EFFECTS OF CONTINUOUS AND INTERVAL EXERCISE TRAINING ON BLOOD PRESSURE, BODY WEIGHT AND PERCENT BODY FAT OF OVERWEIGHT ADULT NIGERIANS

BY

SULEIMAN USMAN OMEIZA

DEPARTMENT OF PHYSICAL AND HEALH EDUCATION,
AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

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SULEIMAN, USMAN OMEIZA
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JANUARY, 2013

DECLARATION

I declare that the research work in this dissertation titled, **Effects of Continuous and Interval Exercise Training on Blood Pressure, Body Weight and Percent Body Fat of Over Weigh Adult Nigerians,** is written by me and that this dissertation has not been written or submitted for the award of any degree to the best of my knowledge. All sources of publications and other related literature cited in this research are duly acknowledged by means of references.

Suleiman Usman Omeiza **Date**

CERTIFICATION

This dissertation titled **"Effects of Continuous and Interval Exercise Training on Blood Pressure, Body Weight and Percent Body Fat of Over Weight Adult Nigerians"**, by Suleiman Usman Omeiza meets the regulations governing the award of the Degree of Doctor of Philosophy (Ph.D) in exercise and sport sciences of the Department of Physical and Health Education, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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Prof. J.A Gwani **Date**
Chairman, Supervisory Committee

______________________ _______________

Prof. C.E Dikki **Date**
Member, Supervisory Committee

______________________ _______________

Prof. K. Venkateswarlu **Date**
Member, Supervisory Committee

______________________ _______________

Prof. C.E Dikki **Date**
Head of Department

______________________ _______________

Prof. A.A. Joshua **Date**
Dean, Postgraduate School

DEDICATION

This research work is dedicated to my family and the entire Ebira Race.

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ABSTRACT

Sedentary lifestyle, especially inactivity, has been shown to promote several disease risk factors, like high blood pressure, diabetes, overweight and obesity. Health professionals and exercise scientists became interested to find out the effects of several modes of training on these disease risk factors. This study was conducted to find out and compare the effects of 12 weeks of continuous and interval training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria. To achieve this purpose, a total of 90 overweight male and female volunteer subjects, without any contraindications to participate in this research, were randomly selected from among those participating in regular exercise at old parade ground, Area 10, Garki, Abuja, to serve as subjects in the study. They were randomly divided into three groups of continuous and interval groups which underwent their respective training programmes for 12 weeks, and a control group that did not undergo any structured training. All the subjects were tested before starting the training, after 6 weeks and 12 weeks of training for their blood pressure, body weight and percent body fat. The findings of this study revealed significant decrease due to continuous and interval training in blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria. The results further showed insignificant differences between continuous and interval training in their effects on the selected variables. However, significant decrease in percent body fat was found only after 12 weeks of training and not after 6 weeks of training. There were no significant differences between overweight male and female adults in their response in selected variables to 12 weeks of continuous and interval training. On the basis of the results of this study, it was recommended that training at moderate intensity should be followed at least thrice a week, for a minimum of 30 minutes in each training session, at least for 12 weeks.12 weeks continuous and interval exercise training prodused signifficant decrease in systolic blood pressure (f=6.9<.01), body weight (f= 78.9 < .01) and percent body fat (f= 75.5 < .01) due to 12 weeks continuous and interval exercise training in adult Nigerians.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Chronic illness like diabetes,heart diseases, stroke and cancer have been some of the most important factors responsible for the mobidity and mortality of significant portion in populations around the world (Dal, 2002).High blood pressure, body weight and increased percent body fat have been shown to be some of the most important risk factors for these illness (Dikki; Leha-Isa; & Venkateswarlu; 2011; Mayo; Granthom & Balasekaran; 2003; Rahimi, 2006).It has therefore become a primary interest for health proffesionals to find strategies to control these desease risk factors (Venkateswarlu, 2009, 2010, 2011).

Several strategies have been proposed in this regard, some of the most popular among which include dietary strategies (O'leary; Marchetti; & Krishman, 2006), exercise strategies (O Leary, et al; 2006) and exercise and dietary strategies (Bouchard; Trembley & Despress, 1990; O'Leary, et al; 2006; Venkateswarlu, 2011).

Dietary strategies are becoming popular because of the recomendations from epidemiological studies that populations ingesting more dietary fat have increased prevalence of overweight condition (Mayo et al; 2003), which appears to result in increased energy intake (Lissuev; Leuislay; Strupp; Kalkwarf & Roc,1987). However, several studies have shown insignificant relationship between saturated fatty acid intake and percent body fat patterns (Maron; Fair; & Haskell, 1991). Although high percentage of dietary fat predisposes to overweight in susceptible populations, it appears that hormonal (Harbor; Marslew & Gotfredsen; Christiansen, 1991), genetic (Bouchard et al; 1990) and environmental (for example ethanol, tobacco, physical inactivity) factors are more important determinants of body fat distribution and therefore of insulin resistance than diet.

Physical inactivity is a well established risk factor for hypertension, overweight and Type II diabetes mellituse (Venables and Jevkendrop, 2009; Venkateswarlu, 2009). Aerobic exercise training has been shown to reduce blood pressure, overweight, adiposity and insulin resistance in adults (O'Leary et al; 2006; Venkateswarlu, 2011). Exercise has therefore become an important component of blood pressure, body weight and percent body fat management control programmes (Aggel Leifssen; Saris, W; Wagenmakers; Senden; Van Baak; 2002). Although there is a lot of information available about the mechanism by which adiposity leads to insulin resistance (Goossene, 2008), and how exercise decreases blood pressure, body weight and increased insulin sensitivity (Ostegard; Jensen & Schmitz, 2007).; You & Nicklas, 2008), there are a number of issues not yet clear. For example, it is not clear whether high intensity or low intensity exercise is more important for stimulating a decrease in blood pressure, body weight and percent body fat. Several studies have shown that the percent body fat decreases from low intensity than high intensity aerobic exercise (Girandola et al; 1979; Swenson and Collen, 1979). A few studies have shown no difference in blood pressure, body weight and percent body fat content between low intensity and high intensity exercise in old sedentary women (Duncan; Gordon; & Scott, 1991), which was similar to the finding on overweight men (Agegle – Leijssen et al; 2002). Contrary to these, Trembley; Simoneau; & Bouchard (1994) reported that relative body fat decreases more in young overweight women due to high intensity rather than low intensity aerobic exercise. However, it has been reported that overweight individuals typically experience greater success at decreasing blood pressure and losing body weight and percent body fat through diet than through exercise, because of which diet - induced weight loss and blood pressure programme has become much more popular than exercise programme. Such programmes appear to preferentially reduce abdominal obesity (Dengel et al; 1994; Hines, 1988) and to decrease specifically the size of the intra-abdominal fat deposit (Ross, 1997). Very little is known about what happens when overweight subjects experience significant decrease in blood pressure and percent body fat loss through exercise alone and whether such decrease is associated with preferential loss in abdominal obesity (Ross & Janssen, 1997).

Other issues relating to the intervention to decrease blood pressure, overweight and percent body fat include the modern methods of exercise training. Several investigations have revealed that walking is a better mode of exercise training for decreasing blood pressure, body weight and percent body fat among adults compared to other modes of exercise training, like cycling (Williams, 2008). Regarding the methods of exercise training to reduce blood pressure, body weight and percent body fat, the result of some studies revealed that interval training is a better method than other forms of training (Tabata; Nishimuru; Kouzaki; Hirai; Ogita; Miyach; & Yamamato, 1996).) while other studies revealed that moderate continuous exercise training is a better method among overweight men (Rahimi, 2006). It is therefore not very clear whether interval exercise training or continuous exercise training should be used to reduce blood pressure, body weight and percent body fat among overweight adults. The study was therefore conducted to find out the effects of continuous and interval exercise training on blood pressure, body weight and percent body fat of overweight male and female adult Nigerians

1.2 Statement of the Problem

Regular participation in physical activities has been shown to be significantly associated with more favourable reduction in disease risk factors of blood pressure, bodyweight and percent body fat of overwight male and female adults (Ogundipe, 2006). Although epidemiological and clinical research suggests that different types and intensities of physical activity produce different physiological effects, interrelationships among the different types and intensities of physical activity patterns have not been well documented (Epstein; Raja; Gold; Paluch; Pak; & Roemmich, 2006). This investigation focused mainly on such disease risk factors as blood pressure, body weight and percent body fat of male and female adult Nigerians.

Several methods of training are used to control and promote desirable cardiovascular health, body weight and percent body fat (Venkateswarlu, 1991). Most of the studies reported in literature were on the effects of different exercise modes on the health of adolescents (Falk; Cohen; Lustiag; Lander; Yaaron; & Ayalon, 2001; US Department of Health and Human Service, 2000). This investigator did not come across studies specifically concerned with the effects of exercise programs on cardiovascular efficiency of overweight adults, especially Nigerian overweight adults. Moreover, studies that involve exercise training programs to promote health benefits used mainly normal exercise training programs, using instruments such as cycle egometers and tread mills. No studies used highly structured training methods, like continuous and interval exercise training followed in competitive sports. This investigation was therefore conducted to find out and compare the effects of continuous and interval exercise training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria.

1.3 Research Questions

This study attempted to answer the following specific research questions.

i. What are the effects of continuous and interval exercise training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria?

ii. Will there be any difference between the effects of continuous and interval exercise training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria?

1.4 Basic Assumptions

On the basis of available research evidence, the following basic assumptions were made for the purpose of the study.

i. There are individual differences in blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria.

ii. Sedentary lifestyle has detrimental effects on health and performance.

iii. Response to training programme is highly related to age, sex, physical activity and lifestyle patterns of subjects.

1.5 Hypotheses

On the basis of the research questions, the following hypotheses are made for the purpose of this study.

Major hypothesis

There are no significant effects of continuous and interval training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria.

Sub-hypotheses

i. There is no significant effect of continuous and interval exercise training on blood pressure of overweight male and female adults in Nigeria.

ii. There is no significant effect of continuous and interval exercise training on body weight of overweight male and female adults in Nigeria.

iii. There is no significant effect of continuous and interval exercise training on percent body fat of overweight male and female adults in Nigeria.

iv. There are no significant differences between overweight male and female adults in Nigeria in their blood pressure, body weight and percent body fat responses to continuous and interval exercise training.

1.6 Significance of the Study

The study is justified on the following basis:

An attempt was made in this study to find out whether continuous and interval exercise training for 12 weeks will have any significant effect on the blood pressure, body weight and percent body fat of male and female adult Nigerians.

Results of this study will show whether these modes of exercise training for 12 weeks would have any significant effect on the blood pressure of overweight male and female adult Nigerians.

Studies have also shown significant decrease in body weight due to physical exercise training (Powers and Howley, 2012). Most of the studies were conducted only on normotensives. It is not clear whether 12 week continuous and interval training will have similar effect on body weight of overweight male and female adults in Nigeria. Results of this study will show whether these modes of exercise training for 12 weeks would have any significant effect on the body weight of overweight male and female adult Nigerians.

Similarly studies have shown significant decrease in percent body fat due to physical exercise training (Perez et al; 2003). Most of the studies were conducted only on normal adults. It is not clear whether 12 week continuous and interval training will have similar effect on percent body fat of overweight male and female adults in Nigeria. Results of the study will show whether these modes of exercise training for 12 week would have any significant effect on the percent body fat of overweight male and female adult Nigerians.

1.7 Delimitations of the Study

This study was delimited to the following:

Findings out the effect of continuous and internal exercise training on blood pressure, body weight and percent body fat of overweight male and female adults between the ages of 30 – 45 years at Old Parade Ground in Abuja.

1.8 Limitations of the Study

This study had the following limitations which were considered while interpreting the results:

Percent body fat is determined by such sensitive laboratory methods like computer termography and dual x-ray equipment but because of the personal limitations and the non availability of such equipment, percent body fat was determined in this study by the use of skinfold calipers. However, it was ensured that skinfold measurements were sensitive, dependable and reliable through test-retest method.

1.9 Operational Definition of Terms

In this study:

- **Adult**

  An adult is an individual between 30 - 45 years of age in Nigeria.

- **Body Mass Index**

  This is index of weight over the square of height (wt (kg)/Ht^2(m). in this study a BMI of 30.0 and above for both men and women was considered over weight.

- **Blood Pressure**

  Is the pressure exerted by the blood against the walls of the blood arteries that carry blood from the heart to all parts of the body.

- **Continuous Training**

  This refers to low intensity running and jogging continuously done for up to 15 minutes nonstop.

- **Interval Training**

  This refers to repetitions of running and jogging for 1½ minutes with a rest interval of 1 minute of walking.

- **Obesity**

  An excessive amount of body fat weighing 20% more than recommended for a given body weight.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 INTRODUCTION

This research work was an attempt to find out the effects of continuous and interval exercise training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria. Available research evidence relating to the purpose of this study was reviewed and discussed under the following sub-titles in this chapter:

2.1 Blood pressure

2.1.2 Effects of physical exercise training on blood pressure

2.2 Body composition

2.2.1 Effects of physical exercise training on body composition

2.3 Assessment of percent body fat

2.3.1 Effects of exercise training on percent body fat

2.4 Training methods

2.4.1 Continuous training

2.4.2 Effects of continuous training on blood pressure, body weight, and percent body fat.

2.1 BLOOD PRESSURE

Recent research studies (Katch et al; 2010; Krassas et al; 2001) revealed that both modern and traditional societies are exposed to series of manifesting behaviours of developing the risk factors of blood pressure. Available research evidence suggests that individuals who lead sedentary lifestyles, especially those whose average daily energy intake does not correspond with daily energy expenditure, who spend less time in physical activities, who consume saturated fat, excess salt intake, who indulge in tobacco smoking, alcohol, drugs and who are overweight are more prone to high blood pressure (Heyward, 1988; U.S. Department of Health & Human Services, 2000). In addition, health professionals suggest that elevation of blood pressure with occupational stress, anxiety and emotional disturbances constitutes high level risk, most especially in industrialized societies (Heyward, 1998 & Ekelund et al; 2002). Recent findings have shown that as a result of stress (mild or acute) anxiety and depression due to psychological problems, blood pressure rises acutely (Ekelund et al; 2002; Heyward, 1998; & U.S. Department of Health and Human Services, 2000).

Williams (2008) & Heyward (1998) supported the view that there is a trend for blood pressure to rise with advancing age and the individuals with already higher blood pressure sustain a faster rise than those with lower pressure. Current epidemiological studies indicate that essential hypertension appears to be one of the most common risk factors for cardiovascular diseases, which are among the common causes of death and disability among adolescents and adults worldwide (Krassas et al; 2001). Unfortunately, high blood pressure is currently occurring much more frequently even in early preadolescents (Dai et al; 2002 & Pate et al; 2002). However, Krassas et al (2001) were of the opinion that there are no longitudinal studies relating to blood pressure in preadolescents and adults.

The World Health Organization (2000),and the U.S. Department of Health & Human Services (2000) are of the view that high blood pressure is higher than normal blood pressure, that is, if any systolic pressure is above 140 mmHg and a diastolic pressure is in excess of 90mmHg. However, they suggested that the level at which blood pressure becomes abnormally high can be established, since a dangerous situation may start consistently between 140/90mmHg and 160/95mmHg and above this could be termed definite hypertension. Their clinical findings suggest that the higher than normal blood pressure is due to a greater amount of force exerted by the arterial blood flow against the walls of the blood vessels, resulting in the arterial wall thickening, thereby altering the blood supply to tissues (Frotini et al; 2001; Pollock et al; 1978).

According to Heyward (1998), hypertension is a chronic, persistent elevation of blood pressure affecting a large number of people worldwide. He is of the opinion that both men and women are at greater risk. In the prevalence of hypertension, clinical research findings (Whitehead and Corbin, 1984) have shown that individuals, not taking antihypertensive drugs and not acutely ill, and based on average of two or more readings on two or more occasions especially in adults 18 years or older, are classified for blood pressure as shown in table 2.1.

Table 2.1 Categories of Blood Pressure

Systolic BP	**Categories**	**Diastolic BP**
(mmHg)		(mmHg)
<130	Normal	<85
130 – 139	High normal	85 – 89
140 – 159	Mild hypertension	90 – 99
160 - 179	Moderate hypertension	100 – 109
180 – 200	Severe hypertension	110 – 119
≥ 200	Very severe hypertension	≥ 120

Source: WHO (2000)

This shows that the greater the difference from normal blood pressure, the greater the risk of high blood pressure. Based on the above, the World Health Organization (2000) suggested that regular exercise, especially aerobic exercise, performed at an intensity of 40 to 60% of maximal oxygen uptake, 3 to 5 times a week, reduces systolic and diastolic blood pressure by 10mmHg in hypertensive individuals. However, these reductions in blood pressure in overweight and normal weight individuals are independent of weight loss (Flegal & Traiano, 2000), although regular physical activity does not lower blood pressure which is normal (Fazard & Tipton, 1994). Nonetheless, research evidence has shown that endurance exercise training lowers blood pressure in men and women with mild to moderate high blood pressure (Hagberg 1990; Bouchard et al; 1990). Resistance training has also been shown to lower blood pressure in both adolescents and adults with hypertension (Harris et al; 1987). However, Querra et al (2002) reported no change in blood pressure in people advanced in age, most especially in older men and women, aged 70 and above with normal or slightly elevated blood pressure, in response to resistance training.

Epidemiological studies have shown a strong relationship between physical inactivity and hypertension (Wilmore et al; 1984). Thus, people who live a sedentary life, are at greater risk of developing high blood pressure (Heyward, 1998). It is equally suggested that people who eat dietary fat in excess and high in starches and sugar are at a greater risk of becoming obese, diabetic and hypertensive (Krassas et al; 2001). It is also suggested that weight gain in early adult life predisposes an individual to the development of high blood pressure but it cannot be said with absolute certainty that over fatness in childhood (preadolescence) increases the risk of blood pressure in later life (Kraemer et al; 1997). However, Heyward (1998) suggested that there is a correlation between weight, diet and blood pressure in childhood.

Several studies reported a linear trend of increase in systolic and diastolic blood pressure with age and waist-hip ratio (Troisi et al; 1990; & Musa et al; 2001). An age related increase in blood pressure is so common in industrialized populations that it is considered a normal consequence of aging. However, because blood pressure is often weakly associated with age in non-industrialized populations, a stressful environment could play a role in the pathogenesis of hypertension (Toselli et al, 2001; Vignerova et al; 2007).

Epidemiological studies reveal that there is a substantial number of populations in which blood pressure does not rise with age. These are mainly primitive people who have not yet been assimilated into the dominant Western civilization like Chinese Aborigines, Melanesian tribes in Kenya, pigmies of Congo, Southern Angola, Bushmen of the Kalahari desert, Masai tribesmen of Tanzania, Malaysians and Fulani tribesmen in Nigeria (Butkap, 2002; Wang &

Beydona, 2007; Kelishadi, 2007). They are more widely distributed and their ancestors may have occupied a large part of northern and eastern Africa as well as the whole of southern Africa (Pupet et al; 2002). It has been shown that these low pressure populations eat diets low in salt, fat and animal protein. Staple food consists of mostly root crops, cereals, leafy vegetables, fruits and engaged in physical activity for existence. It has also been shown that these people loose their immunity to the development of blood pressure when they migrate from these low pressure environments to urban centres whether in Africa or the United States. An upward trend of blood pressure with advancing age soon appears and hypertension follows (Butkap, 2002). Globally, it is estimated that about 52% of cerebrovascular accidents, 25.8% of ischaemic heart disease, 6.2% type 2 diabetes mellitus and approximately 16% of total mortality are attributable to sub-optimal blood pressure (Systolic > 115 mmHg) with little variation by sex (Haruna, 1994; Butkap, 2007 & Lal et al; 2007).

When calories are restricted and weight is lost blood pressure falls (Lauer & Raab, 1980; Haling et al, 2001). Obesity and higher body mass index have been identified as important factors in elevated blood pressure in many populations. The significant positive correlation between weight and blood pressure variables on the one hand and between body mass index and blood pressure variable on the other hand is consistent with findings from other studies. Similarly the correlation of co-efficients of 0.35 and 0.36 between body mass index and systolic blood pressure were reported by Musa, et al, 2001. An important limitation of the body mass index as a measure of obesity is that it tends to ignore the distinction between fat and fat free mass. Hence, excess weight can be caused by high levels of lean muscle mass and additional muscle mass is beneficial. Except in rare instances, such as providing protection from the cold water for an English channel swimmer, excess fat is not beneficial (Plowman & Smith, 1997; Dudeja et al; 2001). Cooper et al, (in Butkap, 2002) suggested that obesity may contribute to chronic elevation of blood pressure by elevating the levels of angiotensinogen in the blood (Butkap, 2002; & Ogundipe, 2006). Body mass index was found to be consistently associated with blood pressure and increased risk of cardiovascular disease, diabetes type II, excess intra-abdominal fat and visceral adiposity. Diastolic blood pressure is known to be less responsive to increase body mass index than systolic blood pressure. Body mass index only affects blood pressure when it reaches a certain threshold above what is considered healthy (Vasconcelos, & Silva, 2003; Roberts et al; 2004; Kalichman et al; 2006; & Venkateswarlu, 2007).

Hypertension, commonly known as high blood pressure is a medical condition in which blood pressure is chronically elevated (Lauer & Raab, 1980; Ganong; 2005). Blood pressure reading indicates the value for two pressures: The numerator, systolic, represents the pressure while the heart is pumping and the denominator, diastolic represents the pressure when the heart is resting between beats (Reddy, 1998, Ogundipe, 2006; Facchini et al; 2007). Blood pressure varies in diurnal or nocturnal sleep as it drops by about 20%. This is termed “dipping”. Hypertensive patients whose blood pressure remains high at night, 140/90mmHg, the non-dippers, are mostly at greater risk of cardiovascular morbidity, coronary heart disease, diabetes mellitus, chronic obstructive pulmonary decrease (Asuzu et al; 1997; Hoeger; 1988; Ganong; 2005; Musa et al; 2001, ACSM, 2004).

2.1.1 EFFECTS OF PHYSICAL EXERCISE TRAINING ON BLOOD PRESSURE

Blood pressure (BP) is a measure of the force or pressure exerted by the blood on the arteries. The highest pressure (systolic) reflects the pressure in the arteries during systole of the heart when myocardial contraction forces volume of blood into the arteries. Following the systole, the arteries recoil and the pressure drops during diastole. Diastolic pressure is the lowest pressure in the artery during the cardiac cycle.

Resting systolic BP varies between 110mmHg and 140mmHg, and diastolic BP between 60mmHg and 80mmHg (Hayward, 1998). An elevated blood pressure (BP) (140/90mmHg) on two occasions indicates hypertension.

Regular aerobic exercise reduces both systolic and diastolic blood pressure during rest and sub-maximal exercise (McArdle et al; 1981, Fox et al; 1993). The largest decrease occurs in systolic pressure and is especially apparent in hypertensive subjects. McArdle et al (1981) reported studies that showed significantly lowered systolic and diastolic blood pressures with regular exercise with normotensive subjects at rest. McArdle et al, (1981) found a decrease in the average resting systolic pressure of seven middle-aged patients from 139 to 133mmHg following 4-6 weeks of interval training. In addition, at similar sub-maximal exercise levels systolic pressure fell from 173 to 155mmHg whereas diastolic pressure reduced from 92 to 79mmHg. This showed an approximately 14% reduction in arterial blood pressure following training. Similar findings were observed for an apparently healthy yet border-line hypertensive middle aged group of men following a 6 months exercise program.

Training, does not affect the resting blood pressure of persons under 30 years of age if their fitness is average and the blood pressure is normal at the start of the training (Fox, 1981). Conflicting results have been reported in literature on the effects of exercise training on blood pressure. Tukur, (2002) indicated that there is available evidence to support the increase in systolic blood pressure with increasing workload during maximal exercise bout. The increment is roughly proportional to the intensity of effort, although greater in relation to oxygen consumption.If small muscles are involved, the diastolic pressure remains practically unchanged in high exercise, or slowly increase with increasing load, so that there is increase in pulse pressure (Masironi & Danolin, 1985).

On the basis of systemic reviews, experts and exercise physiology and sports medicine recomended an exercise programme of at least 30 minutes duration, at an intesity of more than 45% Vo2 max for almost all days of the week to significantly reduce blood pressure of hypertensives (Heyward, 1998; Brooks, Fashey & Baldwin, 2005; Pwores & Howley, 2012). To verify this statement, Cornelissen & Fagard (2005) conducted meta-analyses of randomized controlled triats involving dynamic aerobic endurance training or resistance training. The meta-analyses on endurance training involved 72 trials on 105 study groups. After controlling for the number of trained participants, training caused a significant reduction in resting and day time blood pressures of 3.0/2.4mmHg ($P < 0.001$) and 3.3/3.5mmHg ($P < 0.01$) respectively. This reduction was more pronounced in the 30 hypertensive study groups (-6.9/-4.9) than in the others (-1.9/-1.6, $P < 0.001$ for all). A meta-analyses of 9 randomized control group (12 study groups) are mostly dynamic resistance training by the same authors revealed a weighted net reduction of blood pressure of 3.2 ($P= 0.10$)/3.5 ($P < 0.01$) mmHg. The number of subject used in the study and the training protocol applied are different from those used in this study.

2.2 BODY WEIGHT

An ideal body weight is the body weight which includes only a minimal amount of body fat and depends largely on the skeletal size (Perez et al; 2002). The ideal body weight may be modified to some extent by enlargement of the muscles by training in weight lifting. A person may therefore be overweight without being obese. However, it is said that for all practical purposes, the excess weight or the weight over and above the "ideal" body weight represents accumulated fat.

There are graphs and tables, usually based on height and sex giving the so-called "ideal" body weight. One of the best known of this method is said to be the metropolitan life insurance table (1963). Such norms are said to be rather inaccurate and meant only as a general guide. There are, however, several methods for a quantitative classification of body composition, including the amount of adipose tissue as for example, the radial-ulna diameter skinfold thickness, body densitometry, soft tissue radiography, methods using fat soluble gases, and total body potassium determination.

Body composition, particularly in athletes, is said to be a better guide for determining the desirable weight because of the high proportion of muscular content in their total body composition. However, for practical purposes, obesity is said to be most conveniently diagnosed and judged by the application of simple height and weight methods. These measurements it appears, are at least quite accurate (Perez et al; 2002).

The body mass index is commonly used to determine desirable body weight. Developed by a Belgian, Adolphe Ouetelet, between 1830 and 1850. BMI is a measure of weight in relation to height and is calculated as weight (kg) divided by height (m^2) squared (Klein et al, 2002). People with a BMI of 18.5 to 24.9 are normal while those with BMI of 25.0 to 29.9 are considered overweight and those with BMI of 30 and above are obese.

The waist-to-hip ratio can be obtained by measuring the smallest part of the waist and the biggest part of the hip and dividing the waist measurement by the hip measure. The normal values are 1.0 for men and 0.8 for women (Klein et al; 2002).

Researchers identified a clear association between increased body mass index (BMI) and increased probability the incidence of injuries, including those related to falls, sprains or strains, lower extremity fractures and joint dislocation (Eric et al; 2006). Obesity may increase the chance of infertility. Overweight and obesity have been shown to be associated with chronic diseases, like type 2 diabetes, hypertension, Ischemic Heart Disease (IHD), kidney disease and other specific vascular diseases (Lehoritz, 2006). Obesity is the condition of having too much body fat. When a person consumes more calories than the body needs, the body stores these additional calories as fat causing subsequent weight gain (Bailey et al, 1995).

Obesity increases the risk of developing disease according to the National Institute of Health (1998). Almost 70% of heart disease cases in the United Sate of America are linked to excess body fat and obese people are more than twice as likely to develop hypertension. The risk of medical complications particularly heart disease, increases when body fat is distributed around the waist especially in the abdomen. There is considerable evidence that excessive fat stored in the intra-abdominal cavity may be especially harmful. Releases of large amounts of free fatty acids into the blood streams, portal vein, and are transported straight to the liver. When there is a large amount of intra-abdominal fat, the resulting heavy influx of free fatty acids to the liver is thought likely to disturb hepatic metabolism in ways that lowers the body's sensitivity to insulin (Klein et al; 2002), while also disturbing the blood lipids and ultimately raising the risk of developing type 2 diabetes (Lehoritz, 2006).

The effect of excessive body fat is of growing significance for public health. There is now clear evidence from many sources that a body mass index (BMI) above $25kg/m^2$ increases the risk of developing ischemic stroke, osteoarthritis and at least four types of cancer (colorectal, kidney, endometrial and post menopausal breats). Waist circumference and hip circumference appears to affect vascular disease in opposite direction. Therefore, the ratio of waist-to-hip circumference (waist hip ratio) could be a particularly information predictor of vascular risk, especially myocardial infraction (Yusuf et al, 2004).

For those who are overweight and have additional risk factors (high blood pressure, high IAI cholesterol, low IDI cholesterol, high triglycerides, high blood glucose, family history of early heart disease, sedentary life style and cigarette smoking), the National Institute of Heart, lung, and Blood guidelines recommended weight loss (10 percent of current weight) to lower the risk of obesity related diseases.

Among urban Nigerian Civil Servants, higher socioeconomic status is related to higher blood pressure (Nieman, 1998). The relationship between BMI and blood pressure was for a long time perceived to be strong and universal thereby suggesting that BMI contributes to hypertension prevalence rates (Pupet et al; 2002). Mufunda, (2005) in Eritrea found that BMI was positively associated with Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and mean artial pressure. They also reported that the effect of BMI on blood pressure was higher in males than in females.

Filer (2004) stated that, it takes 10 years for high blood pressure in young people to develop after they become overweight. He added that obesity is one of the strongest predictors of hypertension in young adult. Obesity tends to run in families suggesting a genetic cause. However, families also share diet and life style habits that may contribute to obesity (George, 2001). A person's genetic makeup may determine his/her body weight. Scientists are unclear about which genes affect human obesity. More than 250 genes that may play a role in obesity have been identified in mice and humans (Gary, 2006). The cause of obesity is believed to be complicated and more likely involves the interactions of multiple genes with life style factors such as diet and physical activity.

Repacked foods, soft drinks and fast-food restaurants have become more accessible to Nigerians and to Zaria residents in particular while such food choices offer convenience, mostly to civil servants who hardly have time to cook, they also tend to have high fat, sugar and calories. Most civil servants eat at restaurants and also spend less time devoted to exercise as a result of longer working hours in the offices or at sedentary jobs. There is a general decline in physical exercises training programmes among civil servants. In addition they spend hours browsing internet, playing video games and watching television at their leisure time, in addition to many labor saving devices of the modern life-style, such as car, elevators, and remote controls which promote sedentary life style in Nigeria. This lack of physical exercise by many civil servants has reduced the overall amount of energy expended in the course of a day contributing to the development of obesity. Worldwide epidemic of obesity has resulted primarily from an imbalance in caloric intake and expenditure in societies becoming more affluent and sedentary. However, for any given individual, obesity is a multi factorial trait influenced by both genetic and environmental factors (Holly-Kramer et al; 2005).

Body composition refers to the relative amounts of lean tissue (that is bone and muscle) and fat in the body. It is divided into fatness (% body fat) and lean body mass (% lean body mass). The normal percent body fat levels for' male is 16 percent while that of female is 23 percent (Wilmore et al; 1984). Excess body fat percent is a pathological condition, characterized by an accumulation of fat in excess of necessary amount for optimal body function (Dawber; 1973). An individual who is 15 percent (male) and 20 percent (female) above normal in body fat percent could be considered as overweight (Knittle; 1972).

Getchel (1985) & Knittle (1972) are of the view that childhood obesity (excess body fat) is a serious risk to health. It increases an indivdual's susceptibility to some disorders, reduces life expectancy and complicates already existing conditions. Attention should be paid by parents to childhood body fat percent as excess fat can later lead to overweight or obese adult. Knittle (1972) reported that approximately 80 percent of obese children remain as obese adults. S

Over fatness in most people is as a result of lack of physical activity (Fox et al; 1993, Astrand, 1996; William et al; 1986). This is common among teenagers as well as adults. There is a need for individuals to engage in physical activity from nursery up to university level. Lack of physical activity and over eating may stimulate the formation of the cells (adipocytes) which subsequently cause over fatness. (Buskirk; 1974; Getchell; 1976; Umar, 2000).

According to Ross & Pate (1985), nutritional status, environment and hereditary factors influence fat body composition and blood pressure in adults. However, when diets are carefully planned with caloric intake matching expenditure, the negative effects of obesity, abnormal fat deposition in different regions and unfavourable serum profiles can be averted (Brownson et al; 2000; O'houghin et al; 1999; Prochaska; et al; 2000). Occupational activity relates directly to measures of body composition, as already indicated this relationship which may be confounded by socioeconomic status since occupation is highly associated with socioeconomic status (Holme et al; 1976).

According to Renaat et al (1999) physical activity during work (e.g walking and standing.) is inversely related with weight, BMI, sum of skin folds and total body fat.It is a well-known fact that over weight due to adiposity constitutes an important public health problem, both in developed and developing nations of the world.(United States Department of Health and Human Services 2000; WHO; 2000). The danger, as expressed by authorities, like nutritionists (American Dietetics Association, American Medical Assosiation, 1992, Parizkova, 1993), and exercise physiologists Hubbard, 2000; Malina, 1989; Pate et al; 2002; Kuczmarski et al; 2000), is that it is positively associated with increased risk of hypertension, Coronary Heart Disease (CHD), type 2 diabetes mellitus, stroke, gall bladder disease, certain types of cancer, osteoarthritis and other disorders. This, obesity has adverse consequences for health.

In epidemiological studies, overweight is defined as excess weight relative to a desirable body weight, relative to a (>120%) of desirable weight) or as a BMI in excess of 29.3 for men and 39.8 for women (Heyward; 1998). Studies by Troiaono & Flegal (1998) showed that approximately 11 percent of children and adolescents all over the world might be overweight. Childhood obesity was further said to have an impact on precursors of chronic disease in adults as shown by two decades of longitudinal data from the Bogalusa Heart study (United State General Report (USGR) (1996). According to WHO (2000), obesity is increasing at an alarming rate among affluent families, urban women and women in higher education. In Sub-Saharan Africa, this increased incidence of obesity among women may be associated with affluence and cultural practices.

Obesity is a serious problem that has so many complications. It is difficult to lose weight. Changes must be made at the individual, community and policy levels, (Khan & Bowman, 1999). The best way to minimize incidence of obesity is to use environmental strategies that address many societal factors that influence energy imbalance, especially diet and physical activity is better than dietary change if actual weight is to be lost (Heyward, 1998; Nieman, 1998), Hence the need to emphasize moderate to vigorous physical activity (MVPA) patterns to obviate the hazard of obesity (Venkateswarlu, 1990).

According to Dikki (1995), evaluation of body composition changes considerably during normal growth and maturation, making it uneasy to separate training effects from that associated with growth. Furthermore, the continuity of fatness level from childhood through adolescence is rather weak (Pollock et al; 1984). It is therefore important to obtain accurate estimate of body composition in children, adolescents and young adults, so as to study developmental obesity, provide better estimate of minimal and optimal weight for physical performance and health, and to study influence of genetics, nutrition and physical activity on muscle, bone and fat development (Lohman et al; 1989). The components of body weight are; fat and fat free body weight. Body weight is usually used alone or in combination with age, weight and frame size to ideal weight. These methods however do not address the relative composition or quality of the body weight.

Many devices have been used to evaluate body composition. The methods most widely used include densitometry, hydrometry, gamma ray, spectrometry and anthropometry. Malina (1994) have done a lot of work on the review of body composition. Although the laboratory based techniques have been found to be more accurate, the focus of the literature was on anthropometric techniques, specifically the skin fold measures. Anthropometry has been defined as the science of measurement of the human body and its components (Mathew, 1978). It is widely used for testing body composition. The height, weight, girth circumference and skin folds are usually measured. Measurement of skin folds in adult populations have been found to be of significant accuracy (Frotini et al; 2001; Lohman et al; 1989; Lohman, 1985).

Body composition is determined by using total body fat percent, BMI, or Anthropometric measurements. Little research has been done to evaluate longtime growth of BMI with attention to individual growth variations from childhood through adolescence to young adulthood. BMI growth can be confounded by weight which is only an approximate indicator of biological age since the rate of maturation differs markedly among individuals, Regression equations was formulated (Jackson & Pollock, 1985; Slaughter et al; 1980; Lohman et al; 1985) to predict body fat or BMI. Bolieau et al (1985) in Dikki (1995) carefully considered these problems in developing the following equations.

Males $y = 1.35x - 0.012x^2 - 4.4$

Females $y = 1.35x - 0.012^2 - 2.4$

Where y is percentage fat estimated in all children and young adults from body density, water and fore arm bone mineral measurement using equation

$$\% \text{ fat} = \frac{2.747}{06} - (0.714wt + 1466- 20503)100$$

where X = sum of the triceps plus subscapula skin folds. Slaughter et al, (1985). evaluated these equations for effect of maturation, and reported a variation in the intercept with maturation or age. They therefore modified the equations as follows.

$$\text{Male} = 1.35 \quad x \quad -0.072\, x^2 3.4$$

$$\text{Female} = 1.35 \quad x \quad - 0.012x^2\, 6.4$$

They further reiterated the need for these equations to be cross validated. Lohman et al, (1985) used a formula to estimate lean body mass from triceps and subscapular skin folds. The formula used was.

LBM = 87 (weight) - .36 (triceps) skin fold) - .40 (Subscapular skin fold) + 3 – 71

2.2.1 EFFECTS OF EXERCISE ON BODY WEIGHT

Body composition is a key component of an individual's physical fitness profile (Heyward, 1998). Although the assessment of body composition is not physical fitness test items, the amount of fat deposit in relationship to total body weight is of interest to the exercising public. Body composition fitness is based on the proportion of the body fat to lean mass which has been found to affect one's ability to move. This means the more the fat deposit, the lower the capacity to consume oxygen (Chado, 1992).

The primary health problem at least in the western world relating to body composition concerns the carrying of too much body fat (Fox and Corbin, 1985). Obesity reduces life expectancy by increasing the risk of coronary artery disease, hypertension, type II diabetes, obstructive pulmonary disease, osteoarthritis, and certain types of cancer. Heyward, (1998) indicated that obesity is related to hypertension, elevated serum cholesterol and adult onset diabetes. Too little fat (Heyward, 1998), as found in individuals suffering from eating disorders, such as fibrosis also poses a health risk because the body needs a certain amount of fat for normal physiological functions.

Physical activity in any form constitute the most variable part of the energy expenditure of the every balance equation, been 5% to 40% of the daily energy expenditure (Calles-Escandon & Horton, 1992; & Poehlman, ET; 1989). People perform strenuous exercise have been shown to expand 300-1000kcl during exercise. Therefore some exercise physiologist like powers & Howley (2012) supported previous study according to which exercise training of sufficient duration and intensity causes a significant decrease in body weight. This is further supported by epidemiological evidence that suggest an inverse association between physical activity and body weight among those who are physically active (De-Vries, JH; Zock, PL; Menzink, RP; & Katan, MB, 1994). Consistent with this suggestion, recent studies showed an inverse relationship between BMI and accumulated daily working as accessed by pedometer. Those accumulating more than 10,000 steps per day were more likely to be in the normal BMI range.

Slientz Dutcher, Johnson et al (2004) conducted a randomized controlled trail study on 120 sedentary overweight men and women of 40-65 years of age with mild to moderate dyslipidemia to determine the effects of difference among the intensities of exercise training conducted for 8 months. This study involved 8 months exercise training programmes on 3 groups of high amount/ vigorous intensity, calorically equvelent to about 32kilometers of jogging per week at 65-80% peak oxygen consumption, low -amount /vigorous intensity equivalent to about 19.2 kilometers of jogging per week at 65-80% peak oxygen consumption, and low- amount/ moderate intensity, equivalent to about 19.2 kilometer of walking per week at 45-55% of peak oxygen consumption, This 3 groups of subjects were advised not to change their diet and were encourage to maintain their body weight. The results showed significant ($p < 0.5$) dose -response relationship between amount of exercise, amount of weight loss and fat mass loss. The high amount /vigorous intensity group loss significantly body mass and fat mass (2.9kg and 4.8kg respectively), than the low amount /moderate intensity group (1.8kg and 2.0kg respectively), the low amount / vigorous intensity group (2kg and 3.4kg respectively) and the control group (2.1kg and 3.0kg respectively). Both low amount groups had sufficiently greater improvement than controls but were not different from each other. The present study involve only 12 weeks of training and did not give different intensities and duration of training for the different experimental groups as in the present study, the experimental groups significantly loss weight and fat and the high amount groups lost more weight and fat in a dose-response manner.

It was therefore suggested that a higher amount of activity is necessary for weight maintenance.

2.3 ASSESSMENT OF PERCENT BODY FAT

Available research evidence suggests that excess fatness or obesity is serious health problem. It reduces life expectancy and affects quality of life. It is a greater risk for coronary heart diseases, hypertension diabetes and colon cancer (Heyward, 1998). Thus, it has been suggested that people who have an excessive weight gain relative to a desirable body weight, that is more than 20% of desirable weight, are at a greater risk of several common health problems. On the opposite side, people with too little body fat tend to be malnourished. They have a relatively higher risk of bone disorders, muscle wasting, kidney and reproductive disorders (Heyward, 1998; Wilmore, et al, 1984). Heyward (1998) suggested that in classifying clients percent body fat, disease risk and body composition measures are useful for

- Estimating a healthy body weight and formulating nutritional recommendations and exercise prescription.
- Estimating competitive body weight for athletes participating in sports that use body weight classification for competition (e.g wrestling and boxing).
- Monitoring the growth of children and adolescents and identifying those at risk because of under or over fatness.
- Assessing changes in body composition associated with aging malnutrition and certain diseases.
- Assessing the effect of nutrition and exercise intervention in counteracting these changes.

In the human body, fat is understood as the subcutaneous tissue, which is used as fuel during exercise of low to moderate intensity. Fat deposit is controlled by such factors as heredity, dietary habits and physical activity patterns (McArdle, 1991). It was reported by Fox et al; (1993) that fat deposit during childhood is a result of increase in fat cell size or an increase in fat cell number or both. However, as the individual grows up to adulthood, the body becomes fat as a result of increase in the size of existing number of fat cells.

Although fat is necessary for one's health, too little or too much (obesity) of it is detrimental to health and performance (Chado, 1992, Venkateswarlu, 1990). Although established minimal limit to percent body fat in men and women is not available, the American Medical Association suggests that the upper limits stand at 20% and 30% for men and women respectively. However, BarOr (1987) suggests that low fat is desirable to both men and women.

Just as too little fat in the body poses health hazard because of lack of fuel for exercise and lack of the ability to prevent hypothermia, too much fat also poses health hazard as it can lead to overweight and obesity (Malina, 1996). Furthermore, research evidence shows that the health hazards of obesity range from cardiovascular disease risk to the inability of the individual to accelerate in physical activity of low to moderate intensity (Venkateswarlu, 1990). In as much as there are negative effects of too little or too much of fat in the body, it is important to note that the values of normal percent body fat, which include cell membrane formation (phospholipids), metabolic fuel (triglycerides) and transportation of fat soluble vitamins (A,D,E and K) Goran et al; (1995).

Insight into the study of body fat distribution has been provided by modern technological advancements. Research results show that fat patterns differ from one individual to the other, which depend on heredity, age and sex. This was supported by the results of Perez et al (2002), which showed general increase in both boys and girls in Waist-Hip Ratio (WHR) and waist and hip circumferences, although this was stronger in males during adolescence.

Research evidence shows that growth hormone also plays a major role in body composition (Roemmich et al; 2000), because of which it was suggested that during pubertal growth spurt, a relatively greater amount of growth hormone concentration than growth hormone binding protein is recorded. For this reason, children with growth hormone deficiency usually have reduced subcutaneous fat cell number and increased subcutaneous fat cell size or total fat mass. These children demonstrate a wide variety of fat distribution.

The body may be regarded as being composed basically of two fractions body fat and fat free weight or lean body mass. The amount of body fat or adipose tissue that is stored, according to Fox (1976) in (Perez et al; 2002) is determined by two factors:

1. The number of storing cells of adipocytes and
2. The size or capacity of adiposytes. According to Venkateswarlu (1990), fat distribution refers to the regional location of fat and not to the amount of fat. Body fat accounts for approximately 26 percent for the females.

Among athletes, regardless of sport preference, the body fat is generally lower, with the percentage again differing on the basis of sex. When the weight of fat is subtracted from the total body weight, the remaining weight is fat free weight or lean body mass. The fat free weight reflects the skeletal muscle mass, the weight of other tissues and organs such as bone and skin. The muscle mass makes up about 40 – 50 percent of the fat free weight. The average fat free weight of the college age female is about 75 percent to her total body weight. For most people, gaining weight is easy, but unfortunately, the gain is mostly in body fat which can lead to health problems (Fox, 1979, in Perez et al; 2002).

The present thinking, according to Venkateswarlu (1990), is that adults with a more central (more fat on the abdomen) fat distribution have a great risk of developing cardiovascular disease and non-insulin dependent diabetes. As many chronic disorders have their roots in childhood and adolescence, studies on regional variation in fat distribution during growth are very much needed.

Assessment of percent body fat has become a popular and standard practice for many physicians, athletic trainers, and allied health professionals. Evidence supports the notion that being overweight (excess body fat) is related to musculoskeletal injury, non-adherence to exercise training, reduced athletic performance, and many health problems (Bray, 1985 cited in Maud et al; 1995). More specifically, excessive body fat has been shown to be associated, with such health problems as hypertension, diabetes millitus, depression, hyperlipidemia, and Coronary Heart Disease (CHD).

One of the accurate and valid techniques for evaluating body composition is determination of body density by hydrostatic weighing (Walsh et al; 1984 in

Tanko, 2000). The method requires experience, time, expensive equipment and subject cooperation. This method is not practical for most people, including coaches, in field setting. With improved techniques (Skinner et al; 1990), hydrostatic weighing is relatively easy to perform, economical, and highly repeatable.

In an effort to circumvent the problems associated with hydrostatic weighing, prediction equations have been developed using subcutaneous skinfolds measurements, body circumferences and bone diameters to estimate body density and percent body fat. Skinfolds indirectly measure the thickness of subcutaneous adipose tissue (Heyward, 1998). Skinfolds technique is based on the assumption that 50% of the body fat is subcutaneous (Skinner et al; 1990). They indicted that correlation coefficients of – 0.7 to 0.8 had been reported between skinfolds and hydrostatic weighing in different populations. Predictions based on skin folds are usually within 3% - 5% of values estimated form hydrostatic weight data.

The skinfold method is inexpensive, and measures are easily obtained but there are methodological problems identified (Skinner et al; 1990) which include caliper pressure, inter observer error, difficulty obtaining accurate measures on obese people, and considerable expertise needed to obtain accurate measurements.

Universal standards and guidelines for skinfolds are needed (Heyward, 1998). However, skinfolds prediction equations are developed using either linear (population specific) or quadratic (generalized) regression models. There are well over a 100 population specific equations to predict body density from various combinations of skinfolds, circumferences and bone diameter (Heyward, 1998) and improving the accuracy of converting body density to relative body fat values (Wilmore et al; 1984).

The fat content is estimated from skinfolds thickness as measured by taking a fold of flesh at a suitable site and measure the thickness with calipers that exert a constant, standard pressure (Watson, 1983, cited in Tanko, 2000). Monogram is available for some skinfolds prediction equations (Heyward, 1998). For example, a monogram was developed for Jackson's sum of three skinfolds equations. However, although the monograms are potential time savers, they are based on a two component body composition model, using the Siri equation to convert body density to percent body fat.

2.3.1 Effects of Exercise Training on Percent Body Fat

The changes in body composition (Calles-Escandon & Horton, 1992), induced by exercise training include decrease in total body fat, no change and slight increase in lean body weight. These changes, particularly that of fat loss, are more pronounced for obese men and women than for the already lean individual. Loss of body fat depends on the balance between calories taken in and calories expended. The caloric cost of running and walking is independent of speed, in terms of how many calories are spent in a run or walk, but rather how far you travel.

In a book by (Heyward,1989), has shown that regular participation in an exercise program may alter an individual's body composition. Aerobic exercise and resistance training are effective modes for decreasing skinfold thickness, fat weight and percent body fat for both men and women. Aerobic exercise reduces body fat and dynamic resistance exercise increases fat free mass (Perez et al; 2003 and Heyward, 1989). The significant loss of fat weight and percent body fat with aerobic exercise and resistance training is a function of hormonal responses to exercise (Heyward, 1998). Exercise increases the circulatory levels of growth hormone (GH) and the levels remain elevated for 1 to 2 hours after exercise. Exercise also stimulates the release of catecholamine from the adrenal medulla (Venkateswarlu, 2010). Both growth hormone and catecholamine increase the mobilization of free fatty acids from storage. Eventually, the muscles may metabolize these free fatty acids during rest and low-intensity exercise (Venkateswarlu, 2010).

While low intensity aerobic exercise is more beneficial for fat loss, high intensity resistance training is better for fat free mass gain. The increase in fat true mass with resistance training may be due to muscle hypertrophy, increased protein content in the muscle or increased bone density. Not only does exercise tend to increase energy expenditure and help to create a negative energy balance for weight loss, daily exercise ensures that the weight loss is due to the loss of fat rather that muscle tissue. (Heyward, 1998).

So, TY, Farrington E, Absher RK (2009) conducted a meta-analysis study on the effects of exercise on blood lipids and lipoproteins. The results of 66 training studies involving the measurement of human blood lipid and lipoprotein changes over time, conducted over the last 26 years and representing 2925 subjects (2086 experimental and 839 control) were collected and statistically analyzed using the meta-analysis technique. Across all types of subjects, treatments, sources and research designs. The average exercising subjects was found to have a reduction in total cholesterol of 10mg-dl^{-1} ($p < 0.01$), total triglyceride decreased by 15.8 mg-dl^{-1} ($p < 0.01$), HDL-C increased by 1.2 mg-dl^{-1} (NS), LDL-C decreased by 5.1 mg-dl^{-1} ($p < 0.05$), and total/NDL-C ratio showed a large decrease of 0.48 ($p < 0.01$).

None of the changes for the control groups were significant. Initial levels of total cholesterol, total triglyceride, HDL-C, and total/HDL-C ratio were strongly correlated with their respective changes as a result of training, regardless of the data partitioning. Higher initial levels of total cholesterol, total triglyceride and total/HDL-C ratio resulted to greater decrease post-exercise (r= 0.48, 0.76 and 0.75 respectively; $p < 0.01$), and lower initials levels of HDL-C resulted in greater post-exercise increases ($r=0.50$; $p < 0.01$). Over all, physical training seemed to produce beneficial changes in blood lipids and lipoproteins. However, researchers must be careful when examining the relationship between physical training and serum lipids and lipoproteins because initials levels, age, length of training, intensity, V02max, body weight, and percent body fat have been shown in this meta –analysis to interact with exercise and serum lipids and lipoprotein changes.

The results indicate the general trend of different studies on the effects of training on lipid and lipoprotein which is a significant reduction in this variable due to training. The present study, however, attempted to find out the effect of continuous and interval exercise training only on percent body fat and not on lipid and lipoproteins. The findings of which were a significant reduction on percent body fat and body weight due to both continuous and interval exercise training.

2.4 TRAINING METHODS

Some of the training methods include resistance training, circuit training, pressure training, continuous training, and interval training. Two of the most popular methods of training are continuous training and interval training (Venkateswarlu, 1964).

2.4.1 Continuous Training

There is a growing volume of evidence to suggest that continuous high-intensity exercise is an outstanding means of improving Vo_2 max and lactate thresholds in athletes, (Scott et al; 1977) Although the exercise intensity that promotes the greatest improvement in Vo_2 max may vary from athlete to athlete, it is believed that exercise intensities between 80% - 90% Vo_2 max are optimal.

Continuous training is one of the oldest and the most indispensable methods of training followed in all the sporting activities. It may take the form of long slow training, long fast walking or jogging. The pace can be even or perhaps preferably, with moderate variation, faster and slower

Continuous slow workout is a form of continuous training involving slow workouts performed continuously over a prolong period of time at slow pace.Though the pace varies from individual to individual, it should always be fast enough to increase the heart rate to 150 beats per minute. The distance or duration covered should be related to the athlete is specific event.

Continuous fast workout is a form of continuous training that differs from slow workouts in that the pace is faster and the distance covered is less (Venkateswarlu, 1982).

2.4.2 Effects of Continuous Training on Blood Pressure, Body Weight And Percent Body Fat

Although caloric restriction is a common strategy used for weight loss, and maintenance of blood pressure, a combination of caloric restriction and continuous exercise training has been shown to be more effective intervention (Curioni & Lourenco, 2005). This combination has been shown to reduce the loss of fat-free mass (Marks et al; 1995), promote fat loss (King et al; 2001; Venkateswarlu, 2011), maintain or minimize a decrease in resting metabolic rate (Lennon et al; 1985; Venkateswarlu, 2010), reduce visceral adipose tissue depots (Ross,1997), decrease systolic and diastolic blood pressures (Venkateswarlu, 2009), and improves blood lipids (Datilo & Kris-Etherton, 1992). More importantly, exercise can improve aerobic fitness which can directly reduce the risk of co-morbidities associated with obesity (Mann; 1974; Venkateswarlu, 2009). The exercise regime, commonly employed in obese subjects, involves continuous aerobic exercise training performed at a constant low to moderate intensity (Jacobson et al; 2003; Venkateswarlu, 2010). Campbell et al; (2010) reported that this kind of training was not as effective as interval training for fat-loss or health improvement. One of the main purposes of this study was to find out the relative efficacy of continuous exercise training in reducing blood pressure and positively modifying body composition.

2.4.3 Interval Training

Interval training involves the performance of repeated exercise bouts, with brief recovery periods in between (Scott et al; 1977). The length and intensity of the work interval depends on what the participant is trying to accomplish. For instance, a longer work interval requires a greater involvement of aerobic energy production, while short, more intense interval provides greater participation of an aerobic metabolism (Scott et al; 1977). Therefore, interval training that is designed to improve Vo_2 max should generally utilize interval of > 60 seconds to maximize the involvement of aerobic ATP production (Scott et al; 1977).

According to Scott et al, (1977), there are advantages of interval training over continuous running in that this method of training provides a means of performing large amounts of high intensity exercise in a short time. It is the best way of providing a training overload. For example, it can be modified to provide “over load” in terms of either increasing the total number of exercise intervals performed, or the intensity of the work interval.

According to Venkateswarlu (1992), there are different types of interval training that can be used such as

- Sprint interval training
- Fast interval training
- Stress interval training

- Repetition interval training
- Slow interval training

Sprint interval constitutes workload of more than 80% of maximum speed at a distance of 250m, and has been shown to be useful for sprinters and other sportsmen from sprint type sports disciplines.

Fast interval training constitutes a workload of 77.5% - 80% of maximum speed at a distance of 650m, and has been found to be faster than competition speed in sprint endurance and endurance sport activities. (Venkateswarlu, (1982), stated that this type of interval training is used for speed and strength in an individual.

Stress interval training means working at more than 85% maximum speed at the long sprinting distance and in speed endurance type of sprint which is only suitable for long sprinters, middle distance runners and other similar sportsmen who need to improve their speed endurance.

Repetition interval training constitutes working at more than 80% of speed in the middle distance events and in various sports discipline such as football and hockey (Venkateswarlu, 1982). The author expressed that this method of training is used for preparing athletes for racing or competition.

Slow interval training is the type of interval training in which work is performed at 60% - 75% of maximum speed and at 100m – 400m, and primarily used to develop cardiac efficiency in athletes. Distance runners and sportsmen from endurance type of sports can develop cardio-respiratory endurance through slow interval training method Venkateswarlu (1982), reported that pace interval training is training at the racing or at competition speed at ¼ of racing distance.

Many methods are used to determine the appropriate intensity of repetitions in interval training which include heart rate response during the repetitions. Women under 20 years of age should have their heart rate increased to 190 beats per minute during repetitions, while men and women between the ages of 20-29, 30-39, 40-49, 50-59 and 60-69 should have their heart rate increased to 180, 170, 160, 140 and 140 beats per minute respectively during each repetition for adequate intensity of the repetition (Matthews and Fox, (1981).

2.4.4 EFFECTS OF INTERVAL TRAINING ON BLOOD PRESSURE, BODY WEIGHT AND BODY COMPOSITION

The few studies that have been reported so far, that have compared interval training to continuous aerobic training in an obese population have reported that interval training increased cardio-respiratory endurance and RMR (King et al; 2002), greater fat loss (King et al, 2001, Trapp et al; 2008), and a greater decrease in blood pressure and excess post exercise oxygen consumption (Kaminsky &

Whaley (1993). These results were further supported by the observation of Venkateswarlu, (2009-2010), & findings of Campbell (2010), which showed significant decrease in blood pressure, weight loss and percent body fat and significant increase in cardio-respiratory endurance, compared to the effects of continuous training. The present investigation was also concerned with the comparative effects of continuous and interval training on overweight adults on their blood pressure, body weight and body composition.

Exercise training causes beneficial changes with increase exercise capacity in neuro-hormonal, metabolic and haemodynamic functions in both healthy persons with cardiovascular disease (Jacobson et al; 2003; Campbell et al 2010). Lipid and carbohydrate metabolism is favourably modified by exercise training. The increased High Density Lipoprotein (HDL) due to exercise training in body weight, which have been found in men and women who exercised at higher intensities (Mann; 1974; Venkateswarlu, 2009). The beneficial effect of dietary control on bllod lipoprotein levels in overweight men and women is enhanced when they exercise regularly (King et al, 2001). Recent studies suggest that exercise training plays an important role in the prevention and treatment of oesteoporosis and some neoplastic diseases especially Colon Cancer (Campbel, et al 2010). Exercise training, in addition to these physical benefits causes improvement in didderent index of psychological functioning. Active persons compared to inactive individuals have been shown to be better in cognitive functioning (Powers, et al; 2012), and to exhibit fewer symptoms of anxiety and depression (Curioni & Lourenco, 2005). Longitudinal exercise training studies have shown significant reduction in blood pressure, body weight and percent body fat due to exercise training at an intensity of 60% max heart rate (220-age), for at least 3 times a week for 12 weeks.

2.5 SUMMARY

Exercise scientists have recognized that increase blood pressure, excess body weight and percent body fat have increased the risk of men and women to various degenerative diseases, such as diabetes mellitus, hypertension, atherosclerosis and coronary heart disease which are of great concern in medical practice (Nelson et al, 2006) .The only remedy, is to burn the excess fat off. The rate of such expenditure depends on intensity and duration of activity (Sharkey, 1985).

Exercise plays an important role in weight control and energy balance. When training is systematic and progressive, it results in decrease in blood pressure, redused body weight and increased fat metabolism and utilization and consequently reduced susceptibility to plaque deposition. (Heyward, 1998;

Nieman,1998). The use of exercise of low intensity, and long duration has been observed to yield negative energy balance and weight reduction arising from fat utilization (Sharkey, 1995), Most important aerobic exercise training protocols are the continuous and interval training protocols (Heyward, 1998; Plowmen & Smith, 1997, Watson, 1983). However, when diet is carefully planned in a way that with caloric intake equals, energy expenditure, the negative effects of obesity, abnormal fat deposit in different regions and increase in blood pressure can be averted (Brownson et al; 2000; O'Loughlin et al; 1999; Prochaska et al; 2000).

Continuous and interval exercise training programs are being manipulated to alter body composition variables (Venkateswarlu, 2011). The different study revealed in this chapter clearly indicated a significant reduction in both systolic and diastolic blood pressure due to aerobic training. The present study however, showed a significant decrease only in systolic blood pressure due to 12 week continuous and interval exercise training. All the studies reviewed have clearly shown a sinificant reduction in body weight of the subject who underwent aerobic training. This review further revealed that the decrease in body weight due to training was more in subjects whose initial body weight before training was more.

All the study reviewed in this chapter showed a significant reduction in lipids, lipoprotein and percent body fat. This decrease was more in the subjects whose initial pre-training levels of this variable were higher. The result of the present study supported this finding by showing a significant decrease in percent body fat after 12 weeks of continuous and interval exercise training.

This study has become necessary in order to further ascertain the extent to which both protocols could attain the desired results.

CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

The purpose of this study was to compare the effects of continuous and interval exercise training on blood pressure, body weight, and percent body fat of overweight Nigerian male and female adults. To achieve this purpose, the research design, population, sample, instrumentation, training protocols, testing frequency, experimental controls and statistical technique used in this study are discussed in this chapter.

3.1 Research Design

3 x 2 factorial research design was used in this study (Thomas & Nelson, 1996). In this design, a total of 90 volunteers overweight male and female adults, were randomly assigned to continuous, interval and control groups. The training groups underwent their respective exercise training programmes for 12 weeks, while the control group did not undergo any structured training for 12 weeks, as shown in paradigm 1.

R	O_1	T_1	O_2 Interval group
R	O_3	T_3	O_4 Continuous group
R	O_5	-	O_6 Control group

R = ra ndomized, O = observation, t = training C = control group

Paradigm 1. 3 x 2 factorial research design.

3.2 Population

For the purpose of this study, Male and Female adults whose body mass index is greater than 30.0 as suggested by National Institute of Health (1998), comprised the population for the study.

3.3 Sample and Sampling Technique

On the basis of the subject's acceptance to participate in the study, a total of 45 male and 45 female overweight subjects were tested for blood pressure, body weight and percent body fat. All the subjects were given numbers 1-90. The subjects were chosen on the basis of afixed interval of 3 numbers . that is, 1-3, 4-6, 7-9 etc. The first 15 thus selected were assigned to continuous group, the second to interval group and the third to control group in the case of men. The same procedure was followed in the case of the women.

3.4 Training Protocols

Continuous Training

The continuous training group underwent training thrice a week for 12 weeks.The training session for the 1st 3 weeks consisted of 10 minutes of warming up exercises, which included jogging and stretching exercises. This was followed by 15 minutes of continuous running on a 400m track. The training sessions held on alternate days of the week, which included Tuesdays, Thursdays and Saturdays. The continuous running and jogging was maintained at an intensity of

60% of max heart rate (220-age). This max heart rate was determined by training the subjects to measure their heart rate at rest for 5 seconds and measure it again immediately after exercise training for 5 seconds. The product was multiplied by 12 to get each subject's heart rate per minute.

Subjects were trained on how to measure their heart rate themselves by placing their index and middle fingers on their radial artery and applying a little pressure, and then counts the bits for 5 seconds before and immediately after the exercise training.

It was assumed that the subjects would have adapted to the exercise stress by the end of 3 weeks of training. The continuous running and jogging exercise was increased by 5 minutes, which consisted of 10 minutes of warming up and 20 minutes of running and jogging. The intensity of continuous training remained the same as in the 1st 3 weeks of continuous training. The training sessions remained the same, that is, Tuesdays, Thursdays and Saturdays of the week. It is assumed that the subjects would have adapted to the increased duration of continuous training by the 6th week, after which the duration of the continuous running and jogging was increased by another 5 minutes, which consisted of 10 minutes of warming up and 25 minutes of continuous running and jogging, making a total of 35 minutes. The intensity of running and jogging remained the same. The training sessions were conducted on the same days as before for 3 weeks. After the 9th week of continuous training, the duration of running and jogging was increased by 5 minutes, which consisted of 10 minutes of warming up and 30 minutes of continuous running and jogging on the same days and at the same intensity as before, which was maintained for another 3 weeks. Thus the subjects had undergone 12 weeks of continuous training, immediately after which they were tested in the selected variables.

At the end of each training session, the subjects were made to cool down with the following activities light jogging, walking and stretching exercises for a period of 10 minutes to bring their physiological functioning to normal resting level. This is to avoid any accumulation of fluid in the lower limbs after training sessions (24Hr fitness; 2010; MyDr; 2003).

The description given on the continuous exercise training programme followed in this study is shown in a tabular form in table 3.1a.

Table 3.1a: 12 weeks continuous exercise training programme followed in the study.

Table 3.1a: Continuous Training

Assess Unit	Weeks	Warm Up	Continuous Training	Total Time	Intensity	Cooling Down
1st	1-3	10mints	15mints	25	60% MHR	10mints
2nd	4-6	10mints	20 mints	30	60% MHR	10mints
3rd	7-9	10mints	25 mints	35	60% MHR	10mints
4th	10-12	10mints	30 mints	40	60% MHR	10mints

Source: A Self Developed Table

Interval Training

The interval training group trained thrice a week for a period of 12 weeks as the continuous training group. Each training session consisted of a warming up phase, exercise training phase and the cool down phase. The warming up phase consisted of jogging, walking and stretching exercises for 10 minutes. This was followed by interval training. The interval training consisted of 1½ - 2 minutes of running and jogging followed by 1 minute of walking. This was repeated 3 times after which 3 minutes resting interval was given consisting of walking. Thus, the subjects repeated 3 times of running and jogging interspersed with 1 minute of walking, which constituted a set. In each training session, the subjects performed 3 sets of running and jogging interspersed with 3 minutes of walking between sets (Venkateswarlu, 1980). This is to ensure that the duration and intensity of work performed was similar to the duration of work performed by the continuous group. This programme was followed for the 1st 9 weeks, after which the number of repetition in each set was increased to 4. Thus by the end of the 12th week, the subjects performed 5 repetitions of 3 sets with similar rest interval and intensity as before. The intensity of the exercise training was maintained at an intensity of 60% of max heat rate (220-age).

After conducting the initial tests before training, the tests were repeated after six weeks of training and at the end of 12 weeks of training for both continuous, interval training and control groups.

The discription given on the interval exercise training programme followed in this study is shown in a tabular form in table 3.1b.

Table 3.1b: 12 Weeks Interval Exercise Training Programme followed in the Study

Access Unit	Weeks	Warm Up	Repetitions	Sets	Interval Training	Intensity	Cooling Down
1st	1-3	10mints	3	3	1min30Secs	60% MHR	10mints
2nd	4-6	10mints	3	3	1min30Secs	60% MHR	10mints
3rd	7-9	10mints	4	3	1min30Secs	60% MHR	10mints
4th	10-12	10mints	5	3	1min30Secs	60% MHR	10mints

Source: A Self Developed Table

3.5 RESEARCH ASSISTANTS

For the purpose of data collection in this study, ten research assistants were used. They included one male medical doctor, one female medical doctor and one male nurse and one female nurse. They were all informed about the purpose of the study and its procedures. They were all well trained and experienced in measuring percent body fat with skin fold callipers and blood pressure with sphygmomanometer In addition to the four research assistants for conducting the tests, six research assistants were used to help in conducting the training programmes.

3.6 TESTS

Order of Testing

In order to avoid the influence of one test on the results of another test, the following sequence of testing was followed for all the groups:

- Measurement of blood pressure.
- Recording of weight
- Measurement of height
- Measurement of skin fold.

These measurements was conducted in the morning preceding the commencement of the training.

3.7 INSTRUMENTATION

The following instruments were used in this research for data collection:

Stadiometer

The Holtain stadiometer, made of two metal planes set at right angles with an adjustable pointed arrow head, model NJ07072, manufactured by Pfister Import-Export Inc. U.S.A., was used to measure the stature of the subjects in meters, while standing without shoes against the instrument (Ross & Marful-Jones, 1992).

- 400m running rack
- Field/Tape rule

Non-elastic horse band model S1542, made in China was used to measure the waist and hip circumferences in centimeters. (Plowman & Smith,1997).

Weighing Scale

A portable bathroom type Hanson scale, Model B1801A, made in Ireland was used to measure the subjects weight in kilograms, while lightly dressed without ornaments or wearing shoes (AAHPERD; 1990).

Skin Fold Calipers

A slim-guide skin fold calipers model MI48170, Creative Health Products. Manufactured in Plymouth, U.S.A., were used to measure the skin fold thickness of the subjects in millimeters (Classens et al 1990).

Stop Watch

Six stop watches, Sport spring model 015, manufactured by Jeweled Sports Company, Britain, was used to time the duration of their workouts to the nearest second on each training day. (Sharkey;1995).

3.8 **Experimental Controls**

In order to avoid the influence of extraneous and intervening variables on the results of this research work, the following were controlled.

To avoid intra-tester and inter tester variability of the results of the conducted tests, conducted ten research assistants were used. They assisted in measuring waist and hip circumferences, skinfolds, and to determine the pace of the subjects according to pre-test standards. To ensure test-retest reliability, the research assistants were assigned to a group of subjects for six weeks before they were randomly reassigned to another group of subjects for the same duration (Ilorpe et al; 1990).

All subjects were well briefed with the procedures of the different tests conducted in the study.

As pre-test activities like walking and climbing stairs affect the result of the different tests conducted in the study, all the subjects were discouraged from eating, exercising and smoking a few hours to the starting of the test to avoid their influence on test results.

In order to eliminate any possible previous exertion on the results and all the subjects rested for about 10 to 15 minutes before they were tested

TESTS

The measurements included blood pressure, body weight, percent body fat and skinfold thickness.

Height

Subject's height was measured while standing and looking straight ahead and bare footed against the stadiometer. A horizontal broad blade wooden rule was then rested on the head of each subject against the instrument. The height was then read off the instrument to the nearest 0.1cm.

Weight

The weight of the subjects was measured using a portable bathroom scale with provision for re-calibration while dressed in light dress without footwear. It was recorded to the nearest 0.5kg. The height and weight measures were used to calculate the body mass index (BMI) by dividing weight (in kg) by height (in meters) squared $(wt/Ht)^2$ (Plowman & Smith; 1977, Bray and Cray; 1988).

Waist-Hip Ratio

Waist-hip ratio is the ratio of a subject's waist circumference to hip circumference, mathematically calculated as the waist circumference divided by the hip circumference. The waist and hip circumferences were measured with a standard measuring tape. (Capacity:150 centimeters) by following the recommended guidelines in the Anthropometric standardization reference manual (Lohman, et al; 1988 in; Nicklass et al; 2000) and according to the procedure of Morrow et al (2000) & Venkateswarlu, (2007). While the waist circumference was taken at the level of the narrowest point between the lowest coastal border and the iliac crest after expiration, the hip circumference was taken at the greatest, posterior protuberance of the buttocks. Measurement was taken in centimeters to one decimal place (Dudeja et al; 2001) Waist circumference > 88cm in women, and > 102 cm in men (all ages) was considered as central/abdominal adiposity. Waist-hip ratio between 0.80 and 0.90 and 0.90 and 0.98 for female and male respectively were considered safe (Dudeja et al; 2001; Rosemmich et al; 2000). W.H.R was calculated by using the following formula to determine body fat patterns.

$$\text{Formula for WHR} = \frac{waist - circumerefence(cm)}{Hip - circumference(cm)}$$

Blood Pressure

Although there are many methods that can be used to measure blood pressure, the auscultatory method was chosen for this research. This method which requires the use of a stethoscope and sphygmomanometer has a dual advantage of being simple and is commonly used in many health related fields. Instruments used for this measurement was the KA-112 Aneroid Sphygmomanometer and Dual Head Stethoscope Model S-223 manufactured by Medicare Instruments WUXD (LTD).No.301 Xixin Road Zhangjing India.

Subjects were required to sit on a chair close to a table whose height shall be of the same vertical height as the heart. With the left arm on the table, a cuff was placed around the upper arm and attached to the aneroid manometer. The cuff fitted smoothly and inflated manually by repeatedly squeezing a rubber bulb until the artery is completely occluded. With the help of the stethoscope, the tester listens to the brachial artery at the elbow. The tester slowly releases the pressure on the cuff. When the occluded blood starts to flow in the artery, the turbulent flow will created a “whooshing” or pounding sound. The pressure at which this sound was first heard is the systolic blood pressure. The cuff will further be released until no sound was heard and here, the diastolic pressure is read and recorded accordingly for each subject.

Percent Body Fat

The sites for skin fold thickness values were used to predict percent body fat. The millimeter values of the three measurements; triceps, chest and subscapullar for the males, and triceps, abdomen and supralliac for the females respectively were computed accordingly (Pollock, et al; 1980 in Maud & Foster, 1995; & Dudeja et al; 2001). All measurements were taken on the right side of the body with the subjects standing according to American standardization reference manual. The measurements was taken by a single trained specialist for the study using Harpenden spring loaded calipers (Holtain Ltd, UK) which will be constantly standardized for correct jaw tension and gap-width (Hoeger, 1988; Dudeja et al; 2001; Musa et al; 2001). The correct anatomical landmarks for the three sites of skinfolds for both adults gender were:

- **Triceps:** A vertical fold on the back of the upper arm half way between the shoulders, acromion process, and the olecranon process.
- **Subscapular Skinfold:** The fat pad of the inferior angle of the scapular directly in the midaxillary line was measured.

- **Chest Fold:** A diagonal fold halfway between the shoulder crease and the nipple.
- **Suprailiac:** A diagonal fold above the crest of the ilium, on the side of the hip.
- **Abdomen:** A vertical fold taken about one inch to the right of the umbilicus (Hoeger, 1989; Dudeja et al; 2001).

Two steps are involved in the conversion of skinfold thickness into an estimate of percentage fat (Watson, 1980, in Gunen 1997).

The first step involved the conversion of skinfold thickness to an estimate of Body Density (BD). The three folds were added together and substituted in one of the following gender equations according to sex and age (Pollock et al; 1980 in Maud & Foster, 1995).

Male: $D_B = 1.1125025 - 0.0013125 (x1) + 0.0000055 (x2)^2$
$- 0.0002440 (x3)$

Where: x2 = sum of triceps, chest, subscapular skinfolds (mm)

X 3 = age (years).

Female: $D_B = 1.0902369 - 0.000937(x1) + 0.0000026 (x1)^2$

$- 0.0001087 (x3)$

Where: x1 = sum of triceps, suprailium and abdomen skinfolds (mm);

X 3 = age (years).

The second step involves the conversion of body density scores to an estimate of percentage fat (Watson, 1990 in Gunen, 1997). The equation for the conversion is used by Siri (1956) & Watson, (1990) in Gunen, 1997). Both stressed that it is the same for all types of subjects and gender.

$$\% BF = [(4.95/DB)-4.5] \times 100$$

3.9 STATISTICAL TECHNIQUES

To test the hypothesis of this research, the following statistical techniques were used:

Descriptive statistics of mean, standard deviation and standard error of mean were computed for estimating the magnitude of change due to exercise training.

Repeated measures ANOVA were used for determining the degree and rate of change in the selected variables after 12 weeks of training.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 INTRODUCTION

The purpose of the study was to find out and compare the effects of 12 weeks continuous and interval exercise training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria. To achieve this purpose, the data collected were statistically analyzed, the results of which are presented and discussed according to hypotheses in this chapter.

4.1 RESULTS

Before the results are presented according to hypotheses, information regarding age, body weight, and height of the respondents is presented in table 4.1a.

Table 4.1a: **Demographic Characteristics of Age, Height, and Weight of the Respondents by Group and Sex**

		Age (yrs)					Heights (ms)					Weight (kg)				
Group	**Sex**	**M**	**SD**	**SE**	**t**	**Sig**	**M**	**SD**	**SE**	**t**	**Sig**	**M**	**SD**	**SE**	**t**	**Sig**
Continuous	Males N=45	34.7	6.02	.897	1.1	.271	1.7	.06	.01	-.054	.957	95.7	11.9	1.8	-4.7	-11.333
	Females N=45	33.5	4.08	.608			1.7	.06	.01			107.0	11.3	1.7		
Interval	Males N=45	35.6	5.6	.834	2.1	.040	1.6	.06	.01	-.051	.959	87.8	11.8	1.8	.398	.911
	Females N=45	33.3	4.9	.728			1.6	.06	.01			86.9	10.4	1.7		
Control	Males N=45	37.7	4.7	.704	2.9	005	1.6	.07	.01	.927	.396	101.7	11.8	1.8	-5.5	.000
	Females N=45	34.8	4.9	.722			1.6	.07	.01			117.6	15.5	2.3		

Table 4.1a shows that the female subjects of interval and control groups were significantly younger than their respective male counterparts. In body height, there were no significant differences between male and female respondents of the three groups. In body weight, the female respondents of continuous and control groups were significantly heavier than their respective male counterparts before starting the training.

Information regarding the mean scores in selected variables of respondents by test, group and sex is presented in table 4.1b

Table 4.1b: Means and Standard Deviations of Scores in Selected Variables of Subjects by Test, Group and Sex.

TEST	GROUP	SEX	Blood Pressure				Body Weight		% Body Fat		Heights (MS)	
			Systolic BP		Diastolic BP							
			M	SD	M	SD	M	SD	M	SD	M	SD
T1	Continuous	Male	132.4	18.6	87.1	11.0	95.7	10.0	25.7	1.8	1.7	.060
		Female	129.1	13.9	91.1	11.0	107.7	10.7	28.2	3.5	1.7	.059
		Comb.	130.7	16.2	89.13	11.2	53.2	10.4	26.9	2.7	1.7	.06
	Interval	Male	130.7	13.7	88.9	12.7	88.8	11.1	23.6	1.9	1.6	.063
		Female	123.1	8.3	90.1	12.7	87.8	9.8	29.2	3.0	1.6	.064
		Comb.	129.9	11.0	89.5	12.7	88.3	10.5	26.4	2.4	1.6	.06
	Control	Male	141.5	23.8	81.8	13.6	100.8	13.4	29.8	4.5	1.6	.067
		Female	130.4	21.3	78.7	9.9	120.1	23.6	33.3	3.3	1.6	.067
		Comb.	135.9	22.5	80.1	11.7	110.4	18.5	31.6	3.9	1.6	.07
T2	Continuous	Male	138.1	18.3	81.1	11.1	99.6	10.0	29.7	1.8	1.7	.060
		Female	133.1	13.7	84.5	9.6	111.7	10.7	32.2	3.5	1.7	.059
		Comb.	135.5	15.9	82.8	10.3	105.6	10.4	30.9	2.7	1.7	.06
	Interval	Male	134.7	13.7	80.1	12.7	92.4	11.3	27.6	1.9	1.6	.063
		Female	127.1	8.3	85.3	12.3	91.8	9.8	33.8	1.5	1.6	.064
		Comb.	130.9	11.0	82.7	12.5	92.1	10.6	30.7	1.7	1.6	.06
	Control	Male	141.1	21.2	86.6	12.4	101.8	11.7	30.1	4.2	1.6	.067
		Female	132.1	21.0	84.1	9.8	115.8	10.1	32.3	4.5	1.6	.067
		Comb.	136.6	21.1	85.4	11.1	108.8	10.9	31.2	4.3	1.6	.07
T3	Continuous	Male	131.7	24.2	88.9	9.5	91.7	14.3	20.9	5.0	1.7	.060
		Female	123.1	13.7	78.9	9.5	101.7	10.7	22.2	3.5	1.7	.059
		Comb.	127.4	18.9	83.9	9.5	96.7	12.5	21.5	4.2	1.7	.06
	Interval	Male	124.7	13.7	89.1	12.3	82.5	11.3	17.8	1.7	1.6	.063
		Female	117.1	8.3	79.1	12.3	81.6	9.8	23.5	1.5	1.6	.064
		Comb.	120.9	11.0	84.1	12.3	82.0	10.6	20.7	1.7	1.6	.06
	Control	Male	139.3	17.7	90.4	13.5	102.5	11.0	30.3	4.0	1.6	.067
		Female	127.7	11.6	89.7	13.0	116.9	9.0	32.5	4.0	1.6	.067
		Comb.	133.5	14.7	90.0	13.3	109.7	10.3	31.4	4.0	1.6	.07

T1 is Pre-Training Test
T2 is Mid Training Test (After 6 wks of Training)
T3 is Post Training Test (After 12 wks of Training)

Observation of table 4.1b shows that the pre-training mean systolic blood pressure of male subjects of continuous and interval groups was much less than that of male subjects of the control group, whereas the pre-training mean systolic blood pressure of the females of the interval group was less than that of the female subjects of control and continuous groups. Similarly the pre-training mean diastolic pressure of the control and continuous groups was less than that of the interval group. The mean systolic blood pressure of the male interval group decreased from 130.73mm Hg at pre-training level to 124.73mm Hg at the end of 12 weeks interval training. Similar decrease was found in the mean systolic blood pressure of female interval group after the 12 weeks of training. However, after 12 weeks, the control group did not show much change in the mean systolic blood pressure. Such a change was not evident in the mean diastolic blood pressure of the three groups, Table 4.1b further shows that mean weight of the male control and continuous groups was more than that of the interval group before starting the training. The mean weight of the male interval and continuous groups decreased after 12 weeks of training, which was not evident in the case of male control group.

Similar decrease was found in the mean weight of female interval and continuous groups after 12 weeks of training, which was not evident in the female control group, similar decrease was found in male and female interval and continuous groups after 12 weeks of training in % body fat, which was not observed in the case of control group.

Hypothesis Testing

Major hypothesis: There are no significant effects of 12 weeks continuous and interval training on blood pressure, body weight and percent body fat of overweight male and female adults in Nigeria.

In order to test the major hypothesis, it was decomposed into five sub hypotheses, which are tested below:

Sub-Hypotheses

i. There is no significant effect of 12 week continuous and interval exercise training on blood pressure of overweight Nigerian male and female adults.

ii. There is no significant effect of 12 week continuous and interval exercise training on body weight of overweight Nigerian male and female adults.

iii. There is no significant effect of 12 weeks continuous and interval exercise training on percent body fat of overweight Nigerian male and female adults.

iv. There are no significant differences between 12 weeks continuous and interval training in their effects on blood pressure, body weight and percent body fat of overweight Nigerian male and female adults.

v. There are no significant relationships among blood pressure, body weight and percent body fat of overweight Nigerian male and female adults.

Sub hypotheses 1, 2, 3 and 4 were tested by using one way analysis of variance, the results of which are presented in table 4.2.

Table 4.2: One Way Anova for Differences between Groups in Each Test in Selected Variables of Male and Female Groups

		Males					Females			
Period	**Variables**	**Source**	**Sum of Square**	**df**	**Mean Square**	**F**	**Sum of Squares**	**df**	**Mean Square**	**F**
T1	**Systolic Bp**	**Between Group**	1000.933	2	500.467	1.363	457.778	2	224.889	.980
		Within Group	15420.267	42	367.149		9805.467	42	233.463	
(Week 0)		**Total**	16421.200	44			10263.244	44		
	Diastolic Bp	**Between Group**	239.244	2	119.622	.766	380.978	2	190.489	1.677
		Within Group	6560.400	42	156.200		4771.600	42	113.610	
		Total	6799.644	44				44		
	Body weight	**Between Group**	1125.644	2	562.822	4.196	8052.578	2	4026.289	15.769
		Within Group	5633.333	42	134.127		10723.867	42	255.330	
		Total	6758.978	44			18776.444	44		
	Body fat	**Between Group**	303.852	2	151.926	16.308	215.848	2	107.924	10.143
		Within Group	391.275	42	9.316		446.875	42	10.640	
		Total	695.978	44			662.875	44		
T2	**Systolic Bp**	**Between Group**	389.378	2	194.689	.602	310.000	2	116.956	.667
		Within Group	13579.600	42	323.324		9758.800	42	232.352	
(Mid Test)		**Total**	13968.978	44			10068.800	44		
	Diastolic Bp	**Between Group**	258.533	2	129.267	.890	233.911	2	116.956	1.042
		Within Group	6102.267	42	145.292		4716.400	42	112.295	
		Total	6360.800	44			4950.311	44		
	Body weight	**Between Group**	717.511	2	358.756	2.948	5026.978	2	2513.489	24.018
		Within Group	5111.467	42	121.702		4395.333	42	104.651	
		Total	5828.978	44			9422.311	44		
	Body fat	**Between Group**	53.770	2	26.885	3.308	24.933	2	12.467	1.082
		Within Group	341.335	42	8.127		484.121	42	11.527	
		Total	295.105	44			509.054	44		
T3	**Systolic Bp**	**Between Group**	1599.600	2	799.800	2.204	847.600	2	423.800	3.257
		Within Group	15239.200	42	362.838		5465.200	42	130.124	
		Total	16838.800	44			6312.800	44		
(12th Week)	**Diastolic Bp**	**Between Group**	968.933	2	484.467	3.056	1145.200	2	572.600	4.185
		Within Group	6658.267	42	158.530		5746.000	42	136.81o	
		Total	7627.200	44			6891.200	44		
	Body weight	**Between Group**	3006.400	2	1503.200	9.932	9387.244	2	4693.622	48.120
		Within Group	6356.800	42	151.352		4096.667	42	97.540	
		Total	9363.200	44			13483.911	44		
	Body fat	**Between Group**	1305.243	2	652.622	43.897	923.216	2	461.608	45.056
		Within Group	624.421	42	14.867		430.300	42	10.245	
		Total	1929.665	44			1353.516	44		

$F(2,42) = 3.22 < .05$

Examination of table 4.2 shows insignificant differences between continuous, interval and control groups in the systolic and diastolic blood pressures in both males and females before starting the training. However, there were significant differences between the three groups in their body weight and percent body fat before starting the training, which were mainly due to the fact that women were heaver and fatter than men in the three groups.

After six weeks of training, there were no significant differences between the groups in their diastolic and systolic blood pressures. But, significant differences were found in percent body fat because of a greater decrease in percent body fat in continuous and interval female groups compared to male and female control and interval groups. After 12 weeks of training, there were significant differences between the three groups only in the body weight and body fat, because the male and female groups were much lower in body weight and percent body fat than male and female control groups, as evident from table 4.2.

In order to find out the magnitude and direction of change due to 12 weeks of continuous and interval training the data collected were analyzed for each variable using repeated measures ANOVA, the results of which are presented below:

The results of repeated measures ANOVA for differences in systolic blood pressure by tests, groups and sex are presented in table4.2a

Table 4.2a: Repeated Measures of Analysis of Variance (ANOVA) for Differences in Systolic Blood Pressure by Tests, Groups and sex

Source	Sum of squares	Df	Mean square	F	Sig
Training	3735.7	2	1867.9	6.8	.0001
Sex	3944.5	1	3944.5	14.4	.000
Period	1977.3	2	988.6	3.6	.029
Training. sex	396.1	2	198.0	.720	.488
Training. period	369.2	4	92.3	.336	.854
Sex. period	110.2	2	55.1	.200	.819
Training. Sex. period	104.3	4	26.1	.095	.984
Error	69268.5	252	274.9		
Corrected total	79905.8	269			

$F(2, 42) = 3.22 < .05$
$F(4, 56) = 2.84 < .05$

Table 4.2a shows significant differences between groups by training, by sex and by period (test) in systolic blood pressure. However, the effects of the interaction of training and sex, training and period, sex and period and training, sex and period in systolic blood pressure were not significant. The results of post hoc test (table 4.2b) showed that the significant differences were mainly due to the differences between the effects of 6 weeks and 12 weeks of training on systolic blood pressure

Table 4.2b: Scheffe's Post Hoc Results for Differences between Tests in Systolic Blood Pressure

(i)Period	(j) Period	Mean difference (1- J)	Std. Error	Sig
Week 0	Mid –test	-2.67	2.472	.559
12 weeks		3.92	2.472	.286
Mid test	Week – 0	2.67	2.472	.559
12 weeks		6.59ˣ	2.472	.030
12th week	Week – 0	-3.92	2.472	.286
Mid test		-6.59ˣ	2.472	.030

***Significant at .05 level**

Results of repeated measures analysis of variance for differences in diastolic blood pressure by tests, groups and sex are shown in table4.3a

Table 4.3a: Repeated Measures Analysis of Variance (Anova) for Differences in Diastolic Blood Pressure by Tests, Groups and Sex

Source	Sum of squares	Df	Mean square	F	Sig
Training	6.1	2	3.1	.022	.978
Sex	187.5	1	187.5	1.4	.243
Period	1295.7	2	647.9	4.7	.010
Training. sex	26.6	2	13.3	.097	.908
Training. period	3179.1	4	794.8	5.8	.000
Sex. period	6.7	2	3.3	.02	.976
Training. Sex. period	15.0	4	3.7	.03	.999
Error	34554.9	252	137.1		
Corrected total	39271.7	269			

$F(2, 42) = 3.22 < .05$
$F(4, 56) = 2.84 < .05$

Table 4.3a shows significant differences between groups in diastolic blood pressure due to training and due to the interaction of sex and duration of training. The significant difference due to training in diastolic pressure was because interval and continuous training groups had significant decrease in diastolic blood pressure compared to control group. This decrease was more in the training groups of both male and female groups after 12 weeks of training in diastolic blood pressure.

Table 4.3b: Scheffe's Post Hoc Results for Differences between Tests on Diastolic Blood Pressure

(1) Period	(j) Period	Mean difference (1- J)	Std. Error	Sig
Week 0	Mid –test	-4.28	1.746	.051
	12 weeks	.67	1.746	.930
Mid test	Week – 0	4.28	1.746	.051
	12 weeks	4.94*	1.746	.019
12^{th} week	Week – 0	-. 67	1.746	.930
	Mid-test	- 4.94*	1.746	.019

***Significant at .05 level**

The results of Scheffe's post hoc test (table 4.3b) showed that the significant difference was due to the difference between middle of the training and after 12 weeks of training in diastolic blood pressure.

Results of repeated measures ANOVA for differences in body weight by training, tests and sex are presented in table 4.4a.

Tables 4.4a: Repeated Measures, Analysis of Various (Anova) for Differences in Body Weight by Tests, Groups and Sex.

Source	Sum of squares	Df	Mean square	F	Sig
Training	22744.6	2	11372.3	78.9	.000
Sex	5192.1	1	5192.1	36.0	.000
Period	695.1	2	847.6	5.9	.003
Training. sex	3396.9	2	1698.4	11.8	.000
Training. period	1087.7	4	271.9	1.9	.113
Sex. period	61.9	2	30.9	.2	.807
Training. Sex. period	87.2	4	21.8	.2	.962
Error	36317.5	252	144.1		
Corrected total	70582.9	269			

$F(2,42) = 3.22 < .05$

Table 4.4a shows significant differences in body weight due to training, sex and duration of training, The significant difference due to training in body weight was due to greater decrease of body weight of continuous and interval groups compared to control group, The significant difference due to sex in body weight was due to greater decrease in body weight of female continuous and interval training groups. The significant difference due to period of training in body weight was due to greater decrease of interval and continuous groups after 6 and 12 weeks of training compared to control group in body weight. However, the results failed to show any significant interaction effects on these differences: Results of Scheffe's post hoc test (table 4.4b) show that the significant differences in body weight due to training was due to significant differences between mid test results and results after 12 weeks of training in both continuous and interval groups.

Table 4.4b: Scheffe's Post Hoc Test Results for Differences in Body Weight

(2) Period	(j) Period	Mean difference (2- J)	Std. Error	Sig
Week 0	Mid –test	-2.10	1.790	.503
	12 weeks	3.94	1.790	.090
Mid test	Week – 0	2.10	1.790	.503
	12 weeks	6.04ˣ	1.790	.004
12^{th} week	Week – 0	-.3.94	1.790	.090
	Mid-test	- 6.04ˣ	1.790	.004

***Significant at .05 level**

Results of repeated measures ANOVA for differences in percent body fat by training, periods and sex are shown in table 4.5a

Table 4.5a: Repeated Measures Analysis of Variance (Anova) for Differences in Percent Body Fat by Tests, Groups and Sex

Source	Sum of squares	Df	Mean square	F	Sig
Training	1628.8	2	814.4	75.5	.000
Sex	860.2	1	860.2	79.2	.000
Period	1861.9	2	930.9	86.3	.000
Training. sex	203.4	2	101.7	9.4	.000
Training. period	982.8	4	245.7	22.8	.000
Sex. period	4.4	2	2.2	.2	.817
Training. Sex. period	11.9	4	3.0	.3	.893
Error	2718.3	252	10.8		
Corrected total	8271.6	269			

$F(2, 42) = 3.22 < .05$
$F(4, 56) = 2.84 < .05$
$F(4, 56) = 2.84 < .05$

Table 4.5a shows significant differences in percent body fat due to 12 weeks of training by sex, duration of training, interaction of training and sex, and duration of training. The significant difference in percent body fat due to training was because of the greater reduction of percent body fat of continuous and interval groups compared to control group in both males and females, The significant differences in percent body fat due to sex was because of greater decrease in percent body fat of female continuous and interval groups compared to control group. The significant difference in percent body fat due to training was mainly because the decrease in percent body fat was more in interval group than in other groups. These significant main effects are reflected in significant interaction of training and sex, and period. The results of Scheffe's post hoc test (table 4.5b) showed that the significant difference in percent body fat was mainly due to greater decrease after 6 weeks of training and 12 weeks of training compared to pre-training percent body fat levels of both continuous and interval male and female groups.

Table 4.5b: Scheffe's Post Hoc Test Results For differences in Percent Body Fat

(i)Period	(j) Period	Mean difference (1- J)	Std. Error	Sig
Week 0	Mid –test	-2.6548×	.48960	.000
	12 weeks	3.7466×	.48960	.000
Mid test	Week – 0	2.6548	.48960	.000
	12 weeks	6.4013×	.48960	.000
12th week	Week – 0	-.3.7466	.48960	.000
	Mid-test	- 6.4013×	.48960	.000

***Significant at .05 Level**

DISCUSSION

The purpose of this study was to find out and compare the effects of 12 weeks continuous and interval training on blood pressure, body weight and percent body fat of overweight adult Nigerians. To achieve this purpose, the data collected were statistically analyzed, the results of which are presented in the previous section of the chapter.

1. Effects of 12 weeks continuous and interval training on blood pressure of overweight adult Nigerians.

   The findings of this study revealed insignificant decrease in systolic and diastolic blood pressures of overweight adult Nigerians after 6 weeks of continuous and interval exercise training. This finding is contrary to the observations of McArdle et al (1981), Fox et al (1993) and the finding of Plowmen and Smith (1997), Wallace (2003) and Comellisen & Fagard (2005) according to which 6 weeks of moderate intensity training decreased systolic and diastolic blood pressures of normointensive adults. The failure of this study to find any significant decrease in systolic and diastolic blood pressures of overweight adults may be attributed to the fact that the intensity and duration of exercise protocol followed in both continuous and interval training were not adequate to produce any significant decrease in blood pressure.

However, the findings of this study showed significant decrease in systolic and diastolic blood pressures after 12 weeks of continuous and interval training, which support the results of previous studies,VanderHost et al; 2007; Santos et al; 2008). The decrease in blood pressure was greater in those adults whose blood pressure was higher than that of others before training. The findings suggest that the intensity and duration of exercise training protocols followed in both continuous and interval training groups were adequate to produce a significant decrease in blood pressure after 12 weeks of training. In this study, however, the findings did not show any significant difference between continuous and interval training in their effects on blood pressure. The significant decrease in blood pressure may be attributed to increased milking action of the muscles during training (McArdle et al; 1981). The interesting finding of this study is that better results can be expected in blood pressure if the duration of moderate intensity training is followed for 12 weeks or more. However, it is not clear whether greater benefit in blood pressure can be derived from high intensity (more than 90% Vo2 Max) training. However, the observation of the text book authors could not be verified by the investigator as the empherical studies are not available to him.

2. Effects of 12 weeks continuous and interval training on body weight of overweight adult Nigerians.

   The findings of this study showed significant decrease in body weight of male and female adults in Nigeria due to 12 week continuous and interval training. This decrease in body weight was evident even after 6 weeks of the two training protocols. These results support the previous observation of McArdle et al (1981) & findings of Hoeger (1988), Fahey et al (1994), Rosato et al (1994) & Venkateswarlu (1991, 1992). This decrease was more in women than in men who were heavier than men. The decrease in body weight may be attributed to increased loss of fat and increased resting metabolic rate as suggested by McArdle et al (1981), Wallace (2003), Rosato (1994) & Venkateswarlu (1991, 1992). The findings of the study also suggest that better results can be obtained if the moderate intensity exercise is extended beyond 12 weeks which may significantly reduce body weight. The reduction in body weight may not be evident unless the training is of high intensity performed at least for 6 weeks. However, all the authors sited throughtout this investigation could not be verified empherically as they are not readily available to the researcher.

3. Effects of 12 weeks continuous and interval training on percent body fat of overweight adult Nigerians.

   The findings of this study revealed significant decrease in percent body fat of overweight adult Nigerians due to 12 weeks continuous and interval training. However, there was no significant decrease in percent body fat after 6 weeks of moderate intensity training. This suggests that moderate intensity training should be performed at least for 12 weeks before any reduction in percent body fat is expected. This result supports the observations and findings of McArdle (1991), Wallace (2003), Rosato (1994) & Venkateswarlu (1991, 1992), according to which prolonged training reduces percent body fat. This reduction was shown more in women who had more percent body fat than in men before starting the training. It does appear that it may be easier to reduce weight than percent body fat which should be verified in future studies.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 SUMMARY

The study was conducted to find out the effects of continuous and interval training on blood pressure, body weight, and percent body fat of overweight adult Nigerians. To achieve the purpose of this study, 45 male and 45 female overweight volunteer subjects were selected at random from those attending fitness programme at Area 10, old parade ground in Abuja. The subjects thus selected were randomly distributed into three groups of 15 subjects each of overweight adults separately. Thus a total of 45 overweight male and 45 female adults served as subjects in the study. Group one was continuous training group, group two interval training group and group three control group. Each group of each sex consisted of 15 subjects. Before starting the training, all the subjects were tested for their blood pressure, body weight and percent body fat. The continuous and interval training groups underwent their respective training protocols for 12 weeks, whereas the control groups did not undergo any training. All the groups were tested after 6 weeks of training and again immediately after 12 weeks of training for their blood pressure, body weight and percent body fat.

The data collected were statistically analyzed using descriptive statistics, and inferential statistics of ANOVA and the results of which are shown below:

i. 12 weeks continuous and interval training produced significant decrease in systolic and diastolic blood pressures.

ii. There were no significant differences in blood pressures between the groups after 6 weeks of training.

iii. There was significant decrease in percent body fat and body weight after 12 weeks of training. This decrease was greater among women.

iv. Percent body fat did not significantly decrease after 6 weeks of training.

5.1 CONCLUSIONS

On the basis of the findings and in view of the limitations of this study, the following conclusions are drawn:

i. 12 weeks of continuous and interval exercise training can produce significant decrease in blood pressure, body weight and percent body fat of overweight male and female adults.

ii. Continuous and interval exercise training can produce similar effects on blood pressures, body weight and percent body fat.

iii. The greater the initial values for blood pressure, body weight and percent body fat, the better will be the effects of continuous and interval training on these variables.

iv. Overweight male and female adults responded similarly to continuous and interval exercise training in their blood pressure whereas overweight adult women may respond better to these training protocols in body weight and percent body fat.

5.2 RECOMMENDATIONS

On the basis of the findings of this study, the following recommendations are made for professional practice and further research.

1. The findings of this study showed that 12 weeks of continuous and interval training produced significant decrease in systolic blood pressure (f=6.9<.01), body weight (f=78.9<.01) and percent body fat (f=75.5<.01) among overweight male and female adults. It is therefore recommended that either continuous or interval training can be used at moderate intensity level for at least 12 weeks to produce health benefits.
2. This study is recommending that overweight adults should follow moderate intensity exercise training at an intensity of 60% of max heart rate (220-age) at least for 12 weeks at the rate of three times or more per week.
3. If the intensity and duration of training are increased, the benefits will be better. It is therefore suggested that the intensity of training should be increased gradually along with its duration to derive greater health benefits.

4. As children and adolescents respond differently to training compared to adults, studies similar to the present investigation may be conducted on overweight children and adolescents.

REFERENCES

Aggel-Leijssen, D.P.C; Saris, W; Wagenmakers, A.J.M; Senden, J.M; & Van Baak, M.A.(2002). Effects of Exercise Training at Different Intensities on Fat metabolism of Obese Men. *Journal of Applied Physiology*, 92, 1300-9.

Akinkugbe, O.O, (1992). *Non-Communicable Diseases in Nigeria*. Ibadan: Fed Min of Health and Human Services.

American Alliance for Health, Physical Education Recreation and Dance (AAPHERD) (1990) Instructor's Guide to Physical Fitness Education and Assessment: American Alliance for Health, Physical Education, Recreation and Dance Reston Verinia.

American College of Sports Medicine (ACSM) (2004). Position Stand: Exercise and Type 2 Diabetes. http://www.msse.org.

Astrand, P & Rodahl . (1986) "A Commentary on Children and Fitness: A public Health Perspective" *Research Quarterly for Exercise and Sports.*

Asuzu, M.C; Mufunda, J: Forrester, T; Wilks, Luke, A; Long, AE Cooper RS; and Kanyman, JS. (1997). Relationship between Blood Pressure and Body Mass Index in Lean Populations. *Journal of American Heart Association, Hypertension*; 30: 1511-1516.

Baror,O.(1987). "A Commentary on Children and Fitness" A Public Health Perspective. *Research Quarterly for Exercise and Sports*.228:304-307.

Bouchard, C; Tremblay, A; & Despres, J.P. (1990). The response to long term overloading in identical twince, N and *Journal of Medicine*, 322: 1477-82.

Bouchard,C; Tremblau,A & Despress,J.P. (1990). Effects of Long Term Exercise Training on Body Composition. *International Journal of Obesity*,14: 57-73.

Brooks, George A, Fashey, Thomas D; Baldwin, Kenneth M.(2005). Exercise Physiology, Human Bioenergetics and its Applications. Fourth edition. Published by McGrawHill. New York.

Bragada, J.A; Magathaes, P.P; Vasques, C.S; Barbasa, T.M; & Lopes, V.P. (2009). Net Heart Rate to Prescribe Physical Activity in Middle Aged to Older Active Adults. *Journal of Sports Science and Medicine*, (8) 616-621.

Bray, G.A and Garry, D.A. (1988). Definitions; Measurement and Classification Syndrome of Obesity. *International Journal of Obesity*. 2, 199-113.

Bray,G.A & Cray,D.A.(1988).Definitions, Measurements and Classification Syndrome of Obesity. *International Journal of Obesity*,2:99-113.

Bray,G.A; Rozin,M & Lister.(1970). "Some Relationship between Oxygen Consumption and Body Composition of Obese Patients" Metabolism, 19:418-429.

Browson,R.C; Tyler,A.A; King,A.C & Brown,C.R.(2000). " Patterns and Correlate of Physical Activity among U.S Women 40+ Years. *American Journal of Epidemiology,*142:950-958.

Bryer, R.W; Toffle, R.C; Ulrich,T.H; & Yeater,R.A.(1997). The Effects of Exercise Intensity on Body Composition, Weight Loss and Dietary Composition in Women. *American Journal of Clinic Nutrition*, 16:68-73

Burke, E. (1976) "Validity of Selected Laboratory and Field Tests of Physical Working Capability" *Research Quarterly* Vol. pp. 95-102.

Buskirk, F.R. (1974) "Obesity, a brief Overview with Emphasis on Exercise" Federation Proceedings: 33(8), 225-229.

Butkap, T.G. (2002). The Epidemiology of Essential Hypertension among Working Class adults in Abuja. Ahmadu Bello University, Zaria: Department of Community Medicine (Thesis)

Butkap, T.G. (2007). The Epidemiology of Essential Hypertension among Working Class adults in Abuja. ABU Zaria: Department of Community Medicine (thesis).

Calles-Escanden, J and Horton ES (1992). The Thermogenic Role of Exercise in the Treatment of Morbid Obesity: A Critical Evaluation. The American Journal of Clinical Nutrition 55:533S-537S.

Campbell, L; Wallman, K & Green, D. (2010). The Effects of Intermittent Exercise on Physiological Outcomes in an Obese Population: Continuous and Interval Walking. *Journal of Sports Science and Medicine*, 7:24-30.

Cancello,R; & Clement,K.(2006). Is Obesity an Inflammatory Illness: Role of Low Grade Inflammation and Macrophage Infiltration in Human White Adipose Tissue. *British Journal of Gastrointestinal*,113;1141.

Chado M.A. (1987). The Differences between Pull ups and Push ups Test as a Measurement of Dynamic Strength and Endurance of Upper Limbs Muscle groups. *Journal of Nigeria Association of Sports Science and Medicine,*Vol. 1 pp. 126 -130.

Chado, M.A. (1992). *Physical Fitness for Productive Health* Ahmadu Bello University Press Zaria, Nigeria.

Claessens, A.L.M.; Vanden, E.B.; Renson, R.; & Van Gerven D. (1990). The Description of Tests and Measurements. In: Simons, J.; Beunen, G.P.; Renson, R.; Claessens, A.L.M. Vanrevsel B.; Leferne J.A.V.; Editors. Growth and Fitness of Flemish Girls; The Laueven Growth Study. Champaign. Human Kinetics 1, 21-40.

Comelissen, V & Fagard, R.(2005). Effects of Resistance Training on Blood Pressures: A Metaanalysis of Randomized Control Trails. *Journal of Hypertension* 23, 251-259.

Curioni, C. & Lourenco, P. (2005). Long Term Weight Loss after Diet and Exercise; A Systematic Review. *International Journal of Obesity* 29 (10), 1168-1174.

Dai,S; Labarthe,D.R; Grunbarm,S.A; Harrist,R.B; & Mueller, W.H.(2002). Longitudinal Analysis of Changes Indices of Obesity from Ages 8 years to 18years. Projects Heart Beat. *American Journal of Epidemiolgy, 48:642-672.*

Datilo, A. & Kris-Etherton, P. (1992). Effects of Weight Reduction on Blood Lipids and Lipoproteins: A Meta-Analysis. *The American Journal of clinical Nutrition,56,320-328.*

Dawber,T.R.(1973). “Risks Factors in Young Adults: The Lessons from Epidemiology Studies of Cardiovascular Disease”. *Journal of American College of Heart Association*, 4 (1),117-121.

Dengel, L; D.R.M; Hargerd, N.J; Coon, D.T; Dr Ink Water, & A.P Goldberg. (1994). Comparative Effects in Older Men. *Medicine and Sports Exercises*, 26:1307.

Devries JH, Zock PL, Mensink RP and Katan MB (1994). Underestimation of Energy intake by 3rd Records Compared with Energy intake to Maintain Body Weight in 269 non-Obese Adults. The American Journal of Clinical Nutrition 60: 835-860.

Dikki, C.E. (1992). "Validation of the Vertical Toes. Sit and Research Measurement of Lumber Flexibility*" Sports Science and Medicine*. Vol. 1. 2-6.

Dikki, C.E. (1995), Growth, Body Composition and Physical Performance of Children. Aged 7-12 years. Ph.D Unpublished Thesis. Ahmadu Bello University, Zaria, Nigeria.

Dikki, C.E; Leha-Isa, N.H; & Venkateswarlu, K. (2011). Differences between Nigerian Children Adolescents and Adults in Health Related Fitness. A Paper Presented at International Conference on Physical Education and Sports Sciences.S.V's Sridora Cacullo College of Commerce and Management Studies, Mapusa-Goa, India.

Dowda, M. (2002). Compliance with Physical Activity Guideline, Prevalence in a Population of Children and Youth. *Annual of Epidemiology*, 12 (5), 303-308.

Dudeja, V, Mistra, A, Pandey, R.M, Devina, G, Kumar G: & Vickram N,K. (2001). BMI does not Accurately Predict Overweight in Asian Indian in Northern India. *British Journal of Nutrition*. 86: 105-102

Duhu, R. (1978). Test and Evaluations in Physical Fitness Programme. Hassun Lane. Enugu-Nigeria.

Duncan, J.J; Gordon, N.F; & Scott, C.B.(1991). Women Walking for Health and Fitness: How much is Enough? *Journal of American Association*, 266:32953299.

Edgerton, E. (1976). The Biology of Physical Activity Boston. Houghton Miffin publishing Ltd. Pp.6-12.

Ekblom, T. (1968) "Oxygen Consumption in Relation to Exercise Work Load" *Journal of Applied Physiology*. 24. (114), 219-284.

Ekelund,U;Aman,S; Yngwe,A; Renman,C; Westernter,P.K; & Sjostorm,M. (2002). Physical Activity but not Energy Expenditure is Reduced in Obese Adolescents. A Case Control Study. *American Journal of Nutrition,*76: 935-941.

Epstein, L.H., Raja, S., Gold, S.S., Paluch, R.A., Pak, Y, & Roemmich, J.N. (2006). Reducing Sedentary Behaviour, Psychological Science, 17 (8), 654-659.

Eric, N.P., Neil, J.M; & Andrew, J.S. (2006): Effect at Feeding Systems an Omega 3 Fatty Acids, Conjugated Linoleum Acid and Fatty acid in Australian Beef Cuts: Potential Impact on Human Health. *Asia Pacific Journal of Clinical Nutrition* Vol. 15 (1).

Faccini, P, Flori, G, Bedogni, G, Galleti, L, Belcastro, M.G, Ismagulova, A, sharmanou, T Tsoy, I, Rizzali, S & Goldoni, M, (2007). Prevalence of Overweight and Cardiovascular Risk Factors in Rural and Urban Children from Central Asia: The Kazakhstan Health and Nutrition Examination Survey. *American Journal of Human Biology*. 19: 808-820

Fagard, R.H & Tipton, C.M (1994). *Physical Activity Fitness and Hypertension* in Bouchard, R.J and T. Stephens eds, Physical Activity, Fitness and Health. Champaign, IL: Human Kinetics.

Fahey, R. D, Insel, P. M & Roth, W.T (1994) *Fit and Well*: Core Concepts and Labs in Physical Fitness and Wellness Mountain View, C.A Mayfield Publishing Co.

Falk, B; Cohen, Y; Lustiag, G.; Lander, M; Yaaron, I & Ayalon, J. (2001). Tracking of Physical Fitness Components in Boys and Girls from the Second to Sixth Grades. *American Journal of Human Biology* 13, 65 – 70.

Fernann-Lez-veledos, Nieto-Fasques, I; & Vil-Bedner, R.(2009). Molecular Mechanism involved in Obesity Associated Insulin Resistance Therapeutical Approach. Arch Physical Biochem, 115:227-339

Filer, J.S. (2004): Obesity Wars: Molecular Progress Confronts an Expanding Epidemic: Ceil; 116:337.

Flegal,K.M; &Traiano,R.P.(2000). Changes in the Distribution of Body Mass Index of Adults and Children in the U.S Population; *International Journal of Obesity,* Related Metabolic Disorders,24: 807-818.

Fox, E.L; Bowers,R.W & Foss,M.(1993). The *Physiological Basis for Exercise and Sports.* Madison Brown and Benchman Publications.

Fox, E.L; Pollock,M.E; & Wilmore,J.H.(1984). *Exercise in Health and Disease, Evaluations and Prescription for Prevention and Rehabilitation*: Saunders Company, Philadelphia.

Fox,E.L & Mathews,D.K.(1981*). The Physiological Basis of Physical Education and Athletics*,3rd Edition, Saunders College Publishing, Philadelphia.

Frotini, M.G; Bao,W; Elkasabanu, A; Srinivassan,S.R; & Benenso,G. (2001). Comparison of Weight for Height Indices as a Measure of Adiposity and Cardiovascular Risk from Childhood to Young Adulthood. The Bogalussa Heart Study. *Journal of Clinical Epidemiology,*54;817-922.

Ganong, F.W, (2005). *Review of Medical physiology*. 22nd Edition Boston: McGraw Hill.

George, B. (2001). Clinical Guidelines on the Identification, Evaluation and Obesity in Adults. The Evidence Report. National Health, Lung and Blood Institute Publication 04-3700.

Getchell, B. (1976). Physical Fitness. A way of Life. New York John Willey and Sons Ltd 58, 45-65 (2nd Ed) John Willey and Sons Inc New York 1(4) 102-105.

Getchell,L.H.(1985). Physical Training Comparative Responses in Middle Aged Adults. Architectural Physical Medical Rehabilitation, 56:250-254.

Girandola,R.N. (1979). Body Composition Changes in Women: Effects of High and Low Exercise Intensity. Arch Physical Med, Rehab, 57,297-300.

Gooseesne, G.H.(2008). The Role of Adipose Tissue Dysfunction in the Pathogenesis of Obesity-Related Insulin Resistance.Physio Behav. 94:206-18.

Goran, M.I; Carpenter,W.A; Gloui,A; Johnson,R; Hardin,J.M; & Weinsier.(1995) Children of Lean and Obese Parents.

Gray, D.F. (2006): “Obesity” Microsoft Encarta 2006 (CD), Redmond, W.A.: Microsoft Corporation, 2005.

Gunen, E.A.(1997).Effects of Interval and Continous Training on Selected Physiological Variables of Pre-adolescent Children. M.Sc/Exercise and Sports Science Thesis.

Gwani, J.A. (1986). Relationship between 6 Minutes Run and Coopers 12 Minutes Run Test as Measures of Cardiovascular fitness. Unpublished. M.ed. Thesis Ahmadu Bello University, Zaria. Nigeria.

Hagberg, J.M, (1990) Exercise Fitness and Hypertension Inc, Bouchard, R.J Harris, K.A, and Holly, R.G. (1987) Physiological Response to Circuit Weight Training in Border Line Hypertension Subjects. *Medicine and Science in Sports and Exercise*.

Haling, W.M; Prineas, R.J; Zhu, Y.S & Leaverton, P.E (2001). Body Mass Index (BMI). Growth in a Sample of U.S. Children: Repeated Measure Data Analysis of the Minneapolis Children's Blood Pressure Study; *American Journal of Human Biology* 13: 821-831.

Harbor, J; Marslew,U; & Gotfredsen,A; Christiansen, C; (1991). Post Menstrual Hormone Replacement Theraphy Prevents Central Distribution of Body Fat after Menopause, Metabolism.40: 1323-6.

Harris, K.A & Holly, R.G. (1987). Physiology Response to Circuit Weight Training in Borderline Hypertensive Subject. *Medicine of Sports Sciences and Exercise*. 19:246-252.

Haruna, FR, (1994). The Role of Exercise Programme in the Treatment of Obesity. Kinesiologist: Vol 1 No January- March: 26-32.

Heyward, V.H. (1998). *Advanced fitness Assessment and Exercise Prescription* 3rd Edition New Mexico Burgess.

Himes,, J.H.(1988). Alteration in Distribution of Adipose Tissues in Response to Nutritional Intervention. Fat Distribution during Growth and later Health Outcomes. New York Inc: pp.313-332.

Hoeger, W.W.K. (1988). *Principles and Labs for Physical Fitness and Wellness*. Colorado: Morton Publishing Companies.

Holly-Kramer, Xiaodong Whu, Donghui Kan, AmyLuke, Xioafeng Xhu, Adebowale Adeyemo, Colin Mekenie & Richard Copper (2005).

Angiotension- Converting Enzyme, Gene Poly Morphisms and Obesity. Research 13: 823-828.

Holme, L; Heigel,H; Hjermann, I; Lund-Larsen, P.G; & Leren,J.(1976). Coronary Risk Factors and Socio-Economic Status, Lancet,25,1396-1398.

http://www.24hrfitness.co.uk/fitness%20tips/cooling-down-after exercise.html

http://en.wikipedia.org/wiki/Body-weight.

Hubbard, Svan. (2000).Defining Overweight and Obesity. What are the Real Issues. *American Journal of Clinical Nutrition*, 72 (2),1060-1068.

Jackson, A.S. & Pollock, M. (1985). Practical Assessment of Body Composition. The Physician and Sports Medicine. Vol 13, No 5.

Jacobsen, D; Donnelly, J; Snyder-Heelan, K. & Livingston, K. (2003). Adherence and Attrition with Intermittent and Continuous Exercise in Overwight Women. *International Journal of Sports Medicine* 24(6), 459-464.

Jensen, M.D; Haymond, M.W; Rizza, R.A; Cryzer, P.E; & Miles, J.M.(1989). Influence of Body Fat Distribution on Free Fatty Acid Metabolism in Obesity. *Journal of clinical Investigation*, 83:1168-73.

Kalichman, L; Liushits, G & Kobyliansky, E. (2006). Indices of Body Composition and Chronic Morbidity: A Cross-Sectional Study of a Rural Population in Central. Russia. Int. Sc. *American Journal of Human Biology*. 18: 350-358.

Kaminsky, L. & Whaley, M. (1993). Effects of Interval-type Exercise on excess Post-Exercise Oxygen Consumption (EPOC) in Obese and Normal-Weight Women. *Medicine*, Exercise, *Nutrition and Health* 2,106-111

Katch, F.I, Victor, I.K; & William, D.M.(2010). *Exercise Physiology Nutrition, Energy and Human Performance*. Lippincott Williams and Wilkins. New York, U.S.A.

Kelishadi, R. (2007). Childhood Overweight, Obesity and the Metabolic Syndrome in Developing Countries. *Epidemiology*. *Review*. 29:62-76.

Khan,L.K & Bowman,B.A.(1999). Obesity a major Public Health Problem. *Annual Review of Nutrition*, 9.

Kim K.S; Owen, N; Williams, D & Adams-Caw pbell L.L. (2000). A Comparison between BM and Coinicity Index on Predicting CHD, The Flemingham Heart Study. *Annuals of Endemiology* 10, 42.

King, J; Broeder, C; Browder, K. & Panton, L. (2002). A Comparison of Interval vs. Steady-State Exercise on Substrate Utilization in Overweight Women. *Medicine & Science in Sports and Exercise* 34,130.

King, J; Panton, L; Broeder, K; Quindry, J. & Rhea, L. (2001). A Comparison of High Intensity vs. Low Intensity Exercise on Body Composition in Overweight Women. *Medicine & Science in Sports and Exercise* 33,228.

Klein, S; Wadden, & Sugarmen, H.J. (2002). AGA Technical Review on Obesity. Gastroen Terology. 123:882.

Knittle,J.L.(1972). "Obesity in Children, a Problem in Adipose Tissue Cellular Development". *Journal of Pediatrics.*

Kraemer, J.B; Stone, M.H; O'Bryan, H.S; Conley, M.S; Johnson, R.L. Newman, D.C; Honeycutt, D.R; & Hoke, T.P. (1997): Effects of Single vs Multiple sets of Weight Training: Impact of Volume Intensity, and Variation. *Journal of Strength and Conditioning Research,* 11: 143-147.

Krassas,G.E; Tzotzas,T; Tsametis,C; & Konstantindis,T. (2001). Prevanlence and Trends in Overweight and Obesity among Children and Adolescents in Thessaloniki, Greece, *Journal of Pedriatic Endocrinology Metabolism:* 14 Supplementary, 1319-1326: Discussion 1365.

Kuczmarski, R.J; Caroll, M.D; Flegal, K.M & Troiano, R.P. (2000). Varying BMI Cut of Points to Describe Overweight Prevalence among U.S Adults. Obesity Research, 51-5510.

Lal, & S; Adarsh, Pankaj.(2007). *Textbook of Community Medicine* (Preventive and Social Medicine). CBS Publishers and Distributors: New Delhi.

Lauer, R.M & Raab, R. (1980). "Physical Fitness for Children" Research Quarterly,32 pp.

Lehoritz, H.E.(2006): Insulin Resistance a Common Link between type II Diabetes and Cardiovascular Disease: Diabetes Obsesses metab: 8: 237-249.

Lennon, D; Nagle, F; Stratman, F; Shrago, E. & Dennis, S. (1985). Diet and Exercise Training Effects on Resting Metabolic Rate. *International Journal of Obesity* 9 (1), 39-47

Lissuev, L; Leuislay, D.A, Strupp, B.J; Kalkwarf, H.J; & Roc,D.A.(1987). Dietary Fat and the Regulation of Energy intake in Human Subjects. *American Journal in Nutrition*, 46:886-62.

Lohman, T.G & Boileau, R.A. (1985). The Measurement of Human Physique and its Effects on Physical Performance. Orthopedic Clinical Nutrition and Metabolism Am (3), 563-581.

Lohman, T.G. (1989). Assessment of Body Composition in Children. Pediatric Exercise. Sciences. 1, 19 – 30.

Malina, R.M. (1989). Tracking of Physical Activity and fitness across the Lifespan._Research Questions on Exercise Sports 67 (Suppl) 48-57.

Malina, R.M. (1994). Anthropometry, Strength and Motor Fitness. In Wijaszek, S.J Mascle Taylor C.G.N. Editors, Anthropometry: the Individual and the Population. Cambridge UK. Cambridge University Press, pp 160-177.

Malina,R.M.(1996). Tracking of physical activity and physical fitness across the lifespan. Research Quarterly in Exercise and Sports, 67:48-57.

Mann, G. (1974). The Influence of Obesity on Health. *New England Journal of Medicine* 291, 226-232.

Marks, B.L; Ward,A; Morris,D.H; Gastellani, T & Rppe, J.M. (1995). Fat-Free Mass Maintenance in Women following Moderate Diet and Exercise Program. *Medicine and Science in Sport and Exercise*, 27:1243-1251.

Maron, D.J; Fair, J.M; & Haskell, W.L.(1991): Standard Fat intake and Insulin Resistance in Men with Coronary Artery Disease Coloration: 84:2020-7.

Masironi, R; & Denolin, H. (1985) *Physical Activities in Diseases Prevention and Treatment* London: Butter Worths Publishing Co. pp. 61-97.

Mathew, D.K. (1978). *Measurement in Physical Education* 5th Edition W.B. Saunders Company New York.

Mathew, D.K. & Fox L.E. (1981). *The Physiological Basic of Physical Education and Athletics*, 3rd Edition. W.B. Saunders Company Phildadelphia.

Maud, P.J & Foster, C. (1995). *Physiological Assessment of Human fitness*. Human kinetics, Champaign, IC. www.humankinetics.com.

Mayo, M.S. Granthom, J.& Balasekaran, G. (2003). Exercise-Induced Weight Loss Preferentially Reduces Abdominal Fat. *Medicine Science in Sports Exercise*, Vol.35, No2, pp 207-213.

McArdle, W.D. Katch, F.L. & Katch, V.I. (1981). Exercise Physiology. Energy Nutrition, and Human Performance Philadelphia lea and Fibeger.

McArdle, W.D; Katch, F.L & Katch, V.I. (1991). *Exercise physiology*. *Energy Nutrition and Human Performance*. Philadelphia lea and Fibeger.

Morrow,J.R; Jackson,A.W; Disch,J.G; & Mood, D.P. (2000). *Measurement and Evaluation in Human performance*, 2nd Edition, Australia, Human Kinetics, Australia.

Mufunda, J. (2005). Body Mass index and blood pressure. Where are we now? *Journal of Human Hypertension*:21:57.

Musa, I.D; Lawal, B; & Sarkinfada, M.(2001). Body Fat and Blood Pressure Levels in School Boys in Kano City, Nigeria. Department of Physical and Health Education, Bayero University, Kano.

Mydr. (2003). UBM Medica Australia.
http://www.mydr.com.au/sports-fitness/warming-up-and-cooling-down-for-exercise

Nichols, S.D & Cadogen, F.(2008). Anthropometric Reference Values in an Afro-Caribbean Adolescent Population. *American Journal of Human Biology* 20:51-58.

Nicklass, B.j; Rogue, M.J; Berman, D.M; & Dennis,K.E. (2000) . Responses of Adipose Tissue Lipoprotein Lipase to Weight Loss Affect Lipids Levels and

Weight Regain in Women. *American Journal of Physiology Endocrinology Metabolism*, 279:E101-E1019.

Nieman, D.C. (1998). *The Exercise Health Connections*. Champaign. I.L Human Kinetics.

O'houghlin, Paradis, G; Kishchuk,W & Barnett,T. (1999). Prevalence and Correlates of Physical Activity Behaviour among Elementary School Children in Multiethnic, Low-Income inner-City, Canada, *Annuals of Epidemiology*,397-407.

O'leary, V.B, Marchetti, C.M; & Krishman,R.K.(2006). Exercise-Induced Reversal of Insulin Resistance in Obese Elderly is Associated with Reduced Visceral Fat; *Journal of People Physical*, 100:1584-9

Ogundipe, S. (2006). Management of Hypertension is a Lifestyle Issue. Vanguard Newspapers, Monday March, 19. 41.

Ostegard,T; Jensen, N; & Schmitz.(2007). The Effect of Exercise Training and Inactivity on Insulin Sensitivity in Diabetics and their Relatives; what is New? *Appl. Physical Nutrimental*, 32:541-8.

Pai, Manjunath, P; Frank P. (2000). "The Origin of "Ideal" Body Weight Equation". *The Annuals of Pharmacotherapy* 34:1066-1069.

Parizkova, J. (1993). Age Trends in Fat in Normal and Obese Children. *Journal Applied Physiology*, 16, 170.

Pate, R.R., Freedson, P.S. Sallis, J.F, Taylor, W.C.Sirard, J., Trost S.G., & Dowda, M. (2002). Compliance with physical activity guideline, prevalence in a population of children and youth. *Annuals of Epidemiology*, 12 (5), 303-308.

Perez B.; Landaeta- Jimenez M., & Vasquez M. (2002) Fat Distribution in Venezuelan Children and Adolescents Estimated by the Conicity Index and Wasit/HIP Ration. *American Journal of Human Biology*. 14, 15-20.

Perez, B; Landaeta- Jimenez, M; & Vasquez,M. (2003) . Fat Distribution in Venezuelan Children and Adolescents Estimated by the Conicity Index and Waist (Hip ratio). *American Journal of Human Biology*, 14:15-20.

Plowman, S.A. & Smith, D.L. (1997). *Exercise Physiology for Health, Fitness and Performance*. Allyn and Bacon: USA. Internet: wwwabacon.com. American online keyword: College Online.

Poehlman,E.T.(1989). A Review: Exercise and its Influences on Resting Energy Metabolism in man. Medicine and Science in Sports and Exercise 21: 515-525.

Pollock, I.M.H; Wilmore, W.H; & Fox, S.M. (1984). *Exercise on Health and Diseases Evaluation and Prescription for Prevention and Relaxation* W.B. Saunders Co. Philadelphia.

Powers, Scott K; Howley, Edward T. (2012). Exercise Physiology, Theory and Application to Fitness and Performance. Published by McGraw Hill, New York. Eight Edition.

Proschaska, J.J; Sallis, J.F; Sarkin,J & Calfas, K.J. (2000). Examination of the factor structure of physical activity behaviours, *Journals of Clinical Epidemiology*.

Pupet,F.H; Zoaskah,A.I; & Chukwak,E.K.(2002). Prevalence of Overweight and Obesity among Urban Nigerian Adults in Jos. *Highland Medical Research Journal*, Vol.1 (1):13-16.

Querra, S; Ribeiro, J.C; Costa,R; Duarte, J.A & Mota,J. (2002). Relationship between Cardiorespiratory Fitness. Body Composition and Blood Pressure in School Children. *Journal of Sports Medicine and Physical Fitness*, 42;207-213.

Rahimi, R. (2006). Effects of Moderate and High Intensity Weight Training on the Body Composition of our Weight Men.

Reddy, B.N.(1998). Blood Pressure and Adiposity: A Comparative Study of Socio-Economically Diverse Groups of Andhra Pradesh, India. *American Journal of Human Biology*.10:5-21.

Renaat, M.J; Philipparts, M; Lefeure, J; Delvau, K.J; Thomas, M; Vanreusel, B; Vanden Eynde, B; Albrechl, L; Claessens,, Lysesns, R; & Bevnen, G. (1999). Association between Daily Physical Activity and Physical Fitness in Flemish Males. A Cross-Sectional Analysis. *American Journal of Human Biology, 11:*587-597.

Roberts, S.T., McGarvey, S.T., Viah, S. & Quested, C. (2004). Youth Blood Pressure Levels in Samoa in 1979 and 1991-93. *American Journal of Human Biology*, 16: 158-167.

Roemmich, J.N; Clark, P.A; Walker, K & Patrice, J. (2000). Pubertal Alterations in Growth and Body Composition. *American Journal of Physiology and Metabolism,* 279E: 1426-1436.

Rosato, F. D. (1994) *Fitness for Wellness.* (3rd Edition) Minneapolis West Publishing.

Rose, R & Janssen, I (1999). Is Abdominal Fat preferentially Reduced in Response to Exercise-induced Weight Loss?. *Medicine Science in Sports Exercise* (31). 5568-5572.

Ross, J; & Gandpate R.R. (1985). " The National Children Youth Fitness Study. 11, A Summary of Findings, *Journal of Physical Education:* Recreation and Dance, 53(a): 51-56.

Ross, R. (1997) Effects of Diet and Exercise-induced Weight Loss on Visceral Adipose Tissue in Men and Women. *Sports Medicine 24, 55-64.*

Ross, W.D. & Marfell-Jones, M.J. (1992). Kinanthropometry. In S.D. McDoughal, M.D.; Wagner, P. and H.A. Green (eds), Physiological Test of Elite Athletes Motoal publishing Ohawa.

Santos, R, Aires, L, Santos,P, Ribeiro, J.C & Mota,J (2008). Prevalence of Overweight and Obesity in a Portuguese Sample of Adults from the Aeron Physical Activity and Health Study. *American Journal of Human Biology*, 20:73-85.

Scott, K. & Edward, T.H. (1977): *Exercise physiology*, University of Tennessee-Knoxville. Pp. 395-396.

Sharkey, B.J. (1995). *Physiology of Fitness* 2nd ed Human Kinetics. Champaign, Illionis.

Skinner, J.S; Baldini, F.D; & Gardner, A.W. (1990) "Assessment of Shephered R.J. Mcpherson B.D. Stevenss, I. and Siuton J.R. Exercise Fitness and Health Illinois. Human Kinetics" Books Inc. pp 100-136.

Slaughter, M.H; Lohman, T.G & Misner, J.E. (1980). Relationship of Somato type and Body Composition to Physical Performance in 7-12 Year Old Boys. The *Research Quarterly*,48: 1-5.

Slaughter, M.H; Lohman, T.G; Boilear, R.A; Horwill, C.A; Stilman, R.J; Vanloan,M; & Wilmore, J.H. (1985). Skinfold Equations for Estimation of Body Fatness in Children and Youth. Human Biology, 60:709-729.

Strauss, R.H. (1984) Sports Medicine Philadelphia: W.B. Saunders Co. Pp. 40-4640-46.

SO, TY; Farrington E, Absher RK(2009). "Evaluation of the Accuracy of Different Methods used to Estimate Weights in the Pediatric Population". Pediatrics 123 (6): 1045-51.

Tabata,I; Nishimuru,K; Kouzaki,M. Hirai,Y; Ogita,F;Miyachi,M; & Yamamato,K. (1996). Effects of Moderate-Intensity Endurance and High Intensity Intermittent Training on Anaerobic Capacity and Vo2 max. *Medicine and Science in Sports Exercise*, 28:1327-1330.

Tanko, I, Tukur (2000).Effects of Variations in Duration, Frequency and Intensity on Selected Physiological Variables during Regular Exercise. Unpublished Phd Dissertation. A.B.U, Zaria.

Thomas J.R. & Nelson J.K (1996) *Research Methods in Physical Activity*. Human Kinetics, Champaign I.L.

Tran, Z.V., Weltman, A., Glass, G.V., & Mood, D.P.(2007). The Effects of Exercise on Blood Lipids and Lipoproteins: A Meta-Analysis of Studies. Department of Physical Education and Recreation, and the Laboratory of Education Research, School of Education, University of Colorado.

Trapp, E; Chisholm, D., Freund, J. & Boutcher, S. (2008). The Effects of High Intensity Intermittent Exercise Training on Fat Loss and Fasting Insulin Levels of Young Women. *International Journal of Obesity* 32, 684-691.

Trembley,A; Simoneau,J.A; & Bouchard,C. (1994). Impact of Exercise Intensity on Body Metab Clinic exp 43. (7) 814-8. PMID 8028502. (http://www.ncbi.nlm.gov/pubmed/8028502)

Troisi, R.J; Wetss, S.T; Segal, M.R; Cassano, P.A; Vokonas, P.S. & Landsberg, L. (1990). The Relationship of Body Fat Distribution of Blood Pressure in Normotensive Men: The Normative Aging Study. *International Journal of obesity*, 14: 515-525.

Umar, S.M. (2000). Physical Fitness Status of Male Athletes, non-Athletes and Physical Education Students. M.Ed Unpublished Thesis, Ahmadu Bello University, Zaria, Nigeria.

United States Development of Health and Human Services. (2000). Physical Activity and Health: A Report of the Suregeon General and Human Services Centre for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Health Promotion.

United States, General Report. (1996). University Health and Physical Education Project.

Vander-Horst, K; Paw, M.J; Ch, A; Twisk, J.W.R; & Vandar Mechelen, W. (2007). A brief Review and Correlates of Physical Activity and Sedentriness in youth. *Medicine and Science in Sport and Exercise*, 39 (8), 1241-1250.

Vasconcelos, V.L. & Silva, G.A.P. (2003). Overweight and Obesity Prevalence in Male Adolescent in North West Brazil, 1980-2000 Rio de Janeiro CSP Reports in Public Health 19 (5) 1445 – 1451 (2000). www.wnso.fiocruz.br.csp.

Venkateswarlu, K. (1969) "A Study of Neuromuscular Tension among Sedentary People and Physically Active People" Paper Presented to Physiological Society Patiala. India.

Venkateswarlu, K. (1982). Theory of athletic Training. Department of Physical and Health Education, Ahmadu Bello University, Zaria. Unpublished monograph.

Venkateswarlu, K. (1990). " The Role of Exercise Programme in the Treatment of Obesity". A Paper Presented at Faculty of Education, Ahmadu Bello University, Zaria, Nigeria.

Venkateswarlu, K. (1991). Comparative Effects of three Weight Training Protocols on Arm Explosive Strength. In L.O Amusa (Ed). Sports Science and Medicine 1,217-226.

Venkateswarlu, K. (1992) Training Methods. Ahmadu Bello University, Zaria, Nigeria. Unpublished Monography.

Venkateswarlu, K. (2007) Comparative Analysis of Body Fat Distribution Adolescents in Nigeria and Botswana Applied Category.

Venkateswarlu, K. (2009). *Scientific Foundations of Exercise Programmes for Women*. Ahmadu Bello University Press, Zaria, Nigeria.

Venkateswarlu, K. (2010). Exercise for Disease Prevention and Health Promotion Ahmadu Bello University Press, Zaria, Nigeria.

Venkateswarlu, K. (2011). Role of Physical Education in the Promotion of Healthy Life Style. Paper presented at the International Conference on Lifestyle, Goa, India.

Vignerova, J; Humenikova, L.; Brabec, M; Riedlova, J; & Blaha, P. (2007). Long term Changes in Body Weight, BMI, and Adiposity Rebound among Children and Adolescent on the Czech Republic. Science Direct Economic and Human Biology (5) 409-425.

Wallace, J.P. (2003). Exercise in Hypertension, Sports Medicine. 33(8) 585-598.

Wang, Y. & Beydoun, M.A. (2007). The Obesity Epidemic in the US-Gender, Age, Socio-Economic, Racial/Ethnic and Geographic Characteristics: A Systematic Review and Met Regression Analysis. Epidemiology/Review: 6-28. *http//epirev.oxfordjournals.org.*

Warming up and Cooling down for Exercise. UBM. Medica. Australia, Australia.

Watson, A.W.S. (1983). *Physical Fitness and Athletic Performance. A Guide for Students*, Athletes and Conches. The Longman Longman Publishers pp. 2-10 and 168-286.

Whitehead, J & Corbin, C. (1984). Fitness Assessment Results some Results-some Concepts and Analogy. *Journal of Physical Education*, Recreation and Dance, 60 (6): 39-43.

Williams, M.J; & Hunter, G.R; Szabo, T.K; Snyder, S; Treuth, M. (1986). Regional fat Distribution Fat Distribution in Women and Risk of Cardiovascular Disease. *American Journal of Clinical Nutrition*, 65: 885 – 860.

Williams, P.T. (2008). Self-selection Accounts for Inverse Association between Weight and Cardio-Respiratory Fitness Obesity, 16: 102-106.

Wilmore, K.M.; McBride, P.J; & Wilmore J.H. (1984). Comparison of Bioelectric Impedance and near – Infrared Interactance of Bioelectric Impedance and near Infrared Interrractance for Human Body Composition Assessment in a Population of Self-perceived overweight Adults. *International Journal of Obesity*, 18: 375 – 381.

Wilmore, K.M; McBride, P.J; & Wilmore, J.H. (1984). Comparison of Bioelectric Impedenace and near-Infrared Interractance for Human Body Composition Assessment in a Population to self-perceived overweight Adults. *International Journal of obesity* 18: 375-381.

World Health Organization (2000). Obesity Prevention and Managing the Global Epidemic Report series no 854. Geneva.

You, T; & Nicklas,B.J.(2008). Effect of Exercise on Adipokiness and the Metabolism Syndrome, *Curr.Diab*, Rep, 8:7-11.

Yusuf, S; Hawken,S; & Ounpus,S (2004). Effects of Potentially Modifiable Factors Associated with Myocardial Infarction in 52 Countries (The Inter Heart Study). *Case control study*, Lancet, 364:937-952.

APPENDIX A

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

INFORMED CONSENT FORM

In order to participate in this test to determine my health and fitness status, I…………………………………………… a subject do undersigned and voluntarily accepted to partake in the research conducted on effects of continuous and interval exercise training on blood pressure, body weight, and percent body fat of overweight male and female adults in Nigeria commencing as from ……………………… date……………

As part of the participant in the test, I understand and agree that during the participation, pains and discomforts may arise during and after the exercise.

I have been duly informed and instructed to stop whenever such conditions become severe and unbearable.

……………………………………………   ……………………..…

Candidate's Signature   **Date**

APPENDIX B

SN	TRAINING	AGE	SEX	Week	SYS TOLIC	DIA STOLIC	BODYWT	BODYFAT	HEIGHT
1	Continuous	43	Male	6	121	109	119	28.71	1.53
2	Continuous	39	Male	6	160	80	92	28.10	1.66
3	Continuous	31	Male	6	140	70	97	27.32	1.64
4	Continuous	36	Male	6	140	100	104	25.63	1.54
5	Continuous	44	Male	6	120	70	103	34.58	1.55
6	Continuous	36	Male	6	140	80	107	32.65	1.48
7	Continuous	38	Male	6	125	75	118	35.49	1.60
8	Continuous	30	Male	6	128	80	112	37.10	1.70
9	Continuous	29	Male	6	117	82	80	31.45	1.58
10	Continuous	35	Male	6	120	83	81	21.42	1.61
11	Continuous	43	Male	6	170	90	92	30.00	1.59
12	Continuous	41	Male	6	141	85	100	28.50	1.58
13	Continuous	42	Male	6	170	90	106	28.32	1.49
14	Continuous	40	Male	6	185	110	107	34.60	1.50
15	Continuous	39	Male	6	140	80	109	28.20	1.68
1	Continuous	36	Female	6	110	74	126	29.55	1.59
2	Continuous	33	Female	6	131	85	119	27.81	1.66
3	Continuous	33	Female	6	140	80	110	31.74	1.49
4	Continuous	32	Female	6	140	88	108	20.10	1.40
5	Continuous	39	Female	6	120	70	111	37.10	1.57
6	Continuous	38	Female	6	140	100	101	28.69	1.66
7	Continuous	41	Female	6	135	85	114	35.24	1.60
8	Continuous	40	Female	6	120	100	130	35.89	1.58
9	Continuous	40	Female	6	140	70	110	35.50	1.55
10	Continuous	38	Female	6	130	85	124	32.61	1.62
11	Continuous	30	Female	6	130	80	106	33.04	1.51
12	Continuous	30	Female	6	100	85	130	32.01	1.53
13	Continuous	28	Female	6	130	80	123	33.11	1.61
14	Continuous	20	Female	6	120	80	100	35.09	1.59
15	Continuous	38	Female	6	195	100	125	37.60	1.57
1	Continuous	43	Male	12	121	109	119	28.79	1.53
2	Continuous	39	Male	12	160	81	93	28.15	1.66
3	Continuous	31	Male	12	139	72	96	27.30	1.64
4	Continuous	36	Male	12	140	110	102	25.54	1.54
5	Continuous	44	Male	12	120	70	105	34.62	1.55
6	Continuous	36	Male	12	140	80	110	33.05	1.48
7	Continuous	38	Male	12	120	89	116	35.40	1.60
8	Continuous	30	Male	12	130	80	112	37.00	1.70
9	Continuous	29	Male	12	120	90	84	32.09	1.58
10	Continuous	35	Male	12	120	95	80	23.51	1.61
11	Continuous	43	Male	12	165	90	95	30.05	1.59
12	Continuous	41	Male	12	145	90	105	28.40	1.58

13	Continuous	42	Male	12	170	90	107	28.30	1.49
14	Continuous	40	Male	12	160	120	107	35.35	1.50
15	Continuous	39	Male	12	140	90	106	27.50	1.68
1	Continuous	36	Female	12	115	80	130	29.60	1.59
2	Continuous	33	Female	12	135	90	120	27.71	1.66
3	Continuous	33	Female	12	140	80	112	31.68	1.49
4	Continuous	32	Female	12	140	90	109	22.30	1.40
5	Continuous	39	Female	12	120	80	110	37.10	1.57
6	Continuous	38	Female	12	140	120	106	28.76	1.66
7	Continuous	41	Female	12	130	90	115	35.24	1.60
8	Continuous	40	Female	12	120	110	130	35.60	1.58
9	Continuous	40	Female	12	140	80	111	35.65	1.55
10	Continuous	38	Female	12	130	85	124	33.60	1.62
11	Continuous	30	Female	12	135	80	104	33.05	1.51
12	Continuous	30	Female	12	100	85	130	32.15	1.53
13	Continuous	28	Female	12	130	80	120	33.15	1.61
14	Continuous	29	Female	12	120	85	109	35.10	1.59
15	Continuous	38	Female	12	120	110	123	37.09	1.57
1	Continuous	43	Male	0	121	103	118	28.70	1.53
2	Continuous	39	Male	0	180	70	90	28.10	1.66
3	Continuous	31	Male	0	140	70	98	22.30	1.62
4	Continuous	36	Male	0	138	100	102	25.60	1.54
5	Continuous	44	Male	0	120	60	103	34.60	1.55
6	Continuous	36	Male	0	145	80	106	32.60	1.48
7	Continuous	38	Male	0	125	70	116	35.40	1.60
8	Continuous	30	Male	0	128	81	112	37.10	1.70
9	Continuous	29	Male	0	117	82	75	31.50	1.58
10	Continuous	35	Male	0	128	83	75	21.40	1.61
11	Continuous	43	Male	0	170	90	91	30.50	1.59
12	Continuous	41	Male	0	114	64	98	28.60	1.58
13	Continuous	42	Male	0	172	90	106	28.40	1.49
14	Continuous	40	Male	0	184	103	108	34.60	1.50
15	Continuous	39	Male	0	140	80	114	28.70	1.68
1	Continuous	36	Female	0	110	70	125	29.50	1.59
2	Continuous	33	Female	0	130	80	119	27.80	1.66
3	Continuous	33	Female	0	140	80	108	31.80	1.49
4	Continuous	32	Female	0	136	88	108	29.10	1.40
5	Continuous	39	Female	0	120	70	110	37.20	1.57
6	Continuous	38	Female	0	140	90	100	28.60	1.66
7	Continuous	41	Female	0	130	80	115	35.20	1.60
8	Continuous	40	Female	0	120	90	134	35.90	1.58
9	Continuous	40	Female	0	140	70	106	35.50	1.55
10	Continuous	38	Female	0	130	80	124	32.60	1.62
11	Continuous	30	Female	0	130	80	100	33.00	1.51
12	Continuous	30	Female	0	90	53	126	37.00	1.53
13	Continuous	28	Female	0	130	80	195	33.10	1.61
14	Continuous	29	Female	0	120	80	101	35.10	1.59
15	Continuous	38	Female	0	190	90	130	37.70	1.57
1	Interval	39	Male	6	130	80	102	28.10	1.68

2	Interval	40	Male	6	130	98	77	27.10	1.65
3	Interval	42	Male	6	139	113	108	28.00	1.63
4	Interval	44	Male	6	140	80	100	28.80	1.63
5	Interval	35	Male	6	130	80	77	27.40	1.58
6	Interval	33	Male	6	130	110	92	25.60	1.60
7	Interval	40	Male	6	130	70	105	25.60	1.58
8	Interval	35	Male	6	130	90	106	25.60	1.61
9	Interval	31	Male	6	135	80	96	25.60	1.65
10	Interval	30	Male	6	138	91	82	27.50	1.46
11	Interval	30	Male	6	127	92	85	31.50	1.66
12	Interval	29	Male	6	138	93	85	31.40	1.52
13	Interval	26	Male	6	180	100	101	28.30	1.53
14	Interval	36	Male	6	124	74	95	26.40	1.68
15	Interval	44	Male	6	120	100	76	27.50	1.62
1	Interval	36	Female	6	130	70	70	34.40	1.58
2	Interval	38	Female	6	140	90	100	35.00	1.55
3	Interval	30	Female	6	111	70	85	32.90	1.56
4	Interval	31	Female	6	135	86	90	30.40	1.56
5	Interval	34	Female	6	130	100	88	34.70	1.58
6	Interval	25	Female	6	120	90	89	34.30	1.57
7	Interval	36	Female	6	130	90	95	33.00	1.70
8	Interval	30	Female	6	120	80	104	33.30	1.60
9	Interval	30	Female	6	140	120	90	35.10	1.58
10	Interval	32	Female	6	120	90	90	32.60	1.61
11	Interval	45	Female	6	130	90	81	34.80	1.69
12	Interval	40	Female	6	120	80	104	35.40	1.74
13	Interval	32	Female	6	130	90	86	35.80	1.55
14	Interval	29	Female	6	130	90	108	31.70	1.68
15	Interval	32	Female	6	120	100	94	34.20	1.54
1	Interval	39	Male	12	120	70	92	18.10	1.68
2	Interval	40	Male	12	120	88	67	17.10	1.65
3	Interval	42	Male	12	129	103	98	18.00	1.63
4	Interval	44	Male	12	130	70	90	18.80	1.63
5	Interval	36	Male	12	120	70	67	17.40	1.58
6	Interval	33	Male	12	120	100	82	15.60	1.60
7	Interval	40	Male	12	120	60	95	15.60	1.58
8	Interval	35	Male	12	120	80	96	15.80	1.61
9	Interval	31	Male	12	125	70	86	15.60	1.65
10	Interval	30	Male	12	128	81	72	17.50	1.46
11	Interval	30	Male	12	117	82	75	21.50	1.66
12	Interval	29	Male	12	128	83	75	21.40	1.52
13	Interval	26	Male	12	170	90	91	18.30	1.53
14	Interval	36	Male	12	114	64	85	16.40	1.68
15	Interval	44	Male	12	110	90	66	17.50	1.62
1	Interval	36	Female	12	120	60	60	24.40	1.58
2	Interval	38	Female	12	130	80	90	25.00	1.55
3	Interval	30	Female	12	101	60	75	22.90	1.56
4	Interval	31	Female	12	125	76	80	20.40	1.56
5	Interval	34	Female	12	120	90	78	24.70	1.58

6	Interval	25	Female	12	110	80	79	24.30	1.57
7	Interval	36	Female	12	120	80	85	23.00	1.70
8	Interval	30	Female	12	110	70	94	23.30	1.60
9	Interval	30	Female	12	130	110	80	25.10	1.58
10	Interval	32	Female	12	110	80	80	22.60	1.61
11	Interval	45	Female	12	120	80	71	24.80	1.69
12	Interval	40	Female	12	110	70	94	25.40	1.74
13	Interval	32	Female	12	120	80	76	25.80	1.55
14	Interval	29	Female	12	120	80	98	21.70	1.68
15	Interval	32	Female	12	110	90	84	24.20	1.54
1	Interval	39	Male	0	126	76	98	24.10	1.68
2	Interval	40	Male	0	126	94	75	23.10	1.65
3	Interval	42	Male	0	135	109	104	24.00	1.63
4	Interval	44	Male	0	136	76	96	24.80	1.63
5	Interval	36	Male	0	126	76	73	23.40	1.58
6	Interval	33	Male	0	126	106	88	21.60	1.60
7	Interval	40	Male	0	126	66	101	21.60	1.58
8	Interval	35	Male	0	126	83	102	21.60	1.61
9	Interval	31	Male	0	131	76	92	21.62	1.65
10	Interval	30	Male	0	134	87	78	23.50	1.46
11	Interval	30	Male	0	123	88	81	27.50	1.66
12	Interval	29	Male	0	134	89	81	27.40	1.52
13	Interval	26	Male	0	176	96	97	24.30	1.53
14	Interval	36	Male	0	120	70	91	22.40	1.68
15	Interval	44	Male	0	116	96	72	23.50	1.62
1	Interval	36	Female	0	126	66	66	30.40	1.58
2	Interval	38	Female	0	136	86	96	31.00	1.55
3	Interval	30	Female	0	107	66	81	28.90	1.56
4	Interval	31	Female	0	131	82	86	26.40	1.56
5	Interval	34	Female	0	126	96	84	30.70	1.58
6	Interval	25	Female	0	116	86	85	30.30	1.57
7	Interval	36	Female	0	126	86	91	20.00	1.70
8	Interval	30	Female	0	116	76	100	29.30	1.60
9	Interval	30	Female	0	136	116	86	31.10	1.58
10	Interval	32	Female	0	116	86	86	28.60	1.61
11	Interval	45	Female	0	126	86	77	30.80	1.69
12	Interval	40	Female	0	116	76	100	31.40	1.74
13	Interval	32	Female	0	126	88	82	31.80	1.55
14	Interval	29	Female	0	126	87	104	27.70	1.68
15	Interval	32	Female	0	116	96	90	30.20	1.54
1	Control	36	Male	6	120	100	110	29.70	1.58
2	Control	38	Male	6	130	80	100	31.40	1.65
3	Control	29	Male	6	130	108	91	30.30	1.69
4	Control	30	Male	6	120	80	109	29.50	1.63
5	Control	26	Male	6	110	80	96	27.20	1.62
6	Control	42	Male	6	130	90	108	24.90	1.67
7	Control	44	Male	6	180	90	108	31.40	1.57
8	Control	47	Male	6	150	120	94	30.60	1.56
9	Control	36	Male	6	130	80	99	30.50	1.68

10	Control	30	Male	6	120	90	79	31.40	1.70
11	Control	29	Male	6	160	90	92	30.20	1.75
12	Control	38	Male	6	146	89	91	28.90	1.70
13	Control	31	Male	6	140	90	115	28.20	1.75
14	Control	31	Male	6	140	90	93	31.60	1.60
15	Control	33	Male	6	120	90	110	29.50	1.67
1	Control	34	Female	6	120	80	107	29.30	1.61
2	Control	32	Female	6	140	90	129	27.50	1.53
3	Control	26	Female	6	120	90	96	30.80	1.73
4	Control	41	Female	6	146	98	99	29.10	1.63
5	Control	40	Female	6	130	80	110	27.20	1.59
6	Control	38	Female	6	150	100	110	28.60	1.66
7	Control	36	Female	6	140	90	105	30.50	1.70
8	Control	30	Female	6	130	100	124	35.90	1.72
9	Control	30	Female	6	120	80	116	35.50	1.60
10	Control	29	Female	6	140	90	108	32.60	1.70
11	Control	32	Female	6	140	90	110	33.00	1.64
12	Control	36	Female	6	100	65	136	37.00	1.74
13	Control	31	Female	6	140	90	105	33.10	1.69
14	Control	33	Female	6	130	90	111	35.10	1.65
15	Control	34	Female	6	150	100	109	37.70	1.64
1	Control	36	Male	12	190	90	130	37.70	1.58
2	Control	38	Male	12	120	70	90	21.40	1.65
3	Control	29	Male	12	140	98	81	20.30	1.69
4	Control	30	Male	12	110	70	99	19.50	1.63
5	Control	26	Male	12	100	70	86	17.20	1.62
6	Control	42	Male	12	120	80	98	14.90	1.67
7	Control	44	Male	12	170	80	98	21.40	1.57
8	Control	47	Male	12	140	110	84	20.60	1.56
9	Control	36	Male	12	120	70	89	20.50	1.68
10	Control	30	Male	12	110	80	69	21.40	1.70
11	Control	29	Male	12	150	80	82	20.20	1.75
12	Control	38	Male	12	136	79	81	18.90	1.70
13	Control	31	Male	12	130	80	105	18.20	1.75
14	Control	31	Male	12	130	80	83	21.60	1.60
15	Control	33	Male	12	110	80	100	19.50	1.67
1	Control	34	Female	12	110	70	97	19.30	1.61
2	Control	32	Female	12	130	80	119	17.50	1.53
3	Control	26	Female	12	110	80	86	20.80	1.73
4	Control	41	Female	12	136	88	89	19.10	1.63
5	Control	40	Female	12	120	70	100	17.20	1.59
6	Control	38	Female	12	140	90	100	18.60	1.66
7	Control	36	Female	12	130	80	95	20.50	1.70
8	Control	30	Female	12	120	90	114	25.90	1.72
9	Control	30	Female	12	110	70	106	25.50	1.60
10	Control	29	Female	12	130	80	98	22.60	1.70
11	Control	32	Female	12	130	80	100	23.00	1.64
12	Control	36	Female	12	90	55	126	27.00	1.74
13	Control	31	Female	12	130	80	95	23.10	1.69

14	Control	33	Female	12	120	80	101	25.10	1.65
15	Control	34	Female	12	140	90	99	27.70	1.64
1	Control	36	Male	0	116	96	106	25.70	1.58
2	Control	38	Male	0	126	76	96	27.40	1.65
3	Control	29	Male	0	146	104	87	26.30	1.69
4	Control	30	Male	0	116	76	105	25.50	1.63
5	Control	26	Male	0	106	76	92	23.20	1.62
6	Control	42	Male	0	126	86	104	20.90	1.67
7	Control	44	Male	0	176	86	104	27.40	1.57
8	Control	47	Male	0	146	116	90	26.60	1.56
9	Control	36	Male	0	126	76	95	26.50	1.68
10	Control	30	Male	0	116	86	75	27.40	1.70
11	Control	29	Male	0	156	86	88	26.20	1.75
12	Control	38	Male	0	142	85	87	24.90	1.70
13	Control	31	Male	0	136	86	111	24.20	1.75
14	Control	31	Male	0	136	86	89	27.60	1.60
15	Control	33	Male	0	116	86	106	25.50	1.67
1	Control	34	Female	0	116	76	103	25.30	1.61
2	Control	32	Female	0	136	86	125	23.50	1.53
3	Control	26	Female	0	116	80	92	26.80	1.73
4	Control	41	Female	0	142	94	95	25.10	1.63
5	Control	40	Female	0	126	76	106	23.20	1.59
6	Control	38	Female	0	146	96	106	24.60	1.66
7	Control	36	Female	0	136	86	101	26.50	1.70
8	Control	30	Female	0	126	96	120	31.90	1.72
9	Control	30	Female	0	116	76	112	31.50	1.60
10	Control	29	Female	0	136	86	104	28.60	1.70
11	Control	32	Female	0	136	86	106	29.00	1.64
12	Control	36	Female	0	96	61	132	33.00	1.74
13	Control	31	Female	0	136	86	101	29.10	1.69
14	Control	33	Female	0	126	86	107	31.10	1.65
15	Control	34	Female	0	146	96	105	33.70	1.64