CHAPTER ONE

INTRODUCTION

Background to the Study

Man is a creature, an organism designed for movement with neuromuscular mechanisms which will produce movement of infinite variety and magnitude (Uzoka, 2014). Man certainly lives in technology age. The American College of Sports Medicine (ACSM, 2013) noted that the advances that are seen in technology have simplified many physically demanding tasks. They also added that technology has eased people's physical burdens so much that one day they might be so physically unfit to perform any tasks without the help of technology.

Marc (2012) defined physical fitness as a measure of the body's ability to function efficiently and effectively in work and leisure activities, resist hypokinetic diseases (disease from sedentary lifestyles), and to meet emergency situations. United States National Library of Medicine (2015) defined physical fitness as a state of well-being in which performance is optimal, often as a result of physical conditioning which may be prescribed for disease therapy.

According to Helath-galaxy.com (2013), physical fitness is defined as the state of general wellbeing, physically sound and healthy, along with mental stability. The degree of physical fitness depends upon the individual's state of health, constitution and level of activity, if exerted. Optimal fitness is not possible without regular physical activity. Thus, a fit person has the strength, flexibility, endurance, social and emotional adjustments appropriate for his or her age and sex to engage in daily physical activities without experiencing undue fatigue (Marc, 2011). A fit individual is one who enjoys a quality of health which enables him to live most and serve best. Regular physical activity is one of the most important things one can do for health; it can help lower the risk of heart diseases and other hypokinetics diseases (Medline Plus, 2015). From a survey report of Ogu, Agbanusi and Umeasiegbu (2007), regular exercise has been shown to

exert many positive effects on health while many common chronic diseases are consequences of inactivity and sedentary behaviour. Physical fitness does not apply to athletes alone. There is need for physical fitness for non-athletes, men and women, youngsters and the aged, rich and the poor because it contributes to good health and youth's growth and development (Sharkey, 2012).

Normal function of all parts of the body also contributes to the efficiency and the ability to do a full day's work without fatigue, courage and enthusiasm for life. Barker (2010) stated that regular physical activity and good fitness not only help prevent illness and disease but also promote quality of life and wellness. He further explained that a person who can resist fatigue, muscle soreness, back problems and other symptoms associated with poor health–related fitness is capable of working productively and having energy left over at the end of the day. Churilla (2012) added that physical fitness is the basis of all activities in our society. If our bodies grow soft and inactive; if one fail to encourage physical development and prowess, we will undermine the capacity for work, and for the use of those skills vital to an expanding life.

Historically, physical fitness has often been misrepresented, at times identified exclusively with skills in sports. At other times it is identified closely with only one of the many aspects of physical fitness. In recent years, with the popularity of jogging and other forms of aerobic exercises, physical fitness has been associated almost exclusively with cardio-vascular fitness, including heredity, maturation, environment, and lifestyle such as nutrition. However, it is regular physical activity that is most important in physical fitness development. The area of scientific testing of physical fitness has developed to such dimension that those courses in the techniques of testing, form part of the physical education programmes.

Generally, human beings can only perform work when they are physically fit. They are more likely to have an ideal weight and feel better about themselves. With increased automation, keeping fit has become a universal problem. Today, many people are worried about the general

state of their health and appearance especially women who want to look beautiful and physically fit all the time.

Physical fitness is categorized into two aspects, health-related physical fitness and skill or performance related physical fitness. The President's Council on Physical Fitness and Sports (2011) defined health-related physical fitness as the ability to carry out daily tasks with vigor, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to handle effectively unforeseen injuries. Its components include muscular strength, muscular endurance, cardio-respiratory endurance, flexibility and body composition. They also stated that skill-related physical fitness include those qualities or functions that provide the individual with what is necessary to participate in sports with greater skill. Under skill-related physical fitness we have speed, power, balance, agility, reaction time and coordination. An important dimension of the physical fitness components that was used in this work is health-related physical fitness which includes muscular endurance, body composition, flexibility and cardio-respiratory endurance.

Quinn (2014) defines muscular endurance as the ability of a muscle or group of muscles to sustain repeated contractions against a resistance for an extended period of time. Muscular endurance is closely related to muscular strength. An individual who is strong will be more resistant to fatigue, because relatively less effort will be required to produce repeated muscular contractions. Muscular endurance is very important for people playing any sort of sports, or who are involved in any sort of physical activity that lasts for quite a while.

Scot (2014) defined body composition as the body's relative amount of fat to fat-free mass and also the percentages of fat, bone, water and muscle. An excess of fat in the body is unhealthy, because it requires more energy for movement and may reflect a diet high in saturated fat. Furthermore, it is believed that obesity contributes to degenerative diseases such as high blood

pressure and atherosclerosis. Since early times, the body composition of athletic populations has been of interest to exercise physiologists, dietitians, clinicians and coaches. They used the information on body composition to estimate the optimal body weight, formulate dietary recommendations and exercise prescription (Scot, 2014).

Wise Greek (2014) defined flexibility as the ability of a joint to move through its full range of motion. They further stated that flexibility which means attaining a full range of motion is important because it helps reduce stress on muscles as they perform various tasks, thereby reducing injury rates. Most activities people engage in require relatively "normal" amounts of flexibility. Increased flexibility may increase one's performance through improved balance and reaction time.

Behnken (2014) defined cardio-respiratory endurance as the physical ability to maintain aerobic exercise for prolonged periods of time. Cardio-vascular fitness is the best index for assessing a physically fit person. Cardio-respiratory endurance is very important because the more fit the cardio-respiratory system becomes, the healthier the lungs, heart and vascular system will be (Behnken, 2014). Kodama (2013) explained that regular cardio-vascular exercise promotes fitness and provides additional health and wellness benefits that extend well beyond reducing risks of disease. Lombardo (2012) in his contribution stated that increasing of cardio-respiratory endurance and being more active in general not only reduces the risk of developing depression, but also decreases stress and anxiety, increases happiness, self confidence and creativity; and improves memory and mental clarity.

This study looked at cardio-respiratory variables which are heart rate, blood pressure and maximum oxygen uptake. Others are trunk flexibility, muscular endurance and body composition. American Heart Association (AHA, 2014) defined heart rate or pulse, as the number of times the heart beats per minute, which varies from person to person. Heart rates can

easily be determined by auscultation with a stethoscope or by palpation over the heart, both at rest and during exercise. According to American Heart Association (2014), for adults from 18 and older, a normal resting heart is between 60 and 100 beats per minute (bpm), depending on the person's physical condition and age. The easiest places to measure heart rate are on the wrist and neck.

Blood pressure according to Moore (2011) is the amount of force that the blood exerts against the arterial walls. Blood pressure is determined by two factors – the volume of blood forced into the aoarta (cardiac output) and the resistance encountered by the blood as it passes through the vessels. It can be either monitored directly by cannulating an artery or indirectly by the arm cuff method sphygmomanometer. Morehouse and Miller (2011) revealed that during physical exercise, the cardio-respiratory system makes various adjustments to cope with the increased demand for blood flow to the working muscles.

Maximum oxygen uptake (VO_2max) was defined by Vercci (2012), as the highest oxygen consumption an individual can attain during physical work or exercise while breathing. Corretelli (2012) observed that oxygen consumption at the beginning of exercise seems to consist of a rapid initial increase. Age is a factor that may influence maximum oxygen consumption. According to Moore (2013), VO_2max decreases with age beyond twenty years, however, the peak may be maintained with exercise up to 25 years of age. Another variable is trunk flexibility which is a test for flexibility. The trunk flexibility at the lumbosacral joint is measured with a sit-and-reach test which is an excellent measure of trunk flexibility. It is usually selected because of its feasibility, reliability, logical validity and reported criterion-related validity (Moore, 2013). Muscular endurance as one of the variables is measured with a bent knee sit up which are used to test the local endurance of the abdominal muscles and also depends to some degree on the muscle strength. Body composition which is the proportion of the body fat to lean body tissue is located just below the skin. The skinfold test is used to

determine the body fat which is based on the relationship of subcutaneous fat to total lean body tissue and requires three skinfold measurement.

Circuit training is an important aspect of this study because it was used in the training programme. Circuit training programme consists of a number of "stations" where a given exercise is performed usually within a specific time. Once the exercise is completed at one station, the trainee moves rapidly to the next station, performing another exercise also within a prescribed time period. The circuit is completed once the exercise at all stations is performed. The exercise at the various stations consist mainly of weight resistance exercises but running, swimming, cycling, calisthenics and stretching exercises may also be included. WestCott (2013) stated that the stations in circuit training are usually placed in a circle to facilitate movement. He also added that circuit training needs to be continuous and rhythmical in order to benefit the heart and lungs as well as the muscles, and it is designed to accomplish many different training goals. Trainers and physical educators have in their armour different training methods that could be employed to achieve fitness. Matt (2009) listed the following methods: interval training, continuous training, circuit training and various modifications of these methods such as repetition, running, sprint training, speed play or fartlek training etc. whichever mode one decides to employ depends among other things on the desired goals. He also explains that circuit training helps women to achieve their goals and maintain them longer than other forms of exercise or diet.

According to Sorace (2010), many women suffer hypertension or have high blood pressure, obesity, stroke, heart disease, osteoporosis, etc. which has resulted in a lot of mobidity and mortality. Quinn (2014) stated that excess body fat may lead to obesity which increases the risk of getting these diseases. Due to technological advancements many of the domestic chores which exercise the body of the women have been taken over by time saving, energy usurping gadgets and devices. Unless the today's woman is physically fit, she can hardly cope effectively

with her role as a housewife, mother or professional or involve in successful money making ventures (American College of Sports Medicine - ACSM 2013). They concluded that it is imperative that these women should deliberately seek physical fitness by exercising their body at least two times a week. It is usually advocated that an exercise programme of moderate intensity done three to five times a week and lasting 40-60 minutes each session may be adequate in maintaining the physical fitness of an individual (Kirkendall 2008). It needs to be pointed out that the role of the teacher is of paramount importance in the education system because she is the custodian of knowledge and it is often said that the standard of education cannot grow beyond the level or standard of the teacher, so teachers cannot perform well in their job of teaching if they are physically unfit. To motivate children to be active is for the teacher to lead by example. A physically active and fit teacher is a positive influence. The working class women with routine of office work, especially teachers in secondary schools may not have as much time to devote for exercise. It is therefore necessary to look into ways of fashioning out beneficial exercise programmes of shorter duration for this group of people whose number is daily increasing and whose schedule is getting tighter. It now seems a problem for the physical educators and all those involved in physical training to solve, to see if an exercise regimen of moderate intensity but of short duration may be able to elicit acceptable improvements of physical fitness components. It is proper to reiterate that physical fitness programmes including tests, are basic in the area of physical, health education and recreation. Definite steps should be taken to ascertain the physical fitness of each teacher in our schools, because some of them seem to be out of shape and show laxity in teaching the students and doing other extra curriculum activities and to institute individual remedial and developmental programmes for those that require them, those who are not physically fit. Some individual physical needs cannot be known accurately and the same with the effect of the general physical fitness programme without tests and retests of individual themselves. It should also be noted that good physical condition is equally desirable for teachers in order to prepare them for strenuous tasks of teaching.

The researcher observed from our schools that some laxity in some teachers in executing their job of teaching both academically and in other various extra-curricular activities. This may be as a result of being physically unfit. This present research seeks to find out ways to improve the situation in order to fill the gap. Hence, the motivation for the researcher to study the effect of circuit training exercise programme on selected physical fitness components of female teachers in Anambra State.

Statement of the Problem

The advances that are seen in technology have simplified many physically demanding tasks which women carryout in their various homes. The problem which has been created by the advances in technology especially for women is that the technology products have usurped many of those physically demanding tasks which create the opportunity for women to exercise themselves thus limiting those opportunities through which women keep physically fit. Besides, many women are taking up white-collar jobs which require them to make more use of their intellectual energy and limited use of physical energy. The fact is that many women are taking up sedentary lifestyles which are closely associated with physical inactivity. The result of this is that many women run the risk of being affected by sicknesses that are associated with limited physical activity and exercise such as, heart attacks, high blood pressure, diabetes, etc. In some cases, people die from such cases which could have been averted with some level of exercise.

Apart from this, physically unfit teachers find it difficult to deliver on their tasks for which there are paid. Where teachers are unfit to deliver on their jobs of teaching, the students' achievements will be in jeopardy. There is no doubt that one who is physically fit stands a better chance to achieve one's goal and live a more productive life contributing very well to one's society. Therefore, the stated problem of interest the researcher intends to solve is by investigating effects which circuit training programme could have on physical fitness components of female secondary school teachers in Anambra State.

Purpose of the Study

The main purpose of this study is to find out the effects of circuit training exercise programme on selected physical fitness components of female secondary school teachers in Anambra State. Specifically, the study sought to find out:

- resting heart rate of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained.
- resting systolic blood pressure of female secondary school teachers who were trained with circuit training exercise programme and those not trained.
- resting diastolic blood pressure of female secondary school teachers who were trained with circuit training exercise programme and those not trained.
- maximum oxygen uptake of female secondary school teachers who were trained with circuit training exercise programme and those not trained.
- trunk flexibility of the female secondary school teachers who were trained with circuit training exercise programme and those not trained.
- muscle endurance of female secondary school teachers who were trained with circuit training exercise programme and those not trained; and
- body composition of female secondary school teachers who were trained with circuit training exercise programme and those not trained.

Significance of the Study

The findings of this study will be of immense benefits to teachers of physical education, sports trainers, exercise physiologist, physiotherapists and the general reading public. Teachers will benefit in this study, as the information from the result after the training when disseminated could enhance the performance of teachers in academics as well as in sports and physical activities, and would also encourage them to embark on exercises to keep fit.

Also the findings of this study will help sports trainers in making informed decisions as regards adopting circuit training in enhancing the physical fitness of girls interested in sports. Very busy Nigerians who cannot spare enough time for the regular physical activities will benefit from the study. The outcome of this study would be useful in designing circuit training programmes for the development of total fitness by exercise physiologist, physiotherapist and coaches, as it would reveal the effects of circuit training programme on the selected physical fitness components studied.

The findings of the study will help the public to know the importance of circuit training exercise in developing their physical fitness level and may also help individuals who are obese or who have coronary heart disease, stroke, hypokinetic conditions to ameliorate these conditions and their effects. The findings of this study will also encourage and motivate the participants and other females to take up habitual exercise as part of their lifestyle. Finally, the findings of this study may enrich literature in the field of exercise physiology and may also prove useful in establishing a reliable data for future research.

Scope of the Study

This study basically focused on the effects of circuit training programme on the selected physical fitness components of female secondary school teachers. The study is delimited to the following variables which are heart rate, blood pressure, maximum oxygen consumption, trunk flexibility, muscle endurance and body composition. The study is also limited to six government secondary schools from three local government areas in Otuocha Educational Zone in Anambra State. The schools are shown in the appendix A.

Research Questions

The following research questions were formulated to guide the study:

1. What is the difference in the pretest and post test mean of resting heart rate of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?
2. What is the difference in the pre-test and post-test mean resting systolic pressure of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?
3. What is the difference in the pre-test and post-test mean resting diastolic pressure of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?
4. What is the difference in the pre-test and post-test mean maximum oxygen uptake of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?
5. What is the difference in the pre-test and post-test mean trunk flexibility of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?
6. What is the difference in the pre-test and post-test mean muscular endurance of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?
7. What is the difference in the pre-test and post-test mean body composition of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?

Hypotheses

The following ten null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference in the mean resting heart rate of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP
2. There is no significant difference in the mean resting systolic pressure of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP
3. There is no significant difference in the mean resting diastolic pressure of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP.
4. There is no significant difference in the mean maximum oxygen uptake of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP.
5. There is no significant difference in the mean trunk flexibility of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP.
6. There is no significant difference in the mean muscular endurance of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP.
7. There is no significant difference in the mean body composition of female secondary school teachers who were trained with circuit training exercise programme (CTEP) and those not trained with CTEP.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This Chapter reviewed related literature that is relevant to the present study. The review was organized under the following sub-headings:

Conceptual Framework

- Physical fitness
- Cardio-vascular fitness
- Flexibility
- Body composition
- Muscular endurance
- Circuit training

Theoretical Framework

- Theory of Conditioning
- Theoretical Propositions of the Health Belief Model
- Theory of Reasoned Action

Theoretical Studies

- Heart Rate
- Blood Pressure
- Maximum Oxygen Consumption
- Trunk Flexibility
- Muscular Endurance
- Body Composition
- Circuit Training Exercises

Empirical Studies

- Circuit Training Exercise

Summary of Review of Related Literature

Conceptual Framework

Physical Fitness

Many scholars have written on the concept of physical fitness. United National Library of Medicine (2015), defined physical fitness as a state of well being in which performance is optimal, often as a result of physical conditioning which may be prescribed for disease therapy. According to United States Department of Health and Human Services (2011), physical fitness is a set of attributes that people have or achieve relating to their ability to perform physical activity. Physical fitness is a state of wellbeing with low risk of premature health problems, and energy to participate in a variety of physical activities (Rowley & Frank, 2010). Physical fitness is not entirely dependent on exercise. Mellion (2009) agreed that desirable health practices also play an important role it affects the totality of a person's intellect, emotional stability, physical conditioning and stress level. Also it is generally achieved through correct nutrition, moderate vigorous physical activity, exercise and rest (Malina, 2010). According to Pokins (2010), the human bodies have the ability to move with desired speed, balance, agility and strength gained through proper exercise and nutrition. Physical fitness is training for life. It's the body's ability to be able to withstand whatever life throws its way (Donald, 2012).

According to McGraw-Hill Concise Dictionary (2010), physical fitness is defined by exercise test tolerance to a standard treadmill protocol, which requires a cardio-vascular 'reserve' the degree to which a person meets or exceeds expected working capacity according to body weight. Mosby's Dental Dictionary (2014) defined physical fitness as the ability to carry out daily tasks with alertness and vigor, without undue fatigue and with enough energy reserve to meet emergencies or to enjoy leisure time. Chinder and Godfrey (2011), defined physical fitness as fitness to perform some specific task enquiring muscular effort, it should consider quality of effort as well as intensity of effort.

Fitness according to Hornby in Agbanusi (2014) simply means the condition of being physically fit. This presupposes good health as a result of physical exercise. Physical fitness combines good health and physical development. The object of any programme of physical fitness is to maximize an individual's health, strength, endurance and skill relative to age, sex, body build and physiology (Columbia Encyclopedia, 2010). According to mens-fitnessandhealth.com (2009), physical fitness is the ability to meet physical challenges whether related to work, sport, recreation, combat, or other life activities. A man's physical fitness specifies physical challenges he is likely to face. According to Healthgalaxy.com (2013), physical fitness is defined as the sate of general wellbeing, physically sound and healthy, along with mental stability.

According to Kennedy (2014), physical fitness is not only one of the most important keys to a healthy body it's the basis of dynamic and creative intellectual activity which is an important component of wellness. Physical fitness is specific to the individual and therefore, training to improve and to maintain it should be done regularly (Rippel, 2009). Gella and Brouha (2007) discussed physical fitness in terms of static or medical fitness, soundness of belly, organs dynamic or functional fitness, efficiency of body in strenuous work, motor skills fitness, co-ordination and strength in performance of activities. Dureton (2007) opined that the person who allows his physical condition to deteriorate robs himself of more than an attractive appearance, and such a person actually endangers his health.

According to Chanen (2011), physical fitness promotes good metabolic fitness, a state associated with reduced risk for many chronic diseases. Dishman (2012), opined that the road to physical fitness includes proper medical care, the right kinds of food in the right activity that is adapted to individual needs and physical limitations, satisfying work and study, health play and recreation, and proper amounts of rest and relaxation. Physical fitness is a state of physiologic wellbeing that is achieved through a combination of good diet, regular physical exercise, and other practices that promote good health (Stephens, 2014). He also stated that physical fitness is

a state of physical wellbeing and higher-than-average tolerance to cardio-vascular activity and also exercise test tolerance to a standard treadmill protocol, which requires a cardio-vascular reserve, the degree to which a person meets or exceeds expected working capacity according to body weight.

Paxen and Hallim (2011), viewed physical fitness as a state that allows each and every person to feel, look and perform well in every action they do. They also added that one can attain physical fitness through participation in any of the regular exercising programmes. People who are physically fit will be more confident in public places than others who are not fit (Spain, 2012). Health and Fitness Incorporated (2010) said that our body can be determined by checking our eating habit, way of living, type and amount of food we eat, the number of times we take food and physical exercise.

According to Harper (2013), physical fitness is the ability to physically and mentally do exactly what one wants to do and have the desire to want and help others do the same. Clark (2014) opined that physical fitness is having a healthy mind, body and spirit to allow an individual to maximize their potential and help others achieve same. He also said that being physically fit and healthy involves having a fit mind, body and spirit. Fitness is important to health and wellness as well as to the ability to engage in normal activities of daily living (ADL) without excessive fatigue (Sutton, 2013).

Blair (2009) stated that physical fitness keeps people in the exact frame of mind and boosts mental sharpness and concentration. Good fitness has been shown to be associated with reduced risk for chronic diseases, such as heart disease, and has been shown to reduce the consequences of many debilitating conditions (Rorbin, 2014). According to Fenberger and Bing (2010), good physical fitness contributes directly to the physical component of good health and wellness.

They also added that physical fitness is a result of regular physical activity, proper diet and nutrition, and proper rest for physical recovery within the parameters allowed by the genome.

Towin (2012) defined fitness as the ability to function efficiently in an active environment that suit the personal interest and goals. According to Green (2014), physical fitness is bringing oneself to a state of total balance. He further states that the main guidelines to achieving full overall fitness will be to increase strength physically, mentally, spiritually, emotionally, financially and also nutritionally. Bullock (2014) maintains that fitness is being fit for taking on challenges set in front of you. He further states that being physically fit is important so that one can handle the physical challenges life puts in front.

Green (2014), however, holds a contrary view and maintains that physical fitness is how well one is able to do all the physical tasks needed for each day. Physical fitness is a state of being in good physical condition and is different for everyone. Wicken (2014) in his own contribution, sees physical fitness as a freedom, fitness level is a balance of the body's ability to perform physically, the mind's ability to actively focus and think about the important aspects of life, and the spirit's ability to seek an ever improving lifestyle beyond the current state of being.

Cardio-vascular Fitness

According to Stephens (2014), cardio-vascular endurance is the ability to persist in a physical exertion without experiencing undue fatigue. He also added that cardio-vascular endurance is characterized by moderate contractions of large muscle groups for a relatively long time during which adjustments of the cardio-vascular system to the activity are necessary. According to Surgeon General Report on Physical Activity and Sports (SGRPAS, 2010), cardio-vascular fitness is a health-related component of physical fitness that relates to ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity. According to Kodama (2013), cardio-respiratory fitness requires delivery and utilization of oxygen, which is

only possible if the circulatory and respiratory systems are capable of these functions. According to Folscom Lake College, cardio-vascular endurance is how our body is able to supply fuel during physical activity *via* the body's circulatory and respiratory systems. They also opined that there are two parts of cardio-respiratory endurance, how efficient the heart and lungs are at delivering oxygen to the body and how efficient the body is at creating the ATP or energy your muscles need in order to contract. Cardio-vascular endurance relates to the ability of the circulatory and respiratory systems to supply oxygen to the body during sustained physical activity (Mata, 2014). Cardio-respiratory endurance is the ability of the heart and lungs to absorb, transport, and utilize oxygen over an extended period of physical exertion, it is also an important measure of the overall health and fitness (Wisegeek.org, 2013).

Contributing also to cardio-respiratory endurance, Scott (2014) maintains that cardio-respiratory endurance refers to the ability of the body to perform prolonged, large-muscle, dynamic exercise at moderate-to-high levels of intensity. Donatel (2010) opines that cardio-respiratory refers to the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. He also added that regular exercise makes these systems more efficient by enlarging the heart muscle, enabling more blood to be pumped with each stroke, and increasing the number of small arteries. The definition of cardio-respiratory endurance simply put is the body's ability to continue exertion while getting energy from the aerobic system used to supply the body with energy (Lemouse, 2015).

Lcyd-Jones (2010) is of the opinion that cardio-respiratory fitness can be defined as the ability of the respiratory circulatory and muscular systems to consume, distribute and utilize oxygen during continuous physical activity. BBC (2014) defined cardio-respiratory endurance as the ability of the heart and lungs to provide the working muscles with oxygenated blood for a prolonged period of time.

Flexibility

According to Gummerson (2013), flexibility is defined as the absolute range of movement in a joint or sense of joint that is attainable in a momentary effort with the help of a partner or a piece of equipment. Furthermore, this definition tells us that flexibility is not something general but is specific to a particular joint or set of joints. Flexibility in a joint is also specific to the action performed at the joint.

According to Massachusetts Institute of Technology (2013), flexibility is the range of movement across a joint. Flexibility is important because it improves the ability to link movements together smoothly and can help prevent injuries. Kovacs (2009) in his own terms defined flexibility as the amount of motion that is possible at a given joint or series of joint. A joint with limited ability to bend or straighten is said to be tight or stiff while joints with a high degree of flexibility are referred to as loose-jointed or hypermobile. Scott (2014) stated that flexibility is the range of motion in a joint or group of joints or the ability to move joints effectively. McArdle (2013) defined flexibility as being capable to break and/or usually without breaking or easily bent. Flexibility is defined as the ability to readily bend or twist the body with injury.

Topend Sports (2014) opined that flexibility is the capacity of a joint or muscle to move through its full range of motion. Study.com (2013) defined flexibility as the range of motion of the joint or the ability of the joints to move freely. They also added that it is the mobility of the muscles, which allows for more movement around the joints. Welk (2014) defined flexibility as the range of motion available in a joint. It is affected by muscles length, joint structure and other factors. According to U.S. Department of Health and Human Services (2011), flexibility is the ability to move freely through a full, non restricted pain free range of motion about a joint or series of joints. Brad (2015) maintained that flexibility is the movement of a joint through its full range of motion. He also added that flexibility exercises are also valuable in reducing general neuro-muscular tension and lower back pain.

According to Total Fitness Guide (2010), flexibility is a measure of the range of motion around a joint. It is limited by the physical structure of the joint including the bones, tendon, ligaments and muscles. Flexibility is highly adaptable, which means it can be increased and decreased with inactivity (Karen, 2011). According to Mc-Anthony (2013), flexibility is generally defined as a looseness or suppleness of a joint, more specifically; flexibility is the range and the extension of the movement of a joint. Wise Geek (2014) in their opinion defined flexibility as the ability of a joint to move through its fuel range of motion. They also added that attaining to a full range of motion is important, because they help reduce stress.

Body Composition

According to Mata (2014), body composition refers to the percentage of fat, bone muscle and organ mass in one's body. This is described as the percentages of fat, bone and muscle in human bodies (Fixon & Gibosn, 2012). According to Scott (2014), body composition is the body's relative amount of fat to fat-free mass, those with body composition are typically healthier, more efficient, and in general, feel better than those with less than ideal body composition. Body composition is the technical term used to describe the different body compartments (lean mass), fat mass, body water and bone mass that make up a person's weight (MRC Epidemiology Unit, 2011). Health practitioners universally agreed that too much body fat exposes one to serious health risks such as hypertension, elevated blood lipids, fats and cholesterol.

Kravitz and Heyward (2014) is of the view that body composition refers primarily to the distribution of muscle and fat in the body, and its measurement plays an important role in both sports and health. He also added that excess body fat may lead to obesity and increases the risk of getting many diseases. In sports, excess fat hinders performance as it does not contribute to muscular force production and it is additional weight that requires energy to move about. Buttin (2012) defined body fat as the percentage of body weight which is fat. Klafs and Artnhmn

(2010) opined that body fat is a dead weight. Karter (2013), a minimum level of fats is necessary to sustain body's biological functioning.

According to Dictionary.com (2014), body composition is the proportion of fat, muscle and bone of individual's body, usually expressed as percentage of body fat and percentage of lean body mass. Body composition refers to the make-up of lean tissue and fat tissue in the body, lean tissue is composed of muscle, bone and organs while fat tissue is composed of essential fat, storage fat and non-essential fat (Top end sports 2014). They also defined body composition as a special term used in physical fitness that measures the percentage of fat, muscle, water and bone found in the human body.

Muscular Endurance

Malaky (2010) defined muscular endurance as the ability of the muscles to apply force or to sustain contraction for a long period of time. He also added that it is the ability to persist in physical activity and to resist muscular fatigues. According to Dixie State University (2013), muscular endurance is the ability of a muscle to continue exerting force without tiring out. They also opined that muscular endurance training helps develop the slow twitch fibers in the muscles and can be improved by cardio-respiratory activities such as jogging, dancing and cycling. Matthew (2011), defined muscle endurance as the ability or capacity of a muscle group to perform repeated contractions against a load or sustained a contraction (Isometic) for an extended period of time. BBC (2014) said that muscular endurance is the ability of a muscle or group of a muscle, to work continuously for a long time without tiring. Muscular endurance refers to how long a person's muscles can repeat a physical activity before tiring (Top end sports, 2014).

Brown (2014) in his own contribution defined muscular endurance as the ability of a muscle or group of muscle to repeatedly exert force against resistance. Performing multiple repetitions of

an exercise is a form of muscular endurance, as in running or swimming contributing also on muscular endurance. Topend Sports (2014) defined it as the ability to repeat a series of muscle contractions without fatiguing. National Association for Sports and Physical Education (NASPE, 2013) defined muscular endurance as the ability to move the body or an object repeatedly without getting tired. Muscular endurance is the ability of a muscle to maintain a continuous contraction or repeatedly contract over a period of time (Mc-Anthony, 2013). He also believes that muscle endurance is to some degree dependent on muscle strength. Prokenpck (2012) defined muscular endurance as the ability of a muscle group to perform a series of dynamic contractions or to sustain a static submaximal muscle contraction repeatedly over a period of time. Exercise training enhances local muscle endurance. Astrand (2009) affirmed that the improvement of muscular endurance is a result of more abundant supply of blood to the muscles performing a particular work. Hyman (2010), corroborated this view when he asserted that there was a significant improvement in muscle blood flow as a result of training regimen of athletes.

Circuit Training

According to Kraviz (2011), circuit training is a form of body conditioning or resistance training using high-intensity aerobics building and muscular endurance. Dummies.com defined circuit training as a fast-paced class in which one exercises for 30 seconds to 5 minutes and then move on to another exercise. They further explained that it is like a game of musical chairs, where everyone begins at a station and when the instructor yells time; everyone moves to the next free station. According to Neporentor (2015), circuit training is a series of strength or cardio exercises (or both) repeated two or three times with little or no rest between sets. It is also a great boredom buster, moving quickly from one exercise to the next. Kathleen (2013) opined that circuit training refers to short bursts of resistance exercise using moderate weights and frequent repetitions, followed quickly by another burst of exercise for getting a different muscle

group. Comana (2014), defined circuit training as a high volume (repetitions), how resistance (weight) workout with short rest intervals and is geared primarily at improving muscle tone and definition while improving cardio-vascular fitness. Circuit training is a method of physical conditioning in which one moves from one exercise to another, usually in a series of different stations or pieces of equipment (American Heritage Dictionary of the English Language, 2011). Downey (2012), defined circuit training as one of the training methods in which a given number of exercise arranged and numbered consecutively in a given area. It is based on sound anatomical, kinesiological and physiological principles designed to increase strength, power, flexibility, quickness and cardio-vascular endurance. Parkey (2014), postulated that circuit training provides a strenuous workout entirely suited to an individual's specific needs, existing capacity and rate of adjustment to progressive vigorous exercise. According to Mary (2012), circuit training consists of the performance of high repetitions of an exercise with low … to moderate resistance, progressing from one station to another, performing a different exercise at each station. The stations are usually placed in a circle to facilitate movement.

Circuit Training Exercises: Kravit (2011) explains that exercise "circuit" is one completion of all prescribed exercises in the programme. When one circuit is complete, one begins the first exercise again for the next circuit. Homola (2010) stated that it is important to select basic exercises that cover all major muscle groups without overlapping the muscles.

Types of Circuit Training: Willker (2013), stated that circuit training can be totally customized, which means there are unlimited numbers of different ways circuit training can be structured. He enumerated different types of circuit training as:

Time Circuit: This types of circuit involves working to a set time period for both rest and exercise intervals. For example, a typical timed circuit might involve 30 seconds of exercise and 30 seconds of rest in between each exercise.

Competition Circuit: This is similar to a timed circuit but one has to one's self to see how many repetitions one can do in the set time period. For example you may be able to complete 12 push-

ups in 30 seconds. The idea is to keep the time period the same, but try to increase the number of repetitions one can do in the set time period.

Repetition Circuit: This type of circuit is great when working with large groups of people who have different levels of fitness and ability. The idea is that the fittest group might do, say 20 repetitions of each exercise, the inter mediate group might only do 15 repetitions while the beginners might only do 10 repetitions of each exercise.

Selecting the Proper Exercise: In selecting any circuit training programme, Homola (2010), stated that it is important to select basic exercise that covers all major muscle groups without over lapping the muscle action to the extent that premature fatigues prevents continuous activity. In circuit training, principles of overlapping and progression were stressed by Rockey (2012). He also observed that circuit training utilizes three variables of load, repetitions and time, and this places circuit training on an advantage over other training methods.

Principles of Organizing Circuit Training: The principles of overload is stressed by Rockey (2012), a progressive overload is built into the program of circuit training by increasing the time factor. Pius (2014) states that lower body exercise should be rotated with upper body exercise, so that while the arms are recovering, the legs are working. Twelve repetitions are performed on each machine. Igbanugo (2000), stated that circuit should consist of between 6 and 15 stations, and should consist of between 5 and 20 minutes to complete; usually each circuit is performed 2 to 3 times in one training session. Only 15 to 20 seconds rest is allowed between stations.

Theoretical Framework

It is very important scientifically and practically to recognize implicit theories that may be applied to this study for better understanding. This is because they powerfully enhance understanding of exercise and good health. By understanding both the subject area and the theoretical underpinnings of successful behaviour change, an outline for the intervention can then begin to take shape.

Theories of Conditioning

Classical Condition: Ivan Pavlov (1849-1936) was a Russian scientist. He came up with this theory called Pavlovian conditioning or respondent conditioning and this theory of classical conditioning had a profound impact on the understanding of human behaviour. It is a form of learning in which one stimulus, the conditioned stimulus or CS, comes to signal the occurrence of a second stimulus, the unconditioned stimulus or US. The US is usually a biological significant stimulus such as food or pain that elicits a response from the start. The CS usually produces no particular response at first but after conditioning it elicits the conditioned response C.R. Pavlov performed this experiment using dogs. He observed and recorded information about dogs and their digestive process. As part of his work he began to study what triggers dogs to salivate. The people who fed Pavlov's dogs wore lab-coats. Pavlov noticed that the dogs began to drool whenever they saw lab coats, even if there was no food in sight. He wondered why the dogs salivated at lab coats, and not just at food. He ran a study in which he rang a bell every time he fed the dogs and pretty soon just ringing a bell made the dogs salivate. Pavlov said the dogs were demonstrating classical conditioning. He summed it up like this: there's a neutral stimulus (the ball, which by itself will not produce a response, like salivation. There's also a non-neutral or unconditioned stimulus (the food) which will produce an unconditioned response (salivation). But if you present the neutral stimulus and the unconditioned stimulus together, eventually the dog will learn to associate the two. Think of an unconditioned response as completely natural and a conditioned response as something that we learn. Pavlov's method is very suitable for the acquisition of skills that require practice and conditioning that contain elements such as: speed, spontaneity, flexibility, reflexes, endurance and so on. Something similar is a researcher blowing the whistle signifying the end of one station in a circuit exercise; the athletes know what to do without having to think about it.

Operant Conditioning: This is sometimes referred to as instrumental conditioning is a method of learning that occurs through rewards and punishments for behaviour. Through operant conditioning, an association is made between behaviour and consequence for that behaviour. Skinner is regarded as the father of operant conditioning, but his work was based on Thorndike's law of effect-reinforcement. Behaviour which is reinforced tends to be repeated (i.e. strengthened), behaviour which is not reinforced tends to die out or be extinguished (i.e weakened). Skinner studied operant conditioning by conducting experiments using animals which he placed in a "Skinner Box" which was similar to Thorndike's puzzle box. The subject, a rat is kept in the box and becomes conditioned to press a bar by being rewarded with food pellets each time. Its early ran down movements caused it to press against the bar. The rats quickly learned to go straight to press the bar a few times of being put in the box. The consequence of receiving food if they pressed the lever ensured that they would repeat the action again and again. Positive reinforcement strengthens a behaviour by providing a consequence an individual finds rewarding. Laws of learning were categorized into three:-

Law of Effect: Once a connection is made, the strength of that connection is depended on what follows. A reward will strengthen that behaviour and a punishment will weaken the behaviour.

Law of Readiness: This law stipulated that if an organism has a state of readiness, making a connection will be satisfying and the animal will do things to maintain the connections. If the organism is not ready, the connection will become annoying and they will do things to eliminate it. This readiness however is not like reading readiness; it is more like preparation for action, a physical readiness. An example is when a participant prepares herself for action to start a circuit exercise and if she is not ready, the connection from one station to another may be disorganized.

Law of Exercise: Law of exercise relates to the strengthening connections through practice and weakening other connections through disuse. The laws of exercise have implications for the use of practice and concepts of forgetting. He later added to this law the importance of not simple practice but of practice followed by rewards. Example is when the female teachers who are the

participants in the study puts more effort in the practice of the circuit exercises because if they don't practice, they might be weak or even forget the exercises which will bring disconnection in the stations during circuit exercises.

Becker's Health Belief Model: The Health Belief Model is a psychological health behaviour change model developed to explain and predict health-related behaviours, particularly in regard to the uptake of health services (Janz, Nancy & Becker, 1984). The Health Belief Model was developed in the 1950's by social psychologists at the U.S Public Health Service and remains one of the best known and most widely used theories in health behaviour research (Carpenter & Christopher, 2010). The Health Belief Model suggests that people's belief about health problems, perceived benefits of action and barriers to action, and self-efficacy explain engagement (or lack of engagement) in health promoting behaviour. A stimulus, or cue to action, must also be present in order to trigger the health-promoting behaviour belief model are proposed to vary between individuals and predict engagement in health-related behaviours (eg. getting screened for a symptomatic diseases, exercising etc). The key variables of the HBM are as follows (Rosenstock, Strecher & Becker, 1994; Glanze, Rimer & Lows, 2002).

Perceived Severity: This refers to subjective assessment of the severity of a health problem and its potential consequences. Perceived seriousness encompasses beliefs about the diseases itself (e.g. whether it is life-threatening or may causes disability or pain) as well as broader impacts of the disease on functioning in work and social roles.

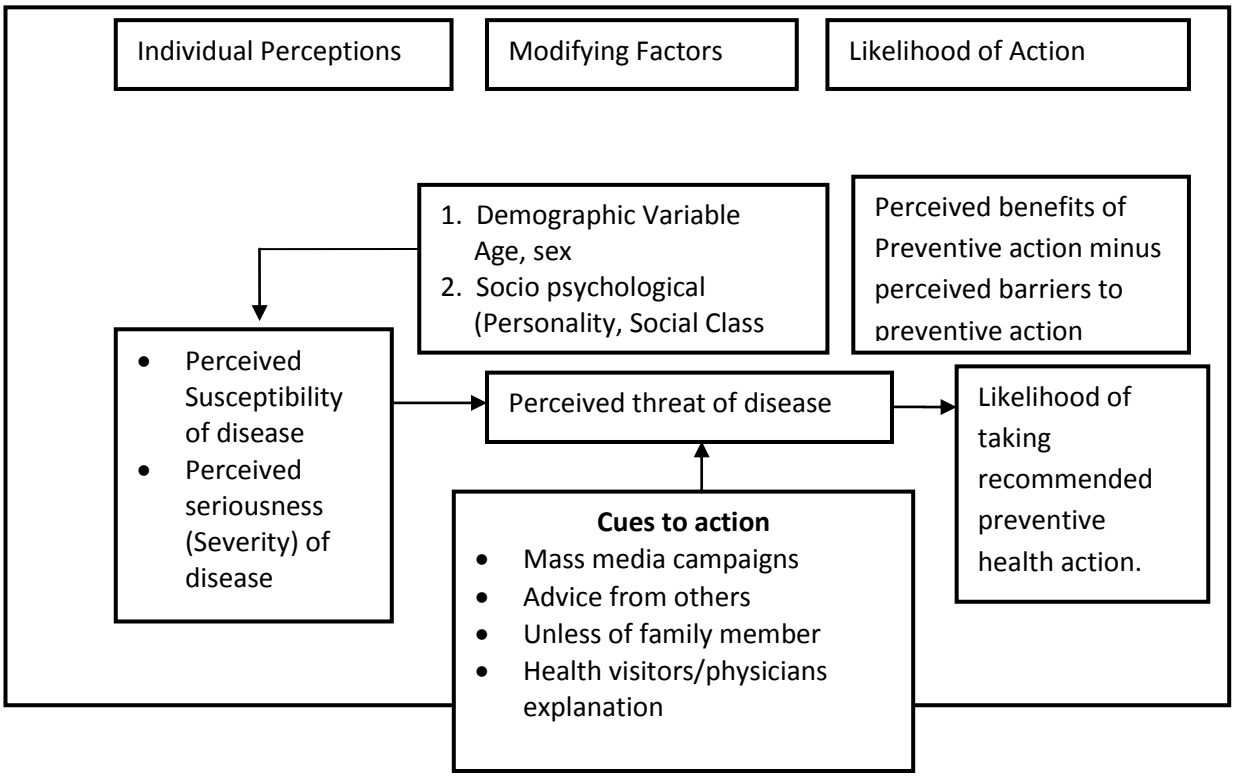
Perceived Susceptibility: This refers to subjective assessment of risk of development a health problem, ones subjective perception of the risk of contracting a health condition.

Perceived Benefits: This refers to an individual's assessment of the value or efficacy of engaging in a health-promoting behaviour to decrease risk of disease.

Perceived Barriers: The potential negative consequences that may result from taking particular health actions including physical, psychological and financial demands.

Cues to Action: The Health Belief Model posits that a cue or trigger is necessary for prompting engagement in health-promoting behaviours. Cues to action can be internal or external. Cues to action are an aspect of HBM that has not been systematically studied. The diagram shows the theoretical propositions of the health belief model describing how they are linked.

Theoretical Propositions of the Health Belief Model
(Rosenstock, Stretcher & Becker, 1994; Mariner & Raile, 2005).



In Janz and Juker (2007), theory has a major impact on the degree to which an individual will engage in regular physical activity. Beliefs such as perceived benefits of a particular behaviour and perceived threats posed by not engaging in a particular behaviour correlate significantly with preventive health behaviour. For example, perceived benefits of exercise might include improvement in physical appearance and long term health benefits, while perceived barriers might include committing the time and effort required to maintain an exercise programme. Going by these theories, the degree to which a female teacher will engage in regular physical activity like circuit training exercise will determine the rate of improvement or her ability to be physically fit.

Theory of Reasoned Action (TRA): The Theory of Reasoned Action advanced in the mid-1960's by Martin Fishbein and IcekAjzen, is based on the assumption that human beings are usually quite rational and make systematic use of the information available to them, and that people consider the implications of their actions in a given context at a given time before they make choices about whether to engage in a particular behaviour or not. The theory states that attitude toward behaviour subjective norms and perceived behavioural control, together shape an individual's behavioural intentions and behaviours. There is perceived control of one's behaviour, that is, a behaviour is under a person's conscious control. Decisions are made on a rational basis following a comparison of the benefits and drawbacks of adopting a new behaviour. Research using the Theory of Reasoned Action (TRA) has explained and predicted a variety of human behaviours since 1967. Based on the premise that humans are rational and that the behaviour being explored are under volitional control, the theory provides a construct that link individual beliefs, attitudes, and intentions. The theory variables and their definitions as described by Milter (2005) are of four components namely:

Behaviour: A specific behaviour defined by a combination of action, target, context, and time.

Intention: The intent to perform behaviour is the best predictor that a desired behaviour will actually occur. In order to measure it accurately and effectively, intent should be defined using the same components used to define behaviour: action, target, context, and time. Both attitude and norms, described below, influence one's intention to perform behaviour.

Attitude: A person's positive or negative feelings toward performing the defined behaviour.

Behavioural Beliefs: Behavioural beliefs are a combination of a person's beliefs regarding the outcomes of a defined behaviour and the person's evaluation of potential outcomes. These beliefs will differ from population to population.

Norms: A person's perception of other people's opinions regarding the defined behaviour.

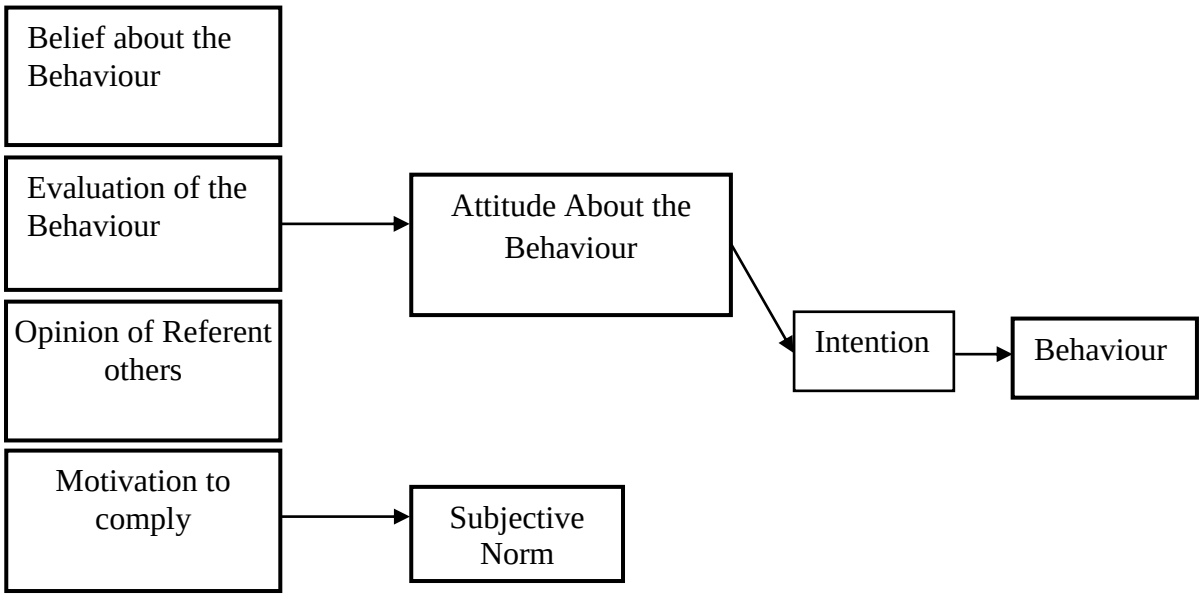
Normative Belief: Normative beliefs are a combination of a person's beliefs regarding other people's view of behaviour and the person's willingness to conform to those views. As with

behavioural beliefs, normative beliefs regarding other people's opinions and the evaluation of those opinions will vary from population to population.

Finally, as the authors of the TRA argue, a person's intention remains the best indicator that the desired behaviour will occur.

Montanw and Kasperzyk's (2002) reasoned action proposed that the main precursor of a behaviour such as exercise is the individual's intention to perform the behaviour. Milter (2005), has demonstrated the effectiveness of the theory of reasoned action in exercise settings; while the theory of reasoned action is a viable model for predicting exercise behaviour. Research had demonstrated that its predictive power is increased when personal control is added to the model. This theory therefore, advocates that female teachers who are to participate in the exercise put more effort and personal control and also individual attitude towards the exercise will bring positive outcome. Patterns of theory of reasoned action is drawn to show they are connected to one another.

Patterns of Theory of Reasoned Action (Fishben & Ajzen, 1991)



Theoretical Studies

Many scholars, sports experts, researchers, exercise analyst have expressed their view, opinions, suggestions or submissions on these variables which the researcher wants to look at in this present study are hereby reviewed:

Heart Rates

American Heart Association (2014) defined heart rate or pulse as the number of time the heart beats per minute which varies from person to person. Eastrand (2011) defined heart rate (HR) as the number of ventricular beats per minute as counted from the records of the electrocardiogram or blood pressure cuff. He also added that heart rate can easily be determined by auscultation with a stethoscope or by palpation over the heart, both at rest and during exercise. At rest, heart rate varies from one individual to another, from one observation to another, under similar circumstance in the same individual. According to American Heart Association (AHA) the easiest places to measure heart rate are on the wrist and neck, for adults 18 and older, a normal resting heart rate is between 60 and 100 beats per minute (bpm) depending on the person's physical condition and age. For children ages 6 to 15, the normal resting heart rate is between 70 and 100bpm. Gulati (2010) identified that the traditional male based calculation (220-age) over estimated the maximum heart rate for age in woman. They investigated the association between heart rate response to exercise testing and age with 5437 women. It was found that mean peak heart rate for women = (206-0.88x ages). Studies have shown that HR max on a treadmill is consistently 5 to 6 beats higher than a bicycle ergometer and 2 to 3 beats higher on a rowing ergometer. Deviries (2011) in his studies pointed out that all other things being equal, the physically fit or athletically trained person has a lower heart rate both at rest and at a given submaximal exercise workload. Studies have shown that the resting bradycardia (decreased heart rate) resulting from training is most evident when athlete and non-athlete subjects are compared and less evident when sedentary subjects undergo training, and least distinct when athletes are

studied in the untrained versus the trained state (Frick, 2013). Chase (2015) showed that in healthy, previously sedentary middle–age and older men strenuous and prolonged endurance trained, elicits small reductions in heart rate at rest, may increase cardiac vagal tone at rest does not alter arterial bar reflex control of heart rate. Achten (2013) in his studies stated that increase Heart Rate Variability (HRV) has been associated with lower mortality rate and is affected by both age and sex. He also stated that during graded exercise, the majority of studies show that HRV decreases progressively up to moderate intensities, after which it stabilizes.

There is abundant evidence from cross-sectional studies that trained individuals have higher HRV than untrained individuals. The results from longitudinal studies are equivocal with some showing increased HRV after trained but an equal number of studies showing no differences. The American Heart Association (2011) in their studies states that exercise helps the heart, both by improving exercise capacity and reducing the risk of heart disease and premature death. In addition, in their studies they reported that people with heart disease can gain important benefits from exercising, though they need medical clearance and special precautions. Sultan (2010) in his studies found out that a slower beating heart is more efficient, requiring less oxygen than the faster beating heart at the same cardiac output level. This allows the trained person to perform any given exercise task at lower level of external cardiac work than previously.

Blood Pressure

This is the process exerted by circulating blood upon the walls of blood vessels. When used without further specification, blood pressure usually refers to the arterial pressure in the systematic circulation (Lanian & Maikris, 2010). Blood pressure according to Moore (2013) is the amount of force that the blood exerts against the arterial walls. It is generated by the heart as it contracts and is maintained by the elasticity of the arterial wall (Parkey, 2014).

Blood pressure can be either monitored directly by cumulating an artery or indirectly by the arm-cuff method (sphygmomanometer); although, the results obtained by the arm-cuff method are accurate, it has become the standard method of blood pressure measurement the word over (Green, 2009). He also contributes that blood pressure is expressed in two values – systolic (higher and numerator) and diastolic (lower and denominator) blood pressure. The systolic pressure is the pressure in the arteries when the heart's contraction forces a large volume of flood into the arteries. This creates high pressure which forces the systole, the arteries recoil and the pressure reached is referred to as diastolic pressure. According to Mc-Anthony (2013), normal blood pressure is considered to be 120/80mmHg in adult. Systolic blood pressure of 140 to 160 millimetres of mercury mmhg or diastolic blood pressure of 90 to 95mmHg is considered borderline hypertension. He also stated that systolic diastolic blood pressure of 96 mm hg or greater is diagnosed as absolute hypertension. The higher the blood pressure the greater the likelihood of coronary heart disease. Arajas and Flaubert (2011) in the study Grounded Theory Hypertension Control, uses it to generate a substantive theory that describes and explains the problem of high blood pressure control among patients. The main purpose of this qualitative research was to determine the essential structure of high blood pressure control in hyper-intensive population and to identify a theoretical explanation for this problem. Lack of knowledge, lack of effective caring relationship and necessity of partnership were identified. Based on these processes, a partnership care theory was developed which provides an appropriate context for the active participation of patients, nurses and physicians in the control of hypertensive disease.

Moore, House and Miller (2011) revealed that during exercise the cardio-respiratory system makes various adjustments to cope with the increased demand for blood flow to the working muscle groups such as running, the total peripheral resistance is decreased, therefore increase in blood pressure may be due entirely to increase in cardiac output. Guyton (2009) in his studies

stated three effects that are essential for the circulatory system to supply the tremendous blood flow required by the muscles. These effects include mass discharge of the sympathetic nervous system throughout the body with consequent stimulation effects on the circulation, increase in cardiac output and increase in arterial pressure. He further stated that when a person performs the whole body exercise in arterial pressure is usually only 20 to 40mmHg, suggesting that the lack of a tremendous rise in arterial pressure results from the vaso-dilation occurring in large muscle masses.

Matthew (2011) reported in his study Variation in Blood Pressure, during an isotonic and isometric exercise that it is dangerous to combine isometric contractions with high loading exercises particularly where high workloads are contradicted as the cardiac rehabilitation exercise or in condition programmes for older adults. He documented certain conclusions about the effects of exercise on blood pressure; in epidemiology surveys, men in physically active occupation had lower systolic and diastolic blood pressure than those identified as unfit. There were improvements in terms of decreased blood pressure of post coronary patient as a result of aerobic type training over a period of three to eight months while matched control groups did not improve; the effects of exercise on the blood pressure of hypertensive individuals are greater than for those with blood pressure with normal range.

Several studies have investigated the relationship between blood pressure and physical activity. Montage, Guber, Cunningham and Dinka (2012) in the Tecumseh study found both systolic and diastolic blood pressure levels to be lower in most active men. Kuper (2010) also reported that systolic but not diastolic blood pressure levels were inversely related to physical fitness in Dallas referrals while Blair (2009) found that low physical fitness level was associated with a high risk of development of hypertension in Dallas referrals.

Maximum Oxygen Uptake (VO_2max)

Maximum oxygen uptake was defined by Clement and Withers (2010), as the maximum rate of oxygen consumption as measured during incremental exercise. They also opined that maximal oxygen consumption reflects the aerobic physical fitness of the individual, and is an important determinant of their endurance capacity during prolonged sub-maximal exercises. Verci (2012) defined maximum oxygen uptake as the highest oxygen consumption an individual can attain during physical work or exercise while breathing air at sea level. Oxygen is used by all cells for oxidative processes in the metabolic changes from which energy is derived and hence supports life and whenever more energy is required; metabolic is increased and hence the need for oxygen is correspondingly increased (Sinning, 2010). Corretali (2012) in his studies observed that oxygen consumption at the beginning of exercise seems to consist of a rapid initial increase. The initial increase is due to changes in the physiology of the body at the start of the exercise, such changes include; changes in alveolar ventilation, changes in the gas concentration in mixed venous blood. Nissen–Meyer (2010) was of the opinion that maximum oxygen uptakes vary consideration from individual to individual, well trained individuals and athletes in endurance events are characterized by high maximum oxygen consumption. The adjustment of the rate of oxygen uptake to varying metabolic needs of the working muscles of the athletes is necessary for efficiency of performance during physical activities (Devries, 2011).

A study by Verma, Sidhu and Kansel (2009), on maximum oxygen uptake and heart rate during work and recovery states that high negative values of between VO_2maxkg body wt./min and VO_2max1kg lean body mass 1min. are found to play an important role in influencing recovery of heart rate. Age is another factor that may influence maximum oxygen consumption. According to Moore (2011), VO_2max decreases with age beyond twenty years, however, the peak may be maintained with exercise up to 25 years of age.

Sultan (2010) found out in his studies that a 19% increase in VO_2max following in middle aged men than older men after a 10-week physical conditioning is attribute to an enlargement of the maximal oxygen delivery by the greater cardiac stroke volume (Clausen, 2009). Hickson (2005) stated that exercise frequency duration and intensity have been established as essential components in promoting adaptive response of training. Intensity is considered the most essential of these variables in stimulating maximum gains in aerobic power in both interval and continuous types of training. Exercise prescription is usually at a specific percent of the maximal exercise heart rate (HRmax). Benneth and Dudley (2013) in a study using an exercise intensity of 85-90% of maxVO_2 founded an increase of 32% in VO_2max in both relative and absolute terms following a seven week endurance programme in their subjects.

Conversely, Orlander (2010) founded only on 11% increase in aerobic power following 12m weeks of training using an exercise of low intensity (40-50 maxVo2). Klafs (2009) in his study documented that the more physically active a person is, the higher his max VO_2 per kilogram of body weight. He also stated that the aerobically trained person is able to establish a steady state oxygen consumption at higher rate of work because of his greater mechanical efficiency in performing the required task, this permit him to do more work with lower energy expenditure or oxygen consumption. Hermansen (2012) reported differences in maxVO_2 and maximal team endurance trained athletes' regional level equivalents. Dorri (2011) reported that long distance runners had a larger VO_2 max than middle distance runners who in-turn had larger maxVO_2 than short distance runners. Consequently, tasks have been developed which estimate maxVO_2 from physiological responses to sub maximal exercise. The most popular methods of sub maximal testing has been those which predict maxVO_2 by extrapolation from the liner relationship between sub maximal oxygen uptake and heart rate values during work. The basis for this prediction rests on the assumption that heart rate is nearly related to oxygen consumption (Fitched, 2013).

Trunk Flexibility

Flexibility is the ability to move a part or the body in a wide range of movement. The requirements of flexibility vary from sports and tend to be developed specifically, as a result of the imposed demands of particular activities (Devries 2011). He also suggested certain components of the body that set the limits of flexibility, namely; bony structure as in elbow and knee. The sit and reach test is the most popular device used in measuring the trunk flexibility because of its feasibility, reliability, logical validity and reported criterion-related validity Mc-Ardle (2013). Scot (2014) indicated that subjects with outlying ratios of arm length to leg length or a combination of trunk and arm length to leg length are affected with predictable results.

Thacker, Gilchnist, Stroup and Kimsey (2014) in their studies observed that flexibility training may help older adults preserve the range of motion they need to perform daily tasks and other physical activity. Nelson, Rejeski and Blair (2013) stated that the American Heart Association recommends that healthy adults engaged in flexibility training two to three days per week, stretching major muscle and tendon groups. According to Hendrick (2012) increased flexibility may increase one's performance through improved balance and reaction time. He also stated that training and the development of physical fitness is essential to successful physical performance. Naiman (2010) stated that regular stretching exercise promotes flexibility – components of fitness that permits movement, contributes to ease and economy of muscular effort, allows for successful performance in certain activities, and provides less susceptibility to some types of injuries or musculo-skeletal problems.

Muscular Endurance

This is the ability of, or capacity of a muscle group to perform repeated contractions against a load or sustain a contraction (isometric) for an extended period of time (Matt, 2009). He also stated that muscular endurance is the opposite of muscle fatigue and that a muscle that fatigues easily has a low endurance capacity.

Astrand (2009) affirmed that the improvement of muscular endurance is as a result of more abundant supply of blood to the muscles performing a particular work. Hyman (2010) corroborated this view when he asserted that there was a significant improvement in muscle blood flow as a result of the training regimen of college swimmers. This shows that improved peripheral circulation, by virtue of improved vascularization of active tissues, is one of the most important mechanisms in the development of improved muscular endurance levels.

Johnson and Risher (2011), stated that muscular endurance will contribute to improved performance in instances, in which fatigue is a limiting factor; increased muscular endurance postpones the onset of fatigues. Lorme (2013) maintained that high resistance – low repetition exercise builds powerful muscles whereas low resistance – high repetition exercise produces the quality of endurance. Studies show that circuit training helps women to achieve their goals and maintain them longer than other forms of exercise or diet (Heavin, Gary, Colman and Carol, 2012).

Body Composition

Body composition refers primarily to the distribution of muscle and fat in the body and its measurement plays an important role in both sports and health. Excess body fat may lead to obesity and it increases the risk of getting many diseases. In sports, excess fat hinders performance, as it does not contribute to muscular force production and it is additional weight that requires energy to move about (Ouinn, 2014). Young and Evans (2010), stated that participants about training added some pounds of lean weight lost four pounds of fat weight, increased their resting metabolic rate by seven percent and increased their daily energy requirement. According to Flegal (2010), health risks associated with overweight are greatly reduced by regular physical activity and reasonable levels of cardio-vascular fitness. The findings consistently show that active people with high BMI levels are at less risk than inactive people with normal BMI levels. Circuit training can improve the body composition, or the

percentage of the total body weight. Heck (2011), observed that body fat percentage is aversely proportional to maximum oxygen consumption. This means that individuals with lower body fat seem to be able to utilize more oxygen at maximal work, resulting in improved performance.

Empirical Studies

Circuit Training Exercise

Many studies have been carried out on circuit training exercise though none to the best knowledge of the researchers have tested the effect of the circuit training exercise on selected physical fitness components of secondary school teachers in Anambra State. Some of these studies are hereby reviewed.

Gotshalk, Berger and Kraemer (2011) conducted a study on cardio-vascular responses to high-volume continuous circuit resistance training. Eleven college males who had completed a minimum of 11 weeks of a beginning resistance training program volunteered for this study. Testing included strength and cardio-vascular fitness assessments. Following standardized procedures, each subject performed a 1RM lift on the following 10 exercises. A week after the strength and cardio-vascular testing, subjects completed the circuit training protocol where oxygen uptake and heart rate were measured during 5 circuit of the 10-exercise protocol. Subjects performed 10 repetitions of each exercise at 40% of their measured 1RM. After the entire workout, physiological data was collected five times during the 5 circuit after completion of 0.6 circuits (2.32 average minutes), 1.6 circuits (6.24 average minutes) and 2.6 circuits. The result of the study shows that the treadmill maximal test provides important maximal VO_2 and HR data from which the physiological measures during the circuit performance can be evaluated. It is consequential to note that all subjects followed the same circuit sequence but started the circuit at different points.

Wevers (2009) in his study, effects of task-oriented circuit class training on walking competency after stroke aimed at the systematically review of randomized, controlled trails of task-oriented circuit class training on gait and gait–related activities in patients with stroke. A computer aided literature search was performed to identify randomized, controlled trails in which the experimental group received task-oriented circuit class training focusing on the lower limb. The methodological quality of each study was assessed and studied with same outcome variable were pooled by calculating the summary effect sizes using fixed or random effects models. The result shows that the meta-analysis demonstrated significant homogenous summary effect sizes in favour of task oriented circuit class training for walking distance (0.43; 95% C1, 0.17 + 00.68, $p < 0.001$), gait speed (0.35, 95% C1, 0.08 + 00.62, $p = 0.012$) and a timed up–and–go test (0.26, 95% C1, 0.00 + 00.51, $p = 0.047$). Along significant summary effect sizes in favour of task-oriented circuit class training were found for the step test and balance control. In conclusion, this meta-analysis supports the use of task-oriented circuit class training to improve gait and gait-related activities in patients with droomic stroke.

Overtusf and Kravitz (2010) in their study, circuit training versus periodized resistance training in women. The purpose of this recent investigation was to determine the training adaptations associated with low-volume circuit type weight training versus a periodized high volume resistance training programme on muscular fitness and performance in women. Thirty-four women with an average age of 23 years were chosen to participate in the 6-month study. All of the women were considered active but untrained in resistance exercise. The result of this study shows that both a single set circuit training programme and a periodized multiple-set programme will increase muscular performance in untrained woman, thus, both have validated usefulness in resistance training design. It is important to observe from this study the result of how volume of exercise and training variation play a vital role in the modulation of the exercise stress and recovery patterns, which ultimately leads to greater muscular adaptations.

A study was conducted by a Brazilian researcher – Ballantyne (2015), who assigned subjects to a 12-week training programme. One group served as an inactive control group, a second group performed aerobic exercise three times per week (35 minutes at 70 percent of maximal heart rate) and a third group did circuit training three days per week. The results showed a similar improvement in peak aerobic exercise performance for both training groups, but only the circuit training group performed better. Miller, Pearley, Cahill and McCarthy (2014) in their study conducted the effect of a short-term high intensity circuit training programme on heart rate. Eight women completed a-four-week high intensity circuit training consisting of three 30minutes exercise sessions per week, for a total of 6 hours of exercise. Participants' heart rates were measured before and after exercise. Data were analyzed by paired t-tests and one-way ANCOVA. With repeated measures, statistical significance was set to $p < 0.05$. Data analyses revealed significant ($p < 0.05$) improvements in resting heart rate (HR).

A study was carried out by Paoli, Parelli, Moro, Marodin and Bianco (2013), on the effects of high intensity circuit training, low-intensity circuit training and endurance training on blood pressure. Fifty participants' age 61 $\pm$ 3.3 years, BMI 29.8 $\pm$ 0.9 were randomly assigned to one of the three exercise treatment groups. The three groups exercised three times per week, 50 minutes per session for 12-week. Their blood pressure was measured. The results showed significantly higher reduction in systolic blood pressure. The findings indicate that high-intensity circuit training is more effective in improving blood pressure than endurance training alone.

Pesce, Crova, Cereatti, Casella and Belluec (2012), composed two forms of aerobic exercise of equivalent aerobic intensity. During one session, preadolescent children (aged 11-12) completed one hour of individual circuit training and during another session completed one hour of aerobic group games. Unlike other studies, the children's motor activity was categorized in order to provide information about the social and cognitive interactions for each form of exercise

(however, the author provided no specific description of either exercise), whereas circuit training contained more opportunities to learn motor skills; also the circuit training consisted solely of individual activity and the group games consisted roughly of equal parts individual activity and group activity. After each session, the children completed a list–learning procedure to assess both immediate and delayed word recall. The result shows that only the acute bout of group aerobic games enhanced memory relative to baseline memory performance; both forms of exercise benefited memory performance.

Klika and Jordan (2013) conducted a study on high-intensity circuit training using body weight, to understand the health benefits and practical application of a high-intensity circuit training exercise protocol. The circuit training protocols called for 9-12 exercise stations. Participants can assess absolute intensity by monitoring their heart rates either manually or with heart rate monitors during exercise. Research has demonstrated that improvement can be made in Vo_2max and insulin sensitivity in as little as 4 minutes of total exercise time in an HICT session. However, it is to be noted that the result often requires working at intensities equivalent to greater than 100% of VO_2max. The result of the study shows that HICT seems to be an efficient means of exercise to help decrease body foot, improve insulin sensitivity and improve VO_2max and muscular fitness. As the hectic of today's corporate world continues to infringe on the amount of time individuals have for exercise, these types of programmes can offer a good option to help busy individuals to improve their health and recover from stress *via* exercise. Baylor University and the Cooper Institute show that circuit training is the most time efficient way to enhance cardio-vascular fitness and muscle endurance. Studies show that circuit training helps women to achieve their goals and maintain them longer than other forms of exercise or diet (Heavin & Canol, 2014).

Morgan and Anderson (2012), claimed that a profound findings on this study from a health perspective is that an investigation clearly showed that performance of this circuit exercise level

is the intensity elicited from oxygen consumption values (39% to 51.5% of VO_2max) that meet established guidelines of the American College of Sports Medicine (ACSM, 2010), for the recommended intensity (40% to 85% of Vo_2max R) of exercise for developing and maintaining cardio-vascular times. The National Strength and Conditioning Association (2014) opined that physical fitness in the fire service – A novel approach to exercise training at the fire station utilizing fire fighter equipment. Specifically, the study will review empirical data demonstrating the effectiveness of this programme, describing how this method can be implemented as part of a circuit training programme, specifically, the investigation evaluated the efficacy of a 12-week circuit–based training intervention in fire fighters that primarily utilized fire service tools and apparatus. Fire fighters trained two days per week for 60 minutes per exercise session.

The result of this study indicated that the novel training program improved the fire fighters' aerobic capacity, body mass index (BMI) and performance on a simulated fire ground test. Circuit training (with fire fighter equipment) has been reported to be an appropriate training method, as it places similar physiological demands on the body when compared to on-the-job fire fighting tasks.

Dunne (2014) in his study, Oregon Circuit Workouts Big Bang for your Training Buck portrayed a case study of a Marathon Runner in his late 30s; Matt who wanted to overcome a pattern of reoccurring running injuries (knee and calf). A 12-week programme with an additional 4 weeks more relaxed preparatory block was administered to him. This preparatory block entailed: 1x Oregon circuits session, 1x Oregon session, 1 x 30-45 minutes fartliek session, 1x longer steady run. In his own words, this preparatory block left him feeling the strongest, he had ever felt going into a marathon training block. There was increase in Matt's long runs over 16 weeks and added appropriate training volume during the 12-week focused training block. The cumulative training load on his body in the last few weeks pre-taper was less likely to see him get sick or injured; compared to before. This worked well in Matt's case and also Oregon

circuits workouts where maintained weekly. The loosely structured 4 weeks preparatory block and the Oregon circuit held within played a big part in Matt's success.

Marx, Ratamess, Nindl, Gotshalk, Volek, Dohi *et al* (2011), portrayed that circuit training versus periodized resistance training in women reviewed 24-week study. The physiological adaptations of a single set circuit training design were compared to a periodized multiple-set programme in an untrained group of women. Thirty–four women with an average age of 23 years were chosen to participate in the 6 months study; all the women were considered active, but untrained in resistance exercise. Testing was conducted on three different occasions throughout the 24-week period. Before the initiation of training (T1), after 12-week of training (T2) and at the end of the six months period (T3), muscular strength, muscular endurance, anaerobic power and body composition was tested. They were later trained with single set circuit (SSC) and periodized high-volume multiple set (MS). The control group did not participate in resistance training. The result showed that the present study demonstrates that a 6-month high volume (periodized multiple set) resistance training programme will have a greater effect on muscular fitness, performance and body composition when compared to a low volume (single set) circuit programme. The MS group had a much greater increase in 1 -12m bench when compared to the SSC group. The MS group showed a greater decrease in per cent body fat (25% vs. 10%) and a higher increase in fat free mass (8% vs. 2%) than the SSC group. The result also shows that both a single set circuit training programme and a period multiple set programme will increase muscular performance in untrained women, thus, both have validated usefulness in the resistance training design.

Balachandran (2011) in his work on Can Circuit Training Increase Strength and Muscle, the main purpose of the study was to study the effect of circuit training with heavier loads 6 (reps) on body fat, strength, muscle, cardio-vascular response compared to a traditional routine. The population of the study was made up of 20 men and the duration was 8 weeks. The traditional

group did same number of exercises separated by 3 minutes rest while the circuit showed that with just 35 seconds rest, circuit training group had similar power, strength increase compared to the traditional training group. There was a decrease in body fat and an increase in body fat of the both groups. The decrease in body fat was only significant in the circuit training group, though, both groups improved in aerobic and anaerobic tests. Circuit training with heavier loads can increase strength and muscle similar to traditional routines and also can cut the workout time by almost half.

Ucan (2014), conducted study on effects of circuit resistance training on body composition and bone status in women, the purpose of the study was to determined the effects of circuit type resistance training on body composition and bone status in women. Twenty-eight moderately active women volunteers were randomly assigned to 12 weeks of circuit resistance training (CRT) of n = 15, 24.3 + 1.4 years) or control (C) of n = 13, 24.8 + 2.1 years). At the end of the 12–week training period, there was a decrease ($p < 0.5$), an increase in FFM (1.46 kg) and no change ($p > 0.5$) in body weight or BND. In C, no significant ($p > 0.5$) changes were observed. Circuit resistance training bone mineral density values were significantly ($p < 0.5$) higher ($.003 gkm^2$) after the 12-week training period versus the control group values ($.005 gkm^2$). The result suggested that 12-week of circuit resistance training in moderately active young males had a positive effect on body composition and bone status with no effect on body weight.

Ferreira, Medeions, Nicosia *et al* (2010) conducted a study on 14 Sedentary Females (33 - 45 years old) using a 10–week, 3 days per week circuit resistance training (CRT) programme for body composition. No significant changes were found in waist circumference and waist to hip ratio. The result suggested that CRT increased FFM and decreased FM and BF percentage. Brown and Wilmore (2011) conducted a similar research in which 7 female national throwers (aged 16 -23) engaged in resistance exercises for six months, three days per week. At the end of the six-month period, all showed a considerable gain in strength with no change in body weight

or BF percentage. These studies were related to the present study because they were concerned with determining the effect of circuit training on physical fitness components and trying to help in solving many problems associated with, not indulging in exercise and hypokinetics diseases.

Summary of Reviewed Literature

This Chapter reviewed literature that is relevant to this study which was based on conceptual and theoretical framework, theoretical and empirical studies. Conceptual framework was reviewed based on the concepts of physical fitness, cardio-vascular fitness, flexibility, body composition, muscular endurance and circuit training. The review examined types of circuit training, the proper exercise for circuit training and principles of organizing circuits training. Theoretical framework was also perused. They include; theories of conditioning which emphasizes conditioning on a particular stimulus which will later elicit a better response, the Becker's Health Belief Models which has a major impact on the degree to which an individual will engage in regular physical activity and theory of reason action which emphasizes that individual's attitude towards exercise will bring positive outcome.

Accordingly, there was overview of the theoretical studies on variables used in the study; they are heart rate, blood pressure, maximum oxygen uptake, flexibility, muscular endurance and body composition. Many scholars, sports experts, researchers, exercise analyst have expressed their views, opinions, suggestions and or submission on the variables. It was observed by the researcher that literature on all these variables show that the trained person performs better than untrained. These studies also report that people benefit from the exercise programmes. Equally consulted were the empirical studies on circuit training exercises. Some of the studies reviewed emphasizes that the use of the task-oriented circuit training exercise improves activities in patients with chronic stroke. Some found out that it is important to observe that the volume of exercise and the training variation play a vital role in the modulation of the exercise which ultimately leads to greater muscular adaptations. However, some of the studies on high intensity

circuit training using body weight seem to be an efficient means of exercise to help decrease body weight. These studies are related to the present study because they were concerned with how circuit training affects different variables.

It was observed by the researcher that circuit training has been an issue of extensive research over the years. More of these concentrated on students, industry, workers among others; few were on the secondary school teachers as their subjects. There was no literature on the effects of circuit training exercise programme on female secondary schools in Anambra State. This gap in the literature is what the researcher intends to address. Specifically, the study tried to find out the effects of circuit training exercise programme on the selected physical fitness components of secondary school teachers in Anambra State of Nigeria.

CHAPTER THREE

METHOD

This Chapter discusses the methodology used in carrying out this research. It is presented under the following subheadings: Research Design, Area of the Study, Population of the Study, Sample and Sampling Techniques, Instruments for Data Collection, Validation of the Instrument, Pilot Study, Method of Data Collection as well as Method of Data Analysis.

Research Design

The research design used for this study was the randomized pre-test and post-test control group design, utilizing a 2 x 2 factorial design, where two groups of subjects are involved; the control group and experimental group. This design is appropriate for this study because it is a true experimental research design (Thomas & Nelson, 2001). This design also provides the avenue through which differences can be checked and changes frequently studied (Kelniger, 2000), because it has an advantage over the post-test only, design where no control is used. The diagrammatic presentation of the design is shown in Table I.

Table 1: **Design of the Study**

Group	**Pre-Test**	**Training**	**Post-Test**
Experimental Group	**O_1**	**X**	**O_2**
Control Group	**O_1**	**_**	**O_2**

Symbols:
X – Training
O_1 – Pre-test
O_2 – Post-test

Area of the Study

The study was conducted in Anambra State which is one of the thirty-six (36) States of Nigeria, and is situated on a generally low elevation of the Eastern bank of the River Niger. Anambra State was created on 27th day of August, 1991, out of the old Anambra State with 21 Local Government Areas, three Senatorial Zones, Six Educational Zones and 177 Communities. The State shares common boundaries with Abia and Imo States by the South, Delta State by the West, Enugu State by the East and in the North with Kogi State. It is known for its industrial centres and markets with about 75 per cent of the population involved in agriculture. Anambra is located in the South-East Zone of Nigeria. The position of the State makes it a focal point for transport and trade in Nigeria. Its biggest market is Onitsha Main Market which attracts traders from other States and other West African countries.

Specifically, the study was carried out in Otuocha Educational Zone of Anambra State. It consists of Anambra East, Anambra West and Ayamelum Local Government Areas, and they are mainly farmers and fishermen. They are regarded as the food basket of the State.

Population of the Study

The population of the study consists of all the female secondary schools teachers in Anambra State, whose population is about 5,975 (Department of Planning, Research and Statistics Post Primary School Service Commission Headquarters, Awka, 2015).

Sample and Sampling Techniques

The sample size of this study was 60 randomly selected participants within the age bracket of 25 - 45. The reason for selecting this group and age bracket is that they are those that can resist or perform the exercise that was involved in the study.

Firstly, purposive sampling technique was used to select two secondary schools each from the three Local Government Areas in Otuocha Educational Zone making it six (6) schools. These three local governments have been purposively selected because of its accessibility to the researcher for monitoring and supervision of the exercise programme. Secondly, simple random sampling techniques were used to draw 10 female teachers each from the six schools, making it a total of 60 female teachers. After the sample random sampling, the teachers satisfied the inclusion criteria participated in the study. The inclusion criteria were the participants filled the Physical Activity Readiness Questionnaire (PAR-Q), which determined their fitness level for the exercise programme and must be within the age bracket of 25 – 45. Those that did not measure up to the requirements needed were dropped and another sampling was conducted until the required number was completed. The participants' were randomly assigned to two groups; one experimental group and one control group (thirty in each group).

Instruments for Data Collection

The following seven instruments were used for collecting data for the study.

Slim Guide Skinfold Caliper: The slim guide by (Creative Health Products in U.S.A, manufactured on Jan. 2013). Skinfold Caliper was used for the measurement of the skinfold of the various sites of the body required for the study. The equipment was calibrated to exert a constant standard pressure of 10g/mm over its entire operating range. Measure was in millimeters and was recorded to the nearest 0.5 millimeter.

Sphygmomanometer: The Kris-Aloy Model Stethoscope manufactured by Medicare instrument (WUXI) Jiangsu China on August 2014 was used in conjunction with the stethoscope for measuring resting blood pressure of the participant.

Stethoscope*:* The Kris-Aloy Model Stethoscope manufactured by Medicare Instrument (WUXI) Jiangsu China on August 2014, was used to measure the heart rate and muscular endurance tests.

Stopwatch: The 'Heuer Track mate' stopwatch was used to determine running time, heart rate and muscular endurance tests.

Measuring Tape: The non-elastic fiber glass make measuring tape, measuring 152mm was used to mark off the 400m track into 50m bits.

Step Bench: A sturdy – step bench 40 cm high made with plywood was used to aid accurate measurement of the sit and reach test, and for the step up circuit of the training programme.

Gym Mats: The sit and reach test and sit-up were used to perform on gym mats. Also all the circuits that require lying down were done on gym mats.

Pre-testing

The instruments that were used in the study are standardized instruments. However, the researcher and her supervisor cross-checked the instruments to ensure that they were in proper working condition before usage.

Pilot Test

Prior to the actual exercise training programme, a pilot test was conducted using five (5) female teachers who would not take part in the study. The aim of the study was to enable the researcher acquaint herself with the test instruments since they are all standardize equipment. The pilot test also provided for identification of problems that would likely occur during the actual study.

Method of Data Collection

Experimental Procedure:

Physical Activity Readiness Questionnaire (PAR-Q): Prior to the physical activity exercise, the participants were given physical activity readiness questionnaire to fill which was used to determine their physical activity level that will help to say if they should check with their doctor before beginning the exercise programme. See Appendix I for the questionnaire.

Training of Research Assistant: Three physical and health education teachers were selected from the schools that were used for the study to assist in the testing and training of the participants. They attended training of trainers (TOT) programme. This programme was organized by the researcher in her school. Data was collected by first administering, the pre-test to both the experimental and control groups by the researcher with the research assistants who helped to record and observe the participants. The test was spread and conducted, such that the preceeding test will not influence the immediate one. The pre-test were followed by training section, which is Circuit Training Exercise Programme (CTEP) done in eight weeks, given only to experimental group. After the training session, the researcher finally conducted the post-test to both experimental and control groups in order to know how the training affects the variables used by the researcher. Scores were collected and recorded.

Testing Procedure:

The researcher with the research assistants conducted the pretest on all the participants. The order of testing was as follows: resting heart rate, resting blood pressure, flexibility, muscle endurance, skinfold measurements and maximum oxygen uptake. All the participants were informed about the nature and the purpose of the test before commencement. The researcher demonstrated the exercise where necessary. The procedures for the collection of data during testing were as follows:

Heart Rate: This was obtained with the aid of stethoscope and a stopwatch. The ear-piece of the stethoscope was placed on the left side of each participant's chest. The number of beats in fifteen seconds was counted with the aid of the stopwatch. The number was multiplied by four to obtain the heart rate in one minute.

Blood Pressure: The resting blood pressure of the participants was determined using the Kris-Aloy sphygmomanometer and stethoscope with the participant seated; the cuff of the sphygmomanometer was applied to the left upper-arm with the diaphragm of the stethoscope

placed on the subjects. The air releasing screw was closed and pressure applies to the cuff from the pressure bulb until the pulse could not be heard. The pressure was increased by 20mmHg above the point of pulse disappearance. The air releasing screw was gradually loosened to release the cuff's pressure slowly and evenly; while the researcher listened for heart sounds. The pressure at which the first pulse sound (Korotkoff sound) heard was recorded as the systolic pressure while the diastolic pressure is the pressure at which the pulse sound started to disappear.

Trunk Flexibility: Trunk Flexibility at the lumbosacral joint was measured with the sit and reach test. The participant assumed a long sitting position with the sole of the feet against the side of a 40cm high bench. The hands were stretched forward as far as possible and this position would be held for three seconds. A non-elastic tape was used to measure the distance in front or beyond the edge of the bench (Porkey, 2014). The best of the three trials was recorded in centimetres to the nearest 0.1cm.

Muscular Endurance: The bent knee sit-ups were used to test the local endurance of the participant's abdominal muscles. The procedure described by Vercci (2012) was followed with interlaced fingers over the back of the head while the participant lies supine and knees bent at 90 degrees or less, and with ankles supported by assistants. The subject sit-up simultaneously touching both elbows to the knees and returned to the starting position. The score was the number of legal sit-ups that was completed in one minute. Two trials were allowed and the better of the two recorded.

Skinfold Measurement: The skinfold of the participants was measured using slim guide caliper at the triceps, thigh and iliac-crest following the procedure described by Amusa and Igbanugo (1985) and Katch (1990). The participant's skinfold was picked between the index finger and the thumb. The triceps skinfold was measured from a vertical skinfold on the back of the arm half way between the acromium and olecranon process. Iliac-crest skinfold was measured from a vertical skinfold over the iliac-crest (point to the hip) in the midaxilliary line (middle of the

armpit) while the thigh skinfold was measured at anterior midline of the thigh, half way between the hip and the knee joint and also the body weight was placed on the opposite leg during measurement. A constant distance of 1 centimetre would be maintained between the caliper, the thumb and the finger holding the site. The measurement read without delay to ensure that the subcutaneous adipose tissue was not dispersed from the measuring position. All the measurements were taken on the right side of the body with the participants in the standing position. After taking the three skinfold measurement, the measurement was summed then on the normogram in the appendix, a ruler was used to connect the point on the left that corresponds to the age with the point on the far right that corresponds to the sum of the three skinfold measurement. Then the score was recorded.

Maximum Oxygen Uptake ($V0_2max$): The maximum oxygen uptake was determined using the 12 – minute run developed by Cooper (1970). A 400m track marked off in eights that is every 50m distance was used. The participants ran round the 400m track and were timed to stop after 12 minutes. The participants were told to walk if they felt winded but would be scored on the distance they covered in the 12 minute period. This procedure has been found according to Amusa and Igbanugo (1985) to be very accurate, easy to administer and practical for testing a large group. Copper (1970) found that the distance covered correlates very accurately with tread mill direct measurement of oxygen consumption and aerobic capacity (r = 0.90). The relationship between the distance covered in 12 minutes and oxygen consumption was worked out using the scoring table. The table was shown in the Appendix II (Coppers Normogram)

Training Procedure:

The training programme was an eight (8) week circuit training exercise. The exercise was carried out two times per week. Initially, it lasted for 30 minutes and was gradually increased to 40 minutes on the school playing ground. The exercise graduated from week 1 to week 8 by increasing the repetitions and sets. The exercise training was done in a circuit with instructions

and supervision by the researcher and her trained assistants. The training session starts with warm–up activities. The circuit training lasted 30 minutes and 4 minutes for cool down stretch. The duration of the circuit training was increased to 40 minutes before the end of the programme, 6 minutes for warm–up stretches or exercises and 4 minutes for cool down stretch. The warm–up activities were carried out weekly on alternate basis, i.e.

Weeks 1, 3 and 6: Jogging round the field, arm swinging sideways, alternate hand touching alternate leg, duck walk.

Weeks 2, 4 and 8: Jogging on the spot, running and stopping at signal, astride jumping and fast walking.

Weeks 5 and 7: Cock-fighting with a partner, kicking an imaginary bull, cycling in the air, skipping with rope.

Circuit Exercise: All participants in the experimental group (30 female teachers) were divided into 5 groups (6 participants in each group). The groups performed the circuit strength training exercises at the different stations. Each group of participants exercised at each station and had 1 minute rest between stations. The participants moved from one station to the other in a clockwise direction. As soon as the time allotted to each station is over, they were required to go through the 5 stations of the circuit three times with 4 minutes rest between sets. The circuit training was performed two times a week on alternative days (Hoeger & Hoeger, 2000).

Circuit training exercises for weeks 1, 3, 5 and 7; the duration of the exercise in each station was increased from 1 - 4 minutes.

Station 1: Bench Stepping

Action – The participants stepped up and down a bench 38.9cm high. They performed one set using the same Leg each time, second set using the other leg and alternate legs on each step–up cycle.

Station 2: Sit-up

Action: The participants lay flat on the floor with feet behind wall bars and knees slightly bent, palms clasped behind the head and repeat sit–up with trunk twisting.

Station 3: Modified Push –Up

Action: The participants maintained their body as straight as possible in a raiment position with the arms and balls of the toes supporting the body. The participants flexed the elbows, lowering the body until it almost touched the floor and then raised the back-up to the starting position.

Station 4: Abdominal Crunch

Action: The participant's heads and shoulders are off the floor, arms are crossed on the chest, and knees slightly bent. The participants curl up to at least 90^{o} and return to the original position.

Station 5: Rowing, Torso

Action: The participants' partners apply enough pressure on the elbows to gradually force the arms forward (horizontal flexion) while the participants tried to resist the pressure. Next, they would reverse the action horizontally forcing the arms backwards as the partner applies sufficient pressure to create resistance.

Circuit training exercise for weeks 2, 4, 6 and 8

Station 1: High Knee Jogging

Action: The participants went on a high knee jogging on the spot for the duration of station.

Station 2: Rope Skipping

Action**:** The participants did rope skipping with one leg and later with alternate legs.

Station 3: Crunch (Curl-up)

Action**:** Prone lying, palms clasped behind the head, with knees bent, curl up until should blade leave floor, then roll-up to the starting position.

Section 4: Modified Push-up

Action: With the knee bent at right angles and the hands on the floor, the participants lowered their bodies to the floor until the chest touched the floor and then pushed back to the starting position.

Station 5: Burpee

Action**:** The participants stood with their hands at their sides. They bent their knees and placed their hands on the floor in front of foot. They trusted their legs back to a full extended position, a front leaning rest position and return to erect position. These processes were repeated until the time allotted for the exercise lapsed.

Cool-down Activities

1. Slow walking around the field relaxed and breathing in and out for 2 minutes.
2. Finding lost coins.
3. Grow as tall as possible

Method of Data Analysis

Descriptive and inferential statistical procedures were used to analyze the data. The mean scores and mean difference for each of the variables pre and post-test were computed and used in answering research questions and also the null hypotheses were tested at 0.05 level of significance using Analysis of Convariance (ANCOVA) to determine if there was any significant difference in the performance of female teachers who were trained and untrained. The choice of ANCOVA was considered appropriate because it is very effective in pre-test post-test control group design as it controls pre-test differences accurately (Gey, 1996). To reject or not to reject the null hypothesis, the calculated probability value P was compared to the 0.05 significant level stipulated. Where the P value was less than 0.05 significant value, the null hypothesis was rejected, however, where the P value was greater than 0.05, null hypothesis was not rejected.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

In this Chapter, the data were presented based on research questions and hypotheses in the determination of effects of circuit training exercise programme on selected physical fitness components of female secondary school teachers in Anambra State. Summary of the major findings were also presented according to the research questions and hypotheses that guided the study.

Research Question 1: What is the difference in the pre-test and post-test mean resting heart rate of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP?

Table 2: **Mean Difference Scores on the Resting Heart Rate of Female Secondary School Teachers who were Trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	81.50	30	81.30	0.20
Control	30	80.90	30	86.83	5.63

Table 2 shows that the mean difference in the resting heart rate for the experimental group was 0.20 and that of the control group was 5.63. This is an indication that teachers trained with Circuit Training Exercise Programme (experimental group) had a lower mean difference score than the group not trained with Circuit Training Exercise Programme (control group).

Research Question 2: What is the difference in the pre-test and post-test mean resting systolic pressure of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not exposed to Circuit Training Exercise Programme?

Table 3: **Mean Difference Scores on the Resting Systolic Pressure of Female Secondary School Teachers Trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	113.83	30	113.97	0.86
Control	30	115.93	30	122.27	6.77

The results displayed in Table 3 shows that the mean difference in the resting systolic pressure for the experimental group was 0.86 and that of the control group was 6.77. This suggests that female teachers not trained with circuit training exercise programme (experimental group) had higher mean difference compared to their counterparts trained with the programme.

Research Question 3: What is the difference in the pre-test and posttest mean resting diastolic pressure of female secondary school teachers trained with Circuit Training Exercise Programme (CTEP) and those not trained with Circuit Training Exercise Programme?

Table 4: **Mean Difference Scores on the Resting Diastolic Pressure of Female Secondary School Teachers Trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	75.53	30	75.60	0.07
Control	30	73.27	30	78.53	5.26

Table 4 shows a mean difference of 0.07 and 5.26 for experimental and control groups respectively. The difference in resting diastolic pressure from pre-test to post-test was lower for experimental group than control group.

Research Question 4: What is the difference in the pre-test and post-test mean maximum oxygen uptake of female secondary school teachers trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.

Table 5: **Mean Difference Scores on the Maximum Oxygen Uptake of Female Secondary School Teachers Trained with Circuit Training Exercise Programme (CTEP) and those not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	33.70	30	36.19	2.49
Control	30	30.12	30	31.86	0.26

The data in table 5 shows a mean difference of 2.49 and 0.26 for experimental and control groups respectively. The mean difference in maximum oxygen uptake from pretest to posttest was higher for experimental group compared to the control group.

Research Question 5: What is the difference in the pre-test and post-test mean trunk flexibility of female secondary school teachers trained with Circuit Training Exercise Programme (CTEP) and those not trained.

Table 6: **Mean Difference Scores on the Trunk Flexibility of Female Secondary School Teachers Trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	13.10	30	13.45	0.35
Control	30	12.96	30	13.03	0.07

The data in Table 6 shows a mean difference of 0.35 and 0.07 for experimental and control groups respectively. The mean difference in trunk flexibility from pretest to posttest was higher for experimental group than control group.

Research Question 6: What is the difference in the pre-test and post-test mean muscular endurance of female secondary school teachers trained with Circuit Training Exercise Programme (CTEP) and those not trained with Circuit Training Exercise Programme?

Table 7: **Mean Difference Scores on the Muscular Endurance of Female Secondary School Teachers Trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	9.00	30	11.83	2.83
Control	30	8.80	30	8.83	0.03

The data in Table 7 shows a mean difference of 2.83 and 0.03 for experimental and control groups respectively. The mean difference in muscular endurance from pre-test to post-test was higher for experimental group compared to the control group.

Research Question 7: What is the difference in the pre-test and posttest mean body composition of female secondary school teachers trained with Circuit Training Exercise Programme (CTEP) and those not trained with Circuit Training Exercise Programme?

Table 8: **Mean Difference Scores on the Body Composition of Female Secondary School Teachers Trained with Circuit Training Exercise Programme (CTEP) and Those Not Trained.**

	Pre-test		Post-test		Mean Difference
Groups	**N**	**Mean**	**N**	**Mean**	
Experimental	30	27.50	30	28.07	0.57
Control	30	26.67	30	27.04	0.37

Table 8 shows a mean difference of 0.57 and 0.37 for experimental and control groups respectively. The mean difference in body composition from pre-test to post-test was higher for experimental group compared to the control group.

Null Hypothesis 1:

There is no significant difference in the mean resting heart rate of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP.

Table 9: **Summary of ANCOVA on the Difference in the Mean Score of Resting Heart Rates of the Experimental and Control Groups.**

Source of Variation	Type III Sum of Square	Df	f	P	Partial Eta Squared
Corrected Model	4790.199[2]	2	534.256	.000	.949
Intercept	79.293	1	17.687	.000	.237
PRERHR	4330.932	1	966.066	.000	.944
GRP	553.932	1	123.561	.000	.684
Error	255.534	57			
Total	429078.000	60			
Corrected Total	5045.733	59			

a. R-squared = .949 (Adjusted R^2 = .948)

Table 9 revealed that there is a significant different between the mean resting heart rate of the experimental and control; $f(1,57) = 123.56$, $p < 0.05$, $\eta_P^2 = .684$. Therefore, since the P value of .000 is less than 0.05, the null hypothesis was rejected. This shows that Circuit Training Exercise Programme had an effect on the resting heart rate of female secondary school teachers who were trained and it is significant in lowering their heart rate.

Null Hypothesis 2:

There is no significant difference in the mean resting systolic pressure of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP

Table 10: **Summary of ANCOVA on the Difference in the Mean Score of Resting Heart Rates of the Experimental and Control Groups.**

Source of Variation	Type II Sum of Square	Df	Mean Square	F	P	Partial Eta squared
Corrected Model	2.45.337[a]	2	1227.168	48.784	.000	631
Intercept	646.046	1	646.046	25.682	.000	.311
PRERHR	1156.987	1	1156.987	45.994	.000	.447
GRP	958.252	1	958.252	38.094	.000	.401
Error	1433.847	57		25.155		
Total	833909.000	60				
Corrected Total	388.183	59				

Table 10 revealed that there is a significant difference between the mean resting systolic pressure of the experimental and control; $f(1,57) = 38.094$, $p < 0.05$, $\eta_P^2 = .401$. Therefore, the null hypothesis was rejected. This shows that Circuit Training Exercise Programme had an effect on the resting systolic pressure of female secondary school teachers who were trained and since the group had a lower mean score, it means that exercise can lower blood pressure.

Null Hypothesis 3:

There is no significant difference in the mean resting diastolic pressure of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP.

Table 11: **Summary of ANCOVA on the Difference in the Mean Score of Resting Diastolic Pressure.**

Source of Variation	Type II Sum of Square	Df	Mean Square	F	P	Partial Eta squared
Corrected Model	3618.473[a]	2	1809.237	672.884	.000	.959
Intercept	36.267	1	36.267	13.488	.001	.191
PRERHR	3489.406	1	3489.406	1297.767	.000	.958
GRP	377.135	1	377.135	140.263	.000	.711
Error	153.260	57				
Total	360128.000	60				
Corrected Total	3771.733	59				

Table 11 revealed that there is a significant difference between the mean diastolic pressure of the experimental and control groups; $F(1,57) = 140.263$, $p < 0.05$, $\eta_P^2 = .711$. Therefore, since the P

value of .000 is less than 0.05 the null hypothesis was rejected. This shows that Circuit Training Exercise Programme had an effect on the resting diastolic pressure of female secondary school teachers who were trained; meaning that exercise can lower blood diastolic pressure.

Null Hypothesis 4:

There is no significant difference in the mean maximum oxygen uptake of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP.

Table 12: **Summary of ANCOVA on the Difference in the Mean Score of Maximum Oxygen Uptake of the Experimental and Control Groups.**

Source of Variation	Type II Sum of Square	Df	Mean Square	F	P	Partial Eta squared
Corrected Model	4881.104	2	1809.237	143.888	.000	.835
Intercept	119.261	1	36.267	7.031	.001	.110
PRERHR	334.483	1	3489.406	19.720	.000	.257
GRP	4874.564	1	377.135	287.390	.000	.834
Error	966.80457	2	.689			
Total	35298.55060	60				
Corrected Total	5847.908	59				

R-squared = .835 (Adjusted R^2 = 0.829)

Table 12 revealed that there is a significant difference between the mean maximum oxygen uptake of the experimental and control groups F (1, 57) = 287.390, P<0.05, η_P^2= .958. Therefore, since the P value of .000 is less than 0.05, the null hypothesis was rejected. This shows that circuit training exercise programme had an effect on the maximum oxygen uptake of female secondary school teachers who were trained.

Null Hypothesis 5:

There is no significant difference in the mean trunk flexibility of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP.

Table 13: **Summary of ANCOVA on the Difference in the Mean Score of Muscular Endurance of the Experimental and Control Groups.**

Source of Variation	Type II Sum of Square	Df	Mean Square	F	P	Partial Eta squared
Corrected Model	276.810[a]	2	138.40	15.781	.000	.356
Intercept	191.649	1	191.649	21.852	.001	.277
PRERHR	257.657	1	257.657	257.657	.000	.340
GRP	21.590	1	21.590	2.462	.122	.041
Error	499.899	28	.770			
Total	9999.710	60				
Corrected Total	776.710	59				

a. R-squared = .356 (Adjusted R^2 = .334)

Table 13 revealed that there was no significant difference between the mean trunk flexibility of the experimental and control groups, f(1,57) = 2.462, p(0.122) > 0.05, η_P^2 = .041. Therefore, since the P value of .122 is greater than 0.05 the null hypothesis was not rejected. This shows that Circuit Training Exercise Programme had no effect on the trunk flexibility of female secondary school teachers.

Null Hypothesis 6:

There is no significant difference in the mean muscular endurance of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP.

Table 14: **Summary of ANCOVA on the Difference in the Mean Score of Muscular Endurance of the Experimental and Control Group.**

Source of variation	Type III sum of square	Df	Mean square	F	P	Partial Eta squared
Corrected Model	11809.419[a]	2	5904.710	204.051	.000	.877
Intercept	1918.556	1	1918.556	66.300	.001	.538
PREMUSEND	27.009	1	27.009	.933	.338	.016
GRP	11722.768	1	11722.768	405.107	.000	.877
Error	1649.437	5.7	28.937			
Total	42976.000	60				
Corrected Total	13458.856	59				

a. R-squared = .877 (Adjusted R^2 = .873)

Table 14 revealed that there is a significant difference between the mean score of muscular endurance of the experimental and control, $F(1, 57) = 405.107$, $p < 0.05$, $\eta_p^2 = .877$. Therefore, since the P value of .000 is less than 0.05 the null hypothesis was rejected. This shows that Circuit Training Exercise Programme had an effect on the muscular endurance of the trained group of female secondary school teachers.

Null Hypothesis 7:

There is no significant difference in the mean body composition of female secondary school teachers who were trained with Circuit Training Exercise Programme (CTEP) and those not trained with CTEP.

Table 15: **Summary of ANCOVA on the Difference in the Mean Score Body Composition of the Experimental Group and Control Group.**

Source of Variation	Type II Sum of Square	Df	Mean Square	F	P	Partial Eta squared
Corrected Model	532.720[2]	2	266.360	44.108	.000	.607
Intercept	20.126	1	20.126	3.333	.073	.055
PRE BOD.COM.	480.454	1	480.454	79.561	.000	.583
GRP	93.127	1	93.127	15.421	.000	.213
Error	344.213	57	6.039			
Total	38778.000	60				
Corrected Total	876.933	59				

a. R-squared = .607 (Adjusted $R^2 = .594$)

Table 15 revealed that there is a significant difference between the mean score of body composition of the experimental and control, $F(1,57) = 15.421$, $p < 0.05$, $\eta_p^2 = .213$. Therefore, since the P value of .000 is less than 0.05 the null hypothesis was rejected. This shows that Circuit Training Exercise Programme had an effect on the body composition of female secondary school teachers who were trained.

Summary of Major Findings

1. Female secondary school teachers trained with Circuit Training Exercise Programme had significantly lower mean resting heart rate than those not trained with CTEP.

2. Female secondary school teachers trained with Circuit Training Exercise Programme had significantly lower mean resting systolic pressure than those not trained with CTEP.
3. There was a significantly lower mean resting diastolic pressure among female secondary school teachers trained with Circuit Training Exercise Programme than those not trained with CTEP.
4. Female secondary school teachers trained with Circuit Training Exercise Programme had significantly higher mean maximum oxygen uptake than those not trained with CTEP.
5. Female secondary school teachers trained with Circuit Training Exercise Programme had significantly higher mean trunk flexibility than those not trained with CTEP.
6. Female secondary school teachers trained with Circuit Training Exercise Programme had significantly higher muscular endurance than those not trained with CTEP.
7. Female secondary school teachers trained with Circuit Training Exercise Programme had significantly higher mean body composition than those not trained with CTEP.
8. There is a significant difference between the mean score of resting heart rate of the experimental and control groups ($p < 0.05$, Table 22).
9. There is a significant difference between the mean score of resting systolic pressure of the experimental and control groups ($p < 0.05$, Table 23).
10. There is a significant difference between the mean score of diastolic pressure of the experimental and control groups ($p < 0.05$, Table 24).
11. There is a significant difference between the mean score of maximum oxygen uptake of the experimental and control groups ($p < 0.05$, Table 25).
12. There is no significant difference between the mean score of trunk flexibility of the experimental and control groups $p(0.122) > 0.5$, Table 26.
13. There is a significant difference between the mean score of muscular endurance of the experimental and control group ($p < 0.05$, Table 27).
14. There is a significant difference between the mean score of body composition of the experimental and control group ($p < 0.5$, Table 28).

CHAPTER FIVE

DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This Chapter discusses the major findings of the study, conclusion drawn from the findings, implications of the study, recommendations, limitations of the study and suggestions for further studies were also presented.

Discussions of Findings

The results from this study were discussed based on the following sub-headings:

1. Resting heart rate of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed to CTEP.
2. Resting systolic pressure of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed to CTEP.
3. Resting diastolic pressure of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed CTEP.
4. Maximum oxygen uptake of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed CTEP.
5. Trunk flexibility of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed to CTEP.
6. Muscular endurance of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed CTEP.
7. Body composition of female teachers exposed to Circuit Training Exercise Programme (CTEP) and those not exposed to CTEP.

Resting Heart Rate of Female Teachers Exposed to Circuit Training Exercise Programme (CTEP) and those not Exposed to CTEP.

The result of the study showed to an extent the difference between the effect of eight weeks of Circuit Training Exercise Programme of the experimental and control groups on the resting heart. The experimental group recorded a lower mean resting heart rate of ($\bar{x}$ = 81.30) than the control group ($\bar{x}$ = 86.83). Hence, there is a difference between the resting heart rate of the experimental and control group after eight weeks of Circuit Training Exercise Programme. Therefore, the exercise training had an effect on the experimental group, showing that heart rate of the experimental group dropped after training which is good for a physically active person. Analysis of Covariance (ANCOVA) carried out showed that there is a significant difference between the experimental and control groups mean scores of resting heart rate of female secondary school teachers. The results of this present study may be due to the regular exercise programme given to the experimental group even through the control group was given simple exercises to be doing on their own but they were not monitored as the experimental group. Also, the experimental group was eager to perform the exercise because the researcher made the whole programme to be interesting though, it was tiresome for them at the earlier stage. The finding of this study was in consonance with those documented by Miller, Pearcey, Cahill and McCarthy (2014) who observed that there was satisfactory improvement in resting heart rate (HR) among women who completed a four-week circuit training exercise.

Similarly, in the study by Ballantyne (2015) which aimed at describing how 12 weeks training exercise affects heart rate; the group that participated in circuit training exercises performed better. This shows that the exercise had an effect on heart rate (HR). The finding of the present researcher is in line with that of Frick (2013) who in his study revealed that there is a difference when trained person shown that his/her heart rate becomes lower at rest.

Also, the result of this study is supported by the findings of Sultan (2010) who held that there is a difference between the trained persons and untrained because a slow breaking heart is more efficient and requiring less oxygen than the faster beating heart at the same cardiac output level. This is because it allows the trained person to perform at any given exercise task. The present study also examined that the variables of resting systolic and diastolic blood pressure maximum oxygen uptake, trunk flexibility, muscular endurance and body composition.

Resting Systolic and Diastolic Blood Pressure of Female Teachers Trained with CTEP and Those Not Trained

With respect to resting systolic blood pressure, the experimental group had lower ($\bar{x}$ = 112.97) than the control group ($\bar{x}$ = 122.27); and in diastolic blood pressure, there was lower mean of $\bar{x} = 75.60$ for the experimental group as against the higher mean of $\bar{x} = 78.53$ of the control group. The statistical analysis showed there was a significant difference between the mean score of both resting systolic and diastolic blood pressure of the experimental and control groups after eight weeks (CTEP) of female secondary school teachers. This indicates that the exercise reduces the blood pressure of the trained teachers. The result of the study is supported by the result of a study by Paoli, Paruchi, Moro, Marcolin and Bianio (2013) which reveals that there is a significant effect in systolic and diastolic heart blood pressure. The researcher added that the circuit training exercise when given to teachers had an effect on their resting and diastolic blood pressure. This recent study is also related with the findings of Matthew (2011) who documented that there is a difference and improvement in terms of decrease in the systolic and diastolic blood pressure of the trained subjects than the control groups. The result of the findings is also in accordance with Montage, Guber, Cunningham and Dinka (2012) in the Tecumseh study both systolic and diastolic blood pressure levels were found to be lower in most active people which show there is a difference between an active and sedentary individual's heart rate.

Maximum Oxygen Uptake (VO_2max) of Female Teachers Trained with CTEP and Those Not Trained

The result of the study showed that there was higher mean maximum oxygen uptake of the experimental group while the control group showed lower mean maximum uptake. However the ANCOVA carried out showed that there was a significant difference between the mean maximum oxygen uptake of the experimental and control groups after eight weeks of Circuit Training Exercise Programme. This study is in agreement with that documented by Klika and Jordan (2013) which indicates that high intensity circuit training improves VO_2max. Also Beneath and Dudley (2013) in a study asserted that using an exercise intensity of 85 – 90% of VO_2 max founded an increase of 32% in VO_2max in both relative and absolute terms following a seven-week endurance programme in their subjects. In a contrary view, Orlander (2010) founded only 11% increase in aerobic power following 12m weeks of training using an exercise of low intensity (40 – 50 VO_2max). The result of the study is supported by the findings of Harmansen (2012) who reported differences in VO_2max of trained and untrained. Orlander (2010) found increase in power after exercise of low intensity. Since oxygen is used for oxidative processes in the metabolic changes from which energy is divided and hence supports life and whenever more energy is required, metabolic is increased and hence, the need for oxygen is correspondingly increased. The researcher thinks that the trained participants in this research show more difference than the untrained because active individuals are characterized by high maximum oxygen consumption.

Trunk Flexibility of Female Teachers Trained with CTEP and Those Not Trained

When the difference between experimental and control group training exercise programme on trunk flexibility was analyzed to help find the effects, the result of the study showed that the experimental group had higher mean ($\bar{x} = 13.45$) than the control group with $\bar{x} = 12.96$. Analysis of covariance carried out showed that there is no significant difference between the

mean score of trunk flexibility of the experimental and control groups after eight weeks of CTEP. This may be due to some difficulties encountered during the training exercise. The result of the study is related to what Karen (2011), said that flexibility is highly adaptable, which means it can be increased and decreased with inactivity.

Muscular Endurance of Female Teachers Trained with CTEP and Those Not Trained

With the data analysed according to muscular endurance, the result of the study showed that the experimental group recorded higher mean score than the control group after eight weeks of Circuit Training Exercise Programme. However, the analysis of convariance carried out shown that there was a significant difference between the mean score of muscular endurance of the experimental and control groups after eight weeks of CTEP, which indicated that the trained participants performed better than the untrained. Moreover, the finding agreed with the findings of Marx, Rataniess, Nindl, Gotshalk, Volek and Dohietal (2011) on circuit training. The training programme had a greater effect on muscular endurance. The result of their findings also shown that when the untrained group were given a single-set circuit exercise their performance increased. The result of the study is also supported by the findings of Astrand (2009) who affirms that the improvement of muscular endurance is a result of more abundant supply of blood to the muscles performing a particular work. Hyman (2010) corroborated this view when he asserted that there was a significant improvement in muscle blood flow as a result of training regimen of participants.

Body Composition of Female Teachers Trained with CTEP and Those Not Trained

The result showed that the experimental group recorded higher mean ($\bar{x} = 28.07$) than the control group with less ($\bar{x} = 27.4$) after eight weeks of CTEP. This indicates there was a difference between the two groups and also the exercise programme had significant effect on the trained teachers. The statistical analysis showed that there was a significant difference between the experimental and control group. The result of the study is supported by the findings of

Orlander (2010) which revealed that using a low intensity exercise regimen, reduces the body composition (weight) on participants. In a contrary to the resent research, Cox, Benneth and Dudley (2008) documented that body composition did not change significantly with the training.

Conclusion

The following conclusions were drawn based on the findings of this study.

1. Female secondary school teachers who were trained with CTEP recorded a lower mean difference resting heart rate, resting systolic and diastolic pressure than those not trained with the programme. The result strongly suggested that exercise, and being physically active lowers resting heart rate, resting systolic and diastolic pressure.
2. Maximum oxygen uptake, muscular endurance body composition and trunk flexibility of the female secondary schools teachers who were trained showed a higher mean difference than the untrained. Also, CTEP had an effect on them.
3. Statistically, there were significant differences between the mean score resting heart rate, resting systolic and diastolic blood pressure, maximum oxygen uptake, muscular endurance and body composition of the experimental and control groups after eight weeks of CTEP.
4. There were no statistical difference between the mean score of trunk flexibility of the experimental and control groups after eight weeks of CTEP.

Implications of the Study

Regular physical activities especially, exercise is central to prevention of sedentary lifestyles, some chronic ailments such as obesity, heart diseases, osteoporosis among others. Everybody should try and be engaged in different forms of exercises especially, map out exercise training programmes such as the circuit training programmes because the study revealed that this exercise programme had a significant effect in various aspects of body mechanisms. The

findings implied that exercise physiologists should recommend a planned and more inclusive exercise regimen that will touch the study systems especially those that can prevent illness. The experiences gained from the study will help the female secondary school teachers as the information from the result after the training will enhance the performance of teachers both in academics, sporting or other physical activities.

The findings also implied that teachers should be encouraged either by praise, rewards and or incentives to make them to be more interested in physical exercises. Based on this study, the researcher observed that female teachers felt motivated and encouraged when the researcher and her research assistant praised them and entertained them with light refreshment after each exercise section.

Female teachers should be indulging in exercise programmes and need to understand the implications of sedentary lifestyle, which can lead to physical unfitness. It therefore calls for teachers to bring out their time and fix exercises they can be performing regularly to avoid obesity and other chronic diseases. Therefore, government should create avenues where teachers should be taught the importance of these exercises and also help them to be indulging in them by mapping out exercise programmes for teachers because this will invariably promote educational status and sporting activities.

Recommendations

In view of the findings on this study, "The effects of Circuit Training Exercise Programme on selected physical fitness components of female secondary school teachers in Anambra State", the following recommendations were made:

1. From the findings that eight weeks of circuit training exercise programme had an effect in various variables used in this study. The researcher recommends that this exercise programme should seriously be upheld by every teacher in the State.

2. Sports unit of the education commissions should take up the responsibility of planning and designing exercise porgrammes for teachers as often as possible as a viable and effective programme in physical conditioning particularly for those who are always busy and don't have time for exercises. This is because from this study, circuit exercise is significant in affecting almost all the variables used in the study.
3. Physical educators and exercise physiologists should educate the teachers and apply all the necessary strategies to encourage them to be indulging in exercise activities. Examples are: organizing road works, exercise workshop (practicals) among others.
4. Non-governmental organizations (NGOs) should sponsor physical exercise programmes for teachers.
5. Organizing inter-house sports in our school should be encouraged because it will help teachers to participate in sports and from time to time, exercise programmes should be restructured and reviewed to meet up with the physical needs of the teachers.

Limitations of the Study

1. The researcher dictated during the filling of Physical Activity Readiness Questionnaire (PAR-Q) that some teachers had some health challenges that hindered their participation in the exercise programme. They were removed and by simple random sampling were replaced again. However, this did not affect the researcher's result.
2. The exercise was very difficult for the women during the first week of training but they later got use to it. However this did not affect the result.

Suggestions for Further Research

1. Further research should be conducted on the effects of twelve weeks circuit training exercise on other physical fitness components of female teachers in Anambra State.

2. A similar study could be carried out among the male secondary school teachers and also teachers in the primary schools.
3. Teachers from different parts of the state and even nationwide could be studied to determine regional differences in circuit training exercise programmes.
4. For future studies of this nature, precision electronic instruments should be used for blood pressure, heart rate and maximum oxygen, consumption determinations to ensure greater clinical accuracy.

REFERENCES

Aarajas, H. S. & Faulert, C. (2011). *Effects of physical training on circulation at rest and during exercise*. A.M.J. cardiol R, NR.

About.com (2015). Exercise.about.com >About.com>About Health Exercise. ND.

Achten, P. (2013). Increase in heart variability. *Exercise and Sports Sciences Reviews 48(4) 105-113*.

Agbanusi, E. C. (2014). *Personal and corporate fitness training in Nigeria*. A paper presented at NASSM Conference.

American College of Sports Medicine (2010). The recommended quantity and quality of exercise for developing and maintaining cardio-respiratory and muscular fitness and flexibility on healthy adults. *Medicine and Science in Sports and Exercise 30(6): 975-991*.

American College of Sports Medicine (2013). *Guidelines for graded exercise testing and exercise prescription.* Baltimore: Williams & Wilkins.

American Heart Association (2014). www.heart.org/HEAR TO RG/conditions/m.ND.

American Heritage Dictionary of the English Language (2011). 4th Edition. Houghton: Mithlin Harcourt Publishing Company.

Amusa, L.O. & Igbanugo, U.C. (1985). *Experiments and laboratory experiences in exercise physiology.* Ibadan: LAP Publications.

Arnheinm, D. (2010). *Principles of athletic training*. Dubuque: McGraw Hill.

Astrand (2009). *Textbook of work physiology.* New York: McGraw Hill.

Barker, L. D. (2010). *Effects of aerobic exercise on middle cognitive impairment Archives of Neurology, 67(1): 71-79.*

Balachandran, A. (2011). *Can circuit training increase strength and muscle. Exercise biology: The science of exercise.*

Ballantyne, C. (2015). *Circuit training for your heart.* www.earlytorise.com

Barr, S. & Mc-Congar, L. (2010). Practical use of body composition analysis in sports. *Sports Med., 5:277 - 282.*

Behnken, M. (2014). *Why the five components of physical fitness are important.* www.healthtopics.org.

Benneth, J. B. & Dudley, G. A. (2013). *Exercise training induced alterations of cardiac morphology*. J. Appl. Physical, 61(3): 926 – 931.

Blair, O. (2009). *Active living everyday*. Champaine, I. L., human kinetics. New York: Harper and Row Publisher.

Blood Pressure (2014). www.bloodpressureuk.org. Retrieved on 10 July, 2015.

Brad, A. (2015). *Stretching and flexibility*. www.comerossoals.com. ND

British Broadcasting - BBC (2014), *Higher bitesize physical education.* www.bbc.co.uk>home>phyiscalEducation>preparation of the body.

Brown, E. (2014). www.livestrong.com>sports and fitness.

Brown, C. H. & Wilmore, J. H. (2011). *The effect of maximal resistances training on the strength and body composition of women athletes*.

Bullock, A. (2014). *NASM elite trainer*. www.share.care.com. ND.

Buttin, J. (2012). *Model of physical fitness and dynamic health*. JOPER, 5:48

Carpenter, L. & Christopher, J. (2010). "A metanalysis of the effectiveness of health belief model variables in predictions." *Behaviour Health Communication, 25(8), 061 - 669.*

Carlsberg, K. A.; Beckman, M. T.; Peak, G. T. & Kiedesel, M. L. (1983). Body composition of phigo-amenorrneric athletes. *Med. sci. sports Ex., 15, 215 - 217*.

Chanen, J. S. (2011). Fitting in fitness. *Lifestyles Health and Exercise, 87(7), 64 - 66*.

Chase, P. E. (2015). Heart rate response to exercise in elderly people. *International Journal of Epidemiology, 40(1), 45 - 59.*

Chinder, E.C. & Godfrey, P.V. (2011). Physiology of muscular activity, 3rd ed., St. Louis C.V. Mosby Company.

Chomder, E. C. & Godfrey, P. V. (2011). *Physiology of muscular activity,* 3rd edition. St. Louis: C.V. Mosby Company.

Chobanian, A. V.; Bakris, G. L. & Black, H. R. (2003). "Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure." *Hypertension, 42(6), 1206 – 52*.

Churilla, J.R. (2012). The metabolic syndrome: The crucial role of exercise prescription and diet. *ASCM's Health and Fitness Journal 13(2): 27-31*.

Clark, M. (2014). DPT fitness sharecare.com > Fitness ND.

Clausen J. P (2009). Review: Effect of physical condition, a hypothesis concerning, circulatory adjustment to exercise. *Scand. J. cun.lab invest; 24:305 - 311*.

Clemente, C. J. & Withers, P. C. (2010). Metabolic rate and endurance capacity in Australian varian lizards. *Biological Journal of the Linear Society, 97(3), 604 - 676*.

Comana, F. (2014). America council on exercise. www.acceftness.org/updateable/update.ND

Copper, K. H. (1970). *The new aerobic*. New York: Bantam books.

Correteili, P. (2012). *Effect of specific muscle training on oxygen uptake on response and early blood locate J.APPL*. physio. Respneuron. EX. Physio. 47(4): 761.

Collumbia Encyclopedia (2010). How much physical activity is good for health? Ann Public Health 13;99-120.

Devries, H.(2011). *Physiology of exercise for physical education and athletics*, 2nd Edition, Dubuque: Lowa Wm Brown and Co.

Dictionary.com (2014). Dictionary. Reference.com/browse/body–composition. ND

Dishman, R.(2012). *Psychological effect of exercise for disease resistance and health promotion*. Bocaraton: CRC press.

Dixie State University (2013). "Muscular endurance." Strength and endurance training: are they mutually exclusive? Sports Med 4(2): 79.

Donald, R. (2012). *Physical fitness appraised and guidance*, 2nd edition. St. Louis: C.V. Mosby Company.

Doneteu, R. (2012). *Health: The basic*. San Francisco: Peers on education. Healthy people 2000: national health promotion and disease prevention objectives.

Dorri, G. (2011). The physiology of flexibility: A review of literature. *Kinesiology Review, 49 - 62*.

Downey, R. (2012). *Circuit training for football scholastic coach, 3*. Effects of varied circuit training programs on strength, Res Q Exercsport33: 168.

Dunne, J. (2014). *Oregon circuit workouts, big bang for your training buck:* A case study. www.kinetic-revolution.com/orgon.c. ND.

Dureton, P. (2007). Health fitness instructor's handbook, Champaign, Human Kinetics.

Eastrand, P. O. (2011). Quantification of exercise capability and evaluation of physical capacity in men. *Progression in cardio-vascular diseases 19(1), 31 - 67.*

Elliot, J. (2008). Neutrality, rationality and the role of the teacher. *Proceedings of the Philosophy Education Society of Great Britain*.

Ellestrad, E. (2010). *Physical fitness: The pathway to healthful living.*

Evans, W. (2010). Increased energy requirements and changes in body composition with resistance training in old Adults. *American Journal of Clinical Nutrition, 60:167-175*.

Feberger, R. E & Bing, A. O. (2010). *The association of changes in physical–activity level and other lifestyle characteristics with mortality among men.* N. EngJ. med. 328:538-545.

Ferreira, F. C.; Medeiros, A. L.; Nicioli, C.; Nunes, J.E.D.; Shiguemoto, G.E.; Prestes, J.; Verzola, R.M.; Balissera, V. & Perez, S.E.A. (2010). Circuit resistance training in sedentary women: Body composition and serumcy to kine level. Applied physiology.

Fitched, M. A. (2013). *Predictability of Vo_2max from sub-maximal cycle* ergometer J. Sports med. 19(2): 450 - 456.

Fishben, M. & Ajzen (1991). *The theory of planned behaviour, organizational behaviour and human decision processes* 50, 179 - 211.

Flegal, K.M. (2010). Prevalence and trends in obesity among U.S. adults. *Journal of the American Medical Association, 303(3): 235-24/108*.

Folsom Lake College (2003). *"Cardio-respiratory fitness & energy system".* 2024-2035.

Frick, M. (2013). Effects of physical training on people. *International Journal of Epidemiology,* 40(1), 45-59.

Fox, E. L. (2009). *Sports physiology.* Philadelphia: W.B. Saunders Co.

Gray, L. R. (2005). *Educational research competencies for analyses and application,* 8th ed. U.S.A: Columbus Charles E. Mernil.

Gay, L. R. (1996). *Educational research competencies for analysis and applications*. USA: Prentice – Hall.

Gella, K. J. & Brouha, I. D. (2007). President's council on physical fitness and sports. *Research Digest, 3(19), 1 – 8.*

George, D. & Mallery, P. (2003). "Frequencies in SPSS for windows step by step: A simple guide and reference 11.0 update." In George, P. and Mallery, P. (eds.), 20 - 52. New York: Pearson Education.

Gotshalk, L. A; Bergen, R. A. & Kraemer, W. J. (2011). Cardiovascular responses to a high volume continuous circuit resistance training protocol. *Journal of Strength and Conditioning Research,* 18(4), 760-764.

Green, L. (2009). *Exercise and cardiovascular health.* New York: Medical Books.

Green, D. (2014). An athletic trainer. www.sharecare.com

Gulati, M. (2010). Heart rate response to exercise stress testing in asymptomatic women. *Exercise Physiology*.

Gummerson, L. I. (2013). The merits of stretching. *ACSINS Health and Fitness Journals 12(4), 5 - 6.*

Guyton P.I. (2009). A textbook of medical physiology. 6th ed., Philadelphia: W.B. Saunders W.

Harper, J. (2013). *Elite fitness trainer*. www.sharecare.com.

Health – galaxy.com. *Definition of physical fitness*. www.health.galaxy.com. ND.

Heavin, A. I.; Gary, W.O.; Colman, C. & Carol, C. (2012). *Curves: Permanent results without permanent dieting*. ISBN 0-399-52956. 108 reprint edition.

Heavin, G. C. & Carol, C. (2014). *Permanent results without permanent dieting,* ISBN 0–399–52956.

Health and Fitness Incorporated (2010). Physiological effect of exercise for disease resistance and health promotion exercise and disease. Boca Raton: CRC Press.

Heck, K. (2011). Nutrition, diet and weight control for athletes. *J. Phy. Educ. Recr: 1-98*.

Hendrick, A. (2012). Flexibility and the conditioning program. *Nath Strength Cond Assc. J. 15(4), 62 - 66*.

Hermansen, O. O. (2012). *Effect of physical training on oxygen transport system in man.*

Hoeger, W.W. K. & Hoeger, S. A. (2002). *Lifetime physical fitness and wellness.* Belmont.wads.worth/Thompson learning, 223 - 226.

Holmes J. E. (2013). *Measurement of breathing rate and volume in routinely performed activities.* California: University press.

Hickson, R. C. (2005). Reduced training intensities and loss of aerobic power, endurance and cardiac growth. *J. Appl. Physiol. 58: 492-499*

Hyman, I. (2010). Human cardio-vascular adjustment to exercise and thermal stress. *Physiol. Review, 54: 75-159*.

Igbanugo, V.C. (2000). *Physiology of human activity centre for external studies.* Ibadan: University press

Janz, N. K & Juker, D. N (2009). *The health education: Theory, research and practice.* 3rd Edition. San Francisco: Jossey–Bass Publishers.

Janzil; Nancy, K.; Marshall, H.; & Baker (1984). *The health belief model: A decade later health education behaviour,* 11(1): 1 - 47.

Kath, F. & Kartch, V. (1990). Measurement and prediction errors in body composition assessment and the search for perfect prediction equation. *Research Quarterly for Exercise and Sports, 51, 849 - 260*.

Kathleen, M. (2013). *Take a shortcut to fitness with circuit training.*

Karen, M.A. (2011). Candidacy kinesiology/exercise physiology. *Research Quarterly*, 29, 205-210.

Karter, L. (2013). Anthropometry of montreal olympic athletes. *Med. Sport Sci. 16:25 - 35*.

Kennedy, F. (2014). What is physical fitness? Healthgalaxy.com. ND.

Kerlinger, F. N. (2000). *Foundations of behavioural research.* New York: Hort. Reinhardt and Winston.

Kirkendall, D. T. (2008). *Exercise pre-occupation for the healthy adult Canadian family physicians, 3, 101-104*.

Kirk, R. E (1995). *Experimental design procedures for the behavioural science,* 3rd edition. Belmont: Brooks and Cole.

Klafs, C. E. (2009). *Modern principles of athletics training.* Toronto: C.V. Mosby.

Klafs, E. C. & Artnhum, O. O. (2010). *Modern principles of athletics training*. Toronto: C.V. Mosby Company.

Klika, B, & Jordan, C. (2013). High intensity circuit training using body weight, maximum results with minimal investment. *ACSMS Health and Fitness Journal, 17(3), 8 - 13*.

Kodama, S. (2013). Cardio-respiratory fitness as a quantitative predictor of all cause mortality and cardiovascular events in healthy men and women*:* A meta–analysis. *Journal of the American Medical Association, 301(19), 2024 - 2035*.

Kovacs, M. (2009). *Dynamic stretching: The revolutionary*. New warm-up method to improve power performance and range of motion. Berkeley, C.A.: Uly press.

Krathwohl, D. R (1993). *Method of educational and social science research.* New York: Longman.

Krawiz L. C. (2011). *New insights into circuit training.* New Mexico: University press.

Kravitz, C. D. & Heyward, B. N. (2014). Disease associated with high body fat. *Journal of health education, 33(4), 134 - 136*.

Koper, K. H. (2010). *The new aerobics*. New York: Bantam Books.

Lemouse, M. C. (2014). *Health guidance for better health.* www.edcation,com>physical health>fitness for elementary school aged children.

Loyd, J. (2010). *Dieting and setting national goals for cardiovascular health promotion and disease reduction: The American heart association's strategic impact goal through, 121, 586 - 613*.

Lombardo, E. (2012). *A Happy you: Your ultimate presentation for happiness.* A clinical psychologist.

Lorme, T. L. (2013). *Restoration of muscle power by heavy resistance exercise.* J. Bone JT Surg., 27, 645 - 662.

Mac-Anthony, G. (2013). *Components fitness: A fundamental approach*, 6th edition. London: Oxford University.

Malaky, R. (2010). *Physical fitness: The pathway to healthful living*, 5th edition. London: Mosby Co.

Malina, O. (2010). *Physical activity and activity of health of youth* constants radius University annals, series physical education and sports/science, movement and health.

Mata, S. (2014). *NASM Elite trainer*. www.sharecare.com. ND.

Mathew, P. I. (2011*).* Frequency and duration of interval training programs and changes in aerobic power. *J. Appl. Physiol. 38(3), 481-484.*

Miller, B. M.; Pearce, G. E.; Cahill, F. & McCarthy, H. (2014). *Effect of a short-term high-intensity circuit training program on work capacity and heart rate.*

Matt, C.A. (2009). Practical fitness advice for everyone. *Morb-mortal Weekly Rep. 42, 66-69.*

Marc, P. (2012). *Learn what is physical fitness along with the top 10 facts of physical fitness.* www.bulttean.com. ND.

Marc, S.A. (2011). Practical fitness advise for everyone. *Morb-mortal weekly Rep. 42, 66-672.*

Massachusetts Institute of Technology (2013). *Flexibility.* www.inst.co.fitness. ND.

Max, J. O.; Ratamess, N. A.; Nindi, B.C.; Gotshalk, L. A.; Volek, J.S.; Dohik; Bush, J. A. & Gomez, A. L. (2011). Low volume circuit versus high–volume. Periodized resistance training in women. *Medicine and Science Sports and Exercise, 33(4), 635-643.*

Mariner, T. A, & Raile, A. M. (2005). *Nursing theorists and their worksheet.* Sakraida, T. Nola J. Pender. The health promotion model. St Louis: Mosby.

Mary B. (2012). Fundamental circuit trainers. Champaign, IL: Human Kinetics.

Mayer, J. (2010). *Overweight, causes, cost and control*. Eaglewood Cliffs, N. J.: Prentice Hall.

Mayoclinic.org (2014). *Exercise: A drug approach to cowering high blood pressure.*

McArdle (2013). *Definition of flexibility.* Dictionary.Reference.com.

McGraw-Hill Concise Dictionary of Modern Medicine (2010).

Meacl, J. (2010). Control of respiratory frequency. *J. Appl. Psysiol. 15(3). 325- 330.*

Medline plus (2015). *Exercise and physical fitness.* www.nlm.nih.gov>Home>Healthtopics.

Mellion, M. (2009). *Edition of sports medicine secrets. Philadelphia*: W.B Saunders Co.

Men's fitness and health.com (2009).

Miller, K. (2005). *Communications theories: Perspectives, processes and contexts.* New York: McGraw-Hill.

Moore .J. (2013). *Physiology of exercise,* 6th edition. St. Louis: C. V. Mosby Co.

Morehouse, L. E. & Miller, A. J. (2011). *Physiology of exercise,* 6th edition. St Louis: C.V. Mosby Co.

Montage, H. J; Guber, S; Cunningham, D. A. & Dinka, S. (2012). *Age and physiological adjustment to continuous graded treadmill exercise.* Res. Quant 43: 175-186.

MRC Epidemiology Unit (2011). Flexibility and the conditioning program, Natlstrens Cond Asso E.J. 15 (4): 62-66.

Morgan, D. C; & Anderson, T. (2012). *Circuit training, contemporary issues in circuit training what work*? Fit society and Armenian College of Sports Medicine.

Mortano, D. E. & Kasperzyk, D. (2002). *Theory research and practice*, 3rd edition. "The theory of reasoned action in K. Glanze *et al* (eds), health behaviour and health education." San Francis: Jossey-bass.

Mosby's Dented Dictionary (2014). *Definition of physical fitness.*

My fit.fitness. Incorporated (2008). www.myfir.com/p/ND.

National Association for Sports and Physical Education (NASPE, 2013). www.humankinetics.com/excesspts/exercise.

National Strength and Conditioning Association (2014). *Enhancing physical fitness in the fire service.* www.nsca.com/education/Articles/hot.

Nelson, M. E.; Rejeski, W. J. & Blair, S. N. (2013). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association, 116: 1094-105.

Neporentor, L. (2015). *Circuit training, exercise and program sport each.* www.brianmac.couk/circuit.htm.

Nieman, D. C. (2010). You asked for it: The merits of stretching. *ACSM's Health and Fitness Journal, 12(40), 5-6.*

Nissen–Meyer (2010). *Inter-relationships between variables in pulmonary gas exchange. Alta physical scand suppl., 54(183), 7.*

Ogu, O. C.; Agbanusi, E.C. & Umesiegbu, G. O. (2007). Survey of leisure time physical activity of Nnamdi Azikiwe University students. *Journal of ICHPERS.D. African Region, 2(2), 21-27.*

Orlander, J. (2010). *Time course of adaptation to low intensity training in sedentary men: Dissociation of central and local effect Acta physical scand.,* 108: 85-90.

Overturt, B. S. & Knauitz, L. (2010). Circuit training periodized resistance training in women. *Medicine and Science Sport Exercise, 33(4), 635 - 643.*

Owolabi, E. O. (2011). *An investigation of selected physical psychological and motor performance requirements of volleyball players.* United Kingdom: Unpublished doctoral thesis, University of Birmingham.

Parkey, R.V. (2014). *Physical fitness: The lead way to health.* St. Louis: C. V. Mosby.

Paoli, A; Pacelli, Q. F.; Moro, T.; Marcolin, G. & Bianco, A. (2013). Physiological effects of high intensity circuit training, low intensity circuit training and endurance training on blood pressure.

Passmore, R.; Strong, J. & Ritchie, F. (2008). *The chemical composition of the tissue lost by obese patients on a reducing regimen. Brit. J. Nutr. 12,113.*

Paxen, W. A & Hallin, B. D. (2011). *Understanding your health,* 8th edition. St Louis: Mc-Gram Hill.

Pexe, C.; Crova C.; Cereatti, L.; Casella, R. and Bellucci, M. (2012). *Physical activity and mental performance in pre-adolescents effects of acute exercise on free-recall memory mental health and physicals activity,* 2:16 - 22.

Physical fitness norms for college freshmen. *Res Quart. 48(2): 4999 - 503.*

Physical fitness. http:allenwikipedia.org/wiki.ND.

President's Councils on Physical fitness and Sports (2011). www.fitness.gov.

Prokenpek, A. (2012). *NASM ELITE Trainer*. www.sharecolre.com

Pius, B. (2014). Circuit training. http://www.bodybuilding.com.ND

Pokins, D. (2010). *Taking steps towards* increasing physical action. Phoix A2. U.S.A: Today.

Qunn, E. (2014). Composition versus body fat. http.//sports.medicine.about.com/c.s/body. complalaa090299a.htm. Retrieved on 20th June, 2015.

Ripple L, G. (2009). Your guide to physical activity for health. New York: Metropolitan Book.

Qunn, E. (2014). *Sports medicine. www.sportsmedicineabout.*com. Exercise science basics. ND.

Robin, C. B. (2014). Towards a uniform definition of wellness: A commentary.

Rockey, V.R. (2012). *Physical Fitness, Circuit Training Fitness and Sports Magazine, 21(4), 1-6*.

Roriter, I. (2012). *Measurement concept in physical education.* St. Louis: C.V. Mosby Co.

Rosenstock, I.; Stretcher, V. & Becker, M. (1994). *The health belief model & HIV risk behaviour change.* In R. J. Dichemente and J.L. Peterson (Eds.)

Rowley, A. & Frank, S.D. (2010). *Health fitness instructions handbook,* Champaign I.L: Human kinetics. New York: Harper Row Publishers.

Scot, J. R. (2014). What is body composition? About.com. health. weight loss

Scott, J. (2014). Weight loose.about.com. How to loose weight (basics) weight loss glossary.

Sharkey, B. J. (2012). Fitness and health campaign. Human kinetics, ISBN 07036039716

Shaw, B. S.; Shaw, I. & Brown, G, A. (2012). Effect of resistance training on total, central and abdominal adiposity. *South African Journal Research in Sport Physical Education and Recreation, 31(2), 90 - 108.*

Sinning, W. F. (2009). Physiology of muscular activity. Philadelphia: W.B. Saunders Co.

Sorace. P. (2010). Pheripheral arterial disease. ACSM's Health and fitness Journal 14 (1): 16-22.

Spain, C. G. (2012). Physical activity and fitness. *President Council on Physical Fitness and Sport Research Digest*, 80(60), 801.

Stephens, J. P. (2014). *Physical activity fitness and health Champaign*. Human kinetics.

Study.com (2013). *Stretching and exercise study*.com academy/lesson/theflexibility.

Sultan, B. (2010). *Response to exercise after bed rest and after training: A longitudinal study of adaptive changes in oxygen transport and body composition circulation* 37, 38: supply, VII: I – 78.

Sutton, B. (2013). NASM Elite trainer. Sports medicine. www.sharecare.com. Retrieved on 18th July, 2015.

Thacker, S. B.; Gilchrist, J.; Stroup, D.F. and Kinsey, C.D.J. (2014). The impact of stretching on sports injury risk: A systematic review of the literature. *Med Sci. Sports Exerc. 36:371 – 8.*

The President's Council on Physical Fitness and Sports (2011). *Definition of health related fitness.* www.myfitnessroad.com.ND.

Thomaidis, S. P. (2009). J. Sports med. phys-fitness. www.Nchr.Nim.Nih.Gov/pubmed/19528853.

Thomas, J. R. & Nelson, J. K. (2001). *Research methods in physical activities* (ed). United States of America Human Kinetics.

Topend Sports (2014). *Sports definition of flexibility and muscular endurance.* www.topedsports.com/fitness/flexibility/muscular.endurance.

Total Fitness Guide (2010). Flexibility of a component of fitness. *Journal of Health and Fitness 48 (6)9-12.*

Towin, T. (2012). Share Care Fitness Expert. www.sharecare.com.

Ucan, J.(2014). "*Effects of circuit resistance training on body composition*: And bone status in women. United status sports academy in contemporary sports.

United States National Library of Medicine (2015). Definitions.net. http: (www. definitions. Net/ definition/physical fitness >.

Udo, J. O. (2007). *Women and physical fitness: Dynamic of physical fitness.* Oshogbo: Adegbara Publishers.

Uzoagwu, A. E. (2011). Practical guide to writing research project: Reports in territory institutions. Enugu: John Jacobs.

Uzoka, P. I. (2014). *Contemporary biology for senior secondary school*. Nigeria: Otuson Nig. Limited. ISBN: 978-050-723.

United States of American Department of Health and Human Services (2011). Physical activity and health: A report of the surgeon general, 12, 174 - 182.

Verci, F. M (2012). *Measurement concept in physical education*. St. Louis: C.V. Mosby Co.

Verma, S. K.; Sidhu, L. S. & Kansau, D. K. (2009). *Br. J. sports Med Arr. 113 (1) 224-28.*

Wails, K. & Dallon, E. (2010). *The sit and reach test of back and leg flexibility.* Res. Quart. 23, 115-118.

Wicken, T. (2014). NASM Elite trainer. www.sharecare.com.

www.wisegeek.org. (2013). What is cardio-vascular fitness. www. wisegeek. Org.

Welk, .R. (2014). *Facolotated stretching,* 3rd edition. Champaign, I.L: Human kinetics.

Womens health. www.womens health mag. Com /fitness/ S. way. To- boast- your endurance. ND.

www.dummies.com /how-to/content/ what is circuit training.

Willker, B. (2013). *Circuit Training and circuit training Routines.* http:// the stretching handbook.com/newsletter. ND.

Wevers, L. (2009). *Effects of task–oriented circuit class training on walkiness competence after stroke. Aha journal.org 12450.*

Wiersman, W. (1991). *Research method in education,* 5th edition. Boston: Allyn and Bacon.

Wisegeek.com (2014). *What is flexibility*? www.wisegeek.org/what-is-flexibility-htm.ND.

APPENDIX I

Physical Activity Readiness Questionnaire (PAR-Q)

Dear Participants,

The purpose of this questionnaire which was developed by Canadian Society for Exercise Physiology, Canada is to determine your physical activity level which will tell you if you should check with your doctor before beginning an exercise programme. All your responses are purely for research purpose and information supplied shall be treated as confidential. Please read the questions carefully and each one honestly tick Yes or No.

SECTION A: **Personal Data**

Name:_____

Name of School:_____

Age:_____

Marital Status:_____

Educational Qualification:_____

SECTIONB**:**

Yes	No	Question
		Do you feel pain in your chest when you do physical activity
		In the past month, have you had chest pain when you were not doing physical activity
		Do you lose your balance because of dizziness or do you ever lose consciousness?
		Is your doctor currently prescribing drug (for example, water pills) for your blood pressure or heart condition
		Do you have a bone or joint problem that could be worse by a chance in your physical activity?
		Do you have any other physical problems that are of concern to you that will hinder you from participating in physical activity?

APPENDIX II

Schools Sampled for the Study

Anambra East:	Justice Chinwuba Memorial Secondary School, Aguleri.
	Father Joseph Memorial Secondary School, Aguleri.
Anambra West:	Community Secondary School, Umueze-Anam.
	Community Secondary School, Mmiata-Anam.
Ayamelum:	Ogbe High School, Anaku.
	Community Secondary School, Omor.

APPENDIX III

Coppers Normogram (Scoring Table)

Distance Covered (Miles)	Oxygen (Consumption (ML/kg/min)
Less than 1.0	Less than 25.0
1.0 to 1.24	25.0 to 33.7
1.25 to 1.49	33.8 to 42.5
1.50 to 1.74	42.6 to 51.5
1.75 miles or more	51.6 or more

(Data based on 17-52 years of age)

APPENDIX IV

Informed Consent Form

I _____ of _____

NAME **NAME OF SCHOOL**

After being briefed by the researcher and getting a thorough explanation, hereby express my willingness to participate in the research as a participant. I voluntarily submit myself to the constraints and control of the research procedure. I solemnly promise to abstain from the following till the end of the research or as may be demanded by the researcher.

1. Drugs
2. Taken meal within an hour before exercise period
3. Coming late to the exercise ground
4. Any form of vigorous exercise 24 hours to the exercise test.

I promise to abide strictly by the instructions provided by the researcher. I shall co-operate fully in the experiment and do my possible best to aid the researcher to collect reliable data for the research.

_____ _____

Participant Signature **Date**

APPENDIX V

Nomo-gram for the Determination of the Percentage of Body Fat

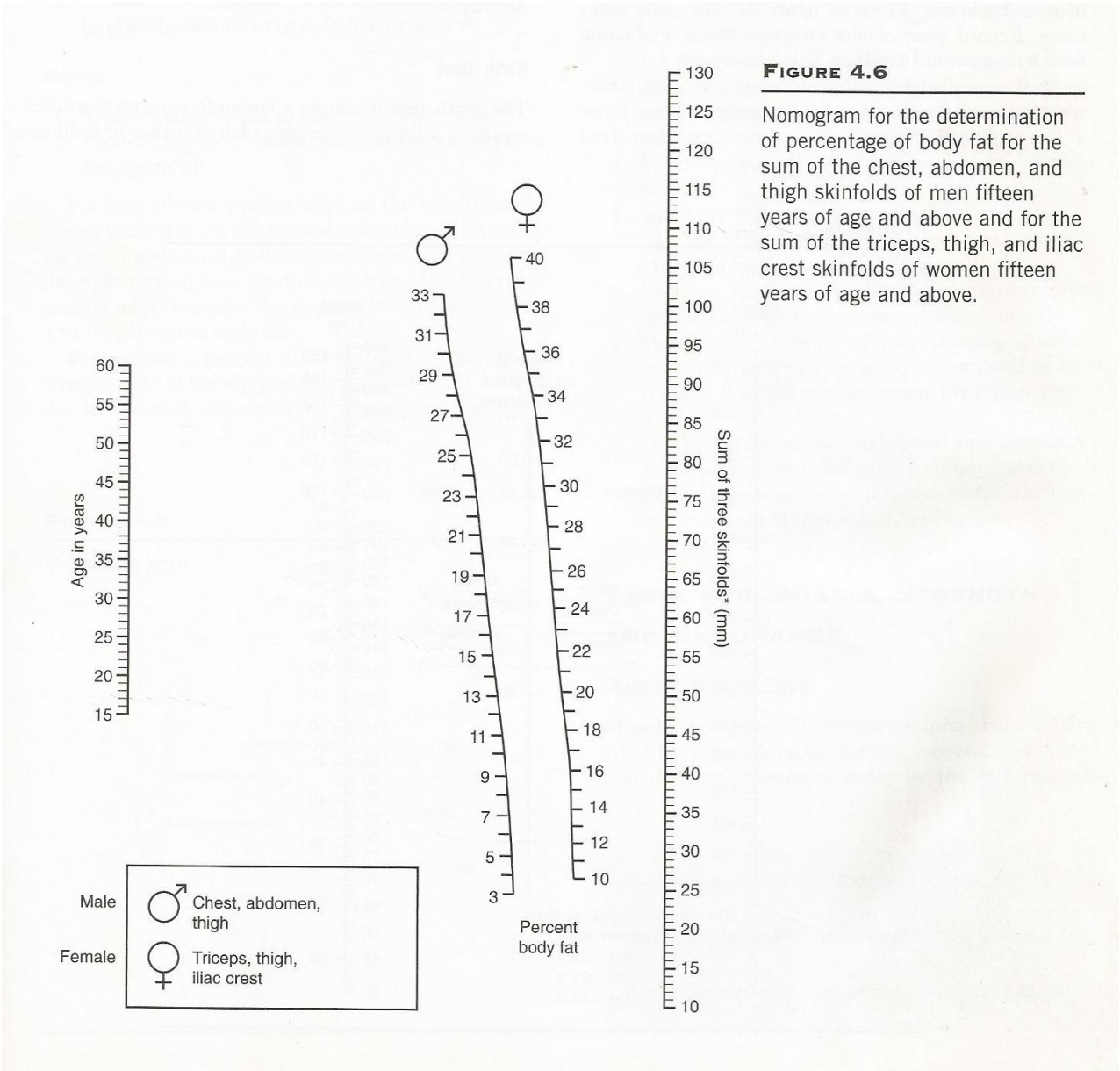


FIGURE 4.6

Nomogram for the determination of percentage of body fat for the sum of the chest, abdomen, and thigh skinfolds of men fifteen years of age and above and for the sum of the triceps, thigh, and iliac crest skinfolds of women fifteen years of age and above.

APPENDIX VI

Experimental Group Pre-Test Data

S/N	RESTING HR	RESTING S/R.P	RESTING D/BP	TRUNK FLEXIBILITY	ABDOMINAL ENDURANCE	BODY COMPOSITION	MAX V_{02}
1.	78	130	78	9.5	10	23	37.5
2.	96	120	78	13.2	15	24	35.0
3.	90	110	80	8.9	9	26	30.5
4.	74	118	88	14.5	7	30	47.3
5.	84	118	70	20.0	8	29	28.4
6.	78	108	78	14.0	9	27	20.4
7.	78	108	70	5.9	8	28	38.7
8.	78	104	60	5.0	10	30	25.1
9.	84	120	80	12.0	9	30	27.2
10.	66	110	78	10.8	10	27	30.4
11.	84	108	78	19.5	9	26	37.5
12.	66	120	90	18.0	4	24	39.4
13.	84	104	80	14.0	5	23	42.4
14.	78	118	88	13.2	11	2	35.6
15.	66	110	70	19.3	10	30	42.6
16.	78	120	80	12.5	13	28	33.9
17.	96	110	70	7.8	7	30	32.6
18.	90	98	60	19.2	5	30	45.9
19.	60	1124	80	15.0	9	24	38.7
20.	78	110	60	10.0	10	27	39.7
21.	96	112	70	14.0	11	17	39.7
22.	90	120	70	18.1	10	20	48.5
23.	78	118	78	15.5	13	28	37.6
24.	96	120	80	13.0	7	26	33.5
25.	72	110	88	13.0	7	26	20.5
26.	90	115	70	10.2	8	16	34.6
27.	84	110	78	9.1	10	29	37.6
28.	84	112	80	7.5	7	20	38.9
29.	82	104	60	12.5	10	27	39.6
30.	81	108	78	19.4	6	28	47.5

APPENDIX VII

Experimental Group Post-Test Data

S/N	RESTING HR	RESTING S/R.P	RESTING D/BP	TRUNK FLEXIBILITY	ABDOMINAL ENDURANCE	BODY COMPOSITION	MAX V_{02}
1.	80	134	78	10.5	15	23	37.5
2.	100	122	78	14.2	20	24	35.0
3.	96	112	80	8.9	10	28	30.5
4.	80	120	88	15.5	10	32	47.3
5.	86	120	70	20.0	10	32	28.4
6.	80	110	78	14.5	10	30	20.4
7.	80	110	70	5.9	12	30	38.7
8.	80	106	60	5.0	12	32	25.1
9.	84	124	80	12.5	11	32	27.2
10.	66	144	78	10.8	11	27	30.4
11.	84	110	78	20.5	11	28	37.5
12.	66	124	90	18.0	8	26	39.4
13.	84	106	80	14.0	8	28	42.4
14.	78	120	88	14.2	12	28	35.6
15.	66	116	70	19.3	12	32	42.6
16.	78	126	80	12.5	16	28	33.9
17.	96	114	70	8.8	8	30	32.6
18.	90	100	60	19.2	10	30	45.9
19.	60	126	80	15.0	11	26	38.7
20.	78	112	60	10.0	11	28	39.7
21.	96	124	70	14.0	12	19	39.7
22.	90	122	70	19.2	13	22	48.5
23.	78	120	78	15.5	15	30	37.6
24.	96	122	80	13.0	12	28	33.5
25.	72	112	88	13.0	10	26	20.5
26.	90	116	70	10.2	10	16	34.6
27.	84	112	78	10.1	11	29	37.6
28.	84	116	80	8.8	12	20	38.9
29.	82	106	60	12.5	11	27	39.6
30.	81	110	78	19.4	8	28	47.5

APPENDIX VIII

Control Group Pre-Test Data

S/N	RESTING HR	RESTING S/R.P	RESTING D/BP	TRUNK FLEXIBILITY	ABDOMINAL ENDURANCE	BODY COMPOSITION	MAX V_{02}
1.	80	24	90	11.2	7	28	28.0
2.	97	20	78	20.0	15	32	31.5
3.	92	100	70	5.0	9	30	26.9
4.	75	110	80	6.0	6	28	27.0
5.	83	118	80	11.3	7	27	27.2
6.	75	122	80	10.0	5	24	27.9
7.	77	110	70	15.2	8	23	32.7
8.	78	110	70	8.1	9	30	24.7
9.	85	120	70	10.7	8	30	27.0
10.	65	110	68	14.0	10	28	29.4
11.	84	118	72	18.0	9	27	24.4
12.	78	120	70	19.2	6	26	22.7
13.	67	100	68	16.0	7	30	26.2
14.	79	128	82	13.2	11	31	32.8
15.	95	120	70	11.2	9	28	35.0
16.	70	120	70	9.0	13	27	38.1
17.	75	126	80	12.5	4	25	36.2
18.	80	120	70	22.1	4	29	34.9
19.	94	120	70	18.3	7	20	27.6
20.	96	108	68	12.0	9	28	40.0
21.	79	120	64	6.8	10	28	35.0
22.	92	100	60	18.3	8	30	38.3
23.	76	110	70	14.0	10	25	28.3
24.	87	120	80	10.5	11	24	27.1
25.	84	120	80	13.4	6	28	27.2
26.	77	118	78	14.9	8	23	22.5
27.	85	100	70	15.0	9	24	36.0
28.	90	134	96	12.0	7	30	36.2
29.	64	120	64	12.1	8	31	33.8
30.	68	110	60	9.1	5	28	40.5

APPENDIX IX

Control Group Post-Test Data

S/N	RESTING HR	RESTING S/R.P	RESTING D/BP	TRUNK FLEXIBILITY	ABDOMINAL ENDURANCE	BODY COMPOSITION	MAX V_{02}
1.	86	124	96	11.2	7	28	28.0
2.	100	126	80	20.0	15	32	31.5
3.	100	116	76	5.0	9	30	26.9
4.	84	120	84	6.0	6	28	27.0
5.	86	126	86	11.3	7	27	27.2
6.	89	116	86	10.0	5	24	27.9
7.	84	120	86	15.2	8	23	32.7
8.	86	114	76	8.1	9	30	24.7
9.	88	124	76	10.7	8	30	27.0
10.	76	118	70	14.0	10	28	29.4
11.	88	120	76	18.0	9	27	24.4
12.	84	122	74	19.2	6	26	22.7
13.	76	120	72	16.0	7	30	26.2
14.	84	132	84	13.2	11	31	32.8
15.	104	126	76	11.2	9	28	35.0
16.	80	124	76	9.0	13	27	38.1
17.	80	130	84	12.5	4	25	36.2
18.	84	128	76	22.1	4	29	34.9
19.	96	126	76	18.3	7	20	27.6
20.	100	108	70	12.0	9	28	40.0
21.	84	126	70	6.8	10	28	35.0
22.	96	118	70	18.3	8	30	38.3
23.	80	128	74	14.0	10	25	28.3
24.	90	126	84	10.5	11	24	27.1
25.	88	124	86	13.4	6	28	27.2
26.	80	120	82	14.9	8	23	22.5
27.	90	138	76	15.0	9	24	36.0
28.	94	126	100	12.0	7	30	36.2
29.	70	114	70	12.1	8	31	33.8
30.	72	110	74	9.1	5	28	40.5