-2, mean shortening fraction fell from 40 to 33 percent. It is important to note that in this study, however, no subject demonstrated a shorting fraction below the lower limit of normal (28 percent).

Despite the fact that it is difficult to define obesity in quantitative terms, obesity is referred to the above average amount of fat contained in the body, this in turned being dependant on the lipid content of each fat cell and of the total number of the cells For example, a BMI greater than $30kg/m^2$ is often considered to indicate obesity (Ashwel, 1997). The basic cause of overweight and obesity is energy in balance in the body (Venkateswarlu, 1990). The energy need and energy expenditure of the body are measured in kilo calories (kcal). A calorie is defined as the amount of heat needed to raise the temperature of 1kg of water 1^0C. The basal metabolic rates (BMR) are the measure of minimal amount of energy needed to maintain vital bodily function in a relaxed, awake and reclined state. BMR varies with age, sex and body size as it is regulated by hormones.

2.3 **Physiological responses to cardiorespiratory variables in adolescents**

George, (2012) states that, the function of almost all physiological systems improves until full maturity is reached or shortly before. After that physiological function plateaus for a period of time before starting to decline with advancing age. Cardiovascular function undergoes considerable change as a child grows. These changes occur during sub maximal and maximal exercise. Blood pressure is lower in children than in adults at rest and during sub maximal exercise, but increases progressively during the late teens. Youths have greater blood flow to active muscle than adults due to there being less peripheral resistance. Since cardiac output (Q) is a product of heart rate and stroke volume, a child's smaller heart size and total blood volume results in a lower stroke volume both at rest and during exercise than in adults. While maximal heart rate is higher in youths than in adults but decreases as they age. Children under the age of 10 years frequently have maximal heart rate of 210 beats per minutes, whereas the average 20 year old has a maximal heart rate of approximately 195 beats per minute (George, 2012)

George, (2012) further opined that the purpose for the basic cardiovascular and respiratory adaptations that occur in response to levels of exercise is to accommodate the muscles need for oxygen. Thus, increase in cardiovascular and respiratory function that accompany growth suggested that aerobic capacity (VO_2max) similarly increases. Studies have shown that the VO_2max peaks between age, the ages of 17-21 years and then decreases with age. Studies of girls have found the same trends, although in females the decrease begins at a much younger age, generally aged between 12-15 years which is thought to come due to an assumption of sedentary lifestyle.

2.3.1 Blood pressure response to aerobic exercise of adolescents

Blood pressure plays a vital role in the way the heart delivers fresh blood, containing the oxygen and nutrients required throughout the body, from the heart to the tiniest

blood vessels within our body from our head to our toes. To get the blood to go that far, fast enough, it has to be under pressure. This pressure is created by the relationship between three things, the heart's pumping action, the size and stretchiness of the blood vessels and the thickness of the blood itself.

Blood pressure is therefore, the force or pressure exerted by the blood on the arteries (vessels walls) which is usually referred to as arterial blood pressure (Heyward, 1998; Wilmore and Costill, 1999). It can also be defined as the force exerted by the blood stream against the walls of arteries that carry blood to various parts of the body. Blood pressure can vary widely. It can rise when you are excited or nervous or while you exercise, or it may become low when you sleep. Most people do not know that blood pressure is high just before they wake up in the morning (6–8 a.m.). It remains at these levels during the day and decreases during sleep. Blood pressure may vary within the course of a day by as much as 20–30 points in someone with "normal" blood pressure and even more in someone with untreated hypertension. The prevalence of hypertension among adolescents in this present dispensation has increased and is consistent with the findings of other studies indicating that BP increases with age (Ejike., Ugwu., Ezeanyika., and Olayemi 2008). The implecation of this observation is disturbing, granted that adolescents who are obese are at great risk of high blood pressure at adulthood and the possibility of developing cardiovascular diseases later in life (Monyaki., and Kemper 2008).

Thus, blood pressure is recorded in two numbers as millimetres of mercury (mm Hg).

For example:

120 mm Hg systolic (pumping pressure)

80 mm Hg diastolic (resting pressure)

Blood vessels have a layer of spiral muscle within their walls, which makes them able to widen or narrow depending on how much blood each part of the body requires. The

action on these muscles is a very complex mechanism controlled partly by hormones. Blood pressure can be compared to a central heating system. Three vital components work together to make the system work: the boiler (heart), the pipes (blood vessels) and the hot water (blood). The radiators are the different organs and parts of the body. The highest pressure (systolic BP) reflects the pressure in the arteries during systole of the heart when myocardial contraction forces a large volume of blood in the arteries, which exerts high pressure on the arterial walls and corresponds to ventricular systole of the heart (Heyward, 1998). While the lowest pressure (diastolic BP) represents the lowest pressure in the artery, corresponding to ventricular diastole when the heart is at rest (Wilmore, and Costil, 1999).

2.3.1a: Systolic blood pressure (SBP)

Systolic pressure is the highest pressure, in your arteries and occurs when your ventricles contract at the beginning of your cardiac cycle. Systolic Blood pressure (SBP) will rise in a pattern very similar to that of the cardiac output. There is an initial rapid increased and a subsequent levelling off once steady state is achieved. The increased in systolic blood pressure is brought about by the increase in cardiac output.

2.3.1b: Diastolic blood pressure (DBP)

Diastolic pressure refers to the lowest arterial pressure, and occurs during the resting phase of your cardiac cycle. Diastolic blood pressure (DBP) remains relatively constant because of peripheral vasodilatation, which facilities blood flow to the working muscle. The small rise in systolic blood pressure and the lack of significant change in diastolic blood pressure causes the mean arterial pressure (MAP) to rise only slightly.

According to the most recent report (issued 2003) by the Joint National Committee (JNC) on Prevention, Detection, Evaluation and Treatment of High Blood Pressure, the following guidelines apply for determining whether you might suffer from hypertension:

Blood Pressure Classification	Systolic	Diastolic

Normal	<120	and	<80
Pre-hypertension	120-139	or	80-89
Stage 1 Hypertension	140-159	or	90-99
Stage 2 Hypertension	≥160	or	≥100

Toriola (1984) states that increase in stroke volume results for an increase in venous return, which in-turn increase, the left ventricular end - diastolic volume (LVEDV) preload. The increased preload stretches the myocardium and causes it to contract more forcibly. Contractility of the myocardium is also enhanced by the sympathetic nervous system, which is activated during physical activity. Thus, an increase in the left ventricular end- diastolic volume and a decrease in the left ventricular end - systolic volume (LVESV) account of the increase in stroke volume during high to moderate dynamic exercise. Heart rate increase immediately at the onset of activity as a result of parasympathetic withdrawal. As exercise continues, further increases in heart rate are due to the action of the sympathetic nervous system (Klafs and Arnheim, 1981). Myocardial oxygen consumption increase due to aerobic exercise since the heart must do more work to pump and increase cardiac output to the working muscles. The blood pressure product will increase in relation to increase in heart rate and systolic blood pressure, reflecting the greater myocardial, oxygen demand of the heart during exercise. Males and females display the same pattern of response for blood pressure; however, males tend to have a higher systolic pressure than females at the same relative workload. Much of the reference in the magnitude of the blood pressure response is attributed to differences in resting systolic blood pressure. The diastolic blood pressure response to such maximal exercise is very similar for both sexes. Thus, mean arterial blood pressure is slightly greater in males during sub-maximal work at the same relative workload. The pattern of response for resistance is similar though, males typically have a lower resistance owing to their greater cardiac output. Males and females both exhibit cardiovascular drifts during heavy, prolonged sub maximal exercise (Malian and Bochard 1991, and Ogawa and Sprain 1992).

The pattern of cardiac output response to sub-maximal dynamic exercise is similar in children, adults with cardiac output increasing rapidly at the onset of exercise and levelling off when steady states is achieved. However, children have a lower cardiac output than adult at all level of exercise, primarily because children have a lower stroke volume than adults at any given level of exercise. The lower stroke volume in children is compensated for by a higher heart rate. And like volume in girls is less than the boys at all levels of exercise (Bar or, 1989: Rowland 1990). With much fat our bodies accumulate as we grow and age, depend on our individual dietary and exercise habits in addition to our heredity. The amount of relative body fat increase with age after physical maturity. This is largely due to the following three factors that occur with aging, increased dietary intake, decrease physical activity and reduced ability to mobilize fat (Wilmore, 1999). Blood volume decreases during dynamic aerobic exercise. The largest changes occur during the first 5 minutes of exercises which is consistent with short-term exercise. Following the initial rapid decrease, plasma volume stabilizes. This suggests that it is fluid shift, rather than fluid loss, the account for the initial decrease in plasma volume. The magnitude of the decrease in plasma volume is dependent upon the intensity of the exercise, environmental factors and hydration status of the individuals (Fortney and Gary, 1981, Wade and Freund, 1990).

Clark (1975) affirmed that the stroke volume increase rapidly during the first minutes of exercise and Plateaus at maximal level after a workload of approximately 40% - 50% of VO_{2max} has been achieved. Thus, during work that requires more than 50% of $VO_{2max,}$ the stroke volume response is not intensity – dependent. So, stroke volume remains relatively constant during the first 30 minutes of heavy exercise. However, if exercise continues beyond proximately 30 minutes, stroke volume gradually drifts downward although it remains elevated above resting values. This is most likely due to thermoregulatory stress and a redirection of blood to the cautious vessels in attempts to

dissipate heat. This effectively reduces venous return and thus course the shifts reduction in stroke volume (Rowell, 1990). During prolonged exercise particularly if performed in the heat, there is a continuous loss of total body fluid owing to profuse sweating. Total body water loss during long duration exercise varies from 900 - 1300 ML/ hr, depending upon work intensity and environmental conditions. If fluid is not replaced during long duration exercise, there is a continued reduction in plasma volume throughout exercise (Rowland, 1990; Wade and Freund, 1990). Dikki (1997), viewed that exercise can be used as a form of therapy in the process of treatment, prevention and rehabilitation of a wide range of disorders and problems both physical and mental. It will reduce the effect of degenerative diseases and could be preventive in nature. It is an aspect that cannot be neglected in the life of an individual.

2.3.2 Effects of jogging on heart rate of adolescents

Regular physical exercise is an important factor to reduce the indexes of cardiovascular diseases risk factors and all causes of morbimortality (Blair et al, 1995; Centres for Disease Control, 1990). Pearson et al (2002) opined that Heart rate (HR) is mediated primarily by the direct activity of the autonomic nervous system (ANS), specifically through the sympathetic and parasympathetic branches activities over the sinus node autorhythmicity, with predominance of the vagal activity (parasympathetic) at rest that is progressively inhibited since the onset of the exercise. Myer et al (2002), states the HR behaviour has been widely studied during different conditions and protocols associated to the exercise. A reduction of the cardiac vagal tone (parasympathetic function) and consequently a diminished HR variability in rest, independently of the protocol of measurement used, is related to an autonomic dysfunction, chronic-degenerative diseases and increased mortality risk. Individuals with high levels of aerobic condition have a lower resting HR, along with a larger parasympathetic activity or smaller sympathetic activity, but it is not necessarily a direct consequence of the

exercise training, as long as other inherent adaptations to the aerobic conditioning can influence the resting HR (Paffenbarger et al, 1996; Tanasescu et al, 2002). The HR response in the onset of the exercise represents the integrity of the vagus nerve, and the HR recovery on the post-exercise transient also denotes important prognostic information; by the way, individuals that have a slow HR recovery in the first minute post-exercise have increased mortality risk (Kraus et al 2002).

Regular physical exercises is an important factor to reduce morbidity and mortality rates of cardiovascular and all other conditions (Blair et al, 1995; Centres for Disease Control, 1990); there also seems to have further and independent benefits from the practice of physical exercises and improvement of the aerobic condition (Myer et al 2002; McGinnis and Foege, 1992), which speaks for their being practiced more and more frequently. The American Heart Association recommends individuals to practice physical exercises in most days of the week, every day if possible, with intensity ranging from moderate to strenuous, according to their physical capability, for a period of 30 minutes or more (Pearson et al 2002). Even though moderate exercises enhance health conditions, there are recent and consistent evidences that high intensity or strenuous exercises have even more significant positive effects on lipid profile (Kraus et al 2002), reducing up to two times mortality rates over a decade (Paffenbarger et al, 1996; Tanasescu et al, 2002). Acute and chronic effects of physical exercises on the human body have been targeted by many researches over the last few decades (Nottin et al, 2002; Ekblom et al, 1968), and are identified as responses to exercise, such as higher HR at the initial transient of the exercise, and adjustments to training, with a lower HR for the same intensity of sub maximal exercise, respectively. Because it is easy to measure, heart rate (HR) behaviour has been extensively studied under different exercise-related types and conditions. HR is primarily controlled by direct activity of the autonomic nervous system (ANS), through actions on its sympathetic and

parasympathetic branches on the sinus node autorhytmicity, especially resting vagal activity (parasympathetic), which is progressively inhibited since the exercise was started (Ekblom, and Hermansen, 1968), and sympathetic when exercise intensity is further incremented.

2.3.3 Effect of jogging on maximal oxygen consumption (vo_2max) of adolescents

Two studies have evaluated cardiac output responses to maximal exercise in obese youth. Rowland and Dunbar (2007) performed progressive cycle tests on 39 girls with a BMI ranging from 14 to 63 kg·m-2, estimating cardiac output by Doppler echocardiography. Maximal cardiac output and stroke volume were directly and linearly related to BMI, with no evidence of a decrement in this relationship at high levels of obesity. Cardiac scope (maximal value expressed as a multiple of that at rest) was approximately 2.7 for those with a BMI of 20 kg·m-2 and 3.1 for those with a BMI >40 kg·m-2 (who had been significantly obese since very early childhood). From these findings one arrives at the unexpected (but valid) conclusion that in an absolute sense, true cardiovascular fitness is superior in the obese compared to non-obese. When expressed as ability to improve cardiac function above the resting state, the two groups were similar. Importantly, these findings indicated no effect of obesity, even those of 10 years' duration with BMI>40kg·m-2, on cardiac functional capacity (i.e., true cardiovascular fitness).

Giordano et al. (2003) used the acetylene re-breathing method to compare cardiac responses to peak treadmill exercise in 24 obese males (mean age 11.9 ± 2.1 years, BMI 32.4 ± 5.8 kg·m-2) and age matched lean control subjects. No difference was observed in absolute values of maximal cardiac output for the two groups (obese 11.5 ± 4.1 L·min-1, lean 10.8 ± 3.5 L·min-1), and values were also similar when adjusted for height1.83. More information is available from studies, which have assessed VO_2max in obese youth, which can be interpreted as a surrogate of maximal cardiac output.

Reflecting the larger diastolic dimension, stroke volume, and cardiac output at rest, absolute values of VO_2max are greater in obese compared to non-obese subjects. Rowland (1991) described a close correlation (r = 0.72) between VO_2max (L·min-1) during treadmill testing and skinfold sum in 27 obese adolescent females. When VO_2max was expressed relative to body mass the reverse trend was observed (r = -0.49). Other researchers have mimicked these findings. Maffeis et al. (1994) showed that obese children had a significantly greater absolute VO_2max compared to non-obese subjects (1.55 ± 0.29 and 1.23 ± 0.22 L·min-1, respectively), but this difference was eliminated when values were expressed relative to fat free mass. Similarly, Goran et al. (2000) reported higher absolute VO_2max in obese versus non-obese children during treadmill exercise (1.56 ± 0.40 versus 1.24 ± 0.27 L·min-1) but the two groups had no significance difference when VO_2max was expressed relative to fat free mass (59.2 ± 4.9 and 57.9 ± Cardiac effects of obesity 324 5.8 ml·kg·FFM-1). Similar findings have been reported in obese youth by Ekelund et al. (2004), Treuth et al. (1998), and Marinov et al. (2003). These data are consistent with the conclusion offered by Goran et al. (2000): VO_2max is most closely related to lean body mass but not fat mass; the lower VO_2max in obese subjects is an expression of metabolically inert fat mass in the per kg denominator. Consequently, the negative correlation observed between VO_2max per kg and degree of obesity does not reflect cardiac dysfunction. In fact, to the contrary, this research information suggests no significant impairment of myocardial functional reserve capacity in obese youth.

2.4 Effects of jogging on cardiorespiratory response of adolescents

The normal resting heart rate is said to be 72 beats per minutes (bpm). However, resting heart rate of 50 to 80bpm are common. People who regularly do physical activity have lower resting heart rate than those who don’t (Venkateswarlu,1996; Dikki,1997; Heyward,1998). Thompson, Goodroe, Johnson and Lambert (1991), studied the

changes of VO_2max , HR frequency, systolic arterial blood pressure, diastolic arterial blood pressure and accumulation of lactates in the blood under the influence of two different aerobic dance programmes. One of the groups only realised the aerobic dance, while, the other group in addition to the aerobic dance programme took upper strength exercise using weight of around .5kg. The subjects who did aerobic dance with weight achieved better results, but there were no difference in the values for heart rate frequency arterial blood pressure and lactate between the two groups (Wayo, 2012).

Similarly, Kostic and Zagore (2005) compared the effects of two high and low aerobic models on cardiovascular fitness of women. The first group exercised for eight weeks, three time a week for a period of 50minutes. The second group also exercised for eight weeks but five times a week, for a period of 35minutes. The intensity was the same for both groups and ranged from 60% to 75% of maximal heart frequency. The evaluation of cardiovascular fitness was carried out by the means of the following variables; RHR, HR under strain, systolic and diastolic arterial pressure and absolute relative oxygen uptake. The results indicated that there were statistically significant differences between the two groups in the initial and final measurement and that the variables; RHR, and relative oxygen uptake were the greatest contributors of the differences. It was concluded that the effects of both aerobic dance models in cardiovascular fitness was positive if the exercise is realised continuously over a long period of time (three times a week for 50mimutes) or if the exercise takes place five times a week, for 35minutes.

Following various research recommendations by different authors, exercise programmes should consist of interval or continuous sessions with an intensity of 50% for beginners up to as much as 80% of the maximal oxygen uptake or heart frequency for the more advanced. The exercise should occur with a frequency of at least three

times a week for a period of 30 to 40minutes. This kind of exercise bring about maximal oxygen uptake, heart volume, maximal minute heart volume and decreased blood pressure, or in a word, general improvement of the body (Astrand, 1999; Dikki,1997; Gwani, et al 1997; Haruna,2006; and Venkateswarlu,2010;2011).

ACSM (1998), recommended that all those who like to maintain and improve their cardio respiratory abilities, should exercise three to five times a week with the use of rhythmic, aerobic activities(walking, jogging, running, bike riding, using stationary bikes aerobic dance etc) which activate large muscles in the human body. The intensity of exercise should be from 55/65% to 90% of maximal heart rate frequency and the duration from 20 to 60 minutes. If the intensity of the exercise is smaller than the recommended maximum heart rate frequency values, the duration of the exercise should be increased. To achieve the recommended guide for exercise, the need to outline the principles of exercise prescription is necessary.

2.5 Adolescents participation in physical activities

Recent findings suggest that physical inactivity is common among Canadian children and youth. The results of the 2000/01 Canadian Community Health Survey (CCHS) indicate that more than half (56%) of Canadian youth aged 12-19 are physically inactive. The Canadian Fitness and Lifestyle Research Institute (CFLRI) estimates that as much as 82% of this population may not have been active enough to meet international guidelines for optimal growth and development. This trend toward inactivity in children may be going unnoticed by parents and caregivers. A 2002 Environics survey conducted for the Canadian Paediatric Society found that a majority (60%) of Canadian adults with children between 6 and 14 years of age believe that their children are adequately physically active. In addition, 66% of those with children in the home agree that their children have enough time and opportunity to be physically active

while at school. The media attention given to childhood obesity since these studies may have increased parents' awareness of the importance of physical activity;

none-the less, these findings bear consideration given that parental support and modelling are key factors in the physical activity of children and youth (Bois, Sarrazin, Brustad, Truilloud, and Curry, 2005)

Venkateswarlu, (1990). Asserts that children lack sustained and relatively high intensity exercise to improve their aerobic capacity (VO_{2MAX}) when expressed in L/min, is lower in children than in adults at similar level of training. This is due primarily to the child's lower maximal cardiac output capacity. When VO_2max values are expressed to reflect the difference in body size between children and adult, there is little or no difference in aerobic capacity. While anaerobic capacity is lower in children than adult which simply might reflect children's lower concentration of the key rate - limiting enzymes phosphocreatinkinase (Wilmore, 1999). Physical activity during childhood and adolescence is thought to positively affect a number of factors related to the risk for chronic disease later in life. While conclusive evidence is still lacking, potential benefits have been observed in some short-term cross sectional studies and also in controlled interventions involving children engaged in specific physical training programmes. There is also evidence, in some cases, to suggest that these benefits track into adulthood, thereby reducing chronic disease morbidity and mortality. Potential health benefits of physical activity include reduced risks of obesity, cardiovascular disease, diabetes and osteoporosis. Physical activity may also result in enhanced academic performance and psychosocial benefits.

Venkateswarlu (1974). In a study of physical fitness of selected school children of Madras city, states that trained children were better in aerobic and anaerobic work than the untrained. He stressed therefore, that the key to cardio respiratory fitness is physical training across all age groups. Also, the fact that childhood over weight is a major

cause of low fitness and cardio vascular disorder has become primary health problem of those in authority (Gunen, 1996). Therefore, there is a general agreement from epidemiologist and exercise scientist that children should have more moderate to vigorous physical activity (MVPA) based on the rational that children are not fit as they should be, more children are becoming over weight and the sure fact that children who participate in MVPA are more likely to participate in such activity as adults (Venkate swarlu, 1990; Gunen, 1996) in (Steve 2004). In healthy young athletes, the risk of sudden cardiac injury or death during participation in sport or exercise is very small. This is due to the fact that children involvement in endurance sport such as running or swimming improves their maximal aerobic power comparable to adults and shows no indices of damage to the cardio pulmonary system. (Ingjer, 1992; and Rowland, 1992).

2.6: Recommended daily levels of physical activity for adolescents

Physical activity guidelines specifically targeted for children and youth are a relatively recent development. Before the early 1990s, physical activity levels in children were often assessed against adult guidelines without consideration of the inherent differences in activity patterns between children and adults. Observational studies of children suggest a typical pattern is very short bursts of intense physical activity interspersed with varying intervals of low and moderate intensity physical activity. Most adult-centred physical activity guidelines (past and present) do not reflect this reality and, as a result, are not valid comparative standards for children and youth. Determining the level of physical activity needed to optimize growth and development in children and youth has been the subject of considerable discussion over the past 5 to 10 years. The growing awareness that children are likely not active enough to support health and wellness has driven the development of physical activity guidelines by governments and non-governmental organizations around the world (Bois et al, 2005). Some areas of

consensus can be found amongst the differing recommendations. These areas include general agreement on the following:

- Children and youth should accumulate at least 60 minutes of physical activity on a daily basis.
- Much of a child's activity will be accumulated through short bouts rather than continuous activity. To accrue optimal benefits, as much as 50% of the accumulated minutes should be in bouts of 15 minutes or more.
- Children and youth should engage in a variety of different types and intensities of physical activity.
- Children should be encouraged to participate in a wide range of activities, including lifestyle activities (e.g., walking to school, yard work), sports, aerobic activities (e.g., cycling, running, jumping), muscular strength and endurance activities (e.g., climbing, jumping, lifting) and flexibility activities (e.g., stretching, dance, reaching).
- Children and youth should be actively encouraged to reduce the amount of time spent engaged in sedentary activities.
- Extended periods (e.g., two hours or more per day) of time spent on sedentary pursuits (e.g., television viewing, computer use) are associated with decreased physical activity levels and an increased risk of overweight and obesity.
- Children and youth should participate in activities that are age appropriate

(e.g., playground games, cycling, dance, martial arts, swimming, cross-country skiing, walking to school, some chores and yard work). While it is useful to note these areas of general agreement, it is essential to recognize that current guidelines for physical activity in children and youth lack a strong empirical or experimental base.

Additional study is needed to establish activity guidelines that are truly evidence-based. Guidelines for optimum physical activity levels in children and youth must recognize that children are not "little adults." Natural patterns of activity in children vary

considerably from those observed in adults. Moreover, physical activity offers children benefits that, in some cases, differ from those that accrue for adults, such as development of basic motor skills. The past decade has seen the rise of physical activity recommendations that recognize age-related differences in physical activity requirements. As a result, it is now possible to compare children to standards that better reflect their unique needs (Sallis, and Patrick, 1994).

2.7: Exercise prescription

Wilmore and Costill (1999) asserts that exercise prescription involves four factors which are: The mode of exercise, frequency of participation, duration of exercise bout, and intensity of the exercise bout. Before examining the components of exercise prescription, it is important to note how much exercise is effective. A minimum threshold for frequency, duration, and intensity of exercise must be reached before any aerobic benefits are obtained. Furthermore, minimum threshold vary widely, making individualized exercise prescription necessary.

2.7a: Mode of exercise

The prescribed exercise programmes should focus on one or more modes, or type of cardiovascular endurance activities. Traditionally, the activities prescribed most frequently are as follows: Walking, jogging, running, hiking, cycling, rowing and swimming. However alternates activities that seem appealing have been identified which also help to develop similar cardiovascular endurance gain. They include aerobic dance, box or bench stepping and most racquet sports.

2.7b: Frequency of exercise participation

The frequency of training refers to how often you participate in a training programme each week. It complements duration and intensity. It is obvious that the more often an individual trains, the greater the total caloric expenditure per week. Research shows that exercising 3 days per week on alternate days (Heyward, 1998; Pollock, Wilmore, and Fox, 1990) or in general 3 to 5 days per week (Williams, 2007) or probably all days of the week (Pate, Pratt, and Blair, 1995 will produce virtually the same effect. However, several studies in prescribing exercise have often placed less emphasis on frequency of training stimulus than on intensity or duration (Powell, Thompson, and Casperon, 1987; Sjodin, Forshund and Westerp 1996) because in reality, training regimen should continue throughout life rather than just for a few weeks.

Pollock, William and O'Connor (1993) carried out a study of a group of youths who trained for either 3 days per or 5 days per week for 8 weeks. The result revealed that the group with a frequency of 3 days per week experienced higher adaptations to training than the 5 days per week group within the first 5 weeks of taining. However, the total energy expenditure was greater for the latter group. Also, data from young men running 30 minutes, 5 days per week showed that they incurred injuries at a significanty higher rate than they were on a 3 days per week programme with 15 and 30 minutes duration (Shinkai, Wantannabe, Kurokwa, and Shephard 1994; Shephard, and Astrand, 1992). Thus, frequency is related to intensity and duration of exercise, and varies, depending on training goals, subject's age, fitness status, and preference (Heyward, 1998; Nieman, 1998). The ACSM (1986) recommended that normal sedentary individuals should train 3 days per week on alternate days to produce significant changes and as the fitness level improves, a 5 day frequency is recommended for continued improvements.

2.7c: Duration of exercise bout

Duration is the amount of time spent during an exercise session. It is closely related to intensity. Both of them play an important modifying role on the fitness status of subjects. The ACSM (1998) recommended 30 to 45 minutes of aerobic exercise, proceeded by 5 to 10 minutes of warm up and followed by 5 to 10 minutes of stretching. However, Haes (2007) said experts have found similar health benefits from a single 30-minutes session of moderate exercise as from shorter sessions through out the day. Pollock, Wilmore, and Fox, (1990) opine that low to moderate intensity, longer duration, types of programmes are generally recommended for beginners.

Although research has recommended 5 to 10 minutes of exercise per day, recent research has also indicated that 20 to 30 minutes per day is an optimal amount. Again, optimal is used here to reflect the greatest return for time refers to the time during which you are at your appropriate exercise intensity. Improvement in aerobic capacity are gained with either a short duration, high intensity programme or a long duration, low intensity programme if the minimal threshold is exceeded for both duration and intensity. Similarly, benefits are also gained whether the daily endurance training session is also conducted in multiple shorter bouts (e.g. three 10 min bouts) or a single long one (e g., as single 30 min bout). Exercise session should begin at a lower intensity and progresses more slowly every 1 to 2 weeks allowing time for adaptation (Has, Feigenbaum, and Franklin, 2001).

2.7d: Intensity of exercise bout

Intensity refers to the demand placed on the body system, especially the cardiovasculay system by the training programme. It dictates the specific physiological and metabolic changes in the body during exercise (Heyward, 1998; Hales, 2007; William, 2007).

Training intensity varies with the type of exercise and with persona goals, age, and fitness level of subjects. It should stress but not over-tax the cardiopulmonary system (ACSM, 1996; Hales, 2007). To improve cardio respiratory fitness, the subject at a minimum, needs to increase his/her heart rate to a target zone, i.e. the level that produces benefits. Activities of moderate intensity burn 3.5 to 7.0 calories per minutes e.g. brisk walking, dancing, and bicycling. While activities of vigorous intensity like jogging, and cycling, burn more than 7 calories per minutes. The more rigorous the activity, the less time needed to burn the same number of calories (Hales, 2007; William, 2007). The influence of intensity of training on different body variables is of interest to exercise physiologist and thus, there is a consensus on the minimum intensity of exercise below which no training effect is produced (Pollock, Wilmore, and Fox, 1990; Shephard, and Astrand, 1992).

Although, intensity and duration are different entities, it is difficult to discuss any of them without mentioning its interaction with the other. Usually, a training programme which elicits improvements in cardio respiratory endurance and fat metabolism is either of low intensity, longer duration or high intensity, shorter duration in nature (Heyward, 1998). The former, which is appropriate for beginners and sedentary but healthy individuals with low cardio respiratory fitness, has been found to cause significant changes in VO_2max, and heart rate (Rowland, 1991). The intensity of the exercise bout appears to be the most important factor. This entails the exhaustive workout an athlete endures to condition him for a particular sport or event. It is evident that a substantial training effect can be accomplished in some people by training at an intensity of 45% or less of their aerobic capacities. However, the most appropriate intensity appears to be at least 60% VO_2 max (Rowland, 1991).

2.8: Summary

In chapter 2 above, the researcher consulted relevant literatures to enhance this study. It was evident that various researchers have shown interest and worked on the effect of jogging on obese adolescents with varying views to the response of the adolescents to different training modes in respect to their body composition and cardio respiratory variables. However, research of this nature was never conducted and no result presented in Numan and its environs before now.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1: Introduction

The purpose of this research was to determine the effects of jogging on body composition and cardio respiratory functions of male and female obese and non- obese adolescents in Numan, Adamawa State. To achieve the purpose, the research design, population, sample and sampling techniques, the research instruments, procedure for data collection, training protocols, and the statistical techniques used in this study are described in this chapter.

3.2: Research design

For the purpose of this study an experimental design using one group repeated trials research design was used as suggested by Ryan (2012). In this design, one group was given different treatment at different times. The base line assessment serves as control while the 4^{th} and 8^{th} weeks were the experimental manipulation. The design was to maximize the between treatment variance, identify the between units variance and to minimize the error variance. In this study, 80 subjects adhered to the appeal of the researcher (40 males and 40 females). The 1x2x2x2 factorial design was also used. This implies that there was 1 training mode (jogging), 2 sexes (male and female), 2 groups (obese and non – obese) adolescents and 2 variables, which were body composition and cardiorespiratory functions. Pre-training, mid-training and post-training assessments were made during the research period.

Table 3:2:1: The factorial Research design.

Training prgramme	Sex	Status	Body composition		Cardiorespiratory function			
			%BF	BMI	SBP	DBP	HR	VO_2max
Jogging	Male	Obese						
		Non-obese						
	Female	Obese						
		Non-obese						

KEY: %BF= percent body fat; BMI= body mass index; SBP= systolic blood pressure; DBP= diastolic; HP= heart rate; VO_2max= maximal oxygen consumption.

3.3: Population

The population for this study comprised of 570 male and female students of Junior Secondary Schools in Numan metropolis. Out of which 88 students who volunteered and exhibited obese tendencies were included for this research. A total of 80 students successfully completed the training programme and their data were analysed.

3.4: Sample and Sampling technique.

A stratified random sampling technique was used to divide the participants (all junior secondary school students) by age, gender, and school location in Numan metropolis. Screening of the weight and height of the participants was carried out to establish their BMI (weight (kg) divide by height (in meter squared).

Using the purposive sampling, only students who were either normal (18.5-24.9) or obese (25.0-29.9) were selected by age and gender. They were briefed on the goals and objectives of the study and using the simple random sampling technique, the participants were selected from five junior secondary schools in the metropolis. It was not feasible to get representative sample, for the study sample was based on willingness and cooperation of the targeted subjects to participate in the research. However, 8 students decline from participation in the study and were therefore excluded. So, 80 students (40 males and 40 females) completed the study and were measured. Specifically, those who were 12 to 15 years, no disabilities, and were not suffering

from any ailment that could impair anthropometric and physical fitness measure were included in the study. Also only those present on the day of measurement were included.

3.4.1: Inclusion criteria

The subjects were screened by gender for weight and height on the basis of which their BMI was computed as weight divided by height (in metres squared). Only those subjects who met the following criteria were included in the study.

a. Adolescents whose BMI were normal (18.5-24.9) or obese (25.0-29.9).
b. Born and raised in Nunan metropolis.
c. Must be in junior secondary school in Numan metropolis.
d. Adolescents between the ages of 12 to 15 years.
e. Were physically present at school on the day of measurement.

3.4.2: Exclusion criteria

Exclusion from the programme was based on:

a. Medical (health) record of the subjects from a medical centre or Numan General Hospital certified to be ill.
b. Any one with physical disability that could impair anthropometric measurement.

Table 3.4.1: Frequency distribution of the subjects on age, sex, and status.

AGE	MALE		FEMALE		TOTAL
	OBESE	NON-OBESE	OBESE	NON-OBESE	
12yrs	5	5	4	5	20
13yrs	5	5	5	5	20
14yrs	5	5	6	6	20
15yrs	5	5	5	4	20
TOTAL	20	20	20	20	80

3.5: Instrumentations

The researcher used the following instruments for data collection:

i. **Weighing Scale**: A portable bathroom type Hanson scale model R1S01A.

ii. **Stadiometer:** The Holstein stadiometer with two metal planes set at right angle to adjustable pointed arrow head; model NJ07072 by Pfister Inc USA.

iii. **Skin fold callipers:** The Lange skinfold calliper model made in Pakistan.

iv. **Stethoscope and Sphygmomanometers:** The UNESCO International made Sphygmomanometer and stethoscope by Ypsilanti Michigan, No. 481179.

v. **Stop watch:** The researcher used a stop watch while taking the resting heart rate measurement of the subjects.

3.6 Order of assessment

The following order was followed during the assessment of body composition and cardio-respiratory variables of the subjects;

BODY COMPOSITION VARIABLES

Percent body fat (%BF):

Body mass index (BMI):

CARDIO RESPIRATORY VARIABLES

Resting blood pressure (SBP and DBP):

Resting heart rate (HR):

Maximal Oxygen Consumption (VO_2max).

3.6.1: Measurement procedure for body composition variables

1. Percent body fat

Using the sum of the skinfolds by sex, the following Percent body fat equation for adolescents and children were used (Sharon, and Denise, 2008)

Skinfold measurement: Skinfolds is defined as the double thickness of skin plus the adipose tissue between the parallel layers. For the purpose of the study and convenience, the researcher used the multicomponent model developed by Slaughter (1988) for both male and female, the sum of triceps skin fold, and calf skinfold was taken and multiplied by 0.735 plus 1.0 for male and 0.610 plus 5.0 for female children respectively to estimate percent body fat of the subjects. The Slaughter, (1988) several skinfold equations for estimating percent body fat of youth used the sum of two different skinfold combinations:

a. Sum of Triceps and Calf skinfolds for boys
b. Sum of Triceps and Subscapular skinfold for girls (Slaughter, (1988), and (Sharon, and Denise, 2008)

The sex-specific sites of skinfold measurement were developed with the multicomponent model and are recommended for use with children of any age or ethnicity. These formulas are as follows:

%BF = (0.735 x Triceps + Calf) + 1.0 (male) and

%BF = (0.610 x Triceps + Calf) +5.0 (female).

2. Body mass index

The participants BMI used assessed by using the quetelet index measuring their weight (kg) divide by height (in meter square). (Plowman and Smith, 1997) and (Bray, 1988).

i. Weight: A portable bathroom, types Hanson scale, model R1S01A made in Ireland was used to measure the subjects' weight to the nearest kilogram with the subject wearing very light cloths and no shoes (AAHPERD: 1990).

ii. Height: The subjects' heights were measured while at a standing position (erect) looking straight ahead and bare footed against the stadiometer. A horizontal steel bar rested on the head of each subject against the instrument. There height reading was to the nearest centimetre. The height and weight measured was used to calculate the body mass index (BMI) using the quetelet index (-weight (kg) divide by height in meters squared)

3.6.2 Measurement procedure for cardiorespiratory variables of children

i. Resting heart rate

Heart rate can be defined as the volume of blood ejected from the ventricles with each beats, expressed in, millilitres of mercury (mmHg). The researcher measured the resting heart rate of each subjects before and after the training programme using the palpation

method. This was carried out when each subject was comfortably seated. The tester placed the top of the middle and index fingers on the wrist. The stop watch was simultaneously started with the pulse beat counting the first beat as zero then for thirty (30) seconds which was later multiplied by two. While palpating the carotid sites, care was taken not to apply to much pressure as baro- receptors at the carotid arteries will tend to detect such heavy pressure and react by causing a reflex, slowing down of the heart rate (Powers and Howler, 2007). The Karvonen formula of predicting heart rate maximal (220 – age of subject) was used to determine the training intensity for each subject. To estimate the maximal heart rate using the Karvonen formuar (Chado, 2011), the age of the individual has to be known. To estimate the target exercise heart rate for progression, the researcher used the Karvonen's formula thus;

Target exercise heart rate = HRmax ($b \cdot m^{-1}$) x % of HRmax (expressed in decimal) or

TE x HR = HR x % HRmax.

However, maximal heart rate measurement for obese subjects was determined using the formula; Maximal heart rate ($b \cdot min^{-1}$) = 200 – [0.5 x age (yrs)] (Miller, Wallece, and Egger 1993).

ii. Resting blood pressure:

Blood pressure is the measure of the force or pressure exerted on the blood arteries. The highest pressure is the systolic pressure which represents the pressure in the arteries during systole of the heart, (when myocardial contraction forces a large volume of blood into the arteries). Following the systole, the arteries recoil and the pressure drops during diastole or the filling phase of the heart (Werner, W. K, H., and Sharon, A. H., 2007).

The following procedure was used to measure the systolic and diastolic blood pressures of the subjects with a stethoscope and a sphygmomanometer thus:

a. Each subject was asked to seat on a comfortable chair with elbow slightly flexed;

b. The cuff was firmly wrapped around the upper arm at the levels of the heart align the arrow on the cuff with the brachial artery;

c. The stethoscope was placed below the antecubital space over the brachial artery and the cuff was quickly inflated to a pressure of 200 mmHg;

d. Then pressure was slowly released at a rate of 2-3 mmHg/sec noting and recording when the first korotkoff sound was heard, which represent the systolic pressure and the slow reduction of pressure continued until the sound disappears which was recorded to represent the diastolic pressure.

iii. Maximal oxygen consumption (VO_2 max) measurement:

Exercise scientists consider the VO_2max to be the most valid measurement of the functional capacity of the cardio respiratory system. The 12 minutes- run/walk test have been found to be highly correlated to VO_2max r = 0.90 (Hayward, 2004). So, the 12 minute run walk test was used to measure the VO_2max of the subjects before and after 8 weeks of training. During the test the subjects were divided into groups according to sex and each subject was assigned a lap scorer, who recorded the number of laps each subject covered at the end of the 12 minutes on a 400 meters standard track. Each group was assembled at the starting point where they were instructed to run or jog continuously for 12 minutes, and no one should stop running entirely during this 12 minutes. Each group was also instructed to stop only at the sound of the whistle and

remain at the exert point standing or sitting but definitely not moving about. At the command "GO" all the subjects in the groups ran and jogged with some forms of encouragement from the assistants. At the expiration of 12 minutes, the whistle was blown for each group to stop and the number of laps was counted and recorded for each subject to the nearest meter as confirmed by the lap scorers. Each subject's total distance covered was then computed as the VO_2max using this formula as reproduced of ACSM (2006). Thus, VO_2max is calculated using the formula below;

VO_2max for male = (ml.kg-1 per) = 47.820 – 0.259 (age) – 0.216 9(%fat) + 3.275 (SRPA) – 0.082 (%fat x SRPA) in litres while,

VO_2max for female = (ml.kg-1 per) = 45.628 – 0.265 (age) – 0.309 9(%fat) + 2.175 (SRPA) – 0.044 (%fat x SRPA) in millilitres. (ACSM, 2006).

3.7 Training protocol

The training session commenced shortly after the subjects were assigned to two experimental groups of forty obese and non–obese male and female youths in each group. The two groups were exposed to 8 weeks jogging (aerobic exercise) used for the study. The training session was conducted between the hours of 4:30pm to 5:45pm on alternate days (Mondays, Wednesdays, and Fridays). The training session consist of three components which were, 10 minutes of warm – up, 45 minutes of jogging session and 10 minutes of cool down as adapted from ACSM (1990) position statement on quantity and quality of exercise prescription. The warm up was a variety of very light exercises and stretches, which was targeted at improving the transition from rest to the exercise state. While the cool–down activity which normally comes at the end of the session was recommended to gradually return heart rate (HR) and blood pressure (BP) toward normal with a view to reducing the chance of a hypotensive episode after an

exercise session (Powers and Howley 2001). In accordance to the recommendation of ACSM (1990), which emphasizes three to five training sessions per week, the researcher used the following training procedures;

Time: The time assigned for each training session was 45minutes.

Frequency: The frequency of training for this research work was 3 days per week.

Duration: The research work was carried out for the period of 8 weeks.

Intensity: At the beginning of training program, the intensity was 55% HRmax, while from 4^{th} week - 8^{th} weeks the intensity was 60% HRmax.

The program was of low intensity and long duration considering the fitness level of the subjects. The intensity of the main jogging started with a working heart rate of 55% of estimated HRmax (1 to 4 weeks) increased progressively to 60% HRmax (5 to 8 weeks) (Raul, Manuel, Manuel, Sean, and Ana, 2010). The progression was from low to moderate intensity of exercise from 0 week to eight (8) weeks of the training programme.

3.8 Research assistants

The researcher trained research assistants to help take measurements of the subjects during the study. They were trained to take heart rates, blood pressure, and skin fold thickness, lap scoring and to monitor the subjects and ascertain maintenance of the intensities. They worked under the direct supervision of the researcher.

3.9 Statistical techniques

Data collected from the pre, mid, and post training programmes, were analyzed using the Statistical Package for Social Science (SPSS) at the Institute of Agricultural Research (IAR), Ahmadu Bello University, Zaria. The descriptive statistics of mean standard deviation and standard error of means was used to analyse the body

composition and cardio respiratory variables. The repeated measure ANOVA 16.0 version was used to analyse the data to determine the effect of jogging on the subject body composition and cardio respiratory variables, and the independent t-test was used to analyze the data for gender. The LSD (lowest significant difference) post hoc was also used to locate level of significance. An alpha level of $p< 0.05$ was used to accept or reject the null hypothesis.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1: Introduction

The purpose of this research was to investigate the effects of jogging on body composition (%BF, BMI,) and cardio respiratory responses (HR, SBP, DBP, VO_2max) of obese and non-obese male and female youths. The subjects were distributed into obese and non-obese male and female and were subjected to 8 weeks jogging. Data collected from the study were analysed in this chapter. The chapter was organized around the research questions and research hypotheses. In the test of hypotheses, Two-way Analysis of Variance was used and where significant effect was observed, a further test was carried out using the LSD (lowest significant difference) post hoc method of mean separation to establish group or level of significant effect. The decision to accept or reject the null hypotheses was set at $P< 0.05$ level of significance. The discussions of the findings are presented at the end of the chapter.

4.2 Results:

Eighty (80) subjects were involved in the training session of this study. The hypotheses which were stated in a null form were tested using the repeated measure ANOVA 16.0 version to assess the effect of jogging programme on body composition and cardio respiratory functions of obese and non-obese male and female adolescents. Prior to presenting the results on the basis of the stated hypotheses, the physical characteristics of the participants are presented in table 4.2.1.

Table 4.2.1: Physical characteristics of subjects showing mean, standard deviation and standard error of obese and non-obese male and female children on %BF, and BMI,

Variable	Sex	Male			Female		
%BF	Obesity status	Mean	SD	SEE	Mean	SD	SEE
	Obese	20.05	5.49	1.23	39.80	11.75	2.62
	Non-obese	19.02	5.50	1.23	35.81	8.54	1.93
BMI	Obese	29.90	4.85	1.09	31.73	5.42	1.21
	Non-obese	19.96	1.69	0.38	20.83	1.76	0.39

An observation of the result in the table revealed that obese male and female participant's % body fat had 20.05 ± 5.49% and 39.80 ± 11.75. While the non-obese male and female youths had 19.02 ± 5.50 and 35.81 ± 8.54 %BF respectively. It is noted that obese and non-obese female had higher %BF than their male counterpart.

The table showed the mean and standard deviation value on BMI of obese male to be 29.90 ± 1.09 and female had 31.73 ± 5.42 while non-obese male and female had 19.96 ± 1.69 and 20.83 ± 1.76 respectively. It is noted here that the BMI for obese and non-obese female seem to be higher than their male counterpart.

Hypothesis Testing

Sub hypothesis i.

There is no significant effect of aerobic training on percent body fat (%BF), and body mass index (BMI), of obese and non-obese male and female adolescents in Junior Secondary Schools of Numal, Adamawa State.

Table 4.2.2: Repeated measure ANOVA for effect of aerobic training on %BF, and BMI, of obese and non-obese male and female children.

Variable	Sex	Male					Female				
%BF	Source	SS	DF	MS	F	Sig	SS	DF	MS	F	Sig
	Corrected model	791.69	5	158.34	6.45	0.000	1129.22	5	225.84	2.18	0.061
	Test	754.75	2	377.37	15.38	0.000*	607.12	2	303.56	2.93	0.057
	Test x obesity	5.29	2	2.64	0.11	0.898	44.37	2	22.19	0.21	0.807
	Error	2797.89	114	24.54			11795.59	114	103.47		
	Corrected total	3589.58	119				12924.81	119			
BMI	Corrected model	405764.67	5	81152.93	1.09	0.369	3660.66	5	732.13	45.74	0.009
	Test	149410.78	2	74705.39	1.01	0.369	87.74	2	43.87	2.74	0.069
	Test x obesity	148551.20	2	74275.61	0.99	0.371	3.71	2	1.86	0.12	0.891
	Error	8475058.12	114	74342.62			1824.70	114	103.47		
	Corrected total	8880822.79	119				5485.36	119			

*= Significant F (2.119) =3.07 P ≤ 0.05

Examination of table 4.2.2 above showed that the difference in %BF between the baseline values and the weeks of training for obese and non-obese male were significant as the obtained values (F (2,119) =3.07 >15. 38) was greater than the calculated values to be significant at 0.05 alpha level. The obtained values for the female counterpart was (F (2,119) =3.07 <2.93) less than the calculated values to be not significant at 0.05 alpha level.

The result for BMI showed that the effects between the baseline values and the weeks of training in the two groups were not significant as the obtained values (F (2,119) =3.07 <1.01) for obese and non-obese male was less than the calculated values to be significant at 0.05 alpha level. Equally, the values for the female obtained was presented as (F (2,119) =3.07 <2.74) less than the calculated values to be significant at 0.05 alpha level. Also, result for BW revealed that effect between baseline values and the weeks of training in the two groups were significant as the obtained values (F (2,119) =3.07 >4.56) and (F (2,119) =3.07 >5.12) respectively. The obtained values were greater than the calculated values to be significant at 0.05 alpha levels.

Table 4.2 3: Results of LSD Post hoc male and female body compositon for effects of jogging on obese and non-obese adolescents in Numan before, during and after trainig:

			MALE					FEMALE				
D V	(I) Test	(J) Test	Mean diff	St.D	Sig	Lower bound	Upper bound	Mean diff	St.D	Sig	Lower bound	Upper bound
% BF	T 1	T 2	2.9322*	1.10777	.009	.7378	5.1267	4.0258	2.27453	.079	-.4801	8.5316
		T 3	6.1410*	1.10777	.000	3.9465	8.3355	5.2705*	2.27453	.022	.7647	9.7763
	T 2	T 1	-2.9322*	1.10777	.009	-5.1267	-.7378	-4.0258	2.27453	.079	-8.5316	.4801
		T 3	3.2088*	1.10777	.005	1.0143	5.4032	1.2447	2.27453	.585	-3.2611	5.7506
	T 3	T 1	-6.1410*	1.10777	*.000	-8.3355	-3.9465	-5.2705*	2.27453	*.022	-9.7763	-.7647
		T 2	-3.2088*	1.10777	.005	-5.4032	-1.0143	-1.2447	2.27453	.585	-5.7506	3.2611
BMI	T 1	T 2	-73.8035	60.96828	.229	-194.5812	46.9742	.8725	.89460	.331	-.8997	2.6447
		T 3	2.0557	60.96828	.973	-118.7219	122.8334	2.0853*	.89460	.022	.3131	3.8574
	T 2	T 1	73.8035	60.96828	.229	-46.9742	194.5812	-.8725	.89460	.331	-2.6447	.8997
		T 3	75.8593	60.96828	.216	-44.9184	196.6369	1.2128	.89460	.178	-.5594	2.9849
	T 3	T 1	-2.0557	60.96828	.973	-122.8334	118.7219	-2.0853*	.89460	.022	-3.8574	-.3131
		T 2	-75.8593	60.96828	.216	-196.6369	44.9184	-1.2128	.89460	.178	-2.9849	.5594

Based on observed means. The error term is Mean Square(Error) = .743.

*. The mean difference is significant at the .05 level.

*=Significant.

Using the LSD (lowest significant difference) Post hoc test for male body composition the result revealed that there were significant effects of jogging on %BF, of the obese and non-obese male and female adolescents. However, there was no significant effect on BMI of the subjects. The observed significant changes in the variables occurred in the mid-week (weeks 3-4) of the training session and progresses to the termination of the training at the 8^{th} week. This means that the training for eight (8) weeks was enough to produce reduction on the variables of the male subjects. As indicated in the Table 4.6 above. The change in values could be seen in test 2 and test 3 which were the mid- test and the post-test respectively. Based on this therefore, the stated null hypothesis on the effects of jogging on male adolescents was rejected.

Table 4.2.4: Physical characteristics of subjects showing mean, standard deviation and standard error of obese and non-obese male and female children on SBP, DBP, HR and VO_2max

Variable	Sex	Male			Female		
SBP	Obesity status	Mean	SD	SEE	Mean	SD	SEE
	Obese	122.23	3.85	0.86	122.55	4.15	0.93
	Non-obese	118.47	1.57	0.35	119.58	1.01	0.23
DBP	Obese	81.43	3.38	0.76	83.17	5.08	1.14
	Non-obese	77.40	2.23	0.49	79.45	1.43	0.32
HR	Obese	100.33	9.41	2.11	102.47	9.58	2.14
	Non-obese	78.40	6.80	1.52	89.20	10.37	2.24
VO_2max	Obese	30.10	2.56	0.53	31.04	3.14	0.70
	Non-obese	38.70	1.88	0.42	37.42	3.17	0.71

From the table above, it could be noticed that values for obese male and female children on SBP are 122.23 ± 3.85 and 122.55 ± 4.15 respectively. While that of non-obese male and female are 118.47 ± 1.57 and 119.58 ± 1.01 respectively. There is a slight decrease in the value for non-obese children compared to the obese children. This could be attributed to the lean body mass of the non-obese children. The observation revealed that obese and non-obese male had 81.43 ± 3.38 and 83.17 ± 5.08 DBP values respectively. While the non-obese male and female children had 77.40 ± 2.23 and 79.45 ± 143 DBP values respectively. An observation in this table gives a descriptive statistic of mean and standard deviation of obese and non-obese male and female children on HR after 8 weeks aerobic training. The obtained values are 83.37 ± 9.41 and 95.83 ± 9.58 respectively obese male and female. While the values for non-obese male and female are 78.40 ± 6.80 and 89.20 ± 10.37 respectively. Observation on this table also revealed value of VO_2max for obese male and female children to be 30.10 ± 2.56 and 31.04 ± 3.14 while that of the non-obese male and female children is 38.70 ± 1.88 and 37.42 ± 3.17 respectively. The data was analyzed using the repeated measure analysis of variance; the result is shown in table 4.2.5.

Sub hypothesis ii.

There is no significant effect of aerobic training in Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Resting Heart Rate (RHR) and Maximal Oxygen Consumption (VO_2max) of obese and non-obese male and female adolescents in Junior Secondary Schools of Numal, Adamawa State.

Table 4.2.5: Repeated measure ANOVA for effect of aerobic training on SBP, DBP, HR, and VO_2max of obese and non-obese male and female children.

Variable	Sex	Male					Female				
SBP	Source	SS	DF	MS	F	Sig	SS	DF	MS	F	Sig
	Corrected model	508.80	5	101.76	12.41	.000	334.07	5	66.81	7.56	.000
	Test	64.95	2	32.48	3.96	.022*	44.22	2	22.11	2.50	.086
	Test x obesity	18.22	2	9.11	1.11	.333	25.82	2	12.91	1.46	.236
	Error	934.50	114	8.19			1007.40	114	8.84		
	Corrected total	1443.30	119				1341.47	119			
DBP	Corrected model	557.47	5	131.49	18.79	0.000	480.54	5	96.11	6.95	0.000
	Test	132.82	2	66.41	9.49	0.000*	50.87	2	25.43	1.84	0.164*
	Test x obesity	36.62	2	18.31	2.62	0.077	15.27	2	7.63	0.55	0.577
	Error	797.70	114	6.99			1577.05	114	13.83		
	Corrected total	1455.17	119				2057.59	119			
HR	Corrected model	17344.67	5	3468.93	78.48	0.000	9261.47	5	1852.23	27.16	0.000
	Test	2664.27	2	1332.13	30.4	0.000*	3979.47	2	1989.73	29.17	0.000*
	Test x obesity	248.27	2	124.13	2.81	0.064	1.87	2	.93	.014	0.986
	Error	4039.20	114	44.20			7775.20	114	68.20		
	Corrected total	22383.87	119				17036.67	119			
VO_2max	Corrected model	2431.16	5	486.23	144.26	0.000	1510.24	5	302.05	39.01	0.000
	Test	199.85	2	99.92	29.65	0.000*	288.96	2	144.49	18.66	0.000*
	Test x obesity	12.94	2	6.47	1.92	0.151	0.21	2	0.11	0.01	0.986
	Error	384.23	114	3.37			882.65	114	7.74		
	Corrected total	2815.39	119				2392.89	119			

*= Significant F (2.119) =3.07 P ≤ 0.05

A close study of table 4.5 revealed that there were significant effects on SBP between the baseline values and the weeks of training values of obese and non-obese male. While result for female clients showed no significant effect. The obtained values were (F (2,119) =3.07 >3. 96) greater than the calculated values for obese and non-obese male and (F (2,119) =3.07 <2.50) less than the calculated values for female to be not significant at 0.05 alpha level.

The result for DBP showed significant effects on the male counterpart with values obtained as (F (2,119) =3.07 >9.49) greater than the calculated values. While the values

for female which revealed no significant effect (F (2,119) =3.07 <1.84) was less than the calculated values to be not significant at 0.05 alpha level.

The same table showed that there were significant effect on HR of both groups with values reading at (F (2,119) =3.07 >30.4) for male and (F (2,119) =3.07 >29.17) for female respectively. The obtained values were greater than the calculated values to be significant at 0.05 alpha levels.

Equally, the result revealed that there were significant effect on VO_2max of both groups with values at (F (2,119) =3.07 >29.65) for male and (F (2,119) =3.07 >18.66) for female respectively. The obtained values were greater than the calculated values to be significant at 0.05 alpha levels.

Table 4.2.6: Results of LSD Post hoc male and female body compositon for effects of jogging on obese and non-obese adolescents in Numan before, during and after trainig:

			MALE					FEMALE				
D V	(I) T	(J) T	Mean diff	St.D	Sig	Lower bound	Upper bound	Mean diff	St.D	Sig	Lower bound	Upper bound
S.B.P.	T1	T 2	.8250	.64021	.200	-.4433	2.0933	.5750	.66471	.389	-.7418	1.8918
		T3	1.8000*	.64021	.006	.5317	3.0683	1.4750*	.66471	.028	.1582	2.7918
	T2	T1	-.8250	.64021	.200	-2.0933	.4433	-.5750	.66471	.389	-1.8918	.7418
		T 3	.9750	.64021	.131	-.2933	2.2433	.9000	.66471	.178	-.4168	2.2168
	T3	T1	-1.8000*	.64021	.006	-3.0683	-.5317	-1.4750*	.66471	.028	-2.7918	-.1582
		T2	-.9750	.64021	.131	-2.2433	.2933	-.9000	.66471	.178	-2.2168	.4168
D. B. P.	T1	T2	1.2000*	.59150	.045	.0282	2.3718	.4500	.83168	.590	-1.1975	2.0975
		T3	2.5750*	.59150	.000	1.4032	3.7468	1.5500	.83168	.065	-.0975	3.1975
	T2	T1	-1.2000*	.59150	.045	-2.3718	-.0282	-.4500	.83168	.590	-2.0975	1.1975
		T3	1.3750*	.59150	.022	.2032	2.5468	1.1000	.83168	.189	-.5475	2.7475
	T3	T1	-2.5750*	.59150	.000	-3.7468	-1.4032	-1.5500	.83168	.065	-3.1975	.0975
		T2	-1.3750*	.59150	.022	-2.5468	-.2032	-1.1000	.83168	.189	-2.7475	.5475
H R	T1	T2	6.6000*	1.48667	.000	3.6549	9.5451	7.4000*	1.84667	.000	3.7418	11.0582
		T3	11.5000*	1.48667	.000	8.5549	14.4451	14.1000*	1.84667	.000	10.4418	17.7582
	T2	T1	-6.6000*	1.48667	.000	-9.5451	-3.6549	-7.4000*	1.84667	.000	-11.0582	-3.7418
		T3	4.9000*	1.48667	.001	1.9549	7.8451	6.7000*	1.84667	.000	3.0418	10.3582
	T 3	T1	-11.5000*	1.48667	.000	-14.4451	-8.5549	-14.1000*	1.84667	.000	-17.7582	-10.4418
		T2	-4.9000*	1.48667	.001	-7.8451	-1.9549	-6.7000*	1.84667	.000	-10.3582	-3.0418
VO_2Max	T1	T2	-1.5992*	.41051	.000	-2.4125	-.7860	-2.4390*	.62220	.000	-3.6716	-1.2064
		T3	-3.1610*	.41051	.000	-3.9742	-2.3478	-3.7443*	.62220	.000	-4.9768	-2.5117
	T2	T1	1.5992*	.41051	.000	.7860	2.4125	2.4390*	.62220	.000	1.2064	3.6716
		T3	-1.5618*	.41051	.000	-3.9742	-.7485	-1.3052*	.62220	.038	-2.5378	-.0727
	T3	T1	3.1610*	.41051	.000	2.3750	3.9742	3.7443*	.62220	.000	2.5117	4.9768
		T2	1.5618*	.41051	.000	.7485	2.3750	1.3052*	.62220	.038	.0727	2.5378

Based on observed means. The error term is Mean Square(Error) = .743.

*. The mean difference is significant at the .05 level.

*=Significant.

The LSD (lowest significant difference) Post hoc test for male cardio respiratory function, the result revealed that there were significant effects of jogging on the parameters measured of the obese and non-obese subjects. The observed significant changes in the variables occurred in the mid-week (weeks 3-4) of the training session and progresses to the termination of the training at the 8th week. This means that the training for eight (8) weeks was enough to produce reduction on the variables of the male subjects. The values in the three tests were significantly different from the base line assessment. The change in values was seen in test 2 and test 3 which were the mid-test and the post-test respectively. Based on this therefore, the stated null hypothesis on the effects of jogging on male adolescents was rejected.

Table 4.2.7: Descriptive statistics of Mean, Standard deviation, and standard error of gender (obese and non-obese).

	Gender	N	Mean	Std. Deviation	Std. Error Mean
%BF	Male	120	19.5343	5.49223	.50137
	Female	120	37.8017	10.42170	.95137
BMI	Male	120	49.9299	273.18265	24.93805
	Female	120	26.2806	6.78936	.61978
SBP	Male	120	1.2035E2	3.48261	.31792
	Female	120	1.2107E2	3.35750	.30650
DBP	Male	120	79.4167	3.49690	.31922
	Female	120	81.3083	4.15821	.37959
HR	Male	120	89.3667	13.71495	1.25200
	Female	120	95.8333	11.96517	1.09227
VO2max	Male	120	34.4032	4.86402	.44402
	Female	120	34.2281	4.48423	.40935

The table above showed the descriptive statistics of mean, standard deviation, and standard error of gender of the participants. In order to find out the effects of 8 weeks jogging on the parameters under investigation of the subjects, the researcher used the independent t-test and result presented in the table below.

Sub hypothesis v.

There is no significant effect of jogging on male and female obese and non-obese adolescents in Junior Secondary Schools of Numan, Adamawa State.

Table 4.2.8: Results of independent t-test for gender of the effects of jogging on body composition and cardiorespiratory functions of obese and non-obese adolescents in Numan, Adamawa state.

		F	T	df	Sig. (2-tailed)	Mean Diff	Std. Error Diff
%B F	Equal variances assumed	61.951	-16.987	238	*.000	-18.26742	1.07539
	Equal variances not assumed		-16.987	180.366	.000	-18.26742	1.07539
B MI	Equal variances assumed	3.218	.948	238	.344	23.64933	24.94575
	Equal variances not assumed		.948	119.147	.345	23.64933	24.94575
SBP	Equal variances assumed	.619	-1.623	238	.106	-.71667	.44160
	Equal variances not assumed		-1.623	237.682	.106	-.71667	.44160
DBP	Equal variances assumed	.397	-3.814	238	*.000	-1.89167	.49598
	Equal variances not assumed		-3.814	231.200	.000	-1.89167	.49598
HR	Equal variances assumed	6.690	-3.892	238	*.000	-6.46667	1.66149
	Equal variances not assumed		-3.892	233.700	.000	-6.46667	1.66149
VO_2max	Equal variances assumed	5.854	.290	238	.772	.17517	.60392
	Equal variances not assumed		.290	236.444	.772	.17517	.60392

* = Significant

The result of the t-test to investigate the effect of jogging on gender shows that there were significant effects of jogging on %BF, DBP, and HR between the two groups of obese and non-obese male and female adolescents after 8 weeks jogging.

However, the result revealed that there were no significant effect of jogging on obese and non-obese male and female adolescents on BMI, SBP, and VO_2max. This means that the pattern of change from weeks 4-8 was constant on the said variables. Base on this therefore, the result for which agrees with the stated null hypothesis was retained.

4.3: Discussion

The purpose of the study was to assess the effects of jogging on body composition and cardio respiratory response of obese and non-obese male and female adolescents in Numan metropolis between the ages of 12 to 15 years respectively. The result which revealed that there were significant effects on %BF of obese and non-obese male adolescents. The obtained values for the female counterpart was (F (2,119) =3.07 <2.93) less than the calculated values to be not significant at 0.05 alpha level. This finding was consistent with the submission of Flegal et al (1998) and Dikko, (2003) which stated that reduction in blood pressure in overweight and normal weight individuals are independent of weight loss. And the finding which said that regular physical activity does not lower normal blood pressure (Foss and Keteyan, 1998; Wilmore and Costill, 1999). The findings in table 4.2.2 which showed no significant effect on %BF of the female subject also agrees with the findings of Wilmore and Costill, 1994 that, there are no significant responses among male and female groups in their %BF irrespective of their sizes. The reason for recorded differential effect based on %BF in their subjects they said might be due to the higher level of fat deposit in female obese subjects which was the same submission of this research finding.

Further comparative analysis of %BF revealed that the differences observed between obese and non-obese male and female in aerobic training programmes were due to higher mean %BF values of female before and after the training. The observed result of

this study is consistent with the findings of Gunen, 1996 who carried out an investigation on children and found out that girls had 18% BF and that of boys of the same age had 16%, and that children growth spurt, female children have more %BF than male.

The result for BMI showed that the effects between the baseline values and the 8 weeks of training in the two groups were not significant as the obtained values (F (2,119) =3.07 <1.01) for obese and non-obese male was less than the calculated values to be significant at 0.05 alpha level. Equally, the values for the female obtained was presented as (F (2,119) =3.07 <2 .74) less than the calculated values to be significant at 0.05 alpha level. This finding is was consistent with the works of Kono et al. (1994), who reported a correlation coefficient of r = 0.60 between adiposity and left ventricular mass normalized for height in 6-year old males, while, Rowland and Dunbar (2007) found a correlation of r = 0.59 between body mass index and left ventricular end diastolic dimension in a group of early adolescent females with a BMI range of 14-63 kg·m2. The average dimension was 44 mm in those with a BMI of approximately 20 kg·m-2 compared to 52 mm with a BMI of 42 kg·m-2. In the only study which has assessed cardiac features relative to duration of obesity, Rabbia et al. (2003) found that a group of 13 year old obese adolescents had a greater average heart mass than non-obese. However, there were no significant difference in left ventricular mass among three groups of the obese adolescents with <4, 4-7, and >7 years duration.

In table 4.2.5, the result showed that there was no significant effect of jogging on systolic blood pressure (SBP) of the female group. However, the result showed that significant effect exist in the male group. Equally, the result revealed a significant effect on diastolic blood pressure (DBP). The result from this variable tends to agree with the stated null hypothesis on cardio respiratory function. This means that changes

from the initial level to the level of termination at eight weeks could not be visible. Thus, more intensity of training and duration could changes in further study. This finding contradicts the submission of some scholars like Toriola (1984) who states that increase in stroke volume results for an increase in venous return, which in-turn increase, the left ventricular end - diastolic volume (LVEDV) preload. The increased preload stretches the myocardium and causes it to contract more forcibly. Contractility of the myocardium is also enhanced by the sympathetic nervous system, which is activated during physical activity. Thus, an increase in the left ventricular end- diastolic volume and a decrease in the left ventricular end - systolic volume (LVESV) account of the increase in stroke volume during high to moderate aerobic exercise. Heart rate increases immediately at the onset of activity as a result of parasympathetic withdrawal. As exercise continues, further increases in heart rate are due to the action of the sympathetic nervous system (Klafs and Arnheim, 1981). Myocardial oxygen consumption increase due to aerobic exercise since the heart must do more work to pump and increase cardiac output to the working muscles. The blood pressure product will increase in relation to increase in heart rate and systolic blood pressure, reflecting the greater myocardial, oxygen demand of the heart during exercise.

More so, it was revealed that changes in the mean score of the subjects was minimal and was consistent with the finding of Malian and Bochard (1991), and Ogawa and Sprain (1992) who stated that males and females display the same pattern of response for blood pressure. Males tend to have a higher systolic pressure than females at the same relative workload. Much of the reference in the magnitude of the blood pressure response is attributed to differences in resting systolic blood pressure. The diastolic blood pressure response to such maximal exercise is very similar for both sexes. Thus, mean arterial blood pressure is slightly greater in males during sub-maximal work at the same relative workload. The pattern of response for resistance is similar though,

males typically have a lower resistance owing to their greater cardiac output. Males and females both exhibit cardiovascular drifts during heavy, prolonged sub maximal exercise (Malian and Bochard 1991, and Ogawa and Sprain 1992).

Regular physical exercise is an important factor to reduce the indexes of cardiovascular diseases risk factors and all causes of morbimortality (Blair et al, 1995; Centres for Disease Control, 1990). Table 4.2.5 also showed that there were significant effect on HR of both groups with values reading at (F (2,119) =3.07 >30.4) for male and (F (2,119) =3.07 >29.17) for female respectively. The obtained values were greater than the calculated values to be significant at 0.05 alpha levels. More so, the result revealed an abnormal increase in heart rate of both obese and non-obese male subjects. This could be attributed to sedentary lifestyle, feeding habit and environment of the subjects which causes a high level of fat deposit in them. The result obtained were a mean score of 89.37 bpm and 95.83 bpm for obese male and female, and 78.4 bpm and 89.20 bpm for non-obese male and female respectively. These findings slightly contradict the normal heart measure of 72 beats per minutes (bpm). However, resting heart rate of 50 to 58 bpm are common among active athelete..

Venkateswarlu, 1996; Dikki, 1997; and Heyward, 1998 opined that people who regularly do physical activity have lower resting heart rate than people who do no regular physical activity. Pearson et al (2002) opined that Heart rate (HR) is mediated primarily by the direct activity of the autonomic nervous system (ANS), specifically through the sympathetic and parasympathetic branches activities over the sinus node autorhythmicity, with predominance of the vagal activity (parasympathetic) at rest that is progressively inhibited since the onset of the exercise. Myer et al (2002), states the HR behaviour has been widely studied during different conditions and protocols associated to the exercise.

A reduction of the cardiac vagal tone (parasympathetic function) and consequently a diminished HR variability in rest, independently of the protocol of measurement used, is related to an autonomic dysfunction, chronic-degenerative diseases and increased mortality risk. Individuals with high levels of aerobic condition have a lower resting HR, along with a larger parasympathetic activity or smaller sympathetic activity, but it is not necessarily a direct consequence of the exercise training, as long as other inherent adaptations to the aerobic conditioning can influence the resting HR (Paffenbarger et al, 1996; Tanasescu et al, 2002). The HR response in the onset of the exercise represents the integrity of the vagus nerve, and the HR recovery on the post-exercise transient also denotes important prognostic information; by the way, individuals that have a slow HR recovery in the first minute post-exercise have increased mortality risk (Kraus et al 2002).

Equally, in table 4.2.5, the result revealed that there were significant effect on VO_2max of both groups with values at (F (2,119) =3.07 >29.65) for male and (F (2,119) =3.07 >18.66) for female respectively. The obtained values were greater than the calculated values to be significant at 0.05 alpha levels. Goran *et al.* (2000) reported higher absolute VO_2max in obese versus non-obese adolescents during treadmill exercise (1.56 ± 0.40 versus 1.24 ± 0.27 L·min-1) but the two groups had no significance difference when VO_2max was expressed relative to fat free mass (59.2 ± 4.9 and 57.9 ± Cardiac effects of obesity 324 5.8 ml·kg·FFM-1). Similar findings have been reported in obese youth by Ekelund *et al*. (2004), Treuth *et al*. (1998), and Marinov *et al*. (2003). The data analyzed are consistent with the conclusion offered by Goran *et al*. (2000). The research reported higher absolute VO_2max in line with the above findings, and the result equally reported that there is no significant effect on obese and non-obese adolescents in response to eight weeks jogging. This study revealed significant changes by way of increased values in the estimated maximal oxygen consumption of both

obese and non-obese subjects in aerobic programme. These changes were evident in the interactions by groups in weeks 4 to 8, with the higher responses observed among the obese groups in the programme. The findings in this research was consistent with those of Rowland (1990) and Gunen (1996) whose studies on children involved in intermittent and continuous training for between 7-12weeks, three to four times a week with training session lasting 15-45 minutes. Their result showed increase in VO_2max from 7-26%. Similarly, in a study of 12 years old boys and girls (Grisogono 1991) observed typical VO_2max value of $47.8ml_{02}\ kg^{-1}\ mm^{-1}$ and $39.5ml_{02}\ kg^{-1}mm^{-1}$ on the treadmill for boys and girls respectively. Since body fat negates endurance performance (Bar-Or, 1989, Watson, 1990).

Generally, from the result obtained in this study, the researcher found out that eight (8) weeks jogging if properly carried out by either group or individual for personal or academic purpose could lead to significant change in body composition and cardiorespiratory function of the subject since involvement of adolescents in well-organized sub-maximal to maximal exercise programmes will help alleviate obesity and overweight conditions, poor fitness levels and cardiorespiratory disorders that have been considered primary health problems (Venkateswarlu 1990). This is consistent with Dikki, (1997) and Wayo, (2012), who viewed exercise as a form of therapy in the treatment, prevention, and rehabilitation process of a wide range of disorder and problems both physical and mental. It reduces the effect of degenerative diseases and could be preventive in nature. This is in line with the findings of this study which indicated that there were no significant differences between obese and non-obese adolescents in response to eight weeks jogging on their cardiorespiratory response to exercise.

The result from the test hypothesis revealed that the effect of jogging on the two groups after eight weeks of moderate intensity training had significant effect on the subjects.

However, from the t-test analysis of variance carried out to find out the effect of jogging on gender, The result in table 4.2.8 which is to assess the effect of 8 weeks jogging on gender shows that there were significant effects of jogging on %BF, DBP, and HR between the two groups of obese and non-obese male and female adolescents after 8 weeks jogging. However, the result revealed that there were no significant effect of jogging on obese and non-obese male and female adolescents on BMI, BW, SBP, and VO_2max. This means that the pattern of change from weeks 4-8 was constant on the said variables. Base on this therefore, the result for which agrees with the stated null hypothesis was retained. To investigate weather there is interaction between the male and female, the LSD post hoc was used and the result revealed that there were interaction between the groups in %BF, DBP, and HR since significant effect was recorded. But no interaction in their BMI, SBP, and VO_2max because there was no significant effect of eight weeks jogging on their assessed variables.

CHAPTER 5

5.0: SUMMARY, CONCLUTION AND RECOMMENDATIONS.

5.1: Summary

The health hazard associated with adolescent obesity cannot be over emphasized as multiple behavioural, environmental, social and physiological factors influence energy balance is concerned. However, changes in dietary intake (energy intake) and physical activity levels (energy expenditure or output) are likely causally related to overweight and obesity in adolescents. While more research is needed to fully assess the impact of this lifestyle, what is known about the relationship between physical activity and obesity is compelling. So, with global increase in the prevalence of obesity and overweight among children and adolescence, there has been a more urgent need for effective physical activity programmes for adolescents. Adolescents who participate in higher levels of physical activity are less likely to display risk factors for cardiovascular diseases.

Adolescent obesity which is a major cause of low fitness and cardiorespiratory disorders, have become a serious health problem among adolescent especially among well to do in urban areas, Numan inclusive. Evidence of sedentary lifestyle among adolescents and the advent of computers have presented a strong cause for public health effort to be geared towards encouraging increased participation of adolescents in physical activities. To effectively carry out this study, the researcher sampled 80 obese and non-obese male and female students of Junior Secondary Schools in Numan metropolis. The age bracket of the subjects ranged from 12 to 15 years. They were subjected to eight weeks aerobic training programme (jogging). A pre, mid, and post training assessment involving measurement of body composition (%BF, BMI,) and

cardiorespiratory function (HR, SBP, DBP, VO_2max) variables was conducted, analysed and discussed in chapter four.

The Repeated ANOVA 16.0 version was used to find out if there exists a significant difference between obese and non-obese male and female children after eight weeks training programme. Result revealed that there were no significant differences recorded for both body composition (%BF, and BMI) and cardiorespiratory function (SBP, DBP, HR, and VO_2max) variables. The study was structured into five chapters. Chapter one gave a background of the study, statement of problem, research questions, and purpose of study, hypotheses, significance of the study, delimitations, limitations, and definition of operational terms. Chapter two consist of relevant literatures on effects of aerobic (jogging) on body composition and cardiorespiratory function of obese and non-obese adolescents. In chapter three, the methodology used in the study was explained. These include the research design, population, sample and sampling techniques, instrumentations, order of assessment, measurement procedures for collection of data and analysis. The statistical analysis and interpretation of the findings were presented in chapter four. One major hypothesis and four sub hypotheses were tested to determine the effects of jogging on the variables investigated.

The results from the test of the hypotheses revealed that eight weeks jogging have significant effect on body composition and cardiorespiratory function of adolescents. There were also gender differences in the effect of jogging on the subjects after the 8 weeks training session.

5.2: Major Research Findings

Base on the results of the analyses, the following conclusions were made:

i. Regular jogging had significant effect on %BF of obese and non-obese male adolescents in Numan metropolis of Adamawa State , Nigeria;

ii. Regular jogging had no significant effect on %BF of obese and non-obese female adolescents in Numan metropolis of Adamawa State , Nigeria;

iii. Regular jogging had no significant effect on BMI of obese and non-obese male and female adolescents in Numan metropolis of Adamawa State , Nigeria;

iv. Regular jogging had significant effect on body composition and cardiorespiratory functions of obese and non-obese male and female adolescents in Numan metropolis of Adamawa State , Nigeria;

5.3 Conclusion

Based on the findings of this study, the following conclusions were drawn.

a. That the aerobic (jogging) training programme engaged in by the subjects was very much effective in producing significant effect on the variables investigated after the expiration of eight (8) weeks of moderate intensity training programme.

b. The study revealed there are specific gender differences in response to jogging. Several modification noticed could be attributed to a lot of factors such as sedentary lifestyle, dietary habit, environment, gender or even age.

c. The result also showed that duration of training have significant impact on the effect of jogging on the variables from mid training period (week 4) of when the intensity of exercise was between 55% - 60% of HRmax of the subjects. This entails that involvement in low to moderate intensity training programmes by adolescents who were previously living a sedentary lifestyle will have positive effects on the stated variables.

d. That eight (8) weeks jogging did not produce significant effect on %BF, SBP, of female, and BMI (male and female), between the ranges of 50% - 60% HRmax moderate intensity thus, the need for increased intensity and

duration could help produce the desired significant change. This therefore implies that regular participation in physical aerobic exercise programmes would help to ensure healthy lifestyle.

5.4: Recommendations

From the result obtained, the researcher came up with the following recommendations which if adhered to will help alleviate this health hazard.

i. Physical Education for children already in existence in school curriculum should be seriously re-emphasized and stressed.

ii. Regular assessment of physical fitness status of youths in Nigerian schools by Exercise Scientist should be emphasized so as to be able to prescribe exercise programmes to meet children's fitness needs and standard.

iii. Obese youths should be exposed to physical activities to improve their aerobic capacity and alleviate obese conditions.

5.5: Recommendations for further research

i. The research was conducted with restriction on adolescents' age 12 to 15 years. There is need to widen the scope of research on adults between the ages of 40 to 45 years considering the high rate of sedentary lifestyle among adults.

ii. Similar work could be conducted in Yola the capital city of Adamawa State.

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APPENDIX A

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION,
AHMADU BELLO UNIVERSITY, ZARIA.

INFORM CONSENT FORM

I---------- the undersigned subject Voluntarily agree to participate in this research study. As part of the said study, I understand, and agree that during the process of the programme, complications may arise, if I am not tolerating working well, it usually becomes necessary that exercise can be stopped by my decision or that of the investigator or his representative. Other Possible risk to encounter aside dizziness could include nausea, vomiting, or even Fainting during participation though rarely.

Students Signature…….

Class……

Age…….

Date……

Witness name…….

Signature……

Address…….

Date……

APPENDIX B

Department of Physical and Health Education,
Ahmadu Bello University, Zaria.

Dear Sir/Madam,

PERMISSION TO INVOLVE YOUR CHILD/STUDENT IN A RESEARCH WORK:

I, **Christopher, Julius Jikoshiafuro** is a Postgraduate student of Physical and Health Education department, Ahmadu Bello University, Zaria. I am conducting a research in partial fulfillment of the requirement for the award of a Master's degree on **"Effect of aerobic training programme on body composition and cardio respiratory function of obese and non-obese male and female adolescents in Junior Secondary Schools in Numan metropolis".**

Your child/ student have been chosen as one of the subjects to be for data collection to enhance the success of the research. I therefore request your kind permission to allow the said subject to participate in this memorable academic exercise.

Thanks for the anticipated co-operation.

Yours sincerely,

Christopher, Julius Jikoshiafuro.
Researcher