EFFECT OF BRISK WALKING ON ANTHROPOMETRIC INDICES AND PHYSIOLOGICAL CHARACTERISTICS OF OBESE ADULTS IN ILORIN METROPOLIS

By

Halimat I'ya ISMAIL-ORIRE

18/27/MKE003

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A THESIS SUBMITTED TO THE DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION, FACULTY OF EDUCATION, KWARA STATE UNIVERSITY, MALETE, NIGERIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF M.SC (Ed) DEGREE IN EXERCISE AND SPORT SCIENCE

APRIL, 2021

DECLARATION

I hereby declare that this Thesis titled, "Effect of Brisk Walking on Anthropometric Indices and Physiological Characteristics of Obese Adults in Ilorin Metropolis", Kwara State Nigeria, is my work and has not been submitted by me for any degree in this or any other tertiary institution. I also declare that as far as I am aware all cited works have been acknowledged and referenced.

_____

Halimat I'ya ISMAIL-ORIRE Date

CERTIFICATION

This is to certify that this study was carried out by Halimat I'ya ISMAIL-ORIRE and has been read and approved as meeting part of the requirements for the award of M.sc (Ed) Degree in Exercise and Sport Science in the Department of Human Kinetics and Health Education, Faculty of Education, Kwara State University Malete, Nigeria.

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DEDICATION

This work is dedicated to Almighty Allah for His absolute guidance and protection.

ACKNOWLEDGEMENTS

I sincerely appreciate my Supervisor Dr. R.O. Ajayi for his useful corrections and contribution during the reading of the manuscripts. Out of your tight schedules, you created time to support me. Indeed you are “father for all” thank you sir.

I equally appreciate all the departmental lecturers for nurturing me to be self-dependent and for your relentless efforts to ensure that my project was a success, most especially, Dr. Y. I. Ajeigbe, who also doubles as the Head of Department, Dr. U.T. Saadu, Dr. J. S. Mamman and Mr. Alabidun Mujib. Special thanks to Dr. S. T. Bakinde for your expert contribution, am grateful to you sir. To my mentor and a father in his own right Dr. Ibrahim Laro Abubakar, I cannot thank you enough sir. I specially acknowledge Prof. M. B. Gambari for being a role model and somebody who is always ready to assist when the need arises, I appreciate you sir, may God continue to be with you in your day to day activities.

Special thanks to the Kwara State University Malete (KWASU) for providing an enabling environment for my study. My sincere appreciation also goes to all my participants that have taken part in this project, even though I may not be able to mention all your names based on the confidentiality agreement, without you, this project would not have been a success. All my research assistants, thank you very much. To my colleagues in the department for their support and understanding during the thick and thin, you are wonderful.

To my lovely parent Alhaji Muritala A. Orire and Alhaja Baliqis Orire, I will forever be happy that I came through you, my siblings Abdulmajeed you are my hero, Abdulfatai you are my boy forever, my cousin sisters, I say thank you for being there for me always. This acknowledgment will be incomplete without appreciating my supportive husband Dr. Saka Ismail Agboola and lovely children (Khalid, Farid, Aisha & Khadijah) to you my family, I love you all.

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Abstract

Brisk walking is regarded by many fitness experts as the most convenient, safe and inexpensive form of exercise especially for older and unfit people such as obese individuals; It also has numerous health benefits ranging from keeping one's heart in a healthy shape and to help in the process of weight management. The purpose of this study is to determine the effect of brisk walking on anthropometric indices (body weight, body mass index, lean body weight, body density and percent of body fat) and physiological characteristics (systolic and diastolic blood pressure and heart rate) of obese adults in Ilorin metropolis.

One group pretest-posttest experimental research design was adopted for the study, the population comprises of 70 obese adults, males and females between ages 25-49 years in Ilorin metropolis. The research instruments were standardized equipment (stadiometer, stethoscope, weighing scale, stopwatch, meter rule, skinfold caliper and sphygmomanometer). The participants were required to brisk walk 3 times a week and 70 minutes per session at an intensity of 40-70% of their respective age-predicted maximum heart rate for 8 weeks. Descriptive statistics of anthropometric and physiological parameters data form were used to collect data for the study. percentage, mean and standard deviation were used to describe the demographic data while the two null hypotheses formulated were tested using parametric statistic of Analysis of Covariance (ANCOVA) at 0.05 level of significance. Anthropometric indices and physiological characteristics were measured at pre and post exercise interventions.

The findings revealed that there were significant effect of brisk walking ($P<0.05$) in body weight, BMI, lean body weight, body density, percentage of body fat and physiological characteristics. Hence, it was concluded that brisk walking for 8 weeks was appropriate exercise for obese adults considering the effects on the anthropometric and physiological parameters.

Based on the findings, the study concludes that there were significant effects of brisk walking on body weight, Body Mass Index, lean body weight, body density, percentage of body fat, systolic blood pressure, diastolic blood pressure and heart rate of obese adults in Ilorin metropolis. It is recommended that the findings of this study should be adopted by Physical Education teachers, Health trainers and Fitness experts for prescribing the brisk walking programme for the adults and by extension different age groups in Ilorin metropolis. There should also be periodic data collection on obesity and overweight to update and evaluate the obesity and overweight situation in Ilorin Metropolis.

Keywords: Brisk walking, Anthropometric Indices, Physiological Characteristics, Obese Adults.

Word Count: 399

CHAPTER ONE

INTRODUCTION

Background to the Study

Obesity has assumed an alarming rate globally and has become a global health problem. The problem is now growing fast in many middle and low-income countries and Nigeria is not left out. Obesity rates have quadrupled in adults and doubled in children in the past 30 years (Ogden, Carroll, Kit, & Flegal, 2014). World Health Organization (WHO, 2016) defined obesity as a condition in which excess body fat has accumulated to such an extent that health may be adversely affected. Obesity can be measured using simple parameters such as Body Mass Index (BMI) and Waist Circumference (WC); these parameters also had association with health risk indicators (Booth & Lee, 2006). Excess body fat produces severe adverse consequences on health, such as high blood pressure and changes in lipid profile, when these factors are combined, predisposes to chronic non-communicable diseases such as type 2 diabetes mellitus, osteoarthritis, some form of cancers and cardiovascular disease (Lunard & Petroski, 2008).

Aarthy (2010) noted that in the middle and low-income countries, with increasing urbanization, mechanization of jobs and transportation, availability of processed and fast foods, and dependence on television for leisure, people are fast adopting less physically active lifestyles and consume more of junk diets. Some of these have impacted changes on dietary practices and participation in physical activity. While many factors contribute to the development of obesity, an imbalance between energy intake and energy expenditure is implicated as a major factor. A lack of physical activity is suggested to play a role in the gradual weight gain that leads to obesity, as obese individuals may not spend as much time being physically active compared to their non-obese peers. (Lunard & Petroski, (2008).

Walking is considered the most common form of physical activity among adult which is easily adoptable, convenient and relatively safe among other forms of exercise. Furthermore, brisk walking is a preferred mode of exercise for the elderly, it is ideal because it does not require any special equipment, since it can be done anytime and anywhere. Ayushveda (2008) affirmed that walking is one of the most relaxing, refreshing and enlivening form of exercise which reaps numerous physical, emotional and psychological benefits. The study asserted further that to stay fit and healthy, one does not need to spend fortune on gymnasium facilities as the natural way of remaining healthy can be achieved by indulging in the healthy practice of brisk walking. Brisk walking has been well researched in literature, the identified health benefits range from keeping one's heart in a healthy shape, to helping in the process of weight management.

Furthermore, walking helps in refreshing and rejuvenating the mind as well as reducing stress and fatigue. Brisk walking implies picking up a pace which is faster than normal leisure speed but it something that is not exhausting. Thus, for an individual to reap the numerous benefits of brisk walking, such a person should pick up a pace which is fast, involving the work out of the entire body but that pace should be within comfortable range and should not result in exhaustion over a short distance.

Frequently cited barriers to exercise have been identified to include lack of time and the belief by individuals that they are not the sporty type. Indeed, walking has been described as the nearest activity to perfect exercise. Brisk walking is a popular and convenient form of exercise that plays an important role in weight loss and weight management. It is often recommended for obese individuals because; it increases energy expenditure (Browning & Kram, 2005). Brisk walking is considered by many fitness experts to be 100 steps per minute or 3 - 4 miles per hour. A brisk pace is relative since it refers to level of exertion which depends on individual fitness level.

The American College of Sports Medicine (ACSM, 2017) classified walking at a brisk pace of approximately 3 - 4 miles per hour with raised heart and breathing rate as brisk walking. According to Mason (2010), if everyone were to walk briskly, 30 minutes a day, we could cut the incidence of many chronic diseases by 30- 40%. The brisk pace is related as a moderate-intensity exercise and because of this it has great sustainability for people of all ages. Furthermore, it delivers an adequate amount of perceived exertion for most people. This means that brisk walker's feel physically and mentally challenged enough that they do not become bored. Each walk is a rewarding exercise for mind and body.

Krishnakant (2013), explained that there are innumerable benefits of brisk walking, especially for obese people, as it helps them greatly in increasing their weight loss programme. Brisk walking helps to fight against stress, by providing complete relaxation to mind. It protects the participants from the clutches of diseases like osteoporosis, colon cancer, constipation to mention but few. It increases the longevity of life, by maintaining fitness. It helps in reducing the problem of depression, thus enabling to derive mental peace. It relieves backache and also acts as a potent remedy for arthritis. It also helps in increasing flexibility by strengthening the muscles, bones and joints, thereby toning the body. Above all, it facilitates proper sleep at night. Brisk walking also enhance positive changes in body composition, body weight and lipid metabolism.

Brisk walking as a means to overcome obesity has been proposed as a modality for the overweight and obese individuals by previous researchers (Ford & Swaine, 2012). Therefore, walking has been proposed as an ideal way for the overweight and obese individuals to begin an exercise programme since it can be performed with minimal instructions or equipment and is cost effective.

Anthropometry is a science of measuring human body part or segment in order to ascertain the average dimensions of the human body form at different ages and in different

division of races, classes among others (Abubakar, Dominic, Adeoye & Abubakar, 2017). Ross and Marfell- Jones, (2004); Abubakar, et.al, (2017) describe Anthropometry as the measurement made of various parameters of the human body such as physical characteristics, body composition and circumference of various body parts. Anthropometric characteristics are traits that describe body dimensions, such as body weight, girth, height and body fat composition. The physical therapist uses test and measurements to quantify anthropometric traits and compare an individual current data with his or her previous data or with relevant predictive norms (Duncan& woodfield, 2006; Abubakar, Abubakar & Adeoye, 2019).

The core elements of anthropometry are; height, weight, Body Mass Index (BMI), body circumference (waist, hip) and skinfold thickness, these measurements are important because they represent diagnostic criteria for Obesity, additionally anthropometric measurements can be used as a base line measure for physical fitness and to monitor the progress of fitness (Sebo, Herrmann & Haller, 2017).

A large number of diseases caused by obesity and a higher percentage of fat which accompanies obesity represent a significant problem that has caught the attention of sports nutrition specialists and sports professionals, this has made them to be more interested in dealing with the issue of reducing fat percentage in the body and determining the effects of training on the changes in the body composition. BMI is considered to be the most popular of all the indices of anthropometric measurements and is calculated by dividing a person's weight in kilograms (kg) by the person's height in meters squared (m^2). The World Health Organization (WHO, 2016) used BMI to classify individuals as underweight (BMI less than 18.5), normal weight (BMI) of 18.5 - 25.0 kg/m^2, overweight (BMI) of 25.0 – 29.9 kg/m^2 or obese as (BMI) of equals or greater than 30 kg/m^2. Although technology may eventually advance to replace anthropometry on some level, however, Hiremath, Ibrahim, Prasanthi, Reddy, Shah and Haritha, (2017) found that the anthropometric measures of waist

circumference (WC) and hip circumference (HC) are superior to ultrasound to assess for regional adiposity, as regional adiposity is critical in the definition of metabolic syndrome.

As obesity has become a significant health problem, numerous interventions have been implemented to reduce the incidences in obese adults and children. Kelley, G. A., & Kelley, K. S. (2013) submitted that there is little evidence to suggest that physical activity alone elicits reductions in BMI, body weight, and central obesity in overweight and obese children However, Wittmeier Mollard, and Kriellaars, (2008) found that daily physical activity consisting of at least 45 minutes of moderate intensity and 15 minutes of vigorous intensity effectively reduced both body fat and BMI.

Recent recommendations suggest that adults should exercise in a continuous or intermittent fashion (minimum of 10-minutes bouts) for 20–60 minutes, 3–5 days per week at 55– 90% of maximum heart rate (Pollock, Gaesser, Butcher, et al. 1998). Much research concerning walking interventions has assessed the effects of training typically 4 or 5 days per week for 30–60 min (Murphy et al., 2002; Asikainen, et al. 2002). However, to the best of researchers' knowledge, not much had been done on the efficacy of walking at the minimum ACSM recommendations, that is, 20 minutes on 3 days of the week especially in Nigeria. Considering lack of time as a major barrier to exercise, an exercise prescription that delivers benefits with minimum time investment is considered attractive. The delineation of a minimum exercise prescription might also be helpful in motivating participants to adopt a healthier lifestyle. This partly constitute a concern for this study.

The focus of the present study, therefore, is to evaluate the effectiveness of brisk walking on the anthropometric indices and physiological parameters of obese adults in Ilorin metropolis, Kwara State. Traditionally in Kwara State, obesity is culturally and socially acceptable and not usually recognized as a medical problem (Iloh, et al. 2011) Based on general perception, obesity is viewed as a sign of wealth and power in many parts of Kwara State. In some cultures in Nigeria, prospective brides are kept in 'fattening' rooms for months

to make them fat enough and more appealing to their prospective grooms. A good understanding of the epidemiology is needed to tackle the scourge of obesity and overweight. The 2013 demographic health survey reported obesity prevalence rate of 25% for women in reproductive age (15- 49 years), with an urban prevalence rate of 33% and rural prevalence rate of 18% (Nigeria Demographic Health Survey, 2014). Nigeria has a double burden of under-and over-nutrition and this brings additional challenges to the country's health system (Kandala, & Stranges 2014). In summary, reliable data on obesity in Nigeria is sparse. The few available data suggest a double burden of under-nutrition and over-nutrition, Obesity prevalence is in epidemic proportions in the well-urbanized cities of Nigeria (Nigeria Demographic Health Survey, 2014).

Statement of the Problem

The problems of obesity are caused by a chronic imbalance between energy food intake and actual energy food needs of the body. According to World Bank report, 2020 on Obesity; Health and Economic consequences of an impending global challenge, it was reported that 2 billion people are affected globally as of 2016, and 70% of the affected 2 billion Obese are found in low- or middle-income countries. World Health Organization (WHO) 2016, report that Obesity account for four million deaths worldwide with increasing prevalence in low and middle income countries particularly in urban settings and Sub-Saharan Africa.

For substantial health benefits, it has been recommended that adults should do at least 150 minutes (two hour and 30 minutes) to 300 minutes (five hours) a week of moderate- intensity, or 75 minutes (one hour and 15 minutes) to 150 minutes (two hours and 30minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate physical activity- and vigorous physical aerobic activity. Preferably, aerobic activity should be spread throughout the week (Office of Disease Prevention and Health Promotion in the US, 2009).

In addition, many researches have been conducted on the effect of dietary intakes especially too much energy given food and fats as a factor that promote overweight and obesity in individual and recommendations suggested that people should watch their dietary intakes to reduce the incidence of obesity but despite the adherence to these recommendations, obesity still account for higher death rates worldwide. This therefore create gap which this research tend to fill and prompted the researcher to evaluate the effectiveness of brisk walking on anthropometric and physiological characteristics of obese adults in Ilorin metropolis as a means of reducing the incidence in our society.

Previous researches have looked into ways by which vigorous intensity exercise can reduce excess fat in obesity, as well as single parameters of the physical and physiological characteristics of obesity, However, there are paucity of documented researches that examined the effect of moderate intensity of physical activity on both the anthropometric and physiological indices of the obese individuals in Ilorin metropolis. This is the gap this research intended to fill by trying to look at the effect of brisk walking on the anthropometric indices and physiological parameters of obese adults in Ilorin metropolis.

Purpose of the Study

The general purpose of the study was to determine the effect of brisk walking on Anthropometric indices and physiological characteristics of obese adults in Ilorin metropolis**.**

The following specific purposes were set for this study:

1. To find out the effect of brisk walking on the anthropometric variables of body weight, body mass index, body density and percentage body fat of obese adult in Ilorin metropolis.
2. To find out the effect of brisk walking on the physiological variables of systolic blood pressure, diastolic blood pressure and heart rate of obese adults in Ilorin metropolis.

Research Hypotheses

The following hypotheses were formulated to guide this study;

Ho1. There is no significant effect of brisk walking on the anthropometric variables of body weight, body mass index, lean body weight, body density and percentage body fat of obese adults in Ilorin metropolis.

Ho2. There is no significant effect of brisk walking on the physiological variables of systolic blood pressure, diastolic blood pressure and heart rate of obese adults in Ilorin metropolis.

Significance of the Study

The finding of this study would be a guideline for teachers, exercise therapists and trainers including regular walkers to plan and develop effective walking schedules. This could significantly help any obese individual to reduce weight by burning excess body fat as well as better weight maintenance. Also, the finding would provide useful information to obese adults, especially on brisk walking as a form of aerobic exercise to achieve cardiorespiratory fitness as well as improvement in the risk factors for other non-communicable diseases and general health conditions. In addition the findings would help fitness instructors in developing a structured brisk walking regimen that will assist their clients to reduce fat mass.

The outcome of this study would also educate the general populace whether old or young, healthy or unfit on how to check their fitness and risk level, and also to be aware of moderate intensity exercise that is safe and very cheap to practice in order to stay healthy and also achieve cardiorespiratory fitness with little effort. The outcome of the study may be useful to form the basis for inclusion of brisk walk as part of the general physical exercise for conditioning.

The findings of this study would be published in reputable journals for wider publicity where obese individuals, fitness instructors, general populace and various researchers would find it handy for reference purposes.

The findings from this study would contribute to the existing body of knowledge in Exercise science and fitness, Equally, it would be useful for reference purpose for researches, especially while studying related topics.

Delimitation of the study

This research was delimited to those variables that are realistically achievable within the scope of research, available resources in terms of equipment, time and level of study of the researcher. It was based on these points that the study was restricted to the effect of brisk walking on the anthropometric indices such as; Body Mass Index (BMI), Lean Body Weight (LBW), Percentage of body fat as well as physiological characteristics such as; Heart rate, Systolic blood pressure and Diastolic blood pressure.

The study population are obese adults in Ilorin metropolis and duration of the study was also limited to eight (8) weeks.

Operational Definitions of Terms

The following terms were defined according to as used in this study:

Brisk walking- is a form of walking at a brisk pace of approximately 3-4 miles per hour with raised heart and breathing rate.

Obesity is abnormal or excessive fat accumulation that may impair health, and whoever is found with such condition is regarded as being obese.

Body Mass Index (BMI) is a simple index of weight for height that is commonly used to classify overweight and obesity in adults. This is defined as a person's weight in kilograms divided by the square of his height in meters (kg /m^2) BMI greater than or equal to 25 is overweight, BMI greater than or equal to 30 is obesity.

Anthropometry: is a science of measuring human body part or segment in order to ascertain the average dimensions of human body form at different ages and in different division of races, classes among others.

Anthropometric variables: refers to weight, BMI, waist circumference, hip circumference, skinfold thickness (bicep, triceps and subscapular) found in obese adults, these measurements are important because they represent diagnostic criteria.

Physiological Characteristics: These are referred to as the various physical attributes, things which cannot be seen, touch and felt, these include non-performance components of physical fitness that relate to biological systems that are influenced by one's level of habitual physical activity. It differentiates health-related measures which are primarily performance measures from non-performance measures e.g. systolic and diastolic blood pressure and heart rate in the obese adults.

Adult- This is defined as a mature, fully developed person in biological term, however, in human context the term adult additionally has meanings associated with social and legal concepts.

Ilorin Metropolis- consists of three local government areas namely; Ilorin East, Ilorin South and Ilorin West.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter focuses on review of related literature that are relevant to this study, these was discussed under the following sub-headings;

Theoretical Framework of the Study

- Foresight theory of tackling obesity, 1997 by Richard Slaughter

Conceptual Framework of the Study

1. Definition and Measurement of Obesity
2. Epidemiology of Obesity among Populations
3. Causes of Obesity
    a) Dietary Factors
        i. Energy intake
        ii. Energy expenditure
    b) Genetic Factors
    c) Built Environment Factors
    d) Socioeconomic Factors
    e) Cultural Factors
4. Classification of Obesity
5. Prevention of Obesity
6. Management of Obesity
    a) Lifestyle modification
    b) Drug therapy
    c) Surgery

7. Concept and Impact of Physical Activity on Brisk Walking and Management of Obesity

    a) Physical activity level and its impact on Obesity.

    b) Physical activity and weight control.

    c) History of Aerobic exercise.

    d) Aerobic Exercise and Obesity

    e) Intensity of Brisk walking

    f) Frequency and Duration of Brisk Walking

8. Concept of Anthropometry and Brisk Walking

    a) Brisk walking and body weight

    b) Brisk walking and the effect on body mass index

    c) Brisk walking effect on percentage of body fat and body composition

    d) Brisk walking and blood pressure management

9. Empirical reviews on effect of brisk walking on reduction and management of Obesity.

10. Appraisal of reviewed literature.

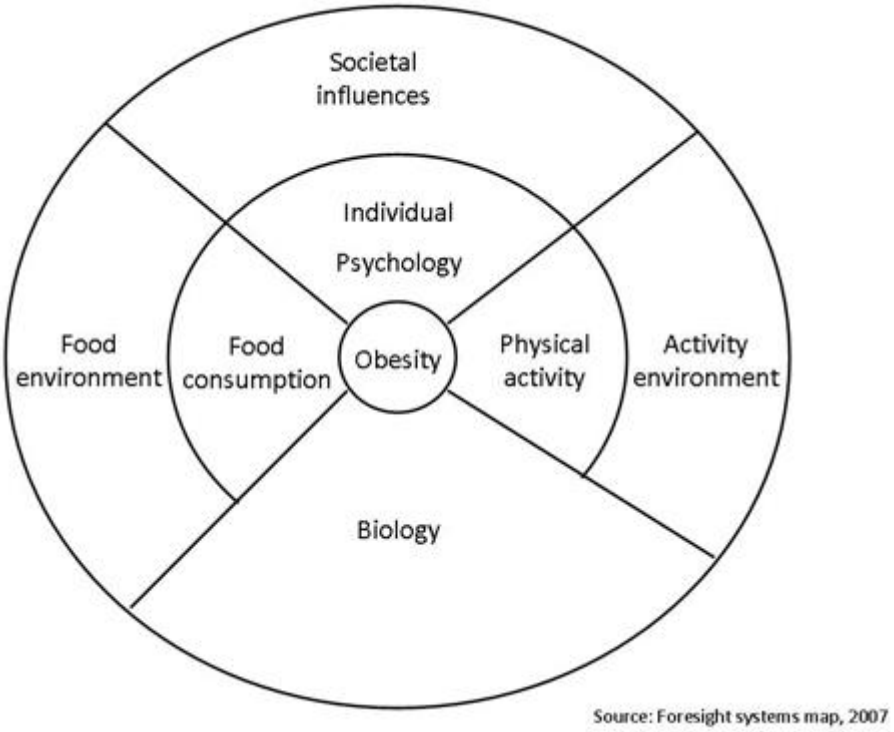
Theoretical review

Foresight theory of Tackling Obesity

Understanding the causes of obesity is critical to the success of prevention and treatment strategies. However, while obesity occurs when energy intake from food and drink consumption is greater than energy expenditure through the body's metabolism and physical activity over a prolonged period (resulting in the accumulation of excess body fat), in reality many complex behavioural and societal factors contribute systemically to the current crisis and no single influence dominates.

The Foresight report refers to a "complex web of societal and biological factors that have, in recent decades, exposed our inherent human vulnerability to weight gain", and presents an obesity system map with energy balance at its Centre and over 100 variables directly or indirectly influencing this energy balance; grouped in 7 cross-cutting themes (below):

Adapted from foresight, 2007



Biology: an individual's starting point - the influence of genetics and ill health;

Activity environment: the influence of the environment on an individual's activity behaviour, for example a decision to cycle to work may be influenced by road safety, air pollution or provision of a cycle shelter and showers;

Physical Activity: the type, frequency and intensity of activities an individual carries out, such as brisk walking, cycling, and hiking vigorously to work every day;

Societal influences: the impact of society, for example the influence of the media, education, peer pressure or culture;

Individual psychology: for example, a person's individual psychological drive for particular foods and consumption patterns, or physical activity patterns or preferences;

Food environment: the influence of the food environment on an individual's food choices, for example a decision to eat more fruit and vegetables may be influenced by the availability and quality of fruit and vegetables near home; and,

Food consumption: the quality, quantity (portion sizes) and frequency (snacking patterns) of an individual's diet.

The Government supports the Foresight view in UK, so also should be supported in Nigeria that's while achieving and maintaining calorie balance is a consequence of individual decisions about diet and activity, our environment (and particularly the availability of calorie-rich food) now makes it much harder for individuals to maintain healthy lifestyles – and that it is for Government, local government and key partners to act to change the environment to support individuals in changing their behaviour. Obesity takes time to develop and excess weight takes time to be lost. The risks of becoming obese may also start at an early stage. Growth patterns in the first few weeks and months of life affect the risk of later obesity and chronic disease. There is therefore a life-course component.

Current obesity problem in the UK as the result of 'societal, technical and ideological change' in the last half-century since the end of World War II and, while acknowledging that the present situation is partially a result of a culture in which highly calorific food is available at pocket money prices and technological advances that have made us a more sedentary nation, note also that: 'the culture of clever and constant advertising flattering choice; the shift from meal-time eating to permanent grazing; the replacement of water by sugary soft drinks; [and] the rising influence of large commercial concerns framing what is available and what sells' has powerfully contributed to the growing obesity problem (Bryony; Susan; Peter; Klim; Sandy; Jane & Vivienne 2007).

Relevance of the Foresight Theory to Obesity

Nigeria has become a nation where being overweight has become usual, rather than unusual. The rate of an increase in overweight and obesity, in children and adults, is striking. Obesity threatens the health and well-being of individuals and will as well place an intolerable burden on an individual with the risk factor in terms of health costs, on employers through lost productivity and on families because of the increasing burden of long-term

chronic disabilities and more (Bryony, et.al 2007). Obesity is a consequence of abundance, convenience and underlying biology. It might also be viewed as the perverse outcome of constantly expanding 'choice'. What is certain is that this epidemic of 'passive obesity' is unlikely to come to a natural end, i.e. without intervention. Obesity presents society with a number of tough choices about the relative importance of different goals and aspirations. Obesity, like climate change, is a complex problem but it is not insoluble. At present the best current scientific advice suggests that solutions will not be found Foresight Tackling Obesities: Future Choices Project 18 in exhortations for greater individual responsibility, nor in short-term fragmented initiatives. Tackling obesity is fundamentally an issue about healthy and sustainable living for current and future generations. This is only likely to be achieved if there is a paradigm shift in thinking, not just by Government but by individuals, families, business and society as a whole (Bryony, et.al 2007).

There is therefore an urgent need for leadership, vision and above all, sustained commitment of exercise such as brisk walking, aerobic dance, stretching and cycling among others. The case for action can be strengthened by identifying potential synergies and complementarities with other policy goals, such as climate change, to provide multiple benefits. Alignment with other issues is crucial if the prospect of 60% of the Nigerian population are being obese in less than 50 years, with its attendant costs, is to be prevented from becoming reality. The Nigerian has the opportunity to build on existing action and pioneer a new long-term integrated approach of exercise and fitness goal that sets a global standard for success.

Definition and Measurement of Obesity

Obesity occur when excess fat accumulation (regionally, globally, or both) *increases risk to health*. It is the point at which health risk is increased that is most important because, as covered below, body weights and fat distributions that lead to expression of co-morbid diseases occur at different thresholds depending on the population.

Ideally, an obesity classification system would have the following characteristics: it would be based on a practical measurement widely available to providers regardless of their setting; it would accurately predict health risk (prognosis); and it could be used to assign treatment strategies and goals. The most accurate measures of body fat (the major component of body weight responsible for adverse outcomes) such as underwater weighing, dual-energy x-ray absorptiometry (DEXA) scanning, computed tomography (CT), and magnetic resonance imaging (MRI) are impractical for use in everyday clinical encounters. Estimates of body fat including body mass index (BMI, calculated by dividing the body weight in kilograms by height in meters squared, or kg/m^2) and waist circumference do have limitations compared to these imaging methods, but still provide relevant information and are easily implemented in a variety of practice settings.

Unwanted weight gain leading to overweight and obesity has become a main driver of the global rise in non-communicable diseases and is itself now considered a non-communicable disease. Because of the psychological and social stigmata that accompany being overweight and obese, those affected by these conditions are also vulnerable to discrimination in their personal and work lives, low self-esteem, and depression. These medical and psychological sequelae of obesity contribute to a major share of current health-care expenditures and generate additional economic costs through loss of worker productivity, increased disability, and premature loss of life.

The recognition that being overweight or obese is a chronic disease and not simply due to poor self-control or a lack of will power comes from the past 70 years of research that

has been steadily gaining insight into the *physiology* that governs body weight (homeostatic mechanisms involved in sensing and adapting to changes in the body's internal metabolism, environmental food availability, and activity levels so as to maintain body weight and fat content stability), the *pathophysiology* that leads to unwanted weight gain maintenance, and the roles that excess weight and fat maldistribution play in contributing to chronic diseases such as diabetes, dyslipidemia, heart disease, non-alcoholic fatty liver disease, and many others Abubakar et al, (2017).

As with other chronic diseases, obesity results from an interaction between an individual's genetic predisposition to weight gain and environmental influences. Gene discovery in the field of weight regulation and obesity has identified several major single-gene effects resulting in severe and early-onset obesity as well as many more minor genes with more variable effects on weight and fat distribution, including age-of-onset and severity. However, currently known major and minor genes explain only a small portion of body weight variations in the population. Several environmental contributors have also been identified but countering these will likely require initiatives that fall far outside of the discussions taking place in the clinician's office between patient and provider since they involve making major societal changes regarding food quality, work-related and leisure-time activities, and social determinants including disparities in socio-economic status.

Epidemiology of Obesity among populations

The prevalence has been on the increase in many countries irrespective of their economy. Globally, there are 1.9 billion overweight & obese adults out of which almost 600 million of them are obese (WHO 2016), the projection was that by the year 2025, 75% of the global obese population would be in low-income countries including Sub-Saharan Africa and that obesity related medical problems will affect very huge number which may exceed 115 million individuals in developing countries.

World Health Organization (WHO),2016) in the final report of the commission on ending childhood Obesity; Geneva 2015 stated that despite the fact that obesity and overweight is a problem of high-income countries, low and middle-income countries particularly in urban settings and Sub-Saharan African countries face the challenge of an increasing trend. Apparently, in 2014 more than 1.9 million adults aged 18 years and older were overweight. Similarly, 13% of the world's adult population (11% of men and 15% of women) were obese in 2014. In Africa, the number of adults who are overweight or obese has nearly doubled from 5.4 million in 1990 to 10.6 million in 2014.

Data from WHO Global info Base, based on individuals aged 30 years and above shows that the prevalence of overweight and obesity together increased by 23% in men and 18% in women, while the prevalence of obesity alone increased by 47% in men and 39% in women within the space of 8 years in Nigeria. In addition, 44% of diabetes burden, 23% of ischemic heart disease burden and between 7% to 14% of certain cancers are attributable to overweight and obesity. The prevalence of overweight and obesity has increased to epidemic proportions in developed countries, and is now dramatically on the rise for underdeveloped and developing countries, especially in urban settings (Okuneye, 2010).

Causes of Obesity

Dietary Factors

i. Energy Intake

Energy is consumed in the diet through protein, carbohydrate and fat intake. In the presence of excess calories, the body will subsequently convert and store these energy nutrients as triglycerides in adipose tissue. Overtime, if excess calories are consumed without a concomitant increase in energy expenditure, excess body fat will be stored which may lead to obesity. Excessive intake of energy nutrients has been reported to increase the size and number of adipocytes at various stages of the lifespan (Spiegalman & Flier, 2001). It has historically been thought that a calorie is a calorie and that the composition of iso-energetic

diets would have no impact on weight gain or loss. However, more recent research has indicated that not all of the macronutrients contribute to obesity in an equal manner (Labayen, Diez, Gonzales, 2003).

In addition to macronutrient influences, the volume of food intake may play a role in satiation and subsequent energy intake. It has been shown that eating low-energy dense foods like fruits and vegetables helps sustain satiety while concurrently reducing energy intake and appears to be a more effective weight loss strategy than fat reduction and decreased portion sizes (Ello-Martin, Ledikwe, Rolls, 2005) Fruits and vegetables are higher in water and fiber, incorporating them in the diet can reduce energy density, promote satiety, and decrease energy intake (Rolls, Ello-Martin, Tohill, 2004).

ii. Energy Expenditure

Energy expenditure is composed of basal metabolic rate, the thermic effect of food, and physical activity. Physical activity can also be broken down into two distinct sub-classes: (1) activity – related thermogenesis (Volitional exercise; and (2) non – activity related exercise thermogenesis (consists of all activity that one performs that is not related to "sporting – like exercise) (Levine & Kotz, 2005).

It has also been shown in epidemiological studies that there is an inverse association between physical activity and weight (Dipietro, 2005) Adding physical activity to promote weight loss encourages favorable changes in body composition. Sedentary lifestyle is commonly mentioned as a significant cause to the mounting prevalence of obesity. In a recent study conducted by Slentz et; al, 2005, researchers affirmed that those individuals who partake in a modest exercise program similar to the ones suggested by the centers for Disease Control and the American College of Sports Medicine (e.g., at least 30 minutes of physical activity, on most days of the weeks, of moderate intensity, in one single or in multiple sessions) significant increase in health benefits can be expected.

A physical activity pattern, such as a sedentary lifestyle, is also associated with weight change. The physical activity pattern has important influence on physiological regulation of body weight. Decreased physical activity plays an important role in obesity. In South West Nigeria, there is no exercise culture, especially among women. However, women are engaged in some physical activity such as walking long distances to hawk their wares, which are strenuous, and even at times deleterious to heath. Other lifestyle factors which could cause obesity include insufficient sleep, endocrine disruptors, food substances which interfere with lipid metabolism, decreased variability in ambient temperature and increased rates of smoking which suppress appetite. Increased use of medication that leads to weight gain such as steroids and some antidepressants may cause weight gain. Increased distribution of ethnic and age groups that tend to be heavier, pregnancy at a later age and intrauterine and intergenerational effects also contribute to the etiology of Obesity according to the study by (Ishola, 2008). In addition to the aforementioned causes of Obesity, there are several hormones, genetic component, and secreted factors currently under investigation that have been implicated in the etiology of obesity.

Genetic Factor

Modern genetic technology with precise definition of single nucleotide changes has advanced our understanding of the molecular mechanisms of weight regulation. Specifically, high throughput sequencing with whole exome, genome and targeted sequencing in individual subjects and cohorts of children with severe obesity has identified little known genetic aberrations. Besides providing insight into the pathophysiology of weight regulation, some of these etiologies hold the potential for treatment in selected individuals. Furthermore, studies in model organisms have elucidated epigenetic modifications that may play a role in weight gain. This review will address the identified genetic causes of obesity, and summarize the current literature on the epigenetic changes.

Genetic causes of obesity can be broadly classified into:

1. Monogenic causes: those caused by a single gene mutation, primarily located in the leptin- melanocortin pathway.
2. Syndromic obesity: severe obesity associated with other phenotypes such as neurodevelopmental abnormalities, and other organ/system malformations.
3. Polygenic obesity: caused by cumulative contribution of a large number of genes whose effect is amplified in a ‘weight gain promoting’ environment.

Environment Factor

Environmental Factors While extensive television viewing and the use of other electronic media has contributed to the sedentary lifestyles, other environmental factors have reduced the opportunities for physical activity. Opportunities to be physically active and safe environments to be active in have decreased in the recent years. The majority of children in the past walked or rode their bike to school. A study conducted in 2002 found that 53% of parents drove their children to school. Of these parents, 66% said they drove their children to school since their homes were too far away from the school. Other reasons parents gave for driving their children to school included no safe walking route, fear of child predators, and out of convenience for the child. Children who live in unsafe areas or who do not have access to safe, well-lit walking routes have fewer opportunities to be physically active.

It is clear that whatever the contribution of genes to the propensity to gain weight, obesity will only become manifest if the environment is conducive to weight gain, and this has clearly been a major factor in the recent rapid increase in obesity rates seen in the last few years. The environmental factors that are likely to contribute are changes to the quantity or composition of food in the diet, and changes in the amount of physical activity undertaken by the population.

Socio-economic Factor

Obesity is a common feature in migrants, where a population with a common genetic heritage live under new socioeconomic and cultural conditions. Pima Indians, who live in the USA, are on average 25 kg heavier than Pima Indians who live in Mexico.20 Migration of Asian-Indians21 and Australian Aboriginals22 from rural areas to an industrialized environment is related to an increasing prevalence of obesity in these societies.

Studies have found that BMI is significantly higher among low socio-economic than middle and high socio-economic groups23,24 with lower socio-economic status (SES) being associated with accelerated weight gain during adulthood.25,26 Thus, data from the

Whitehall study shows that over a five year period of follow-up, subjects with a clerical post had a twofold greater risk of an increase in BMI of > 3 units than subjects with an administrative post.26 The effect of socioeconomic status (SES) on the prevalence of obesity may be mediated by low income which will limit the availability of the more healthy food options. In many populations the level of education is inversely associated with obesity especially in women,23,27 while husbands' education was found to be correlated negatively with the prevalence of obesity in their wives.27 Conversely, in a national obesity survey in South Africa, a multivariate regression analysis demonstrated that women with greater than 12 years of education had higher BMIs than women with 1–12 years of education ($p < 0.0001$). A possible explanation for this phenomenon is that women in the latter group tend to perform higher levels of manual labour than the more educated women

Cultural Factor

Socio-cultural factors have also been found to influence the development of obesity. Our society tends to use food as a reward, as a means to control others, and as part of socializing. These uses of food can encourage the development of unhealthy relationships with food, thereby increasing the risk of developing obesity

Classification of Obesity

Obesity can be classified into central or peripheral obesity. In central obesity, otherwise called "android" obesity, the distribution of fat is commonly on the upper part of the trunk (the chest and abdomen) and is more common in the males (Anate & Olatinwo 1998). Android obesity is more clearly associated with disordered lipid and glucose metabolism and diseases like diabetes mellitus, gout, atherosclerosis, osteoarthritis, cardiovascular disease especially hypertension, and some cancers (Anate and Clark,, 1998) However, in the peripheral or "gynecoid" type of obesity, the distribution of fat is mainly on the hip and thighs and is more common in females, before the menopause, lipid assimilation is favored in the abdominal and femoral depots. However, after the menopause, these

differences in fat metabolism between the abdominal and femoral sites disappear. The differences seen in the metabolism of fat suggest that female hormones are responsible before menopause (Anate, 1998).

There are various measures of obesity, and the BMI is a very useful and common one. It is a mathematical formula that is highly correlated with the body fat (Luke, Darazo-Arvizu, Rotimi, 2007). BMI is calculated as weight in kilograms divided by the square of the height in meters, it takes into account both frame size and body composition and is considered to provide a realistically achievable range of healthy weights and is a predictor of dangers associated with obesity according to (Wardle & Johnson 2002) in their study.

Waist-hip ratio (WHR) is another means of knowing if a person is obese and is calculated by using the ratio of waist circumference to hip circumference as prescribed by (Ojoawo, 2002) Waist and hip measurements are simple and their expression as a ratio (WHR) makes it possible to do studies on a large number of obese individuals. Using this method of calculation of (WHR) extreme gynecoid distribution has a WHR of about 0.5, whilst WHR is 1.0 in the android type (Anate et al,1998) Another classification of WHR is 0.76-0.80 which is normal, 0.81-0.86 which is moderate obesity, while above 0.86 is severe obesity (Ojoawo, 2002).

Prevention of Obesity

It is important to begin prevention of obesity early because prevalence of childhood obesity is increasing throughout the world. In some developing countries, there is an increasing trend toward the western lifestyle such as adoption of the dietary pattern of eating “fast foods”, which are high in carbohydrate and fat. Within the United Kingdom, estimates of obesity range from 6% in preschool children to 17% by the age of 15 years. Schools provided an opportunity for preventing and treating obesity and can be employed for primary prevention through early detection of obesity. The use of health promotion, intended to

influence dietary and physical activity behavior as a method of prevention of obesity, can also be employed (Sahota 2001).

Okosun 1999 in his study stated that primary and secondary prevention should be emphasized in the prevention of obesity. The healthcare costs of obesity are considerable, especially when complicated by associated conditions such as diabetes mellitus, osteoarthritis, hypertension, gall stone disease, post-menopausal breast cancer, and colon cancer. Prevention of obesity is thus cost effective and should begin in early childhood by instilling healthy patterns of exercise patterns of exercise and diet.

Management of Obesity

Chantel, 2002 in his book stated that it is important to emphasize to the individual that management of obesity is lifelong. Health education and counseling have a remarkable role in encouraging adoption of lifestyle modifications. Health education should be offered to the individual about the etiology and treatment options for obesity. Referral may be necessary to other members of the multidisciplinary team, such as the physiotherapist, occupational therapist, the social worker, the dietician, and the clinical psychologist.

- **Lifestyle Modification**

Lifestyle modification in the management of the patient as a whole focuses on dietary modification and exercise. Weight reduction can be done through dietary modification and exercise. Dietary modification follows satisfactory counseling and involves a 24-hours activity associated dietary recall. This recall includes detailed information about the meal schedule, and the quantity and quality of food intake. The dietary recall is a verbal report of food intake over the past 24 hours, or “yesterday”, and may help in nutritional intervention. The role of the physician is to set reasonable weight loss goals. A realistic goal is a weight loss of 0.5-1kg per week. This weight loss is achievable using diets of 1000-1500kcal/day, which is known as low calorie diet. All obese people lose weight on a low energy intake. The physician should aim for a BMI of 25kg/m^2 for the patient who wants to undergo dietary

modification. After 6 months of therapy, the rate of weight loss on this regimen usually declines and then plateaus. The second phase of weight loss therapy is the maintenance phase and this second stage should take priority. The physician also helps the patient select an appropriate weight loss program, and if simple diet sheets are not effective for dietary modification, the Family Physician refers the patient to a dietitian. Very low calories that are less than 800kcal/day can be used to treat morbid obesity. Very low calorie diets, however, generally have a limited place in the management of obesity as the pattern of eating cannot be maintained and rebound weight gain is seen on stopping this type of diet. Once a patient has lost weight, diet still needs to be monitored by the physician, and also by behavioral and group therapy. There is, however, little evidence to show that dietary advice by physicians is heeded. Most influence on diet comes from national food policy, price of food, advertising, General education and cultural influences.

Behavioral therapy is effective individually and in groups, when combined with low calorie diets. Behavior change strategies involve techniques in stimulus control. The simplest form of behavior therapy involves involve advice to avoid situations that tempt overeating. Other forms of advice are keeping food out of sight or eating only at the table. Practice eating management such as eating slowly is also included under behavior therapy. Behavior substitution can be done, such as exercising instead of eating when angry. Self-monitoring could be done by keeping food and exercise diaries and rewards can be given as a form of behavioral therapy. Prevention of relapse in obesity may require group therapy. Cognitive restricting could also be included such as use of personal self-talk that focuses on progress rather than failure.

Group activities such as weight watchers, who offer weekly meetings focused on nutrition, behavior modification and relapse prevention, can be joined. Exercise is also encouraged in these weight loss groups. There is one-time registration fee for the weight watchers and a weekly fee, and when participant reaches goal weight, he or she becomes a

lifetime member and may attend monthly meetings without charge as an incentive and encouragement to the new members.

Exercise is an integral part in lifestyle modification of obesity. Exercise is a useful treatment for many other conditions managed by physicians. Regular exercise reduces the risk of coronary heart disease, diabetes mellitus, obesity, colon cancer and osteoporosis. In hypertension, exercise can result in a reduction of 10mmHg in systolic and 8mmHg in diastolic blood pressure. In hypercholesterolemia, exercise causes high-density lipoproteins (HDL) to increase and low-density lipoproteins (LDL) to decrease, therefore reducing the risk of atheroma formation. Exercise also helps to reduce anxiety and the intensity of depression.

Assessment of physical activity includes asking about regular exercise such as walking to work, to the market and whether in active employment. The Allied Dunbar National Fitness Survey Activity levels are graded from 0 to 5. It measures and activity of 20min on each occasion in the previous 4weeks: 5 stands for greater than or equal to 12 occasions of a mix of moderate and vigorous activity; 3 stands for greater than or equal to 12 occasions of moderate activity; 2 stands for 5-11 occasions of a mix of moderate and vigorous activity; and 0 stands for no moderate or vigorous activity of greater than 20min duration. The target physical activity level as per the age group is 5 for 16-34 years, 4 for 35-54 years, and 3 for 55-74 years.

Negotiating change in lifestyle is possible by encouraging sedentary people to increase their activity levels. As with all lifestyle interventions, the patients must want to change if they are to alter their lifestyle. If exercise levels are satisfactory, congratulate and inform the patient about the benefits of exercise. If the level of exercise are unsatisfactory, encourage the patient to increase the physical activity and support the individual with health education leaflets. There is more success if exercise recommended is moderate, if the exercise does not require a special facility, and if the type of exercise can be incorporated into

daily life routines such as walking to work. Regular aerobic exercise also helps to reduce weight and improve health. The Family Physician should tailor advice to suit the individual and local facilities available. Light exercise, such as aerobics, is as effective as walking to some. Swimming and cycling are recommended for obese women due to lack of weight bearing during the activity. Other adjuncts to lifestyle modification for obesity include drug therapy (Rakel 2002).

- **Drug Therapy**

Medications for treatment of obesity are formulated to reduce energy intake, increase energy output or decrease the absorption of nutrients. There are several types of drugs that can be used in the management of obesity. Methylcellulose, which works by decreasing absorption of nutrients, has been tried but found ineffective for treatment of obesity. Phentermine, a catecholaminergic drug, is used as an appetite suppressant and is only licensed for a 12-week use in patients with moderate to severe obesity. Phentermine is, however, not recommended for the routine management of severe obesity. Rapid weight relapse usually occurs after short-term use of an appetite suppressant and Phentermine also carries the added risk of pulmonary hypertension, which is rare and insidious in onset (Barke 2000).

Orlistat (Xenical) is a gastric and pancreas lipase inhibitor. Orlistat decreases fat absorption in the intestines. Patients taking this drug are also started on a medical action plan, which includes diet and exercise. Orlistat is expensive and is only used for motivated patients (those who have lost over 2.5kg in the previous month and have a body mass index over $30kg/m^2$). Anti-depressants may also be needed as an adjunct therapy for obesity, as some of these obese patients may be depressed because of their weight and some may end up eating more to ease their depression. However, it is to be noted that some of these anti-depressants, especially Amitriptyline, could cause increased appetite and worsen obesity.

- **Surgery**

The physician should only consider referral for surgery as a last resort, if behavioral and dietary modifications have failed and BMI is over 40kg/m^2. Wiring of the jaws together so that only liquid diet can be taken through a straw can be done as a surgical modality while managing morbid obesity. Gastroplasty is the most common procedure done surgically for managing obesity in developed countries. Mortality following Gastroplasty is high. Other surgical modalities for management of obesity are gastric bypass, adjustable silicone gastric banding (ASGB), and vertical gastric banding (VGB). Surgical excision of excess fat from various sites has also been advocated and tried, but usually fat reappears at other sites and the scars produced following the excision of fat may be uncosmetic (Ghasseman, 1997; Chantel 2002).

Concepts and Impact of Physical Activity on Brisk Walking and Management of Obesity

Regular, vigorous exercise has been necessary for survival throughout evolution. It is only during the past few decades that it has become possible for people to go through life with minimal physical activity. The modern way of living promotes comfort and well-being in a less energy-demanding environment; however, we are not genetically adapted for this sedentary lifestyle. Physical inactivity has become so prevalent that it is common to refer to exercise as having "healthy benefits" even though the exercise-trained state is the biological normal condition. Pedersen (2006) reported that it has long been known that regular physical activity induces multiple adaptations within skeletal muscles and the cardiorespiratory system, all of which providing positive outcomes for the prevention and treatment of many metabolic disorders. Lack of exercise should rather be perceived as "abnormal" and associated with numerous health risks (Hawley, 2004). The objective for us as researchers and health care practitioners is to be more innovative in finding ways to motivate people to exercise and adopt healthier lifestyle choices.

In the field of obesity research, physical exercise has been traditionally considered as a strategy to burn calories. However, physical exercise is much more than that. It is a stimulus that, when properly managed, contributes to a significant improvement in energy and macronutrient balance regulation and to global body functioning, that is, a precise regulation of body homeostasis (Trembley, 2006). It thus seems appropriate to propose that an active lifestyle can influence energy balance and body fat to a much greater extent than what is generally perceived by health professionals. To reach this outcome, exercise should ideally be performed regularly and on a permanent basis.

Physical Activity Level and its Impact on Obesity

Monsivais and Drewnowski (2009) revealed in their study that low physical activity level (PAL) accounts for 6% of deaths worldwide and inadequate PAL, especially, concerns populations of low SES. Reductions in PAL, over the past years are linked to several factors: less energy expenditure activities such as farming and forestry, a rise in sporadic activities such as sitting in front of a computer terminal, and patterns of low activity during leisure hours (Bergiers Kapka-Skrsypczak, Bilinski, Paprsyeki & Nojtyla, 2012). As such, concurrent marked reductions in PAL have been reported within every occupation. To illustrate the significant increase in mean BMI noted from 1981 to 1990 which may be associated with reduced PAL, Africa stands as a proper example. During these years, in African regions, the epidemic of obesity, at least can in part be explained by decreased levels of physical activity as in the late 1980s; roads were tarred with taxis and buses becoming the most common transport means and in addition, there was an ongoing trend away from manual labour to less physically strenuous jobs and the shift to less nutrient-dense diet (Samuel & Atinmo, 2008).

Temple et al (2001) reported that use of screen time has been associated with other equally unhealthy behaviours such as eating palatable fatty foods. Watching television is linked to high cholesterol levels and unhealthy diets and which is also influenced by

unhealthy nutrition messages in commercials. In addition, low PAL is amplified by inadequate community designs and infrastructure characteristics such as lack of safe walkways, bicycle paths and playgrounds (Banks, Lim, Seubsman & Sleigh 2011). Turcroni, Guarcello, Maccarini, Cignoli, Setti, Bazzano & Roggi, (2006) in their study revealed how low socioeconomic status and low educational level in developing countries are associated to low PAL due to, primarily a worse access to sports facilities, PAL is twice as much among rural residents than urban one due to higher household activities which compensate for low PAL during free time.

Physical Activity and Weight Control

Physical training can alter body composition. Many people have believed that physical activity has little or no influence on changing body composition and that even vigorous exercise burns too few calories to lead to substantial body fat reductions. Researches has demonstrated the effectiveness of exercise training in promoting moderate changes in the body composition (Kenney, Wilmore & Costill 2012).

An important relationship was discovered during the 1990s that suggests another substantial benefits of fitness and activity. Physical activity is a key modifiable lifestyle behaviour for obesity prevention. With most evidence on physical activity for a healthy weight based on studies of aerobic physical activity (walking, cycling, running). For those who are overweight or obese, their overall risk of death from disease is greatly reduced if they are physically active and fit. Although most weight loss trainer use aerobic exercise such as brisk walking, 200-meter race, quarter milled race amongst others (Kenney, et.al 2012).

History of Aerobic Exercise

Aerobic exercise is defined as planned, structured physical activity that involves large muscle groups in dynamic activities that, if effective, results in improvements in the function of especially the cardiovascular system and the skeletal muscles and leads to an increase in cardiovascular fitness.

According to Wikipedia, both term aerobic and the specific exercise method were developed by Dr. Kenneth H. Cooper, an exercise physiologist in San Antonio air force hospital in Texas and Col. Pauline Potts, a physical therapist, both of the United States Air force. Cooper, an exercise enthusiast, was puzzled about why some people with good muscular strength were prone to perform poorly at activities such as long-distance running, swimming and cycling. He began using a bicycle ergometer to measure sustained performance in terms of a person's ability to use oxygen. In 1968, he published aerobics, which included exercise programs using running, walking, swimming and bicycling. At the time the book was published, a person called Jackie Sorenson developed a series of dance routines known as "the aerobic dance to generously improve the cardiovascular fitness". So aerobic dance and other forms of exercise gain existence and made its way prudently between the masses all over United States and many other countries and that too in a very short span of around two decades. The number of aerobic participators in the U.S alone raises from an estimated 6 million in 1978 to 19 million in 1987.

Aerobic Exercise and Obesity

Aerobic exercises are ones in which the body burns calories with maximum use of oxygen Şenturk (1992). They are done for longer periods with less strength. Aerobic exercise can be considered as a set of low-intensity, longer period activities making use of large muscle groups. "Aerobic exercise programmes are based the organism's burning as much oxygen as possible" (Alves, Marta, Neiva, Izquierdo, & Marques, (2016)). "They are defined as planned and structured body movement resulting in increased oxygen and calories expenditure. Walking, jogging, swimming, and attending aerobic classes can be part of the weight- loss and weight control programme." (Bouchard, 2014; Pekmez; Ozdemir; Ersoy; & Obezite, 2012). Aerobics exercises are systems developed for strengthening physical condition that increases body oxygen capacity. It was determined in Canada that sedentary

life is effective on BMI of adolescents, and sedentary way of living increases weight (Elgar, 2005).

It's known that physical activity has an important role in preventing and the treatment of obesity, gaining weight causes many physical, mental, and social problems for all ages, in adolescence when physical appearance matters the most, it is regarded by the adolescents as a physical problem. Although the adolescents approve the importance of physical activity, they can't just form a habit. Insufficient exercise and stagnant life-style are among the most important factors causing obesity both in childhood and adolescence (Menteş, Menteş & Karacabey, 2011).

Intensity of Brisk Walking

When aerobic exercise is done at moderate intensity, the heart beat faster and breathing becomes harder than normal meanwhile one is still able to talk or make a sentence at once. However, aerobic exercise performed with vigorous or high intensity pushes the body a little further with higher effort, gets the body warm and brings about heavy sweat, making a complete sentence is usually difficult without running out of breath. Several trials have shown that vigorous high intensity aerobic exercise entails using the large muscle groups which requires 10-11 kcal /minute and duration. Aerobic exercise increases peak oxygen consumption ($V0_2$ peak), which is closely correlated with total body fat percentage (BF %); aerobic exercise is also a powerful strategy for weight loss, particularly body fat loss (Donelly, 2013).

Okura, Nakata, Tonaka (2012), affirmed that aerobic exercise, a popular form of exercise, particularly among women is representative of moderate to vigorous intensity exercise. Whether it is moderate or vigorous the ultimate benefit is usually an improved cardio-respiratory fitness. Walking at a brisk pace is generally considered moderate-intensity physical activity, and doing this most days of the week for 30 minutes or more enables one to meet the criteria for physical activity for health benefits recommended by ACSM and the

American Heart Association (Haskell, 2007), When designing a suitable weight loss program, exercise duration and intensity are generally manipulated. Moderate aerobic exercise for at least 150 minutes per week may improve risk factors for metabolic syndrome like body composition, insulin resistance and glycosylated haemoglobin (HbA1c), (Hagan, Devito, Boreham, 2013).

In another view, American College of Sport Medicine (ACSM 2009) classified exercise according to intensity as very light (<10%$V0_2$max), light (30%-49%VO_2max), moderate (somewhat hard) (50%-74%VO_2max), heavy (75%-84%VO_2max), and very heavy (>85%VO_2max). Light exercise is not considered effective for adults who are healthy; however, in elderly people and those who have a very low fitness level initially, it is assumed to have positive effects. The interest in moderate exercise, such as brisk walking has been growing because of feasibility and safety aspects, and also suggested that long-term moderate aerobic exercise for > 150 or 200-300 minutes per week can significantly reduce body weight when the diet is not controlled, however when exercise intensities differ, exercise expenditure is not the only factor responsible for weight loss. Hence, the effects of increasing exercise intensity on weight loss when exercise duration is kept constant remain unknown.

Frequency and Duration of Brisk Walking

There are no any hard and fast rules about frequency of aerobic activities individuals must obey at any point in time. This is dependent on the target programs, patients' health or medical condition and what types of fitness to be achieved. According to the American College of Sports Medicine (ACSM) recommendations (2012), at least 30 minute of moderate intensity aerobic workouts for 5 days a week or 3 days of high intensity activity for 20 minutes will give an individual an appropriate cardio-respiratory fitness. If, however, the individual is interested in modifying body composition, training frequency and duration may be altered to suit or accommodate that purpose. It is important to note that any type of cardiovascular workout that increases heart rate to the minimum of 20 consecutive minutes or

longer will achieve an aerobic effect. Irrespective of the aerobic activity type one chooses to perform it is important to understand the frequency of an aerobic effect. The body will prosper from the 3 days' workout than being overworked and becoming dehydrated because of oxygen flow being unable to keep up. Therefore, in a position statement of ACSM titled "Quantity and Quality of Exercise for developing and maintaining Cardio respiratory, Musculoskeletal and Neuromotor Fitness in Apparently Healthy Adults:

Guidance for prescribing exercise" the ACSM provide current scientific evidence on physical activities and it include; recommendation on aerobic exercise, strength training and flexibility, consistent with the 2008 physical activity guidelines for Americans, and the overall recommendation is for most adults to engage in at least 150 minutes of moderate-intensity exercise each week. The position statement's purpose is to offer health and fitness professionals, scientific evidence-based recommendations that help them customize exercise prescription for healthy adults which was published in July 2011.

The basic recommendations by exercise category are;

- **Cardiorespiratory Exercise:** Adults should get at least 150minutes of moderate intensity exercise per week. Exercise recommendation can be met through 30-60minutes of moderate intensity exercise 5days per week or 20-60minutes of vigorous intensity exercise 3days per week. One continuous session and multiple shorter sessions of at least 10minutes are both acceptable to accumulate the desire amount of daily exercise.
- **Resistance Exercise:** Adults should train each major muscle group 2 or 3 days each week using a variety of exercises and equipment. Very light or light-intensity is best for older individual or previously sedentary adults just starting to exercise. Two to four sets of each exercise with anywhere between eight and twenty repetitions, will help adults improve strength and power.

- **Flexibility Exercise:** Adults should do flexibility exercise at least 2-3 days each week to improve range of motion. Each stretch should be held for 10-30 seconds, to the point of tightness or slight discomfort. Repeat each stretch 2-5 times, accumulating 60 seconds per stretch.
- **Neuromotor Exercise:** This is also referred to as "functional fitness training" is recommended 2-3 days per week. Exercise should involve motor skills (balance, agility, coordination and gait) proprioceptive exercise training and multifaceted activities (Yoga) to improve physical function and prevent falls in older adults. Between 20-30minutes per day is appropriate for neuromotor exercise.

In addition to outlining basic recommendations and their scientific reasoning, the position statement also clarifies three new points.

- Pedometers are not an accurate measure of exercise quality and should not be used as the sole measure of physical activity.
- Though exercise protects against heart disease. It is still possible for active adults to develop heart problems. All adults must be able to recognize the warning signs of heart disease, and all health care providers should ask patients about these symptoms.
- Sedentary behavior is distinct from physical activity and has been shown to be a health risk in itself meeting the guidelines for physical activity does not make up for a sedentary lifestyle.

Concept of Anthropometry and Brisk Walking

Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. Measures of subcutaneous adipose tissue are important because individuals with large values are reported to be at increased risks for hypertension, adult-onset diabetes mellitus, cardiovascular disease, gallstones, arthritis, and other disease, and obesity. Combined with the dietary and related questionnaire data, and

the biochemical determinations, anthropometry is essential and critical information needed to assist in describing the data collected from persons in the field.

According to Oxford Dictionary of Sports Science & Medicine (2007) anthropometry is the measurement of the size and proportions of the human body and its different parts. Exact anthropometrical studies have identified ideal values for the body dimensions of athletes in different sports. However, athletes who deviate from the ideal are still able to excel in competitions because there are other factors than physical attributes described anthropometry as a technique of measuring the human body in terms of dimensions, proportions, and ratios such as those provided by classification and comparing humans to other primates, the techniques is now also used for deciding the range of clothing sizes to be manufactured and determining the nutritional status of people.

Anthropometry in the twentieth century included estimation of the ratio of fat to lean body mass and this is important in the study of energy balance. Obesity is a measurement of body density or skin fold thicknesses. And more recently, it is measured by the application of technologies such as magnetic resonance imaging and radioisotope studies. Anthropometrics is the process of measuring dimensions of the human body and these measurements are then used to either describe size and proportion or to indirectly estimate body compositions (Toriola, 1999; Ajayi-Vincent, 2003; Dominic, 2006; Dominic, 2011).

a. Brisk Walking And Body Weight

Walking at a brisk pace has been approximately put at 3-4 mph for most people. ACSM recommends participating in walking or other moderate intensity exercise for 30minutes or more at least 5 days per week for health benefits. For weight loss 45-60 minutes of moderate intensity activity is recommended per day and 60-90 minutes per day for weight maintenance.

For many people, more than 30 minutes of moderate intensity activity may be necessary to maintain weight or contribute to significant weight loss, However, people with

relatively high daily energy expenditures tend to be less likely to gain weight over time compared with those who have low energy expenditures. Since the control of body weight responds to both calories consumed as well as the number of calories expended during activity, both intake and expenditure have to be considered by the individual trying to prevent unhealthy weight gain or achieve weight loss.

Adults regardless of body size or shape should be encouraged to meet the moderate. Intensity minimum of 30 minutes per day on 5 days/week guideline. For individuals who achieve this level of activity, but remain overweight, an increase in their physical activity is a reasonable component of any strategy to lose weight.

b. Brisk walking and the effect on body mass index

Obesity especially central obesity is the accumulation of fat in the abdominal region. The degree of body weight is usually expressed as body mass index (BMI); this is the ratio of weight in kilograms to the square of height in meters. The BMI is used to classify a person's body weight as underweight (BMI less than 18.5) normal weight (BMI 18-24.9) overweight (BMI 25.0 – 29.9) or Obese (BMI greater them 30) this simple parameters also had association with health risk medications. (Booth & Lee 2006).

Excess body fat produces severe adverse consequences on health, such as high blood pressure and changes in lipid profile. When these factors are combined, predisposes to chromic non-communicable diseases such as type 2 diabetes mellitus, Osteoarthritis, some form of cancer (Lunard & Petroski 2008). In order to reduce the risks of this non-communicable diseases as well as ensure normal function of all organs and the systems in the body, it is necessary to perform some form of physical activities regularly.

Brisk walking at an individual level, prove to be the physical activity most easy to maintain and could be progressively increased in intensity, achieving a cardiorespiratory benefit and decrease adiposity in the unfit.

c. Brisk Walking Effect on Percent Body Fat and Body Composition

When sedentary individuals undertake exercise, the activity provides a massive stimulus with widespread physiological implications. The precise metabolic regulation brought about by exercise is expressed at many levels of regulatory processes, be if by stimulating the effect of key enzymes, by increasing cell sensitivity to numerous hormones by facilitating substrate transport through membranes, by influencing cell receptors in a tissue specific manner and much more. (Hawley, 2004).

The increasing number of nutritionist and sports professionals is becoming more and more interested in dealing with the issue of reducing fat percentage in the body and determining the effects of training on the charges in the body composition. There are a lot of training models and methods of exercising which are used in order to reduce the body fat percentage amongst which running and cycling are said to be the most effective and the most popular ways (Shimamoto, Adachi, Takahashi & Tamaka 2008).

Donnelly *et. al*, (2013) reported that brisk walking exercise increase peak oxygen consumption (VO_2Peak). Which is closely correlated with total body fat percentage, aerobic exercise is also a powerful strategy for weight loss particularly body fat loss. When designing the suitable weight loss program, exercise duration and intensity are generally manipulated, moderate aerobic exercise for at least 150 minutes per week may improve risk factors for metabolic syndrome like body composition, insulin resistance and glycosylated haemoglobin (HbAIc), (Hagan, Devito & Boreham 2013).

d. Brisk Walking and Blood Pressure Management

Physical activity strongly reduces both the risk of dying from cardiovascular disease and risk of developing one. Significant reductions in risk of cardiovascular disease occur at activity levels equivalent to 150 minutes a week of moderate. Intensity physical activity.

According to physical activity guidelines for Americans, a regular aerobic exercise such as brisk walking can greatly affect blood pressure and effects can be immediate. People

who have normal blood pressure benefit because the risk of developing hypertension is reduced. People who have hypertension also benefit because systolic and diastolic pressure are lowered.

Both aerobic and muscle strengthening physical activity are recommended to improve blood pressure, even activity at levels below the key guidelines tends to benefit blood pressure and engaging in more physical activity can have even greater benefits.

Empirical reviews on effect of Brisk Walking on Reduction and Management of Obesity

Chen (2016), the study was conducted to investigate the effect of brisk walking and resistance training on cardiorespiratory fitness, body composition and lipid profiles among overweight and obese individuals. 54 overweight and obese male and females were recruited for the study, aged between 21 to 55 years. The participants were age, gender and weight-matched before being randomly assigned into 3 groups, with 18 participants per group.

The brisk walking group was required to brisk walk 3 times a week at an intensity of 60-70% of their respective age-predicted maximum heart rate for 8 weeks. Anthropometric indices data sheet and self-structured questionnaire were used for data collection. Significant p-value was set at ($p > 0.05$) for the formulated hypotheses and a repeat measure of ANOVA was used to analyze the pre and post intervention data. Outcome of the study showed significant improvement in cardiorespiratory fitness for the brisk walking and resistance training groups at post intervention compared to pre intervention value. There were also significant improvements in percentage body fat, body mass index (BMI), waist-hip ratio (WHR) and free fat mass. Hence, it was concluded and recommended that both brisk walking and resistance training for 8 weeks were appropriate exercise modality to reduce some of the cardiovascular risk factors among overweight and obese.

Ganeswara (2015), in his study where 45 overweight and obese women from Maharishi Markandeshwa University (MMU) campus in North India were investigated for the effect of brisk walking on overweight and obese women. A pre-test and post-test

intervention experimental design was used where all women were randomly assigned to 3 groups; group A (n=15) the control group, group B (n=15) was termed the brisk walking group with controlled diet and performed brisk walking for 45 minutes/day for 5days/week and group C (n=15) termed the aerobic group also with controlled diet and performed aerobic exercise for 45 minutes/day, 5days/week. The diet was explained to group B & C and a diet chart to be followed for 10 weeks was given. The BMI, waist and hip circumferences as well as skinfold thickness and BP measurements were performed before and after the completion of brisk walking or step aerobic exercise. Inclusion criteria were being overweight or obese while, men, pregnant women, women with musculoskeletal or cardiovascular disorder were excluded from the study. Group A did not perform brisk walking or aerobic exercise. Self-structured questionnaire which comprises of the demographic data and the participants and anthropometric data sheet were used for data collection and the study lasted for 10 weeks.

The study received ethical approval from the department of Maharishi Markandeshwa Institute of Physiotherapy and Rehabilitation, MMU, Haryana India. All women were provided with an explanation of the study program and written informed consent was obtained. The pre-exercise anthropometric and skinfold thickness data were not significant ($p > 0.05$) and the values recorded before the study were considered pre-values. The study however, showed that the post-values recorded after 10 weeks significantly differed among the 3 groups. The control group participants (Group A) showed minimal change as they did not participate in brisk walking, aerobics or diet therapy. The second (brisk walking) and third (aerobics) groups showed better results when compared with the control group. Therefore, it was recommended that aerobic and brisk walking with diet therapy is a better intervention for reducing body fat and weight maintenance.

Godison (2010) studied the problem of hypertension, obesity and obesity related /diseases. It has become significant cause of disability and premature death in both developing and newly developed countries, with over bearing demand on national health

budgets. Godson took 325 male and 254 female Nigerians of ages 20-80 years of the Ibo ethnicity through random sampling in his study. He divided the sample population into three major groups based on their educational levels; primary, secondary and tertiary levels. systolic and diastolic blood pressure (SBP & DBP) levels, body mass index (BMI), waist hip ratio (WHR), waist height ratio (WHtR), waist circumference (WC), all the indicators of subcutaneous fat, general obesity, and central obesity, largest mean deposition was noted to be highest in the lowest education group and least in the highest 23 education group. Mean blood pressure parameters were also highest in the least education group.

-Fat deposition was noted to be highest in all the females of all the groups, the males showed larger mean BP values. Education was noted to have a significant inverse relationship with most of the fat indicators and blood pressure parameters and cardiovascular disease risk highest in the least education groups. Education showed a significant impact on obesity and blood pressure and could be one of the major tools to reduce the high prevalence of obesity, hypertension and other obesity associated diseases.

Appraisal of Literature Reviewed

The review of the literature showed that obesity is a menace ravaging most countries of the world irrespective of their economic status, the prevalence keep increasing in developed countries with more dramatic increasing trends in developing countries. It is also learnt in this review that obesity result from imbalance between energy intake and energy expenditure which usually occur overtime, even though other factors such as genetic predisposition, physical inactivity and medical condition could be a contributory factor. This literature review has linked obesity to predisposition to certain non-communicable diseases such as hypertension, type 2 diabetes mellitus, gall bladder disease, osteoarthritis and certain form of cancers.

Physiological characteristics can be referred to as the various physical attributes, things which cannot be seen, touch and felt (Montgomery, 2008, and Abubakar, *et. al* 2019).

Physiological profiling has been recommended in literature, Groppel and Roetert (1992) reported that the method has been adopted for purpose of fitness assessment and developing norms, as well as for establishing a basis for longitudinal tracking. Blood pressure (systolic and diastolic) and heart rate are the direct link by which physiologic characteristics on non-performance aspect of fitness can be assessed especially among the obese. It has been documented that there is an increase of 3mmHg and 2mmHg in systolic and diastolic pressures, with every 10kg rise in body weight (in hypertension, exercise can result in a reduction of 10mmHg in systolic and 8mmHg in diastolic blood pressure, (Ishola, 2008).

The review also showed that brisk walking is a form of moderate intensity exercise that is very easy to perform with increased progressiveness adjusted to suit individuals performance level. It was shown to have positive impact in weight loss and weight maintenance program with overall improvement in health and physical fitness. The review also suggested several studies which pointed at the significant impact that brisk walking had on all the body composition variables and anthropometric indices of an obese individual. It also pointed out significant positive effect it has on physiological parameters of obese and weight reduction plan generally.

However, most of the review does not really dwell on the pace at which brisk walking and all other forms of exercise will bring all these effect on the aforementioned indices on obese individuals.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter discusses the methodology adopted for this research; this was discussed under the following sub headings: research design, population for the study, sample and sampling technique, research instruments (validity and reliability of the instrument), procedure for data collection and method of data analysis.

Research Design

The research design for the study was one group pretest-posttest experimental design. That means that there was initial and final measurement of anthropometric indices and physiological characteristics of the participants before and after 8 weeks of exposure to brisk walking. The design combined both pretest and posttest study by carrying out a test on a single group before the treatment was administered and after the treatment was administered; with the former being administered at the beginning of treatment and latter at the end. The dependent variables were measured once before, prior to treatment and once after treatment was implemented. Each participant was tested first under the control condition and then under the treatment condition.

Population of the Study

The population of this study comprised the obese adults within the three (3) Local Government Areas of Ilorin Metropolis (namely; Ilorin East, Ilorin South and Ilorin West). The population was drawn from among those that fall between the ages of 25 to 49 years, male and female inclusive.

Sample and Sampling Technique

The sample for the study was 70 participants drawn across the three (3) Local Government areas under study. (Ilorin East 23, Ilorin South 25, Ilorin West 22 respectively) Purposive sampling technique was adopted to select the participants based on the inclusion criteria.

Inclusion criteria

1. Adults aged between 25 to 49 years were used
2. An adult with BMI $\geq$30.0
3. Those that appropriately filled, signed and returned the informed consent forms and are willing to follow the stated guidelines for the study.

Exclusion criteria

The following categories of adult were excluded in the study.

1. Pregnant women
2. Those with physical impairment
3. Those acutely sick
4. Those diagnosed with hypertension or any other chronic ailments and are on medical prescriptions.
5. Those on other exercise intervention sections
6. Those that are on weight reduction pills.

Research Instrument

The following research instruments were used for data collection:

The data sheet was divided into two sections, the first section is on bio-data which comprises of; Age, Gender, Occupation, Marital Status and Educational Qualifications, while the anthropometric variables that was measured comprises of the; height, weight, BMI, lean body weight, body density, biceps, triceps and subscapular girth while the physiological variables that was measured include the systolic and diastolic blood pressure and heart rate.

The instrument that was used for measurement are;

- Stadiometer: This was a piece of medical equipment used for measuring human height. It is usually constructed out of ruler and a sliding. Manufactured by Schiller Healthcare India Pvt Ltd. 2014.
- Weighing scale machine: This is used to measure weight and /or mass of an object. Manufactured by Hindustan Scale Company, Masjid Bankar, Mumbai GST-27AACFH239F1ZP 2014.
- Multi-function Medical BMI Tape: Used to measure Tape (meter) rule.
- Skinfold caliper. (Manufacture by health care product Body Fitness Skinfold body fat measuring caliper, INC) 2016.
- Mercurial Sphygmomanometer is a device that measures blood pressure. (High Performance Medical Device. Manufacture by U-MEC 2014.
- Stethoscope (CM -4189 PRO medical cardiology stethoscope with tunable diaphragm). Manufactured by Shanghai Caremete Medical Device Co. Ltd 2012.
- Stop watch (Sports Waterproof LCD Digital Countdown Timer Stopwatch. Manufactured by Shenzhen Oskyoo Technology Co., Limited 2012).

Validity of the Instrument

Validity can be defined as the extent to which an instrument accurately reflects what it supposed to measure Nkemakolam, (2002) opines that validity can be referred to as the accuracy, that is, the degree to which a measuring instrument fulfills what it is set out to achieve. To ensure validity of the instrument, the anthropometric and physiological parameters data sheet that was adapted by the researcher for data collection was validated by experts in the Department of Human Kinetics and Health Education, Kwara State University, Malete and University of Ilorin after which, it was given to the researcher's supervisor for approval.

Standardized instruments were used for the measurements. These instruments include; tape (meter) rule, stethoscope, stop watch, sphygmomanometer and weighing scale. The researcher with the help of the supervisor and five trained research assistants revalidated the used instruments by checking for recalibration to ensure that they are in good state.

Reliability of the Instrument

Reliability of instruments refers to the quality of a test, which means the extent to which the results obtained in the test can be relied upon as a true score or results. The instrument was well calibrated and used for pilot study, to test the reliability of the measuring scales before used for the main experiment. According to Safrix & Woods, (2002) the weighing scale has a reliability coefficient of 0.96, Willet, (2001) also reported a reliability coefficient of 0.96 for stadiometer.

A pilot study was carried out using 10 participants from Malete who were not part of the actual study. This helped the researcher to ascertain the reliability of the test instruments and also to acquaint the researcher and the trained research assistants with the test instrument and testing procedure.

Procedure for Data Collection

The following procedures were followed:

Ethical Permission

Ethical approval was obtained from the research and ethics committee of the Kwara state university before proceeding with the study.

A letter of introduction was collected from the Head of Department of Human Kinetics and Health Education, Kwara State University, Malete in order to access the participants, this facilitated the smooth administration of research tools through the research assistants. Physical characteristics of height, weight and bio-data of the participants were taken. Anthropometric and Physiological characteristics were also measured and recorded in the data sheet for analysis. Five research assistants were trained to assist the researcher in conducting exercise intervention during the period of the study.

Height and weight: These were measured using the Health-O-meter (with height and weight) measuring components. The height scale is calibrated in meters from 0.75cm to 2.5 meters. Height was recorded to the nearest 0.01m (1cm) the weight scale is calibrated in kilograms from 0 kg to 240 kg. Weight measured are recorded to the nearest 0.05 kilograms. BMI, was then calculated as weight in (kg) divided by the square of height in meters (m^2).

Physiological Characteristics that was measured include Systolic and Diastolic blood pressures and Resting Heart rate to the millimeter of mercury (mmHg) and beats per minutes (bpm) respectively. The blood pressure and heart rate were measured using sphygmomanometer (Accosson, NY, USA) and stethoscope (CM 4189 PRO medical cardiology stethoscope). The participants sitting down relaxed, the sphygmomanometer cuff tied around the arm. The cuff was inflated to exert pressure at the brachial artery. The diaphragm of the stethoscope was placed at the brachial artery near its bifurcation at the cubital fossa. The readings of systolic and diastolic blood pressure of the participants was then recorded in millimeter of mercury.

Heart rate was determined by measuring the pulse rate (in beats per minute) taken by palpating the radial pulse placing the index and middle finger over the radial artery and counting the number of pulse gotten using stopwatch (sports waterproof LCD digital timer) for one minute, Respiratory rate in (cycles per minute) while counting the inspiration and expiration values with a stopwatch for a minute.

Anthropometric indices that were measured includes the lean body weight, body density and percent body fat. The measurements were recorded in centimeters. These measurements were taken in standard anatomical site around the body as recommended by National health and nutritional examination survey (NAHNES, 2006 & Mueller, 2013).

Waist circumference (WC) was measured to the nearest 0.1 cm by using a flexible tape (Shanghai, China) at the level midway between the lower rib margin and the iliac crest, while Hip circumference (HC) was measured at the widest level over the greater trochanters. Waist-to-Hip ratio (WHR) was then calculated using WC divided by HC.

Skinfolds thicknesses was measured at three (3) different sites, the biceps, triceps, and subscapular using a Harpenden skinfold calipers (Harpenden caliper, UK), to measure the skinfold for the estimation of body density and percent body fat. The scale permitted readings of up to 60mm, with accuracy of +- 1mm. Measurement was taken by skin pinch without any underlying muscle and the caliper was applied to take the measurement. Subscapular skinfold was taken at the inferior angle of the scapular, parallel to axillary border. Triceps fold was taken on a vertical line midway between the tips of the acromion and the olecranon process.

All these were checked before and after commencement of the brisk walking exercise. All participants were instructed to stick to their typical diet. Demographic data, some vital signs and anthropometric measurements were assessed at baseline and at the end of week eight.

Exercise Intervention

All participants were given pre-programme orientation as all the activities performed were demonstrated before the commencement of the training sessions. Also, the research assistants helped in monitoring and supervising activities performed by the participants to ensure that they were correctly carried out. Brisk walking session was done on 3 alternate days each week, that is, Mondays, Wednesdays and Fridays, after all the required baseline measurements must have been taken.

The exercise programme lasted for 70 minutes per session three times a week (totaling 210 minutes weekly) for eight weeks, each session included 10-min warm up and 10-min cool down with 50-min brisk walking of 3-4.5 mph on the field. All activities were carried out at a safe level of moderate-intensity between 40% and 70% of age predicted maximum heart rate (220 - age of the participants.). The moderate-intensity training was commenced at 40%-50% HRR during week 1-4, increasing to 50%-70% HRR during week 4-8.

Exercise Intervention Activities Table

	Warm up	Core Exercise	Warm down
Week 1-2	5-10 minutes mild stretching	Brisk walking at 40% HR for 50mins	5-10 minutes of moderate stretching
Week 3-4	5-10 minutes mild stretching	Brisk walking at 50% HR for 50 minutes	5-10 minutes of moderate stretching
Week 5-6	5-10 minutes mild stretching	Brisk walking at 60% HR for 50 minutes	5-10 minutes of moderate stretching
Week 7-8	5-10 minutes mild stretching	Brisk walking at 70% HR for 50 minutes	5-10 minutes of moderate stretching

Method of Data Analysis

The data taken from participants were analyzed using statistical package for social science (SPSS) 25.0, descriptive statistics of mean and standard deviation were used to analyze the demographic data while parametric statistic of Analysis of Co-variance (ANCOVA) was used to test the hypotheses at 0.05 alpha level.

CHAPTER FOUR

RESULTS, ANALYSIS AND DISCUSSION

This chapter presents the data analysis and discussion of research findings. The chapter begins with the presentation of information on demographic characteristics of the participants, analysis of anthropometric variable, test of hypotheses and summary of findings.

Demographic Information of the Participants

Table 1: Personal Data of Participants

Variables	Frequency	Percentage
Gender		
Male	30	42.9%
Female	40	57.1%
Total	70	100%
Occupation		
Civil Servant	19	27.1%
Public Servant	12	17.1%
Self-Employed Business	17	24%
Others (Students, Bankers)	22	31.4%
Total	70	100%
Marital Status		
Single	10	14.3%
Married	60	85.7%
Total	70	100%
Educational Background		
O level/OND/NCE	23	32.9%
HND/BSc	41	58.6%
MSc	06	8.6%
Total	**70**	**100%**

Table one presents the demographic information of the participants, the mean age is 39.50 while the standard deviation is 6.812. Male participants were 30 (42.9%) while Female were 40 (57.1%). Further, occupational distribution revealed that 19 (27.1%) were civil servants, 12 (17.1%) were public servants, 17 (24.3%) were self-employed and 22 (31.4%)

were students/bankers. Also, 10 (14.3%) were single while 60 (85.7) were married.23 (32.9%) possessed O Level/OND/NCE, HND/B.Sc. 41(58.6%), M. Sc. 06 (8.6%).

Table 2: Descriptive Statistics on Anthropometric Parameters of Participants (N= 70)

Variables		**Mean**	**Std. Deviation**
Age of the Participants		39.50	6.812
Height	Pretest	168.31	7.125
	Posttest	168.31	7.125
Weight	Pretest	98.80	12.054
	Posttest	93.69	10.294
BMI	Pretest	34.8754	3.76675
	Posttest	33.0610	3.16261
Lean body weight	Pretest	47.46	7.863
	Posttest	44.44	8.050
Body density	Pretest	47.04	7.226
	Posttest	44.03	7.820
Percentage of body fat-Biceps	Pretest	13.501	6.3788
	Posttest	11.226	5.4579
Percentage of body fat-Triceps	Pretest	15.170	6.8735
	Posttest	12.690	5.7111
Percentage of body fat-subscapular	Pretest	16.271	7.3916
	Posttest	16.344	23.8767

Table two presents descriptive statistics on anthropometric parameters of the participants. The mean age was 39.50 with standard deviation of 6.812. Height presented a mean of 168.31and standard deviation of 7.125; mean weight for pretest was 98.80 with standard deviation of 12.054; posttest mean was 93.69 with standard deviation of 10.294; BMI pretest mean was 34.8754 and standard deviation of 3.76675; posttest mean was 33.0610and standard deviation of 3.16261; Lean body weight pretest mean was 47.46 with standard deviation 7.863; posttest mean 44.44 and standard deviation of 8.050; Body density pretest mean was 47.04 with standard deviation of 7.226; posttest mean was 44.03 and standard deviation of 7.820; Percentage of body fat-biceps pretest mean was 13. 501 and

standard deviation 6.3788; posttest mean was 11.226 and standard deviation of 5.4579; Percentage of body fat-triceps pretest mean was 15.170 and standard deviation of 6.8735, posttest mean was 12.690 with standard deviation of 5.7111; Percentage of body fat-subscapular pretest mean was 16.271 and standard deviation of 7.3916, posttest mean score was 16.344 and standard deviation of 23. 8767.

Table 3: Descriptive Statistics on Physiological Parameters of Participants

Variables		**Mean**	**Std. Deviation**
Systolic Blood Pressure	Pretest	141.00	18.289
	Posttest	127.00	12.111
Diastolic Blood Pressure	Pretest	91.29	9.195
	Posttest	83.71	15.433
Heart Rate	Pretest	68.66	4.830
	Posttest	65.57	3.429

Table three presents the descriptive statistics on physiological parameters of participants. Pretest mean for systolic blood pressure was 141.00 and standard deviation of 18.289; posttest mean was 127.00 and standard deviation of 12.111; diastolic blood pressure pretest mean was 91.29 and standard deviation of 9.195; posttest mean was 83.71 with standard deviation of 15.433; heart rate pretest mean score was 68.66 with standard deviation of 4.830; posttest mean was 65.57 and standard deviation of 3.429.

Table 4:

Univariate Analysis of Co-Variance showing effect of brisk walking on anthropometric indices of obese adults

Dependent variables:

Body weight, body mass index, lean body weight, body density and percentage body fat.

Source	Type III sum of squares	df	mean square	f	mean	standard error	R squared	adjusted R squared	p
Weight	9464.018	69	312.023	117.754	97.781	.319	.989	.981	.000
BMI	905.831	69	15.555	47.107	33.615	.072	.996	.975	.000
Lean body weight	4743.052	69	172.815	94.189	44.007	.225	.984	.973	.000
Body density	4413.64	69	143.355	48.807	45.118	.246	.974	.954	.000
Percentage body fat	3556.266	69	162.161	51.588	110.195	2.327	.958	.939	.000

Table four presents ANCOVA result on the effect of brisk walking on body weight of obese adults in Ilorin metropolis. The main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] = 117.754, P<0.05. There was significant effect of training on the weight of the participants; hence the hypothesis is not accepted. The mean square =312.023;.R Squared = .989; Adjusted R Squared = .981. This implies that brisk walking had a significant main effect on the weight of the participants.

The table further present ANCOVA result on the effect of brisk walking on body mass index of obese adults in Ilorin metropolis. The main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] = 47.107, P<0.05. There was significant effect of training on the body mass index of the participants; hence the hypothesis is not accepted. The mean square = 15.555; R Squared = .996; Adjusted R Squared = .975. This implies that brisk walking had a significant effect on the body mass index of the participants.

The ANCOVA result on the effect of brisk walking on lean body weight of obese adults in Ilorin metropolis further shows that the main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] = 94.189, P<0.05. There was significant effect of training on the waist circumference of the participants; hence the hypothesis is not accepted. The mean square = 172.815; R Squared = .984; Adjusted R Squared = .973. This implies that brisk walking had a significant main effect on the lean body weight of the participants.

ANCOVA result on the effect of brisk walking on body density of obese adults in Ilorin metropolis shows that the main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] = 48.807, P<0.05. There was significant effect of training on the body density of the participants; hence the hypothesis is not accepted. The mean square = 143.305; R Squared = .974; Adjusted R Squared = .954. This implies that brisk walking had a significant main effect on the body density of the participants.

The table further presents ANCOVA result on the effect of brisk walking on the percentage of body fat of obese adults in Ilorin metropolis. The main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] =51 .588, P<0.05. There was significant effect of training on the percentage of body fat of the participants; hence the hypothesis is not accepted. The mean square = 162.161; R Squared = .958; Adjusted R Squared = .939. This implies that brisk walking had significant main effect on the percentage of body fat of the participants.

Table 5:

Univariate Analysis of Co-Variance showing effect of brisk walking on physiological characteristics of obese adults.

Dependent variables:

Systolic blood pressure, diastolic blood pressure and heart rate.

Source	Type III sum of squares	df	mean square	f	mean	standard error	R squared	adjusted R squared	p
Systolic blood pressure	16730.000	69	1470.670	42.885	139.257	1.079	.879	.859	.000
Diastolic	9429.771	69	416.923	3.970	85.203	2.634	.309	.859	.000
Heart rate	1073.143	69	46.237	6.578	68.081	.482	.646	.548	.000

Table five presents ANCOVA result on the effect of brisk walking on the systolic blood pressure of obese adults in Ilorin metropolis. The main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] =42 .885, P<0.05. There was significant effect of training on the systolic blood pressure of the participants; hence the hypothesis is not accepted. The mean square = 1470.670; R Squared = .879; Adjusted R Squared = .859. This implies that brisk walking had significant main effect on the systolic blood pressure of the participants.

Furthermore, the table presents ANCOVA result on the effect of brisk walking on the diastolic blood pressure of obese adults in Ilorin metropolis. The main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] =3 .970, P<0.05. There was significant effect of training on the diastolic blood pressure of the participants; hence the hypothesis is not accepted. The mean square = 416.923; R Squared = .309; Adjusted R Squared = .859. This implies that brisk walking had significant main effect on the diastolic blood pressure of the participants.

Also, the table presents ANCOVA result on the effect of brisk walking on the heart rate of obese adults in Ilorin metropolis. The main effects of the training was statistically significant at 0.05 level of significance [(f 1,69)] =6 .578, P<0.05. There was significant effect of training on the diastolic blood pressure of the participants; hence the hypothesis is not accepted. The mean square = 46.237; R Squared = .646; Adjusted R Squared = .548. This implies that brisk walking had significant main effect on the diastolic blood pressure of the participants.

Discussion of Findings

The finding of this study revealed that there was significant effect of brisk walking on body weight among obese adults; it is generally believed that physical training can alter body composition. Many believed that physical activity has little or no influence on changing body composition and that even vigorous exercise burns too few calories to lead to substantial body fat reductions. This was in line with other authors like Kenney, Wilmore and Costill (2012), whose research has demonstrated the effectiveness of exercise training in promoting moderate changes in the body composition. The authors further stated that most weight management trainers use aerobic exercise such as brisk walking, 200-meter race, quarter milled race amongst others. These observations also agree with the work of Slentz, Aiken and Houmard (2005), who reported that physical activity such as brisk walking was associated with marked reduction in body weight and fat mass in overweight and obese middle-aged men and women, in a close response manner. Indeed, obese individuals who exercised for about 175min per week lost significantly more body weight and total fat mass than those who exercised for less than that Ross, Freeman and Hudson: (2008) also discovered that study conducted on 298 obese women between 50-75 year of age with an aerobic exercise program consisting of 30min per day of brisk walking for 24weeks result in significant body weight reduction.

There was significant effect of brisk walking on body mass index (BMI) from this study, there was significant reduction in the BMI of the participants which is also in line with the finding of Chen, Ismail and Abdulaziz (2016), affirmed that there was a positive improvement in terms of lower BMI in the exercise intervention group after 8 weeks exposure to brisk walking in his study. Hanson and Jones (2015), also highlighted in their research study that group walking is effective and safe and it brought about wide range health benefits including lowering of BMI, total cholesterol and increased Vo_{2max}.It was further reported that walking appears to be acceptable intervention to participants with high levels of adherence and a low risk of serious side effects; thus brisk walking is an appropriate and feasible exercise modality for the

overweight and obese individuals except for overly obese (BMI> 40.0) and individual with chronic knee pain (Chen, 2014). Chaudhary, Kang and Sandhu, (2010) have also reported that both aerobic training at 60-70% of maximum heart rate and resistance training 3 times per week for 6 weeks resulted in a significantly lower BMI and body fat percentage.

This study also reported significant effect of brisk walking on lean body weight, the study is in line with Azeem (2011) who also reported similar findings of a significant reduction in body density, lean body weight and BMI in obese males following a 12week brisk walking programme at a frequency of 5 times per week, 45 minutes per session. This finding is also in line with the work of Ross, Freemanm Hudson and Janssen (2004) who have suggested that exercise is an effective tool in reducing lean body weight or waist hip ratio even though there was no substantial weight loss. The reduction of lean body weight is of particular clinical importance since the increased risk of insulin resistance, diabetes, metabolic syndrome and mortality is associated with excess abdominal adiposity. (Ross, Janssen& Kuk, 2002). Similar to the findings from an earlier published study by Egbe, Asuquo, Ekwere, Olufemi and Ohwovoriole, (2014). Who stated a positive linear correlation between lean body weight and BMI of participants in brisk walking. This supports the findings of a systematic review of studies done in sub-saharan Africa (Ekoru, Murphy& Young, 2017; WHO, 2011; Okafor, Raimi, Gesawa, Sabir, Enang& Puepet, 2016). Melam, Alhusaini, Buragadda, Kaur and Khan, 2016) have also demonstrated in their study that brisk walking for 45mins, 5days per week for 10 weeks significantly reduces BMI, lean body weight and body density. The outcome of this finding could be attributed to either strict adherence to certain dietary restrictions or the holistic approach of safe, convenient and easy to achieve attribute associated with brisk walking in our environment.

This study also reported significant effect of brisk walking on body density, this study is

in consonance with Papaino (2014) who ascertain that regular brisk walking of not less than 10-12 weeks would significantly contributed towards the reduction of body density and it improved an individual physiological age, this was also corroborated by Azeem (2011) who also reported similar findings of a significant reduction in body density, lean body weight and BMI in obese males following a 12week brisk walking programme at a frequency of 5 times per week, 45 mins per session. Melam, Alhusaini, Buragadda, Kaur and Khan, 2016) have also demonstrated in their study that brisk walking for 45mins, 5days per week for 10 weeks significantly reduces BMI, lean body weight and body density. The outcome of this finding could be attributed to either strict adherence to certain dietary restrictions or the holistic approach of safe, convenient and easy to achieve attribute associated with brisk walking in our environment.

There was significant effect of brisk walking on percentage of body fat, this agrees with a previous report from (Akinpelu, Akinola, & Gbiri 2009). It has also been previously reported that triceps percentage of body fat has a better correlation with body mass index in women than in men. The implication is that the findings of this study will add to the building knowledge base on triceps percentage of body fat and obesity. Furthermore, it is imperative to note that triceps percentage of body fat has better sensitivity and specificity in detecting obesity in both male and female participants. This study is also in line with (Shimamoto, Adachi, Takahashi & Tamaka, 2008) there are a lot of training models and methods of exercising which are used in order to reduce the body fat percentage amongst which brisk walking, running and cycling are said to be the most effective and the most popular ways.

Based on the findings, there was significant effect of brisk walking on systolic and diastolic blood pressure of obese adults. The finding conforms with that of Arnab (2006) who recommended that brisk walking is useful to lower blood pressure, blood glucose, and obesity (particularly central obesity) in middle-aged obese individuals. Chanudet, Gilles and

Bonnevie, (2006) also affirmed that thirty minutes of brisk walking daily is beneficial and not limited to blood pressure. Byron (2008) reported that brisk walks appear to be very effective for lowering blood pressure. According to a study by Kaukab (2011), it was concluded that twelve weeks brisk walking is beneficial for lowering of blood pressure, body mass index, and anthropometric circumference of obese males. Paul, Ford, Gill, Perkins and Swaine, (2012) reported that regular accumulated bouts of brisk walking during the day can positively affect body composition especially among children.

There was a significant effect of brisk walking on heart rate of obese participants in this study; this finding corresponds with the outcome of Ali and Cheryl (2013), which shows significant improvement in the systolic and diastolic blood pressure as well as heart rate. There were significant linear and quadratic decreases in both blood pressure and heart rate over time. This study also in line with Onifade, (2010) Ascertain that effect of brisk walking on heart rate on obese cannot be overemphasized and regular walking can increased the chance of living longer and it enhances the pumping of blood through the heart to vessels.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

This chapter presents summary, conclusion and recommendations.

Summary

This study focused on effect of brisk walking on anthropometric indices and physiological characteristics of obese adults in Ilorin metropolis. The study began with an introduction and background to the study. The key concepts related to the study were discussed and a brief on previous similar studies was reviewed. The chapter also presented the statement of the problem and hypotheses were stated including significance of the study. The section ended with operational definition of terms as used in the study.

Literature reviewed dealt with an overview of brisk walking, anthropometrics, physiological characteristics and obesity. Previous studies as reported by scholars on etiology of obesity, theoretical review of Foresight Theory by Slaughter (1997) was also discussed. Conceptual reviews focused on epidemiology, classification, management and prevention of obesity, importance of physical activity in the reduction of obesity and efficacy of brisk walking in the management and reduction of obesity. The chapter ended with an appraisal of the reviewed literature.

The pretest-posttest one group experimental research design was adopted for this study. The training lasted for 8 weeks. Standardized measuring instruments were used for the study. Purposive sampling technique was adopted for the study based on the inclusion and exclusion criteria. The data collected were analyzed using descriptive statistics for the demographic data of the respondents while parametric statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Conclusions

Based on the findings, this study concludes as follows:

There was significant effect of brisk walking on Anthropometric Variables (body weight, body mass index, lean body weight, body density and percent body fat) of obese adults in Ilorin metropolis.

There was also a significant effect of brisk walking on physiological characteristics (systolic blood pressure, diastolic blood pressure and heart rate) of obese adults in Ilorin metropolis.

Recommendations

The following recommendations were made based on the findings of this study:

1. It was suggested that the findings of this study should be adopted by Physical Education teachers, Health personnel and Fitness experts for prescribing the brisk walking programme for the adults and by extension different age groups in Ilorin metropolis.

2. There was need for a collaborative effort among Exercise scientists, Fitness experts and other sports professionals to educate all classes of people (rural and urban), on the importance of involvement in physical activities especially brisk walking and active lifestyle so as to lead a healthy living devoid of hypokinetic diseases.

3. It was advocated that exercise scientists should work with other health professionals to formulate policies and programmes that will promote awareness of the health benefits of physical activity and outdoor physical exercise to assist in reducing the scourge of obesity among the adults.

4. Effective use of media such as newspaper, television and radio was advocated for educating the populace about the adverse health effects of obesity and importance of exercise in improving their healthy living.

Suggestion for Further Studies

Other researchers should broaden the scope of the studies by increasing the anthropometric indices and physiological variables.

It is also suggested that other researchers should extend the number of weeks to accommodate for maximum resultant effect of brisk walking on anthropometric indices and other physiological parameters.

Contribution to Knowledge

The findings from this study would contribute to the existing body of knowledge in Exercise science and fitness, Equally, it would be useful for reference purpose for researches, especially while studying related topics.

The findings of this study would be published in reputable journals for wider publicity where obese individuals, fitness instructors, general populace and various researchers would find it handy for reference purposes.

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APPENDIX I

CONSENT FORM FOR PARTICIPANTS IN THE RESEARCH

I freely, voluntarily and without force or coercion consent to participate in the research involving adults which is aimed at helping in addressing the problem of obesity and to enhance health and wellbeing of participants.

I understand the purpose of the research and I am aware I will be asked questions pertaining to my feelings while participating. I also understand that I will be completing paper and pencil questionnaires and take part in exercise training sessions. I understand my participation is completely voluntary and I may choose not to participate at any time without penalty.

All my responses will be kept confidential, my name will not appear on any of the results and no individual responses will be reported. I understand that there are minimal risks involved in participating in this study. I might experience anxiety over any of the questions asked of me or during any of the training activities. If I experience any form of emotional discomfort while participating, I am free to quit.

I understand there are benefits of participating in this study and that this consent may be withdrawn at any time without prejudice.

I understand that I may contact the researcher or the project supervisor for answers to questions about this research or my rights.

I have read and understand this consent form.

…… ……..

Participant's Name and Signature **Date**

APPENDIX II

ANTHROPOMETRIC AND PHYSIOLOGIC VARIABLES DATA SHEETS

BIODATA

Age:…….…… Gender:…….Occupation:……..

Marital Status:…….. Educational Qualification……..

CLIENTS PARAMETERS

S/No	Anthropometric Variables	Pre-test	Post-test (8 weeks)
1	Height		
2	Weight		
3	BMI		
4	Lean body weight		
5	Body density		
6	Percentage of body fat • Biceps • Triceps • Subscapular		
	Physiological Variables		
7	Systolic Blood Pressure		
8	Diastolic Blood Pressure		
9	Heart Rate		

STETHOSCOPE

STADIOMETER

SKINFOLD CALIPER

SPHYGMOMANOMETER

WEIGHING SCALE MACHINE