

**ASSESSMENT OF THE EFFECT OF BRISK WALKING ON ANTHROPOMETRIC  
AND BODY COMPOSITION INDICES OF OBESE FEMALE ADULTS IN KADUNA  
METROPOLIS, NIGERIA**

**BY**

**Omolara Ekugbe SAIWO**

**DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION,  
FACULTY OF EDUCATION  
AHMADU BELLO UNIVERTY,  
ZARIA**

**OCTOBER, 2018**

**ASSESSMENT OF THE EFFECT OF BRISK WALKING ON ANTHROPOMETRIC  
AND BODY COMPOSITION INDICES OF OBESE FEMALE ADULTS IN KADUNA  
METROPOLIS, NIGERIA**

**BY**

**Omolara Ekugbe SAIWO  
(Ph.D./EDUC/P14EDPE9011)**

**A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES,  
AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA,**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF  
DOCTOR OF PHILOSOPHY DEGREE (Ph.D.) IN EXERCISE AND SPORT  
SCIENCE**

**DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION,  
FACULTY OF EDUCATION,  
AHMADU BELLO UNIVERSITY, ZARIA,  
NIGERIA**

**OCTOBER, 2018**

## **DECLARATION**

I declare that the research work titled ‘Assessment of the Effect of Brisk Walking on Anthropometric and Body Composition Indices of Obese Female Adults in Kaduna Metropolis, Nigeria’ has been written by me in the Department of Human Kinetics and Health Education under the supervision of Prof. E. A. Gunen, Prof. M. Aliyu and Prof. M.A. Chado. All quotations and authors cited in this work have been indicated and sources of information are specifically acknowledged by means of references. No part of this dissertation was previously presented for another degree or diploma at any University.

.....  
**Omolara Ekugbe SAIWO**

.....  
**Date**

## CERTIFICATION

This dissertation entitled “**Assessment of the Effect of Brisk Walking on Anthropometric and Body Composition Indices of Obese Female Adults in Kaduna Metropolis, Nigeria**” by Omolara Ekugbe SAIWO meets the regulations governing the award of the degree of Doctor of Philosophy (Ph.D.) in Exercise and Sport Science, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

.....  
**Prof. E. A. Gunen**  
Chairman Supervisory Committee

.....  
**Date**

.....  
**Prof. M. Aliyu**  
Member, Supervisory Committee

.....  
**Date**

.....  
**Prof. M. A. Chado**  
Member, Supervisory Committee

.....  
**Date**

.....  
**Prof. M.A. Suleiman**  
Head of the Department

.....  
**Date**

.....  
**Prof. S. Z. Abubakar**  
Dean, Postgraduate School

.....  
**Date**

## **DEDICATION**

I dedicate this work to my dear husband, children, mother and siblings for their love, patience, encouragement and all round support.

## **ACKNOWLEDGEMENTS**

The researcher returns all glory to God Almighty, the alpha and omega, the lifter of her head and the ever present help in times of need.

The researcher acknowledges and appreciates the supervisory roles of Prof. E. A. Gunen, Prof. M. Aliyu and Prof. M.A. Chado for their expertise, the technical and critical comments at all stages of this research. Their brilliant and scholarly inputs, energy and the time devoted to this work are highly appreciated.

The researcher sincerely thanks the Ethical Committee of Barau Dikko Teaching Hospital and Ahmadu Bello University Zaria, for the permission to conduct this study; the management of Barau Dikko Teaching Hospital and Ahmadu Bello Sports Commission for the permission to use their facilities to conduct the study. Miss Yemisi Oyewole and Miss Sefiyat Mustapha (physiotherapists) for all their assistance and support during the course of data collection. The researcher appreciates specially, aunty Asabe Ado for her immense assistance towards getting the permission to use the track at Ahmadu Bello Stadium, Kaduna.

The researcher wishes to register her sincere thanks and appreciation to all the staff of the Department of Human Kinetics and Health Education, Ahmadu Bello University, Zaria, Kaduna State for assisting the researcher in numerous ways throughout the duration of the programme. You are highly cherished.

Finally, very big thank to Mr Tunji Saiwo (husband) for the permission to take up this programme, the undying love and encouragement cannot be waved away as you have been a special source of great motivation all these years. The researcher owes Adetunji, Efetobore, Temisan and Rahab (children) gratitude for the sacrifices and support shown throughout the period of this programme.

## ABSTRACT

This study was conducted to assess the effect of brisk walking on anthropometric and body composition indices of obese female adults in Kaduna metropolis, Nigeria. To achieve this purpose repeated measure research design was used for this study. The population for the research was obese female adults of Kaduna metropolis. Using purposive sampling, 17 obese female adults with body mass index between 30.0 and 39.9 kg/m<sup>2</sup> and ages of 40 - 50 years who met the inclusion and exclusion criteria were selected for this study. There were 3 attritions leaving 14 participants in the group. The training group was subjected to, brisk walking for 30-50 minutes with 10 and 5 minutes of warm up and cool down activities respectively. The exercise programme was conducted on 3 alternate days per week for 12 weeks. Body weight, height, waist and hip circumferences, visceral adipose fat, percent body fat and lean muscle mass were measured at base-line, immediately after the 6<sup>th</sup> and 12<sup>th</sup> week of training period. The descriptive statistics of mean, standard deviation and standard error of means were used to analyze the data of the physical characteristics of the participants. Repeated-measures ANOVA was used to assess the effect of training on all the assessed variables while post hoc Bonferroni Multiple comparison was used to evaluate the effect of the training on the variables. The null hypotheses raised for this study were tested at 0.05 alpha levels. The results of this study revealed that brisk walking significantly reduced the total body weight  $F(2, 26) = 80.010, P = 0.005$ , body mass index  $F(2, 26) = 57.576, P = 0.005$ , waist circumference  $F(2, 26) = 50.982, P = 0.005$ , percent body fat  $F(2, 26) = 18.120, P = 0.005$  and significant increase in lean muscle mass  $F(2, 26) = 12.025, P = 0.005$  of the participants. However, 12 week of brisk walking did not significantly reduce waist-hip-ratio  $F(2, 26) = .085, P=0.005$  and visceral fat  $F(2, 26) = .127, P=0.005$  of the participants. It was concluded that brisk walking significantly reduced the total body weight, body mass index, waist circumference, percent body fat as well as lean muscle mass but did not significantly reduce waist-hip-ratio and visceral fat of obese female adults. Although there were significant changes in the total body weight, body mass index and the %body fat due to brisk walking, the participants were still obese. It was therefore recommended that brisk walking should not only be prescribed for the modification of anthropometric and body composition indices, it should be made a lifestyle practice for optimal weight management benefit. Brisk walking may also be used to assist individuals with obesity problem.

## TABLE OF CONTENTS

Title Page	ii
DECLARATION	iii
CERTIFICATION	iv
DEDICATION	v
ACKNOWLEDGEMENTS	vi
ABSTRACT	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xi
LIST OF FIGURES	xii
LIST OF APPENDICES	xiii
OPERATIONAL DEFINITION OF TERMS	xiv
ABBREVIATIONS	xv
<b>CHAPTER ONE: INTRODUCTION</b>	
1.1 Background of the Study	1
1.2 Statement of the Problem	5
1.3 Research Question	8
1.4 Purpose of the Study	8
1.5 Basic Assumptions	9
1.6 Hypotheses	9
1.6.1 Major Hypothesis	9
1.6.2 Sub - Hypotheses	9
1.7. Significance of the Study	10
1.8 Delimitation of the Study	12
<b>CHAPTER TWO: REVIEW OF RELATED LITERATURE</b>	
2.1 Introduction	13
2.2 Body Fat Patterns	14
2.2..1 Total body weight	16
2.2.2 Body mass index	17
2.2.3 Waist Circumference	19
2.2.4. Waist-Hip-Ratio	22
2.3 Body composition	25
2.3.1 Visceral Adipose Fat	25



2.3.2	Percent Body Fat	26
2.3.3	Lean muscle mass	28
2.4	Effect of brisk walking on body fat patterns of female adults	29
2.4.1	Effect of brisk walking on total body weight	
2.4.2	Effect of brisk walking on body mass index	29
2.4.3	Effect of brisk walking on waist circumference	32
2.4.4	Effect of brisk walking on waist-to-hip ratio	33
2.5	Effect of brisk walking on body composition	34
2.5.1	Effect of brisk walking on visceral fat	35
2.5.2	Effect of brisk walking on percent body fat	37
2.5.3	Effect of brisk walking on lean muscle mass	38
2.6	Physiological Modification of Obesity during Brisk Walking	38
2.6.1	Brisk walking prescription for obese individuals	39
2.6.1.1	Moderate Exercise Intensity	41
2.6.1.2	Target Heart Rate and Estimated Maximum Heart Rate	41
2.6.1.3	Perceived Exertion (Borg Rating of Perceived Exertion Scale)	42
2.6.1.4	Metabolic Equivalents	42
2.6.1.5	Talk Test	43
2.7	Summary	44
<b>CHAPTER THREE: METHODOLOGY</b>		
3.1	Introduction	48
3.2	Research Design	48
3.3	Population	48
3.4	Sample and Sampling Techniques	48
3.5	Research Instruments	49
3.6	Procedures for Data Collection	49
3.6.1	Informed Consent	49
3.6.2	Research Assistants	50
3.6.3	Testing sequence	50
3.6.4	Anthropometric and body composition measurement	51
3.7	Training Protocol/Procedure	55
3.8	Procedures for Data Analyses	56

## **CHAPTER FOUR: RESULTS AND DISCUSSION**

4.1	Introduction	58
4.2	Results	58
4.2.3	Testing of Hypotheses	63
4.3	Discussion	73

## **CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS**

5.1	Summary	79
5.2	Conclusions	80
5.3	Contribution to knowledge	81
5.4	Limitations of the study	82
5.5	Recommendations	82
5.6	Suggestions for further Studies	83
	REFERENCES	84

## LIST OF TABLES

### TABLES

Table 2.2.1 BMI ranges for adult	18
Table 2.2.3 Classification of Waist-to-Hip Ratio for women (Heyward 2010)	23
Table 2.2.4 Abdominal Obesity Measurement Guidelines	24
Table 2.3.2 General population body fat percentages for females and their classification	27
Table 2.3.3 Body fat percentage for the average population	27
Table 3.7 Summary of Training Protocol/Procedure	55
Table 4:2:1 Demographic Data of the participants	58
Table 4:2:2 Descriptive statistics of the anthropometric and body composition	59
Table 4:2:3a Repeated-measures ANOVA on body mass index of obese female adults at base-line, immediately after 6 <sup>th</sup> and 12 <sup>th</sup> week of brisk walking	65
Table 4:2:3b LSD Multiple comparison (pair wise) on body mass index of the	66
Table 4:2:4a Repeated-measures ANOVA on waist circumference of obese female adults at base-line, immediately after 6 <sup>th</sup> and 12 <sup>th</sup> week of brisk walking	67
Table 4:2:4b LSD Multiple comparison (pair wise) on waist circumference of the	68
Table 4:2:5a Repeated-measures ANOVA on waist-hip-ratio of obese female adult at base-line, immediately after 6 <sup>th</sup> and 12 <sup>th</sup> week of brisk walking	69
Table 4:2:6a Repeated-measures ANOVA on visceral fat of obese female adults at base-line, immediately after 6 <sup>th</sup> and 12 <sup>th</sup> week of brisk walking	70
Table 4:2:7a Repeated-measures ANOVA on percent body fat of obese female adults at base-line, immediately after 6 <sup>th</sup> and 12 <sup>th</sup> week of brisk walking	71
Table 4:2:7b: LSD Multiple comparison (pair wise) on per-cent body fat of obese	71
Table 4:2:8a Repeated-measures ANOVA on lean muscle mass of obese female adults	72
Table 4:2:8b: LSD Multiple comparison (pair wise) on lean muscle mass of obese female	73

## LIST OF FIGURES

<b>FIGURES</b>	<b>Page</b>
Fig. 4:2:2a Changes in the mean values of participants' BMI at base-line, immediately after 6 <sup>th</sup> and 12 <sup>th</sup> weeks of brisk walking	60
Fig. 4:2:2b Changes in the mean values of participants' waist circumference at base-line, immediately after 6 <sup>th</sup> and 12th weeks of brisk walking	61
Fig. 4:2:2c Changes in the mean values of participants' waist-hip-ratio at base-line, immediately after 6th and 12th weeks of brisk walking	61
Fig. 4:2:2d Changes in the mean values of participants' visceral fat at base-line, immediately after 6th and 12th weeks of brisk walking	62
Fig. 4:2:2e Changes in the mean values of participants' percent body fat at base-line, immediately after 6th and 12th weeks of brisk walking	62
Fig. 4:2:2f Changes in the mean values of participants' lean muscle fat at base-line, immediately after 6th and 12th weeks of brisk walking	63

## LIST OF APPENDICES

Appendix A: Introductory Letter to Barau Dikko Teaching Hospital for Data Collection	95
Appendix B: Approval from Health Research Ethics Committee of B.D.T.H	96
Appendix C: Introductory Letter to Ahmadu Bello Sports Commission for Data Collection	98
Appendix D Letter of Permission to Use Ahmadu Bello Stadium Track	99
Appendix E ABUCUHSR Approval to use Human Participants	100
Appendix F Physical Activity Readiness Questionnaire	101
Appendix G Consent Form for Participation in the Research Study	102
Appendix H Postal for Recruiting Study Participants	104

## **OPERATIONAL DEFINITION OF TERMS**

**Brisk walking:** In this study, walking at intensity levels between 50% and 65 % of maximum heart rate of obese female adults in Kaduna metropolis, Nigeria.

**Obese Adult:** This refers to female adults between the ages of 40 and 50 years with body mass index of 30.0 to 39.9 kg/m<sup>2</sup> in Kaduna metropolis, Nigeria

## **ABBREVIATIONS**

**ABU:** Ahmadu Bello University

**ACSM:** American College of Sports Medicine

**AT:** Aerobic training

**%BF:** Body fat percentage

**BIA:** Bioelectrical impedance analysis

**BMI:** Body mass index

**CDC:** Centre for Disease Control

**DEXA:** Dual energy x-ray absorptiometry

**HC:** Hip circumference

**HDL-C:** High-density Lipoprotein Cholesterol

**HRR:** Heart rate reserve

**NHS:** National Health Services

**NIH:** National Institute of Health

**IAF:** Intra-abdominal fat

**LDL-C:** Low - density lipoprotein cholesterol

**MRI:** Magnetic resonance imaging

**NHANES:** National Health and Nutrition Examination Survey

**PAR – Q & YOU:** Physical activity readiness questionnaire

**RHR:** Resting hearth rate

**RT:** Resistance training

**TBW:** Total body weight

**TC:** Total Cholesterol

**T2DM:** Type 2 diabetes mellitus

**THR:** Training heart rate

**UAB:** University of Alabama at Birmingham

**VAT:** Visceral adipose tissue

**VF:** Visceral fat

**WC:** Waist circumference

**WHO:** World Health Organisation

**WHR:** Waist - hip - ratio



## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background of the Study**

Life-style is generally considered a personal issue. However, World Health Organization (WHO) (2016b), reported a strong correlation between mortality rate and lifestyle practices globally. One of such lifestyle practices is physical inactivity or sedentary living which was highlighted as one of the causes of obesity, leading to metabolic and cardiovascular diseases and other related problems (Ding, Rogers, Van der Ploeg, Stamatakis &, Bauman, 2015; WHO, 2016b). Experts in nutrition stressed that obesity is difficult to define qualitatively; but it is generally accepted that anyone who has a body mass index (BMI) equal to or greater than  $30\text{kg/m}^2$  is obese (Kent, 2005; WHO, 2016b). It generally results from a chronic imbalance between energy intake and expenditure resulting in weight gain mostly as fat (Ahima, 2010). Globally, there has been an increased intake of energy-dense foods that are high in fat; and an increase in physical inactivity due to the increasing sedentary nature of many forms of work, changing modes of transportation and increasing urbanization (WHO, 2016b). Changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with development and lack of supportive policies in sectors such as health, agriculture, transport, urban planning, environmental, food processing, distribution and marketing as well as education (WHO, 2016b). Physical inactivity and unhealthy diet have been linked with obesity and obesity has been found to contribute to approximately 55% of type 2 diabetes mellitus (T2DM) (Rother, 2007). The incidence of T2DM doubles with every 20% of excess weight and this figure applies to the young as well as the older diabetic persons (Makama, 2010). Similarly, physical inactivity is the fourth leading risk factor for mortality (WHO, 2017). Physical activity is a vital part of a comprehensive weight loss and weight control programme and it can increase

cardiorespiratory fitness and also lead to weight loss in overweight and obese adults (Melam, Alhusaini, Buragadda, Kaur & Khan, 2016)

Anthropometric measurements are set of noninvasive and quantitative techniques for determining an individual's body fat patterns by measuring, recording and analyzing specific dimensions of the body, such as height, weight and body circumferences at the hip and waist (Kaur, Kaur & Puri, 2016). They are used to determine the relationship between various body measurements for epidemiological and medical outcomes. Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters;  $\text{weight (kg) / height (m}^2\text{)}$  (National Institute of Health, 2012; Centre for Disease Control, 2015a; WHO, 2016b). Body mass index is the most commonly used and simple measure of body size (generalized obesity), especially for estimating the frequency of obesity in large epidemiological studies (Farzad, Fatemeh, Salehi & Nojomi, 2012). However, BMI does not consider the distribution of body fat, resulting in variability in different individuals and populations (Liu, Tong, Tong, Lu & Qin, 2011). In the assessment of obesity, the central distribution of body fat cannot be overlooked; hence the use of other anthropometric indices such as waist circumference (WC), hip circumference and waist - hip - ratio (WHR) as measures of adiposity (Sanya, Ogwumike, Ige & Ayanniyi, 2009).

Waist circumference has been recommended as a simple and practical measure for identifying overweight and obese individual. It is particularly useful for individuals and population groups with different body builds. Similarly, WHR has also been shown to be a better and simpler indicator of both intra- abdominal fat and coronary artery disease than BMI. Waist circumference and waist hip ratio are used to predict the risk of obesity as they account for regional abdominal adiposity (Liu *et al.*, 2011). A meta-regression analysis of

prospective studies by De Koning, Merchant, Pogue & Anand, (2007) showed that WHR and WC measurements were strongly associated with incidence of coronary heart disease, independent of BMI. Furthermore, a study conducted among 359,387 participants from nine countries in Europe showed that both general and abdominal adiposity are associated with the risk of death and support the use of WC, WHR and BMI in assessing the risk of premature death (Pischon, Boeing, Hoffmann, Bergmann, Schulze & Overvad, *et al.* (2008).

Body composition is a component of health - related fitness used to describe the percentage of fat, bone, water and muscle in the body expressed as percent body mass, visceral fat and lean muscle mass. Excessive body fat is associated with increased metabolic risk and its measurement is important in implementing curative and preventive health measures (Ranasinghe, Gamage, Katulanda, Andraweera, Thilakarathne & Tharanga, 2013). Many studies have shown an association between increased abdominal or visceral adipose tissue and conditions such as hyper-insulinemia, hypertension and dyslipidemia, independent of general obesity or fatness. A greater risk of chronic disease mortality and morbidity has been shown with an increased level of abdominal adiposity, rather than gluteal or femoral adiposity (Warren, Schreiner & Terry, 2005).

American College of Sports Medicine, (2015) reported that aerobic training has the potential of altering anthropometric and body composition of adults. People who are insufficiently physically active have a 20 – 30% increased risk of all causes of mortality compared to those who engage in at least 30 minutes of moderate intensity physical activity on most days of the week (WHO, 2010; ACSM, 2015; CDC, 2015b). Administration of such exercise leads to significant health benefits. A study conducted by Gary Hunter, an exercise physiologist and his team, in the University of Alabama at Birmingham (UAB) Department of Human Studies

found that as little as 80 minutes a week of aerobic or resistance training helped not only to prevent weight gain, but also to inhibit a regain of harmful visceral fat one year after weight loss (Hunter, Brock, Byrne, Chandler-Laney, Corraat, & Gower 2010). The American College of Sports Medicine, (2015) recommends that adults should get at least 150 minutes of moderate intensity exercise per week. The exercise recommendation can be met through 30-60 minutes of moderate intensity exercise (three to five days per week) (ACSM, 2018).

Aerobic exercise is believed by many exercise scientists to be the single best predictor of weight maintenance. Aerobic exercise reduces weight and improved cardiopulmonary fitness in obese subjects better than anaerobic exercise (Al Saif & Alsenany, 2015). Aerobic exercise includes any rhythmic activity involving large muscle groups that elevate the heart rate for a sustained period (Rogers, 2015). These include walking, running, swimming, jumping, cycling, rowing, rope skipping and many such activities. Though the principles of aerobic exercise are the same for everyone, someone who is obese may find certain forms of aerobic exercise unrealistic (Rogers, 2015). For instance, high-impact activities, such as running and jumping may be uncomfortable or stressful to the joints of obese adults, while walking, swimming, cycling or using an elliptical trainer might be better choices for starting regular exercise for this group of persons (Rogers, 2015).

Walking is an excellent, low-intensity activity with little risk of injury. It does not require special facilities and minimum amount of attention is necessary, so socializing is easy and convenient (Ehrman, Gordon, Visich & Keteyian, 2013). Walking is an enjoyable, free, easy, social and great exercise. A walking program is flexible and boosts high success rates because people can stick to it. It is easy for walking to become a regular and satisfying part of life (American Heart Association, 2016). People of almost any fitness level can find a comfortable walking pace to participate in this low-impact aerobic activity. Walking at a pace

of 5.7km/h, Borg scale of perceived exertion 11 – 14 is considered brisk walking which is a popular and convenient form of exercise that plays an important role in weight management and it is often recommended for obese individual because it increases energy expenditure (Melam *et al.*, 2016).

This study, therefore, was conducted to assess the effect of brisk walking on anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

## **1.2 Statement of the Problem**

There is an increasing trend of overweight and obesity among adults in developing countries of the world which makes it a major health problem. This is because obesity is the most pervasive and chronic disease in need of new strategies for medical treatment, management and prevention.

The prevalence of obesity has risen steadily over the past decades in adults and children to become a global epidemic and represents a major public health challenge (Melam *et al.*, 2016). In 2014, more than 1.9 billion (39 %) adults age 18 years and above were overweight and over 600 million (13%) were obese. Of this obese figure, 11% were men, 15% women and 41 million children under the age of 5 were also estimated to be overweight or obese in 2014 (WHO, 2016b). Globally, the prevalence of obesity in women exceeds that in men (Kaur & Walia, 2007; WHO, 2010; 2016b).

Obesity is no longer just a concern for developed countries, but it is becoming an increasing problem in many developing countries. Data from the World Health Organization shows that the prevalence of overweight and obesity increased by 20% between 2002 and 2010 in Nigeria (Akarolo-Anthony, Willett, Spiegelman & Adebamowo, 2014). The prevalence of

obese individuals in Nigeria is of epidemic proportions and there is a need to pay closer attention to combating this health disorder (Chukwuonye, Chuku, John, Ohagwu, Imoh, Isa, Ogah & Oviasu 2013). According to the WHO, 2010 survey data on Nigeria, the prevalence of overweight was 26% and 37% in men and women respectively, while the prevalence of obesity was 3% and 8.1% in men and women respectively. World Bank Gender Statistics (2015) also, reported increased statistics of obese women from 13.4% in 2010 to 16.3% in 2014 in Nigeria. Other studies have also shown higher incidence of obesity among females than males in Nigeria (Wahab, Sani, Yusuf, Gbadamosi., Gbadamosi, & Yandutse, 2011; Banwat, Chingle, Lar, Damib & Zoakah, 2012; Adebayo, Balogun, Adedoyin, Obasoro, John, Bisiriyu & Abiodun, 2014; Fadupin, Adeoye, & Ariyo, 2014). Reports from various population sub-groups in Nigeria as described by Iloh, Amadi, Nwankwo, Ugwu and (2011) in Imo State, Wahab *et al.* (2011) in Katsina State, Adebayo *et al.* (2014) among adults in Osun State, Akarolo-Anthony *et al.* (2014), of a government worksite in Abuja and Banwat *et al.* (2015) in Jos, showed obesity predominance among adult aged 40 years and above with class 1 obesity as the most prevalent followed by class 2 obesity.

Although several research studies have been reported on the prevalence of obesity in Kaduna, there is paucity of information on its management (Adaramaja & Olanrewaju, 2008; Shehu, Abdullahi & Adekeye, 2010; Oladimeji, Fawole, Nguku & Nsubuga, 2012; Dahiru & Ejembi, 2013). A study conducted among civil servants in Kaduna State reported 27% prevalence of obesity with women four times more obese than the men (Oladimeji *et al.*, 2012). Lack of regular exercise has been identified as a major cause of obesity in Kaduna State (Adaramaja & Olanrewaju, 2008; Shehu *et al.*, 2010). Increasing use of motorized transport and sedentary types of occupation such as office work, accompanied by high risk dietary and lifestyle/behaviors were associated to the prevalence of obesity in Kaduna City. Physical inactivity was the most prevalent behavioral factor, 91%, followed by unhealthy diet 90%,

and cigarette smoking 6% (Oladimeji *et al.*, 2012). Dahiruna & Ejembi, (2013) conducted a research in Dakaci, a semi-urban settlement near Zaria, Kaduna State to assess clustering of cardiovascular disease risk-factors (hypertension, physical inactivity, cholesterol, T2DM and obesity), the result shows that only 20% of the population had no risk factor, while more females than males had various risk-factors. In addition, the proportion of subjects with risk-factors increased with increasing BMI, particularly high blood pressure.

The medical risk of obesity is highly associated with the distribution of body fat, and abdominal fat is considered at least as an important medical risk as the total amount of body fat. BMI, waist circumference (WC), and waist-to-hip ratio (WHR) are used to classify obesity and the risks of abdominal fat accumulation (Vazquez, Duval, Jacobs, & Silventoinen, 2007; Kavak, Pilmane & Kazoka, 2014). Generally, researchers have linked high BMI, WC, WHR, visceral fat and percent body fat with chronic diseases such as hypertension, dyslipidamia, T2DM and coronary heart disease (Dehghan & Merchant, 2008; Oda, 2008; Zhang, Rexrode, Van Dan, Li, & Hu, 2008; Srikanthan, Seeman & Karlamangla, 2009).

Walking at a pace of 5.7 km/h, Borg scale of perceived exertion 11 – 14 is considered brisk walking, and it is a popular and convenient form of exercise that plays an important role in weight management and it is often recommended for obese individual because it increases energy expenditure (Melam *et al.*, 2016). Report on the association of brisk walking and obese adult women of Kaduna State is limited and there are no published perspective data on the association.

In view of the epidemic state of obesity in Nigeria, especially in Kaduna State, and the advocacy to promote healthy living and reduce diseases associated with increasing inactivity

such as obesity, this study, was conducted to assess the efficacy of brisk walking on selected anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

### **1.3 Research Question**

This study was conducted to answer the following research questions:

Can brisk walking modify:

- i. total body weight (TBW) of obese female adults in Kaduna metropolis, Nigeria?
- ii. body mass index (BMI) of obese female adults in Kaduna metropolis, Nigeria?
- iii. waist circumference (WC) of obese female adults in Kaduna metropolis, Nigeria?
- iv. waist - hip - ratio (WHR) of obese female adults in Kaduna metropolis, Nigeria?
- v. visceral fat of obese female adults in Kaduna metropolis?
- vi. percent body fat of obese female adults in Kaduna metropolis, Nigeria?
- vii. lean muscle mass of obese female adults in Kaduna metropolis, Nigeria?

### **1.4 Purpose of the Study**

The purpose of this study was to determine the effects of brisk walking on:

- i. TBW of obese female adults in Kaduna metropolis, Nigeria
- ii. BMI of obese female adult of Kaduna metropolis, Nigeria.
- iii. WC of obese female adult of Kaduna metropolis, Nigeria.
- iv. WHR of obese female adult of Kaduna metropolis, Nigeria.
- v. Visceral fat of obese female adult of Kaduna metropolis, Nigeria.



- vi. Percent body fat of obese female adult of Kaduna metropolis, Nigeria.
- vii. Lean muscle mass of obese female adult of Kaduna metropolis, Nigeria.

### **1.5 Basic Assumptions**

Based on the available research evidence, the following assumptions were made for this study:

1. Aerobic exercise like brisk walking is effective for improving metabolism and fat utilization among obese persons.
2. Metabolic response to brisk walking can be assessed
3. Walking is a natural form of exercise, so obese individuals can easily adapt to it with less injuries.
4. Brisk walking can influence anthropometric indices of obese women.
5. Brisk walking can modify body composition indices of obese women.

### **1.6 Hypotheses**

Based on the research questions and the purpose of this study, the following hypotheses were raised for this study:

#### **1.6.1 Major Hypothesis**

There is no significant effect of brisk walking on selected anthropometric and body composition indices of obese female adults in Kaduna metropolis, Nigeria.

#### **1.6.2 Sub - Hypotheses**

- i. There is no significant effect of brisk walking on total body weight of obese female adults in Kaduna metropolis, Nigeria

- ii. There is no significant effect of brisk walking on body mass index of obese female adults in Kaduna metropolis, Nigeria.
- iii. There is no significant effect of brisk walking on waist circumference of obese female adults in Kaduna metropolis, Nigeria.
- iv. There is no significant effect of brisk walking on waist- hip- ratio of obese female adults in Kaduna metropolis, Nigeria. .
- v. There is no significant effect of brisk walking on visceral fat of obese female adults in Kaduna metropolis, Nigeria. .
- vi. There is no significant effect of brisk walking on percent body fat of obese female adults in Kaduna metropolis, Nigeria.
- vii. There is no significant effect of brisk walking on lean muscle mass of obese female adults in Kaduna metropolis, Nigeria.

### **1.7. Significance of the Study**

Excessive body fat is associated with increased metabolic risk and its measurement is important in implementing curative and preventive health measures (Ranasinghe, Gamage, Katulanda, Andraweera, Thilakarathne and Tharanga, 2013). Lack of regular exercise training as been identified as among the major risk factors affecting normal body composition and anthropometric indices of an obese individual; (Adaramaja and Olarenwaju, 2008; Shehu *et al.*, 2010; WHO 2010). The risk of obesity co-morbidities increases with increasing BMI (Iloh *et al.*, 2011). The results of this study was to show if brisk walking as an exercise mode could be used to modify the total body weight as well as the BMI of obese female adult in Kaduna metropolis, Kaduna State, Nigeria.

Evidence-based guidelines on the management of obesity promote the use of waist circumference as a measure of abdominal obesity for predicting excess relative risk of disease in overweight and class I obese persons. This investigation was to prove whether brisk walking could be prescribed for the modification of waist circumference in obese female adults.

The Nurses' Health Study also found that waist circumference and waist-to-hip ratio are equally effective at predicting who was at risk of death from heart disease, cancer, or any cause (Zhang *et al.*, 2008). The result of this study was also to show if brisk walking could be used to modify the waist-hip-ratio of obese female adults of Kaduna metropolis. Excess abdominal fat (also known as visceral, central or upper-body fat) is associated with an increased risk of cardio-metabolic disease (Despres, 2007). That explains why increasing attention has been paid to abdominal adiposity and its association with increased mortality over the last several years, (Vissers, Hen, Taeymans, Baeyens, Poortmans & Gaal, 2013). This investigation would show if brisk walking could be effective in improving metabolism and abdominal fat utilization of obese female adults. Increased percent body fat is strongly associated with the risk of chronic diseases such as hypertension, dyslipidemia, diabetes mellitus, and coronary heart disease (Dehghan & Merchant, 2008). The results of this study could be helpful in accepting or rejecting the beneficial effect of brisk walking on percent body fat as reported by previous researchers. Habibzadeh and Dneshmandi (2010), showed significant effect of brisk walking on lean muscle mass of obese young women suffering from bulimia nervosa, the results of this study could be used to modify the lean muscle mass of obese female adults of Kaduna metropolis, Nigeria.

The findings of this study would indicate if brisk walking could be prescribed to assist individuals with health related problems associated with obesity. Results of this study would contribute to the existing literature on the effect of brisk walking on the anthropometric and

body composition indices of obese female adults. The result of this study could provide base-line data on the current status of women with regards to the effect of brisk walking on the anthropometric and body composition indices of obese female adults of Kaduna metropolis, Nigeria.

This study could highlight areas for further research on the brisk walking in the control and management of obesity, which may be investigated in the future.

### **1.8 Delimitation of the Study**

This study was delimited to:

- i. obese women with BMI between 30.0 and 39.9 kg/m<sup>2</sup> and age 40 to 50 years
- ii. brisk walking as the mode of exercise
- iii. body weight, height, waist and hip circumferences (anthropometric variables)
- iv. visceral fat, percent body fat and lean muscle mass (body composition variables)

## **CHAPTER TWO**

### **2.0 REVIEW OF RELATED LITERATURE**

#### **2.1 Introduction**

This study was conducted to assess the effect of brisk walking on anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

For the purpose of this study, related research literature was reviewed under the following headings:

#### **2.2 Body Fat Patterns**

2.2.1 Total body weight

2.2.2 Body Mass Index

2.2.3 Waist Circumference

2.2.4 Waist – Hip Ratio

#### **2.3 Body Composition**

2.3.1 Visceral Fat

2.3.2 Percentage Body Fat

2.3.3 Lean muscle mass

#### **2.4 Effect of brisk walking on body fat patterns**

2.4.1 Effect of brisk walking on total body weight

2.4.2 Effect of brisk walking on body mass index

2.4.3 Effect of brisk walking on waist circumference

2.4.4 Effect of brisk walking on waist-hip-ratio

#### **2.5 Effect of brisk walking on body composition**

2.5.1 Effect of brisk walking on visceral fat

2.5.2 Effect of brisk walking on percent body fat

2.5.3 Effect of brisk walking on lean muscle

## **2.6 Physiological Modification of Obesity during Brisk Walking**

2.6.1 Brisk walking prescription for obese individual

## **2.7 Summary**

### **2.2 Body Fat Patterns**

Adipose tissues of the body are made of adipocytes (fat cells) whose sole job is to store energy in the form of fat (Hansen, Hajri, Abumrad, 2011; Science Daily, 2017). As individual ages, bone mineral density and lean mass decrease, while body fat mass increases and is specifically in the abdominal region (Chang, Beason, Hunleth & Colditz, 2012). Generally, body weight is influenced genetically, hormonally and by body maintenance condition. Likewise, body fat and its distribution are influenced by age, genetic inheritance and to a greater extent by gender specific hormone (Ciocan, 2016). These hormones are responsible for the distribution of fat in certain zones of the bodies: thus oestrogen which is responsible for the typical female characteristics influence the fat deposit in pear format, favoring its laying in the hips, thigh and belly while testosterone ‘lead’ fat mostly towards tummy and upper body (Ciocan, 2016). Scientists ascertained that the specific body shapes are: the android shape, or apple shape common among men (fat deposits on the middle section of the body, mostly the abdomen) and the gynoid, or pear shape more common among women (fat deposit on the hips and bottom). It is clear that increase in body fat affects health, however, its distribution on the body influence the state of health of the specific organ (WHO, 2016b). Body fat distribution differs from person to person. There are generally two types of fat storage:

1. Visceral (surrounding internal organs).
2. Subcutaneous (beneath the skin - about 80% of all body fat).

It is increasingly recognized that there is need to consider not only the amount of excess fat in assessing the risk associated with obesity but also the topography of adipose tissue. Srikanthan, Seeman, & Karlamangla, (2009), stated that the increased risks associated with obesity are of greater concern depending on the pattern of fat distribution in the body (for example, in the torso and abdomen versus the hips, thighs and buttocks). Torso and abdominal fat, referred to as visceral, central or intra-abdominal fat, is related to health abnormalities including insulin resistance and abnormal blood lipid levels, escalating the risk of diabetes mellitus and cardiovascular disease, respectively (Ness-Abramof & Apovian, 2008). A preferential increase in visceral fat (VF) can occur independently of changes in body weight, total adiposity or waist circumference (Falsarella, Gasparotto, Barcelos, Coimbra, Moretto, Pascoa, Ferreira & Coimbra, 2015).

Life-style factors that contributed to these age changes in body fat distribution include dietary changes, higher intakes of saturated fats and simple sugar, reduce physical activities with less skeletal muscle mass and reduce strength (Chang *et al.*, 2012). Presently, body mass index (BMI), waist circumference, and waist-to-hip ratio are employed for classifying obesity and the risks of abdominal fat accumulation.

Regular exercise and proper nutrition can help reduce body fat as well as protect against chronic diseases associated with obesity (ACSM, 2016). Rather than disappearing from a particular place, body fat comes off layer by layer from the whole body (Le'Doux, 2011). Moreover, the way fat is shed is different from person to person. It tends to go from the most recent place it appeared. The very last place for the fat to disappear from is the first site of fat deposit. This is why, for example, a man may complain of getting too thin in the face and yet

have a small 'spare tire' around his waist. Or a woman may complain of a smaller bust, and yet the hips may have barely moved an inch.

Anthropometric measurements are set of noninvasive and quantitative techniques for determining an individual's body fat patterns by measuring, recording and analyzing specific dimensions of the body, such as height, weight and body circumferences at the hip and waist. They are used to determine the relationship between various body measurements such as BMI, WHR for epidemiological and medical outcomes. Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters;  $\text{weight (kg)/height (m}^2\text{)}$  (National Institute Health, 2012; Centre for Disease Control, 2015a & WHO, 2016b). In the assessment of obesity, the central distribution of body fat cannot be overlooked; hence the use of other anthropometric indices such as waist circumference (WC), hip circumference and waist hip ratio (WHR) as measures of adiposity (Sanya, Ogwumike, Ige & Ayanniyi, 2009).

### **2.2.1 Total body weight**

Total body weight is the measurement of weight without items located on the body. Practically though, body weight may be measured with light clothes, but without shoes or heavy accessories. Excess or reduced body weight is regarded as an indicator of determining an individual's health. Moderate weight loss (~10-15% or 4.5-9.1 kg) can assist in achieving metabolic goals. Nutrition therapy and regular exercise combined are more effective than either in achieving moderate weight reduction and thereby improving metabolic control (Albright et al, 2010).

The goals of aerobic exercises have been to offset disturbed physiology and impaired performance by mobilizing latent reserves, which can be achieved by means of stimuli in the form of exercise and training. In order to achieve the desired result, some parameters like



intensity, duration, and frequency of exercise has to be quantified in definite ratio to each individual's physical work capacity.

To improve body weight and body composition, regular exercise at an intensity of about 50% VO<sub>2</sub>max, five times or more per week, for about 1 h per session sustained for years would appear to be necessary (Braun, Zimmermann and Kretchmer,1995). Therefore, it is important for health professionals to guard against unrealistic expectations of quick or easy weight loss in individuals beginning an exercise program.

### **2.2.2 Body Mass Index**

Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters that is, weight (kg)/height (m<sup>2</sup>) (NIH, 2012; CDC, 2015a; WHO, 2016b). It is the most popular anthropometric index used for the assessment of obesity among individual subjects, which can be compared across populations and studies and it has been found to have a high correlation with body fat (Iloh, Amadi, Nwankwo & Ugwu, 2011). Body mass index is an inexpensive and easy-to-perform method of screening for weight category, for example underweight, normal or healthy weight, overweight, and obesity (CDC 2015a). It is age independent and is the same for both sexes (CDCa, 2015; WHO, 2016b). The standard weight status categories associated with BMI ranges for adults are shown in Table: 2.2.1.

**Table 2.2.1 BMI ranges for adult  
Classifications for BMI (Heyward, 2010)**

Classification	BMI (kg/m <sup>2</sup> )
Underweight	<18.5
Normal weight	18.5 – 24.9
Overweight	25 – 29.9
Obesity (class 1)	30 – 34.9
Obesity (class 2)	35 – 39.9
Extreme Obesity (class 3)	≥40

The BMI, therefore, provides guidelines on the identification, evaluation and treatment of adults who are obese. The risk of obesity co-morbidities is negligible in the normal weight range, mildly increased in overweight, moderately increased in class I obesity (mild obesity), severe in class II obesity (moderate obesity) and very severe in class III obesity (extreme obesity) (Iloh *et al.*, 2011). The correlation between the BMI and body fatness is fairly strong, but even if two people have the same BMI, their level of body fatness may differ (CDC, 2015a). In general,

- i. At the same BMI, women tend to have more body fat than men.
- ii. At the same BMI, Blacks have less body fat than do Whites, and Asians have more body fat than Whites
- iii. At the same BMI, older people, on average, tend to have more body fat than younger adults.
- iv. At the same BMI, athletes have less body fat than non-athletes (CDC, 2015a).

The accuracy of BMI as an indicator of body fatness also appears to be higher in persons with

higher levels of BMI and body fatness. While, a person with a very high BMI (for example, 35 kg/m<sup>2</sup>) is very likely to have high body fat, a relatively high BMI can be the results of either high body fat or high lean body mass (muscle and bone) (CDC, 2015a). Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Risk of coronary heart disease, ischemic stroke and type 2 diabetes mellitus increase steadily with increasing body mass index (BMI). Raised BMI also increase the risk of cancer of the breast, colon/rectum endometrium, kidney, esophagus (adenocarcinoma) and pancreas (Giovanni & Franco, 2013).

Data from epidemiological studies demonstrate a direct correlation between BMI and the risk of medical complications and mortality rate (Klein, Allison, Heymsfield, Kelley, Leibel, Nonas, & Kahn, 2007). For example, men and women who have a BMI  $\geq 30$  kg/m<sup>2</sup> are considered obese and are generally at higher risk for adverse health problems than those who are considered overweight (BMI between 25.0 and 29.9 kg/m<sup>2</sup>) or lean (BMI between 18.5 and 24.9 kg/m<sup>2</sup>). Therefore, BMI has become the “gold standard” for identifying patients at increased risk for adiposity-related adverse health outcomes.

$$\text{Body mass index} = \frac{\text{weight (kg)}}{\text{Height (m)}^2}$$

### 2.2.2 Waist Circumference

Body fat distribution is an important risk factor for obesity-related diseases. Excess abdominal fat (also known as visceral, central or upper-body fat) is associated with an increased risk of cardio-metabolic disease (Despres, 2007). Visceral adipose tissue (VAT) seems to be the most pathogenic fat depot and is considered to play a central role in the metabolic syndrome (Hansen *et al.*, 2011). That explains why increasing attention has been

paid to abdominal adiposity and its association with increased mortality over the last several years, (Vissers, Hen, Taeymans, Baeyens, Poortmans & Gaal, 2013).

The precise measurement of visceral fat requires the use of magnetic resonance imaging or tomography, which are scientific techniques that visually depict the internal tissue compositions. Waist circumference is a substitute technique for these scientific assessments. Waist circumference is actually a perimeter, which provides an estimate of body girth at the level of the abdomen. This excess adipose tissue in the abdomen, especially around visceral organs, increases metabolic risk of cardiovascular disease (CVD) independent of the total amount of adipose tissue (Despres, 2006; Haffner, 2007). In fact, evidence-based guidelines on the management of obesity promote the use of waist circumference as a measure of abdominal obesity for predicting excess relative risk of disease in overweight and class I obese persons [body mass index (BMI; in  $\text{kg}/\text{m}^2$ ): 25.0–34.9]. (Wellborn & Dhaliwal, 2007; Nicklas, Wang, You, Lyles, Demons, Easter, Berry, Lenchik, Carr, 2009), indicated that waist circumference is superior to BMI in predicting cardiovascular disease risk. Waist circumference (WC) is now accepted as a practical measure of adipose tissue distribution. The following four body sites for WC measurements are commonly used; immediately below the lowest ribs (WC1), the narrowest waist (WC2), the midpoint between the lowest rib and the iliac crest (WC3), and immediately above the iliac crest (WC4) (Wang *et al.*, 2003; WHO, 2008).

The most commonly used sites reported in studies that evaluated the relationship between morbidity or mortality rate and WC were at the mid-point between the lowest rib and the iliac crest (29%), umbilicus (28%), and narrowest waist circumference (22%). The United States (US) National Institutes of Health (NIH) protocol provided in the NIH Practical Guide to Obesity (NHLBI Obesity Education Initiative, 2000) and the protocol used in the US

National Health and Nutrition Examination Survey (NHANES) III (WestatInc, 1998) indicated that the waist circumference measurement should be made at the top of the iliac crest. Although sites that use an easily identifiable and reproducible landmark (for example, just above the bony landmark of the iliac crest) might be more precise and easier to use than other sites, there are no data from any studies that demonstrate an advantage of one measurement site over others (Klein *et al.*, 2007). In practice it may be difficult to accurately palpate those bony landmarks in extremely obese individuals, in which case placing the tape at the level of the belly button is recommended. Measurement is taken at the end of normal expiration, when the diaphragm is in its neutral position; during an inspiration the diaphragm descends into the abdominal cavity, enlarging the waist circumference measurement.

The use of a stretch-resistant tape that provides a constant 100 g of tension through the use of a special indicator buckle is recommended; use of this type of tape reduces differences in tightness (WHO, 2008). The waist circumference measurement for women at which there is an increased relative risk is defined as  $\leq 80\text{cm}$  and substantially increased risk  $\leq 88\text{cm}$  (WHO National Obesity Forum, 2016).

In some populations, waist circumference may be a better indicator of risk than BMI e.g. in persons of Asian descent (National Obesity Forum, 2016). As mentioned previously, not only is there a physical difficulty in measuring waist circumference in very obese patients but in those with a BMI  $>35\text{ kg/m}^2$  waist circumference has little added predictive power of disease risk. In patients with a BMI in the region of  $25\text{--}35\text{ kg/m}^2$  incorporating measurements of waist circumference will provide additional information about risk and can be used as an additional measure of progress with weight loss.

The Nurses' Health Study, one of the largest and longest studies to date that has measured abdominal obesity, looked at the relationship between waist size and death from heart disease, cancer, or any cause in middle-aged women (Zhang, Rexrode, van Dam, Li & Hu 2008). At the start of the study, all 44,000 study volunteers were healthy, and all of them measured their waist size and hip size. After 16 years, women who had reported the highest waist sizes "35 inches or higher" had nearly double the risk of dying from heart disease, compared to women who had reported the lowest waist sizes (less than 28 inches) (Zhang et al., 2008). Women in the group with the largest waists had a similarly high risk of death from cancer of any cause, compared with women with the smallest waists. The risks increased steadily with every added inch around the waist. The study found that even women at a "normal weight" "BMI less than 25" were at a higher risk, if they were carrying more of that weight around their waist: Normal-weight women with a waist of 35 inches or higher had three times the risk of death from heart disease, compared to normal-weight women whose waists were smaller than 35 inches. Likewise, the Shanghai Women's Health study found a similar relationship between abdominal fatness and risk of death from any cause in normal-weight women (Zhang, Shu, Yang, Li, Cai, Gao & Zheng, 2007).

This is due to the fact that, the fat surrounding the liver and other abdominal organs, so-called visceral fat, is metabolically very active. It releases fatty acids, inflammatory agents, and hormones that ultimately lead to higher LDL cholesterol, triglycerides, blood glucose, and blood pressure (Klein *et al.*, 2007).

### **2.2.3. Waist-Hip-Ratio**

With the waist-to-hip-ratio (WHR), the waist is measured at the narrowest part of the waist, between the lowest rib and iliac crest, while the hip circumference is taken at the widest area of the hips at the greatest protuberance of the buttocks. The WHR is calculated simply by dividing the waist measurement by the hip measurement. World Health Organization defined

the ratio >0.85 in women as one of the decisive benchmarks for metabolic syndrome. Welborn & Dahliwal (2007); Srikanthan, Seeman, & Karlamangla (2009) confirmed, and cited several other investigations that show waist-to-hip ratio being the superior clinical measurement for predicting all cause and cardiovascular disease mortality. Welborn & Dhaliwal (2007) added that the hip circumference indicates a lower risk for body fat accumulation, and thus including it into the waist-to-hip equation enhances the accuracy of this measurement technique. The classification of Waist-to-Hip Ratio for women is shown in the Table 2.2.3 below (Heyward 2010)

$$\text{Waist-to-hip ratio} = \frac{\text{waist circumference (cm)}}{\text{Hip circumference (cm)}}$$

**Table 2.2.3 Classification of Waist-to-Hip Ratio for women (Heyward 2010)**

Classification	Ratio		
	20 – 29 years	30 – 39 years	40 – 49 years
Low	<0.71	<0.72	<0.73
Moderate	0.71– 0.77	0.72 – 0.78	0.73 – 0.79
High	0.78 – 0.82	0.79 –0.84	0.80 – 0.87
Very High	>0.82	>0.87	>0.87

### **Waist Circumference versus Waist-to-Hip Ratio**

Scientists have long debated which measure of abdominal fat is the best predictor of health risk: Waist size alone or waist-to-hip ratio (Waist Size Matters, 2016). The research to date has been mixed, but adding up the evidence from multiple studies suggests that both methods do an equally good job of predicting health risks. In 2007, for example, a combined analysis of fifteen prospective cohort studies found that waist-to-hip ratio and waist circumference were both associated with CVD risk” and were no different from each other in predicting CVD risk (De Koning, Merchan, Pogue, & Anand 2007). Other researchers have also found

that waist circumference, waist-to-hip ratio, and BMI are similarly strong predictors of type 2 diabetes (Vazquez, Duval, Jacobs, & Silventoinen, 2007; Qiao, & Nyamdorj, 2010).

The Nurses' Health Study also found that waist circumference and waist-to-hip ratio are equally effective at predicting who was at risk of death from heart disease, cancer, or any cause (Zhang *et al.*, 2008). In practice, it is easier to measure and interpret waist circumference than it is to measure both waist and hip. That makes waist circumference the better choice for many settings. While waist circumference should be measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape that provides a constant 100G tension. Hip circumference should be measured around the widest portion of the buttocks, with the tape parallel to the floor. For both measurements, the subject should stand with feet close together, arms at the side and body weight evenly distributed, and should wear light clothing. The Subject should be relaxed, and the measurements should be taken at the end of a normal expiration. Each measurement should be repeated twice; if the measurements are within 1 cm of one another, the average should be calculated. If the difference between the two measurements exceeds 1 cm, the two measurements should be repeated (WHO, 2008). Guidelines for abdominal Obesity Measurement is as presented in the Table 2.2.4

**Table 2.2.4 Abdominal Obesity Measurement Guidelines**

<b>Organization</b>	<b>Measurement used</b>	<b>Definition of abdominal obesity</b>
American Heart Association, (2016); National Heart, Lung and Blood Institute (2016)	Waist circumference	Women: > 88 cm (35 inches)
World Health Organization (WHO, 2008); (WHO,2016b)	Waist-to-hip ratio	Women: > 0.85



## **2.3 Body Composition**

Body composition is a key component of health in both individual and populations. It is a component of health related fitness used to describe the percentage of fat, bone, water and muscle in the body expressed as percent body mass, visceral fat and lean muscle mass. The ongoing epidemic of obesity in children and adults has heightened the importance of body fat for short term and long term health. However, other components of body composition also influence health outcomes and its measurement is increasingly considered valuable in clinical practice. Excessive body fat is associated with increased metabolic risk and its measurement is important in implementing curative and preventive health measures (Ranasinghe, Gamage, Katulanda, Andraweera, Thilakarathne & Tharanga, 2013).

### **2.3.1 Visceral Adipose Fat**

Over the last several years, increasing attention has been paid to abdominal adiposity and its association with increased mortality (Pischon, Boeing, Hoffmann, Bergmann, Schulze, and Overvad *et al.*, 2008; Vissers *et al.*, 2013). Unlike subcutaneous fat that lies just under the skin and is noticeable, visceral fat lies in the abdominal cavity under the abdominal muscle. Visceral fat is more dangerous than subcutaneous fat because it often surrounds vital organs (University of Alabama at Birmingham, 2009), and its increase is strongly associated with many adverse health conditions such as metabolic syndrome, inflammation, dyslipidemia, insulin resistance, type 11 diabetes mellitus, cardiovascular diseases, some cancer and ultimately death (Chang *et al.*, 2012; Vissers *et al.*, 2013). Adipose tissue is not only considered an energy storage organ but is now recognized as an endocrine and paracrine organ that plays an active role in energy homeostasis through the release of a large number of cytokines and bioactive mediators (Ahima, 2006). These risk factors and markers do not only influence body weight homeostasis, but also insulin resistance, diabetes, lipid metabolism, inflammation, explaining premature atherosclerosis in obesity (Vissers *et al.*, 2013). The

metabolic characteristics of intra-abdominal fat (IAF) is more lipogenic and releases free fatty acid into the portal circulation which drains directly into liver, whereas subcutaneous fat drains into the systemic circulation. The influx of free fatty acids in the liver results in over production of hepatic very low lipoprotein and retention of same in the blood stream. This also leads to decrease level of high density lipoprotein possibly from an increased exchange of cholesterol for triglyceride in very low density particles (Warren, Schreiner & Terry, 2005).

The measurement of body fat and the differentiation of IAF from subcutaneous fat can be determined using computerized tomography, x-ray absorptiometry and MRI but waist circumference is often used in population based studies as a surrogate measure of IAF because they are expensive and time consuming to use (Warren, Schreiner, & Terry, 2005). The more visceral adipose fat (VAT) one has, the greater is the chance of developing Type 2 diabetes and heart disease. This has caused the hypothesis on the underlying mechanisms of the metabolic syndrome to shift towards an adipose tissue disease (adiposopathy) or lipotoxicity (Oda, 2008). However, exercise has been shown to reduce VAT in obesity, independent of weight loss (Dobrosielski, Gibbs, Chaudhari, Ouyang, Silber & Stewart, 2013).

### **2.3.2 Percent Body Fat**

Body fat consists of essential body fat and storage fat. Essential body fat is present in the nerves tissues, bone marrow, and organs (all membrane), and we cannot lose this fat without compromising physiological function. Storage fat, on the other hand, represents an energy reserve that accumulates when excess energy is ingested and decreases when more energy is expended than consumed (Jeukendrup & Gleeson, 2010). Essential body fat is approximately 3% of body mass for men and 12% of body mass for women. Women are believed to have

more essential body fat than men because of childbearing and hormonal functions (Jeukendrup & Gleeson, 2010). In general, the body fat percent (essential plus storage fat) is between 12% and 15% for young men and between 25% and 28% for women. Average percentages of body fats for the general and average population are presented in the Table 2.3.2 and Table 2.3.3 respectively.

**Table 2.3.2 General population body fat percentages for females and their classification**

% body fat	Rating
8 – 15	Athletic
16 – 23	Good
24 – 30	Acceptable
31 – 36	Overweight
> 37	Obese

The term athletic in the above table refers to sports where low body fat is an advantage

An excerpt from Sport Nutrition, 2<sup>nd</sup> Ed. Human Kinetics by Jeukendrup and Gleeson, (2010)

**Table 2.3.3 Body fat percentage for the average population**

	Up to 30	30 -50	50+
Female	14 – 21	15 – 23	16 – 25

An excerpt from Sport Nutrition, 2<sup>nd</sup> Ed. Human Kinetics by Jeukendrup and Gleeson, (2010)

Percent body fat is strongly associated with the risk of chronic diseases such as hypertension, dyslipidemia, diabetes mellitus, and coronary heart disease (Dehghan & Merchant, 2008). In epidemiological studies, surrogate measures of body fatness such as body mass index (BMI), waist circumference, waist-hip ratio and skin fold thickness have been used extensively. However, these techniques do not precisely characterize persons by body composition

(percentage of body fat or muscle mass). Several techniques have been used to assess percent body fat in controlled laboratory conditions. These include underwater weighing (densitometry), dual energy x-ray absorptiometry (DEXA), bioelectrical impedance analysis (BIA) and magnetic resonance imaging (MRI). Densitometry, DEXA, and MRI are expensive, inconvenient for the participant, and not feasible to conduct in the field because they require large specialized equipment. For these reasons, their use in large epidemiological studies is limited (Dehghan & Merchant, 2008).

The two most common methods of measurements used for percentage body fat are skinfold measurement and bioelectrical impedance analysis. Bioelectrical impedance analysis (BIA, by contrast, is relatively simple, quick (takes only a few minutes), and non-invasive which gives reliable measurements of body composition with minimal intra-and inter-observer variability the results are available immediately and reproducible with <1% error on Repeated-measurements (Dehghan & Merchant, 2008).

### **2.3.3 Lean muscle mass**

Muscle plays a major role in physical performance and the regulation of muscle mass is a vital mechanism for ensuring good health over the entire life span. The small change in the mechanism regulating muscle mass, either through genetic or chronic disease and/or situation such as ageing, immobilization and sedentary lifestyles can result in severe muscle wasting and increase the risk of death of other diseases (Russell, 2009) Lean muscle mass, is a concept related to lean body mass which is the content of the body minus fat. Lean body mass is used to calculate basal metabolic rate. Lean muscle is less of a scientific term and more a term of art that refers to muscle that is independent of, and not obscured by, fat. In the context of body building, lean muscle mass is that which is gained without a corresponding addition of fat or that which remains after fat is shed. It can also be thought of as the amount of muscle on the body independent of fat, bone and other parts (Nichols, 2015).

## **2.4 Effect of brisk walking on body fat patterns of female adults**

Physical activity is a vital part of a weight loss and weight controlled program that can decrease abdominal fat, increase cardio-respiratory fitness and lead to weight loss in overweight and obese adults (Melam, Alhusaimi, Buragadda, Kaur & Khan, 2016). Studies have indicated that brisk walking is one of the methods for controlling and reducing weight and body mass composition; (National Health Services (NHS), 2015; Chen, Ismail & Al – Safi, 2016; & Melam *et al.*, 2016).

Report from the annual English Surveys from 1999 to 2012 by researchers from the London School of Economics and the University of Queensland showed that a brisk of 30 – minute walk, five days a week is more effective than any other form of exercise for keeping weight down. It was linked to the biggest difference in BMI for women (NHS, 2015). Similarly, a study conducted by Chen *et al.* (2016) to determine the effect of brisk walking and resistance training on cardio-respiratory fitness, body composition and lipid profiles in overweight and obese individual reported significant decrease in BMI, WHR, free fat mass and increased HDL – cholesterol. Likewise, Melam *et al.* (2016), in their study on ‘impact of brisk walking and aerobics in overweight women recorded significant decrease in the weight, BMI, waist circumference and skin fold thickness.

### **2.4.1 Effect of brisk walking on total body weight**

Lack of physical activity and an uncontrolled diet cause excessive weight gain, which leads to other metabolic disorders (Melam *et al.* (2016). Of considerable interest to both the general public and the scientific community are the control of weight gain and the extent of weight loss and change in body composition induced by exercise training. Data have accumulated suggesting that physical activity may enhance weight loss and, in particular, weight

maintenance when used along with an appropriate calorie-controlled meal plan (National Health Services (NHS), 2015; Chen, Ismail & Al – Safi, 2016; & Melam *et al.*, 2016).

Walking at a pace of 5.7km/h, (4mph) Borg scale of perceived exertion 11 – 14 is considered brisk walking which is a popular and convenient form of exercise that plays an important role in weight management and it is often recommended for obese individual because it increases energy expenditure (Melam *et al.*, 2016). It was reported by Melam *et al.*, 2016, that previous study showed that including a moderate –intensity walking program in a weight maintenance program accelerated weight loss.

In line with this, a study conducted to investigate the effect of moderate intensity walking program on weight maintenance in premenopausal obese women resulted in accelerated weight loss and decrease the waist circumference (Fogelholm, Kukkonen-Harjula, Nenonen & Pasanen, 2000). Also, a study was conducted on regular exercise of walking in sedentary obese women, using body weight and body mass index (BMI), as a tool to investigate the effects on the body parameters. The study involved 30 obese sedentary women (age:  $36.93 \pm 11.10$  years; height:  $157.50 \pm 4.73$  cm, body weight:  $77.89 \pm 10.98$  kg), 8 weeks, 5 days per week, at exercise intensity of 75% HRmax. Results reported that the difference in body weight and BMI values along with other body composition indices were statistically significant ( $p < 0.05$ ) (Zileli & Özkamçı, 2016).

#### **2.4.1 Effect of brisk walking on body mass index**

Body mass index, or BMI, is a measure of body fat levels based on height and weight. The National Heart, Lung and Blood Institute (2011) stated that healthy weight can help minimize the risk of several obesity-related diseases, and therefore recommend that adults should have a BMI of approximately  $18.5\text{kg/m}^2$  to  $24.9\text{kg/m}^2$ . World Health Organization (2015), define

obesity as a BMI greater than or equal to  $30\text{kg/m}^2$ . Elevated BMI and abdominal obesity are associated with a number of diseases and metabolic abnormalities that have high morbidity and mortality (Melam *et al.*, 2016). Broadly, health risk increases with increase BMI, and weight is a serious and imminent threat to the health of individuals with obesity type 111 (Hu, Tuomilehto, Silventoinen, Barengo, Peltonen & Jousilahti, 2004). Regular exercise has modest effects on reducing body weight with substantial greater effects on improving body composition (Adenoyi, 2014). There are certain types of exercises that can help achieve a healthy BMI.

Studies designed to determine changes in cardiopulmonary functions after aerobic and anaerobic exercise training in obese subjects shows aerobic exercise reduces weight and improves cardiopulmonary fitness in obese subjects better than anaerobic exercise (Chaudhary, Kang & Sandhu, 2010; Al-Saif & Alsenany, 2015). Walking or jogging offers the benefit of decreasing BMI while improving cardiovascular health. The Centres for Disease Control and Prevention, (2015b), recommends that adults get at least 30 minutes of moderate aerobic exercise, such as a brisk walk, five days per week. The Centre for Disease Control also recommends five hours of exercise per week for an even greater health benefit. This was also supported by the positive influence recorded in a study conducted by Shenbagavalli & Mary (2008) to investigate the effect of aerobic training (walking and jogging) five days in a week for a period of 8-weeks on BMI of sedentary obese men.

A study designed to examine the effect of (60min, three times per week, for 10wks) intensity of aerobic exercise on forty five obese/overweight women, age 25-40 years and body mass index (BMI)  $\geq 25$  to  $30\text{ kg/m}^2$  who were randomly assigned into three groups: 1. Light aerobics [45-50% heart rate reserve maximum ( $\text{HR}_{\text{max}}$ )], 2. Moderate aerobics (70-75%  $\text{HR}_{\text{max}}$ ) 3. No exercise training (control) resulted in significant improvement of weight and

BMI for both intensities with moderate intensity, being more obvious (Marandi, Abadi, Esfarjani, Mojtahedi & Ghasemi, 2013).

Also, a study was conducted on regular exercise of walking in sedentary obese women, using body weight, body mass index (BMI), waist and hip circumference, waist - hip ratio and body fat percentage (BFP) as a tool to investigate the effects on the body parameters. The study involved 30 obese sedentary women (age:  $36.93 \pm 11.10$  years; height:  $157.50 \pm 4.73$  cm, body weight:  $77.89 \pm 10.98$  kg), 8 weeks, 5 days per week, at exercise intensity of 75% HRmax. Results reported that the difference in body weight and BMI values along with other body composition indices were statistically significant ( $p < 0.05$ ) (Zileli & Özkamçı, 2016).

#### **2.4.2 Effect of brisk walking on waist circumference**

The degree of overweight can be simply and quickly evaluated by using two measures; BMI, and waist circumference. Waist circumference is a simple measure of abdominal fat, the most significant fat-related risk to health. A high waist circumference  $>35$  inches (88 cm) in women is associated with an increased risk of high blood pressure, diabetes, abnormal cholesterol, and the metabolic syndrome (Janssen, Katzmarzyk, Ross, 2002; Ness-Abramof & Apovian, 2008).

Waist circumference is most useful in people with a BMI in the  $25-35\text{kg/m}^2$  range where further risk stratification can guide counseling and/or aggressiveness of treatment (Bigaard, Tjønneland, Thomsen, Overvad, Heitmann, & Sorensen, 2003). A larger waist circumference in this range indicates greater health risks related to obesity. Researchers at the London school of Economics studied seven years' worth of data in the Health Survey for England, connecting physical activity with waist circumference and body mass index. It was discovered that for women, brisk walking was the biggest indicator even when compared to



other sports and exercises. Those who walked briskly for 30 minutes, five days a week had 4.3 cm smaller waist circumference measurement than those who did not (NHS, 2015).

In line with this, a study conducted to investigate the effect of moderate intensity walking program on weight maintenance in premenopausal obese women resulted in accelerated weight loss and decrease the waist circumference (Fogelholm, Kukkonen-Harjula, Nenonen & Pasanen, 2000). Likewise, a study investigated on the effects of two different walking volumes (30min 5days /wk. and 60min 5 days/wk. for 12 wks. each) in combination with a low – fat ad libitum diet, compared to diet only control group on weight loss and modifiable health related variables in an ethnically diverse sample of sedentary, overweight women found similar significance ( $P < 0.05$ ) for waist circumference with both exercise groups only (Brill, Perry, Parker, Robinson & Burnett, 2002). Other studies that reported significant effect of brisk walking on waist circumference of obese women include: cross-sectional study by Hu *et al.* (2004); NHS (2015); & Melam *et al.* (2016)

### **2.4.3 Effect of brisk walking on waist-to-hip ratio**

Scientists have long debated which measure of abdominal fat is the best predictor of health risk: Waist size alone or waist-to-hip ratio. The research to date has been mixed, but adding up the evidence from multiple studies suggests that both methods do an equally good job of predicting health risks. In 2007, for example, a combined analysis of fifteen prospective cohort studies found that waist-to-hip ratio and waist circumference were both associated with CVD risk and were no different from each other in predicting CVD risk. (De Koning, Merchant, Pogue, & Anand, 2007). Other researchers have found that waist circumference, waist-to-hip ratio, and BMI are similarly strong predictors of type 2 diabetes. (Vazquez, Duval, Jacobs, & Silventoinen 2007; Qiao, & Nyamdorj, 2009). The Nurses' Health Study

also found that waist and waist-to-hip ratio are equally effective at predicting who was at risk of death from heart disease, cancer, or any cause. (Zhang *et al.*, 2008).

World Health Organization (2016) stated that regular physical activity of moderate intensity such as walking; cycling or doing sports has significant benefits for health. A study investigated the impact of brisk walking and aerobics in overweight women recorded a significant impact for both brisk walking and aerobics but concluded that aerobics is a more effective intervention program for weight reduction and control (Melam *et al.*, 2016).

Another study was conducted to determine the effect of brisk walking and resistance training on cardiorespiratory fitness, body composition and lipid profiles in overweight and obese individual. 54 men and women age 21 to 55 years divided into three equal groups (brisk walking, resistance and control) were recruited for the study. The brisk walking group was engaged 3 times a week for 45 minutes at an intensity of 60 – 70 % HRmax. The results showed significant improvement in the BMI, WHR, lean fat mass of the brisk walking group (Chen *et al.*, 2015).

Furthermore, a study investigated the effect of 12 - week brisk walking versus brisk walking plus diet on triglycerides and apolipoprotein B levels in nineteen middle-aged overweight/obese Korean women with high triglyceride levels reported significant decrease in the WHR in both interventions (Lee Mi-Ra & Wan-Soo 2006).

## **2.5 Effect of brisk walking on body composition**

Body composition is a component of health related fitness used to describe the percentage of fat, bone, water and muscle in the body expressed as percent body mass, visceral fat and lean muscle mass. Of considerable interest to both the general public and the scientific community are the control of weight gain and the extent of weight loss and change in body composition

induced by exercise training. To determine recommended body weight, percentage of body fat and lean tissue mass needed to be found, in other words assess body composition, Once the fat percentage is known, recommended body weight, also known as “healthy weight”, implies the absence of any medical condition that would improve with weight loss, or fat distribution patterns that is not associated with high risk for illness (Hoeger & Hoeger, 2015)

Studies have reported a significant effect of moderate intensity aerobic exercises on body composition (Marandi *et al.*, 2013; Chen *et al.*, 2016; Melam *et al.*, 2016).

Apart from the above studies, a study conducted to review the effect of brisk walking on postural stability, bone mineral density, body weight and composition in women over 50 years with a sedentary occupation: a randomized controlled trial also reported a significant decrease in the body composition indices of the participants (Gaba, 2016).

### **2.5.1 Effect of brisk walking on visceral fat**

Published data on the effect of exercise training intensity on body composition and regional body fat are mixed (Irving, Davis, Brock, Weltman, Swift Barrett, Gaesser, and Weltman 2012; Willis *et al.* 2012; Dobrosielski, *et al.* 2013; Vissers *et al.* 2013 & Hong *et al.* 2014,). A study was conducted to assess the effect of exercise training intensity on abdominal visceral fat and body composition reported significant reduction in abdominal visceral fat ( $p < 0.001$ ) with high intensity exercise training compared to low intensity exercise training and control groups (Irving, Davis, David, Brock, Weltman, Swift, Eugen, Barrett, Gaesser, and Arthur Weltman, 2012). Slentz, Duscha, Johnson, Ketchum, Aiken, Samsa, Houmard, Bales and Kraus, (2004), reported that low-amount/moderate-intensity and low-amount/vigorous-intensity endurance training (i.e., activity equivalent to ~12 miles•week-1 of walking or jogging) were equally effective in reducing % body fat, fat mass, waist circumference, and abdominal circumference in previously sedentary, overweight, middle-

aged adults. They also reported that high-amount/vigorous intensity endurance training (activity equivalent to  $\sim 20$  miles $\cdot$ week<sup>-1</sup> of jogging) was more effective in reducing % body fat and fat mass compared to the two low-amount training groups (Slentz *et al.*, 2004). Exercise has been shown to reduce visceral adipose tissue (VAT) in obesity independent of weight loss (Dobrosielski, Gibbs, Chaudhari, Ouyang, Silber & Stewart, 2013). In the same vein, a systematic review and meta-analysis was conducted among Caucasian and Asian participants to describe the overall effect of exercise on visceral adipose tissue and to provide an overview of the effect of different exercise regimes, without caloric restriction, on visceral adipose tissue in obese persons. The results suggested that an aerobic exercise program, without hypo caloric diet, can show beneficial effects to reduce visceral adipose tissue with more than 30 cm<sup>2</sup> (on CT analysis) in women and more than 40 cm<sup>2</sup> in men, even after 12 weeks (Vissers *et al.*, 2013).

Another study conducted to investigate the effect of walking exercise on abdominal fat, insulin resistance and serum cytokines in obese women showed significant reduction in both abdominal and subcutaneous adiposity (Hong, Jeong, Kong, Lee, Yang, Ha & Kang, 2014).

Also in a study, at the University of Alabama at Birmingham, randomly assigned 45 European-American and 52 African-American women to three groups: aerobic training, resistance training or no exercise. All of the participants were placed on an 800 calorie-a-day diet and lost an average 24 pounds. The researchers then measured total fat, abdominal subcutaneous fat and visceral fat for each participant. Afterward, participants in the two exercise groups were asked to continue exercising 40 minutes twice a week for one year. After a year, the study's participants were divided into five groups: those who maintained aerobic exercise training, those who stopped aerobic training, those who maintained their resistance training, those who stopped resistance training and those who were never placed on

an exercise regimen. It was found that those who continued exercising, despite modest weight regains, regained zero percent visceral fat a year after they lost the weight," Hunter said. "But those who stopped exercising, and those who weren't placed on any exercise regimen at all, averaged about a 33 percent increase in visceral fat. "Because other studies have reported that much longer training durations of 60 minutes a day are necessary to prevent weight regain, it's not too surprising that weight regain was not totally prevented in this study (Hunter, Brock, Byrne, Chandler-Laney, Corraat, & Gower, 2010).

A study was also carried out on 234 subjects of Duke University and East Carolina University to examine the effect of aerobic (AT) and or resistance training (RT) on body mass and fat in overweight or obese adults. Aerobic training was found to significantly reduce visceral adipose tissue more than RT which provided compelling evidence that AT is the optimal mode of exercise for improving amount of body fat (Willis, Slentz, Bateman, Shields, Piner, Bales, Houmard, Kraus, 2012).

### **2.5.2 Effect of brisk walking on percent body fat**

Marandi *et al.* (2013); Chen *et al.* (2016); and Melam *et al.* (2016) reported on the beneficial effect of brisk walking on the percent body fat in their studies. Likewise it was reported in the Medical Briefs, (2015) that Dr Christine M Friedenreich of Alberta Health Services, Canada, and his colleagues compared 300 minutes of exercise per week with 150 min per week of moderate to vigorous aerobic exercise for its effect on body fat in 400 inactive post-menopausal women who were evenly splited into the two exercise groups. The women, who had body mass index (BMI) 22 to 40, were asked not to change their usual diet. Any aerobic activity that raised the heart rate 65% to 75% of heart rate reserve was permitted, and most of the supervised and home-based activities involved the elliptical trainer, walking, bicycling

and running. Average reductions in total body fat were larger in the 300 min versus 150 min group (by 1kg or 1% body fat).

A study was also carried out on 234 subjects of Duke University and East Carolina University to examine the effect of aerobic (AT) and or resistance training (RT) on body mass and fat in overweight or obese adults. Aerobic Training was found to significantly reduce visceral adipose tissue more than RT which provided compelling evidence that AT is the optimal mode of exercise for improving body fat amount (Willis, Slentz, Bateman, Shields, Piner, & Bales, *et al.*, 2012).

Another research was conducted to determine the effect of aerobic training (isolated walking training programme) on Percentage of Body Fat, total Cholesterol (TC) and High Density Lipoprotein Cholesterol (HDL-C) among obese female students from various department of Annamalai University, Tamil Nadu, India. The result showed that there were significant changes in Percentage of Body Fat, TC and HDL-C (Narayani & Sudhan Paul Raj, 2010).

### **2.5.3 Effect of brisk walking on lean muscle mass**

Studies have shown significant effect of brisk walking / aerobic exercise on the lean muscle mass of obese women (Marandi *et al.*, 2013; Chen *et al.*, 2016; Melam *et al.*, 2016). A study conducted to examine the effect of walking exercise at 50 – 75% of maximal heart rate, 3 days per week for two months in order to provide means of overcoming bulimia nervosa in obese young women suffering from bulimia nervosa recorded a significant result not only on the BMI and percentage body fat but also on the lean muscle mass (Habibzadeh & Dneshmandi, 2010).

## **2.6 Physiological Modification of Obesity during Brisk Walking**

Adipose tissue is not only considered an energy storage organ but is now recognized as an endocrine and paracrine organ that plays an active role in energy homeostasis through the

release of a large number of cytokines and bioactive mediators (Ahima, 2006). These risk factors and markers do not only influence body weight homeostasis, but also insulin resistance, diabetes, lipid metabolism, inflammation, explaining premature atherosclerosis in obesity (Vissers et al., 2013). The metabolic characteristics of intra-abdominal fat (IAF) is more lipogenic and releases free fatty acid into the portal circulation which drains directly into liver, whereas subcutaneous fat drains into the systemic circulation. The influx of free fatty acids in the liver results in over production of hepatic very low lipoprotein and retention of same in the blood stream. This also leads to decrease level of high density lipoprotein possibly from an increased exchange of cholesterol for triglyceride in very low density particles (Warren, Schreiner & Terry, 2005).

During brisk walking, there will be an improved efficiency of the aerobic energy-producing systems that can increase cardiorespiratory endurance. There will be skeletal muscle adaptation and reduction in fat mass elicited by a powerful response to insulin sensitivity due to carbohydrate deficit it created by the efficient metabolism of glucose during the training programme (Woolf-May, Kearney & Jones, 2011; Heden, Liu, Parky, Winn, Kanaley, 2015). This will in-turn regulate insulin production and modifies metabolic conditions (Woolf-May, Kearney & Jones, 2011)

#### 2.6.1 Brisk walking prescription for obese individuals

The objectives of an exercise prescription to treat obesity, in decreasing order of priority, are prevention of additional weight gain, reduction of body weight, and long-term maintenance of reduced body weight (Matthew & McQueen, 2009). An exercise prescription for obese individuals defines the mode, intensity, duration, and frequency of exercise activities. Components of a particular training session include the warm-up, conditioning phase, and cool down. The 5 to 20 minute warm-up prepares muscles for more vigorous exercise and may reduce injuries. Stretching is recommended following the warm-up and is thought to

reduce muscular injury. The conditioning phase involves a cardiorespiratory or resistance training session lasting 20 to 60 minutes. This is followed by a cool down, which may attenuate post exercise hypotension, allow better dissipation of body heat, remove lactic acid, mitigate the rise in potentially arrhythmogenic catecholamines, and possibly reduce the risk of cardiac events during the recovery period. The volume of exercise needed for weight loss is greater than that which is necessary to improve fitness. Modifications to the standard fitness exercise prescription focus on greater overall energy expenditure. Initial training intensity should be modest (40% – 60%  $\text{VO}_2$  Max or heart rate reserve), account for deconditioning, and emphasize duration and frequency rather than intensity.

The American College of Sports Medicine recommended that overweight and obese individuals progressively increase to a minimum of 150 minutes of moderate intensity physical activity per week, but for long-term weight loss and for prevention of weight regain, overweight and obese adults should eventually progress to 200 to 300 minutes per week of moderate-intensity physical activity (Jakicic, Manore, Rankin & Smith, 2001; Donnelly, Blair, Jakicic, Manore, Rankin & Smith, 2009 & Matthew & McQueen, 2009;).

These guidelines also reiterate the importance of calorie restriction. This level of training obviously poses a challenge, and progression should proceed slowly along with behavioral strategies (Jakicic, *et al.*, 2001) The consensus concerning intensity is that moderate-intensity exercise at 55% to 69% of maximum heart rate is appropriate for the management of body weight rather than activity of more vigorous intensity (Jakicic, *et al.*, 2001).

According to the CDC and ACSM guidelines, brisk walking is defined by the level of intensity as moderate activity of 3.0 – 6.0 METs (3.5 to 7kcal/min) or walking at apace of 3 to 4.5 mph (4.8-7.2km/h) (CDC, 2016).



### **2.6.1.1 Moderate Exercise Intensity**

Intensity refers to the rate at which the activity is being performed or the magnitude of the effort required to perform an activity or exercise (WHO, 2010). The American College of Sports Medicine (ACSM) defines exercise intensity by percentage of maximum heart rate, rate of perceived exertion, and METS (metabolic equivalents) in their Position Stand; and also Recommended Quantity and Quality of Exercise for Development and Maintenance of Cardiorespiratory, Muscular Fitness and Flexibility in Healthy Adults (Sagiv, 2012; AHA, 2016).

### **2.6.1.2 Target Heart Rate and Estimated Maximum Heart Rate**

Moderate activity has been defined as 55 - 69 percent of maximum heart rate (HRmax) (Matthew & McQueen, 2009). One way of monitoring physical activity intensity is to determine whether a person's heart rate is within the target zone during physical activity. For moderate-intensity physical activity, a person's target heart rate should be 50 to 70% of his or her maximum heart rate. This maximum heart rate is based on the person's age. An estimate of a person's maximum age-related heart rate can be obtained by subtracting the person's age from 220. For example, for a 50-year-old person, the estimated maximum age-related heart rate would be calculated as  $220 - 50 \text{ years} = 170$  beats per minute (bpm). The 50% and 70% levels would be:

50% level:  $170 \times 0.50 = 85$  bpm, and

70% level:  $170 \times 0.70 = 119$  bpm

Thus, moderate-intensity physical activity for a 50-year-old person will require that the heart rate remains between 85 and 119 bpm during physical activity (CDC, 2015d).

### **2.6.1.3 Perceived Exertion (Borg Rating of Perceived Exertion Scale)**

The Borg Rating of Perceived Exertion (RPE) is a way of measuring physical activity intensity level. Perceived exertion is how hard you feel like your body is working. It is based on the physical sensations a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue. Although this is a subjective measure, a person's exertion rating may provide a fairly good estimate of the actual heart rate during physical activity\* (Borg, 1998, CDC, 2015c).

The Borg's Scale is used during activity to assign numbers to express perception. Self-monitoring on how hard the body is working with numbers 6 to 20 and can help in adjusting the intensity of the activity by speeding up or slowing down on the movements. The scale starts with "no feeling of exertion," which rates a 6, and ends with "very, very hard," which rates a 20 (Chan, (2018)).

Dr Gunnar Borg, who created the scale, set it to run from 6 to 20 as a simple way to estimate heart rate – multiplying the Borg score by 10 gives an approximate heart rate for a particular level of activity (Borg's Scale, 2017). Moderate activity register 11 to 14 on the Borg scale ("fairly light" to "somewhat hard"), while vigorous activities usually rate a 15 or higher ("hard" to "very, very hard") (Chan, (2018)).

### **2.6.1.4 Metabolic Equivalents**

Metabolic Equivalents (METs) are commonly used to express the intensity of physical activities.

MET is the ratio of a person's working metabolic rate relative to their resting metabolic rate.

One MET is defined as the energy cost of sitting quietly and is equivalent to a caloric consumption of 1kcal/kg/hour. It is estimated that compared with sitting quietly, a person's

caloric consumption is three to six times higher when being moderately active (3-6 METs) and more than six times higher when being vigorously active (>6 METs) (WHO, 2016).

#### **2.6.1.5 Talk Test**

Recent studies have helped validate an easier way to stay on track – the Talk Test. It is a simple and relative intensity measurement of the level of effort required by a person to do an activity. When using relative intensity, people pay attention to how physical activity affects their heart rate and breathing. The Talk Test was developed to be an informal, subjective method of estimating appropriate cardiorespiratory exercise intensity. The method entails maintaining an intensity of exercise at which conversation is comfortable. When an exerciser reaches an intensity at which he or she can “just barely respond in conversation,” the intensity is considered to be safe and appropriate for cardiorespiratory endurance improvement (Persinger, Foster, Gibson, Fatar & Porcari, 2004; CDC, 2015b). In general, talking is comfortable but singing is difficult during moderate-intensity activity while during vigorous-intensity activity, saying more than a few words without pausing for a breath is quite hard (CDC, 2015b).

Study reviews conducted by Block and Kraviz, (n.d.); Persinger, *et al.* (2004) to examine the consistency and effectiveness of the Talk Test as a tool for exercise prescription supports the usefulness of the Talk Test and highlights its ability to closely reflect actual heart rate and VO<sub>2</sub> levels on the treadmill and cycle ergometer.

Short term body weight normalization is too aggressive a target and slow steady gains over time are more appropriate. Programs should target long-term weight reduction. Even limited levels of weight loss may have significant positive influences toward health improvement and risk factor management in the presence of hypokinetic diseases. Maintenance of exercise is a

predictor of long-term weight management and of prevention of regain (Matthew & McQueen, 2009).

## **2.7 Summary**

Obesity is a complex mal-relationship between energy intake and expenditure that results in a homeostasis that is resistant to change. Obesity clearly has negative health implications that are well documented in consensus literature (WHO, 2015). Epidemiology studies have shown greater increase prevalence in overweight / obese among people of different genders and ages (WHO, 2015). Excess or reduced body weight is regarded as an indicator of determining an individual's health. Correction of body weight reduces the incidence and severity of comorbid diseases. A key aspect to this end is a significant amount of physical activity that is appropriately supervised and quantified. The objective of this study is to assess the effect of brisk walking on anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

Scientists ascertained that the specific body shapes are: the android shape, or apple shape commonly among men (fat deposits on the middle section of the body, mostly the abdomen) and the gynoid, or pear shape more common among women (fat deposit on the hips and bottom).

Anthropometric measurements are set of noninvasive and quantitative techniques for determining an individual's body fat patterns by measuring, recording and analyzing specific dimensions of the body, such as height, weight and body circumferences at the hip and waist. They are used to determine the relationship between various body measurements such as BMI, WHR for epidemiological and medical outcomes. BMI has become the "gold standard" for identifying patients at increased risk for adiposity-related adverse health outcomes. BMI is a person's weight in kilograms divided by the square of height in meters i.e. weight (kg) / height (m<sup>2</sup>) (NIH, 2012; CDC, 2015a & WHO, 2016b). WHO, (2016b) defines obesity as a

BMI greater than or equal to 30 kg/m<sup>2</sup>. Over the last several years, increasing attention has been paid to abdominal adiposity and its association with increased mortality (Vissers *et al.*, 2013). Waist circumference is actually a perimeter, which provides an estimate of body girth at the level of the abdomen. A waist circumference >35 inches (88 cm) in women is associated with higher cardio-metabolic risk (Ness-Abramof & Apovian, 2008). This excess adipose tissue in the abdomen, especially around visceral organs, increases metabolic risk of cardiovascular disease (CVD) independent of the total amount of adipose tissue (Despres, 2006; Haffner, 2007). In fact, evidence-based guidelines on the management of obesity promote the use of waist circumference as a measure of abdominal obesity for predicting excess relative risk of disease in overweight and class I obese persons [body mass index (BMI; in kg/m<sup>2</sup>): 25.0–34.9]. (Welborn & Dhaliwal, 2007; Nicklas *et al* 2009). indicated that waist circumference is superior to BMI in predicting cardiovascular disease risk.

The waist-hip-ratio is calculated simply by dividing the waist measurement by the hip measurement. World Health Organization defines the ratios of >0.85 in women as one of the decisive benchmarks for metabolic syndrome. The Nurses' Health Study also found that waist circumference and waist-to-hip ratio are equally effective at predicting who was at risk of death from heart disease, cancer, or any cause (Zhang *et al.*, 2008). BMI it is a crude index that does not take into account the distribution of body fat. On the other hand, WC and WHR are used as a surrogate for body fat centralization (Movaseghi, *et al.*, 2014). However, these techniques do not precisely characterize persons by body composition (percentage of body fat or muscle mass).

Body composition is a key component of health in both individual and populations. It is a component of health related fitness used to describe the percentage of fat, bone, water and muscle in the body expressed as percent body fat, visceral fat and lean muscle mass. The ongoing epidemic of obesity in children and adults has heightened the importance of body fat

for short term and long term health. However, other components of body composition also influence health outcomes and its measurement is increasingly considered valuable in clinical practice. Excessive body fat is associated with increased metabolic risk and its measurement is important in implementing curative and preventive health measures (Ranasinghe, Gamage, Katulanda, Andraweera, Thilakarathne & Tharanga, 2013).

Several techniques have been used to assess percent body fat in controlled laboratory conditions. These include underwater weighing (densitometry), dual energy X-ray absorptiometry (DEXA), bioelectrical impedance analysis (BIA) and magnetic resonance imaging (MRI). Densitometry, DEXA, and MRI are expensive, inconvenient for the participant, and not feasible to conduct in the field because they require large specialized equipment. For these reasons, their use in large epidemiological studies is limited (Dehghan & Merchant, 2008). The two most common methods of measurements used for percent body fat are skin fold measurement and bioelectrical impedance analysis. Aerobic exercise is believed by many scientists to be the single best predictor of weight maintenance.

Studies have reported a significant effect of moderate intensity aerobic exercises on body composition (Marandi *et al.*, 2013; Chen *et al.*, 2016 & Melam *et al.*, 2016). According to the CDC and ACSM guidelines, brisk walking is defined by the level of intensity as moderate activity of 3.0 – 6.0 METs (3.5 to 7kcal/min) or walking at a pace of 3 to 4.5 mph (CDC, 2016). A study conducted to review the effect of brisk walking on postural stability, bone mineral density, body weight and composition in women over 50 years with a sedentary occupation: a randomized controlled trial also reported a significant decrease in the body composition indices of the participants (Gaba, 2016).

The objectives of an exercise prescription to treat obesity, in decreasing order of priority, are prevention of additional weight gain, reduction of body weight, and long-term maintenance

of reduced body weight (Matthew & McQueen, 2009). An exercise prescription for obese individuals defines the mode, intensity, duration, and frequency of exercise activities. Components of a particular training session include the warm-up, conditioning phase, and cool down (Heyward, 2010).

The American College of Sports Medicine (ACSM) recommends that overweight and obese individuals progressively increase to a minimum of 150 minutes of moderate intensity physical activity per week, but for long-term weight loss, overweight and obese adults should eventually progress to 200 to 300 minutes per week of moderate-intensity physical activity. The American College of Sports Medicine defines exercise intensity by percentage of maximum heart rate, rate of perceived exertion, and METS (metabolic equivalents) in their Position Stand, Recommended Quantity and Quality of Exercise for Development and Maintenance of Cardiorespiratory and Muscular Fitness and Flexibility in Healthy Adults (AHA, 2016). Also, recent studies have helped validate an easier way to stay on track – the Talk Test. It is a simple relative intensity measurement of the level of effort required by a person to do an activity.

Body weight normalization is too aggressive a target, and slow steady gains over time are more appropriate. Programs should target long-term weight reduction of 5% to 10%. Even limited levels of weight loss may have significant positive influences toward health improvement and risk factor management in the presence of hypokinetic diseases. Maintenance of exercise is a predictor of long-term weight management and of prevention of regain (Matthew & McQueen, 2009).

## **CHAPTER THREE**

### **3.0**

### **METHODOLOGY**

#### **3.1 Introduction**

The purpose of this study was to assess the effect of brisk walking on anthropometric and body composition indices of obese female adults in Kaduna metropolis, Nigeria. To achieve this purpose, the research design, population, sample and sampling techniques, research instrument and procedures for data collection, training methods and procedures for data analysis are described in this chapter.

#### **3.2 Research Design**

A quasi experimental research design was used in this study. This involved one treatment, (brisk walking), one training group and assessments taken at three separate time point repeatedly throughout the research duration. The study group was engaged in brisk walking and they were tested for all the variables investigated three times during the training period at base-line, immediately after the 6<sup>th</sup> and 12<sup>th</sup> week.

#### **3.3 Population**

The population for this research study was obese female adults in Kaduna metropolis. According to the National Population Commission Census of 2006, there are 28,582 adults age 40 – 49 years in Kaduna north local government (National Population Commission of Nigeria, 2007). From this population, only females whose BMI was between 30.0 - 39.9 kg/m<sup>2</sup> and between the ages of 40 to 50 years were included in this study.

#### **3.4 Sample and Sampling Techniques**

The study subjects were recruited using postal notices and direct contact within Kaduna metropolis (Appx. H). All female volunteers were screened for BMI and age. Using the



purposive sampling technique, seventeen (17) female volunteers from Kaduna metropolis that met the inclusion criteria, and on the basis of personal interest and availability for the programme, were included in the study.

The exclusion criteria for the study included those women that were pregnant and having history of uncontrolled metabolic and cardiovascular diseases such as hypertension, coronary heart disease, type 2 diabetes mellitus, as well as on medications affecting metabolism like steroids.

### **3.5 Research Instruments**

The following instruments were used in this study:

1. Stethoscope: Littman Classic II S.E. Stethoscope by 3M Health Care St. Paul, MN 55144- 1000 (2009 AW).
2. Stop watch: Digital stop watch (CASIO) model 015, made in China.
3. Heart Rate Monitor: Polar FT4 Heart Rate Monitor.
4. Weighing Scale (Commercial Stadiometer): Health Scale, Model ZT 150A. Made in England by Harris.
5. Non-elastic Tape: (Model X635, 1-150 cm), made in China.
6. Omron body composition monitor with scale fitness indicator and 90 - day memory. 1200 Lakeside Drive Bannockburn, Illinois 60015, Made in China.

### **3.6 Procedures for Data Collection**

#### **3.6.1 Informed Consent**

Before the commencement of base-line assessment, the researcher sought and got permission from the Ethical Committee of Ahmadu Bello University Zaria (Approval No:ABUCUHSR/2017/002) (Appx. E); Barau Dikko Teaching Hospital, Kaduna, Kaduna

State (Reference No: 17-0020-1) (Appx. B) and the Management of Ahmadu Bello Stadium (Appx. D). The researcher also worked closely with a physician in Barau Dikko Teaching Hospital, Kaduna. Physical Activity Readiness Questionnaire (PAR – Q & YOU) (Appx F) was filled and signed by each participant and the Physician certified that the participants had no contraindication to undergo the training programme. Each participant signed the informed consent section to justify the wiliness to participate in the study (Appx. G).

### **3.6.2 Research Assistants**

Two research assistants (physiotherapists) assisted the researcher in this study. The physiotherapists assisted in the collection of data on the resting heart rate and height measurement while the researcher measured the body weight, anthropometric (waist and hip circumferences) as well as the body composition indices (visceral fat, percent body fat and the lean muscle mass) of the participants. Both assistants were tested in all the variables to ensure reliability as recommended by Gunen (2007). The data were collected at base-line, immediately after the 6<sup>th</sup> and 12th weeks of the training.

### **3.6.3 Testing sequence**

The following test sequence was followed:

1. Resting heart rate
2. Height (stature)
3. Waist circumference
4. Hip circumference
5. Total body weight
6. Visceral adipose fat
7. Percent body fat

## 8. Lean muscle mass

### **Resting Heart**

Each participant was asked to sit comfortably in a chair for 5-10 minutes before the commencement of any measurement. This was to allow for better relaxation and relief of anxiety which might affect the values of the measurements. The heart rate was taken at 7 a.m. using auscultation method by placing a stethoscope over third intercostal space to the left of the sternum. Measurements was taken for 30 seconds and then multiplied by 2 to convert it to beats per minute (b/m) (Heyward, 2010). Three heart rate measurements were taken for each participant and the average was calculated.

### **3.6.4 Anthropometric and body composition measurement**

**Total body weight:** This was measured using Omron Full Body Sensor Body Composition Monitor and Scale fitness indicator. It was a device that works by measuring the way the body conducts electricity according to the Bioelectric Impedance Analysis (BIA) method: It analyses the electrical resistance of the body tissues by sending an extremely weak electrical current of 50 kHz and less than 500  $\mu$ A through the body by way of electrodes situated on the hands and feet.

The following procedure was used for the measurement:

Once the power switch was turned on, the display for personal data (age, gender and height) for each participant was entered into the monitor and the set button was pressed.

Each participant weight was measured by the participant stepping onto the measurement platform and placing feet on the foot electrodes with weight evenly distributed.

**Height:** Health Scale, Model ZT 150A, made in England by Harris was used to measure the participant's height. It has a platform of 28 cm by 38.5 cm with a height meter rule of 190 cm. Each participant was ensured to dress in very light cloths. Each was made to stand on the platform erect, bear footed and facing forward with the buttocks and scapulae protrusions having contact directly with the machine. The overhead rule was adjusted to the highest point of the participant head (the vertex). The participant then dismounted the machine while the reading was taken and recorded in centimeters. The measurement in centimetres was later converted to meters.

**Waist Circumference:** A non-elastic tape, (Model X635, 1-150 cm) made in China was used. Each participant waist circumference (WC) was measured in horizontal plane with the subject standing erect using non-elastic tape. Measurements were taken on the right side of the body at the greatest anterior extension of the abdomen usually at level of the umbilicus in centimeter (ACSM, 2013). To ensure accuracy, the tape was held at zero end with the left hand and positioned snugly below the other part of the tape which was held with the right hand. Measurements were taken at the end of normal expiration to the nearest 0.1 cm.

**Hip Circumference:** using the non-elastic tape, the hip circumference (HC) was taken at the level of maximum posterior extension of the buttocks (ACSM, 2013). Same standard procedure as in waist circumference was followed to ensure accuracy. Measurements were taken to the nearest 0.1 cm.

**Waist-hip-ratio:** waist – hip ratio (WHR) was calculated by dividing waist circumference measurement by the hip circumference measurement in cm.

$$\text{WHR} = \text{WC (cm)} / \text{HC (cm)}$$

**Total body weight:** This was measured using Omron Full Body Sensor Body Composition Monitor and Scale fitness indicator. It was a device that works by measuring the way the

body conducts electricity according to the Bioelectric Impedance Analysis (BIA) method: It analyses the electrical resistance of the body tissues by sending an extremely weak electrical current of 50 kHz and less than 500  $\mu$ A through the body by way of electrodes situated on the hands and feet.

The following procedure was used for the measurement:

Once the power switch was turned on, the display for personal data (age, gender and height) for each participant was entered into the monitor and the set button was pressed.

Each participant weight was measured by the participant stepping onto the measurement platform and placing feet on the foot electrodes with weight evenly distributed.

### **Body Mass Index**

This was also measured using Omron Full Body Sensor Body Composition Monitor and Scale fitness indicator.

Once the weight was measured, the monitor starts to calculate body composition.

Immediately START appears on the display, the participant, looking straight ahead with knee and back straight while grasping the grip electrodes firmly, then raised arms horizontally to make angle 90° with the body without bending the elbow.

The device within few seconds analyzes the electrical resistance of the body tissues by sending an extremely weak electrical current of 50 kHz and less than 500  $\mu$ A through the body by way of electrodes situated on the hands and feet.

When the measurement was completed, the indicator in the measurement progress bar at the bottom of the display gradually appeared from left to right, based on the measurement taken as weight → body fat percent → visceral fat level and BMI.

### **Visceral fat**

Visceral fat was also measured using Omron Full Body Sensor Body Composition Monitor and Scale fitness indicator. Same standard procedure as in body mass index was followed to

ensure accuracy. When the measurement was completed, the indicator in the measurement progress bar at the bottom of the display gradually appeared and the result was documented.

### **Percent body fat**

Percent body fat was also measured using Omron Full Body Sensor Body Composition Monitor and Scale fitness indicator. Same standard procedure as in body mass index was followed to ensure accuracy. When the measurement was completed, the indicator in the measurement progress bar at the bottom of the display gradually appeared and the result was documented.

### **Lean muscle mass**

Lean muscle mass was equally measured using Omron Full Body Sensor Body Composition Monitor and Scale fitness indicator. Same standard procedure as in body mass index was followed to ensure accuracy. When the measurement was completed, the indicator in the measurement progress bar at the bottom of the display gradually appeared and the result was documented.

### **Maximum heart rate & heart rate zone estimation**

Each participant maximum heart rate (HR<sub>max</sub>) was determined using the formula: 220 – age. Each participant's aerobic training zone was estimated using the Karvonen equation:

Training heart rate zone (THR<sub>zone</sub>) = (% THR) (HR<sub>max</sub> – HR<sub>rest</sub>) + HR<sub>rest</sub> (Heyward, 2010). For example, a 40 – year – old person's training zone at 60% - 70% of HR<sub>max</sub> was calculated using the procedures as shown below:

THR<sub>zone</sub> (lower) = (60%) (180 – HR<sub>rest</sub>) +HR<sub>rest</sub>.

THR<sub>zone</sub> (upper) = (70%) (180 – HR<sub>rest</sub>) +HR<sub>rest</sub>.

The participants were educated on rating of perceived exertion (RPE) for self-intensity monitoring.

## DESCRIPTION OF BRISK WALKING

The participants were asked to stand up straight with elbows bent and shoulders relax.

Looking straight ahead, each participant starts walking, heel to toe.

The participants move arms forward and back as walking progresses.

The subjects were informed to relax hands instead of clenching the fists while walking.

While walking, subjects experienced growing warmth and sweat, slightly elevated heart rate and heavy breathing.

Subjects were able to talk but not able to sing (Persinger, Foster, Gibson, Fatar & Porcari, 2004; CDC, 2015b; Borg Scale, 2017)

### 3.7 Training Protocol/Procedure

The training programme was conducted on the track of the national Stadium (Ahmadu Bello stadium), Kaduna in the morning between the hours of 6.30 and 8.00 a.m. The training protocol/procedure was as summarized in table 3.7.

**Table 3.7 Summary of Training Protocol/Procedure**

Mode	Training Phases	Intensity	Monitoring Technique (Borg's scale)	Frequency	Duration		
					Warm up & Cool down	Main Training	Total
Brisk Walking	1 <sup>st</sup> -4 <sup>th</sup> Wk.	50 - 55% HRmax	9 – 11(very light)	3x / WK	10 & 5 mins.	30 mins.	45 mins.
	5 <sup>th</sup> -8 <sup>th</sup> Wk.	55-60% HRmax	11 -13 (light)			40 mins.	55 mins.
	9 <sup>th</sup> -12 <sup>th</sup> Wk.	60-65% HRmax	13 -15 (somewhat hard)			50 mins.	65 mins.

During the initial 4 weeks of training, the participants trained at intensity levels of between 50 and 55% maximum heart rate, which was monitored using Borg's scale rating of 9 – 11

(very light) and heart rate monitor, three times per week for a duration of 45 minutes (10 minutes warm-up and 5 minutes of cool-down and 30 minutes brisk walking). Between the 5<sup>th</sup> and 8<sup>th</sup> week, the training intensity level was maintained between 55 and 60% maximum heart rate which was monitored using the Borg's scale rating of 11-13 (light), three times per week and for a duration of 55 minutes (10 minutes warm-up and 5 minutes of cool-down and 40 minutes brisk walking). Likewise, between the 9<sup>th</sup> and 12<sup>th</sup> weeks, the training intensity was further increased to 60 and 65% maximum heart rate using Borg's scale 13 - 15 (somewhat hard) at a duration of 65 minutes (10 minutes warm-up and 5 minutes of cool-down and 50 minutes main training). The increases in the intensity levels and durations were in line with the recommendations of Matthew and McQueen, (2009); Heyward, (2010) & Ehrman, Gordon, Visich, and Keteyian , (2013).

During the exercise, care was taken by the participants, the researcher and the research assistants to ensure prompt identification of signs and symptoms of exhaustion, such as weakness, dizziness, chest pains, shortness of breath, palpitations, nausea. This was with the view to stop any participant from further exercising to prevent collapse. Since obese individuals are susceptible to dehydration, water was made available by the researcher before, during and after the work out (ACSM, 2013).

### **3.8 Procedures for Data Analyses**

The following statistical tools were used to analyze the collected data:

- i. The descriptive statistics of means, standard deviation and standard error of means was used to analyzed the data
- ii. Repeated-measures Analysis of Variance (ANOVA) was used to determine the interactional effect of the training on the variables.



- iii.** Post-hoc using Bonferroni Multiple comparisons (pair wise) was used to determine where the effects of the training duration lies.
- iv.** An alpha-level of 0.05 was used to accept or reject the null hypotheses.
- v.** Statistic Package for Social Sciences Version 17 was used in running all the analysis.

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

#### 4.1 Introduction

The purpose of this study was to assess the effect of brisk walking on anthropometric and body composition indices of obese female adults in Kaduna metropolis, Nigeria. To achieve this purpose, the data collected for this study was statistically analyzed, the results of which are presented and discussed in accordance with the research questions and hypotheses in this chapter.

#### 4.2 Results

Seventeen (17) participants were recruited for this study. The study started with seventeen (17) participants but there were three attritions between base-line and the sixth week of the training programme. One of the participants dropped out because of frequent trips on political engagement, one stopped on medical ground while the third participant dropped out due to time incompatibility. The training lasted for 12 weeks with exercise intensity between 50% and 65% of maximum heart rate for duration of training session lasting between 45 and 65 minutes on three alternate days per week. Data were collected at base-line, immediately after the 6<sup>th</sup> and 12th weeks of training on all the variables for the remaining fourteen (14) participants. The demographic data of the participants on age, height and weight is presented in Table 4:2:1

**Table 4:2:1: Demographic Data of the participants**

VARIABLES	N	Mean	SD	SE
Age (yrs)	14	47.643	2.437	.651
Height (m)	14	1.604	.068	.018
Weight (kg)	14	91.693	11.862	3.170

SD= Standard deviation and SE = Standard error

Table 4:2:1 shows the demographic data of the participants. There were fourteen (14) participants for the study. An observation of the Table showed that the mean age was  $47.643 \pm 2.437$  years while the mean height and mean body weight were  $1.604 \pm 0.068$ m and  $91.693 \pm 11.862$  kg respectively.

Before the results are presented in accordance to the stated hypotheses, the descriptive statistics of the participants on the anthropometric and body composition variables used in this study at the base-line, immediately after the 6<sup>th</sup> and the 12th weeks are presented in table 4: 2:2.

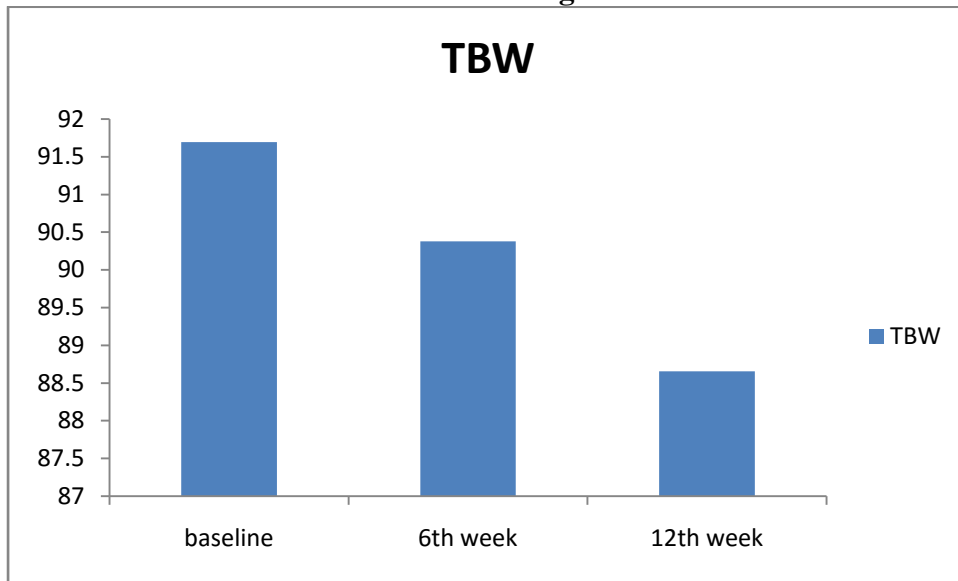
**Table 4:2:2 Descriptive statistics of the anthropometric and body composition variables at base-line, 6<sup>th</sup> and 12th weeks of training**

Variables	N	baseline			6 <sup>th</sup> week			12 <sup>th</sup> Week		
		M	SD	SE	M	SD	SE	M	SD	SE
TBW	14	91.693	11.862	3.381	90.379	12.349	3.301	88.657	11.892	3.178
BMI	14	35.493	2.990	.799	34.986	3.027	.809	34.336	2.920	.780
WC	14	106.647	9.704	2.594	105.807	9.534	2.548	104.336	9.814	2.623
WHR	14	.889	.054	.015	.871	.054	.015	.869	.055	.015
V/Fat	14	11.429	1.742	.465	11.071	1.542	.412	10.714	1.437	.384
%B/F	14	50.357	4.742	1.267	48.607	4.485	1.199	47.043	5.341	1.427
LMM	14	21.757	2.117	.566	22.675	2.037	.544	23.843	2.656	.710

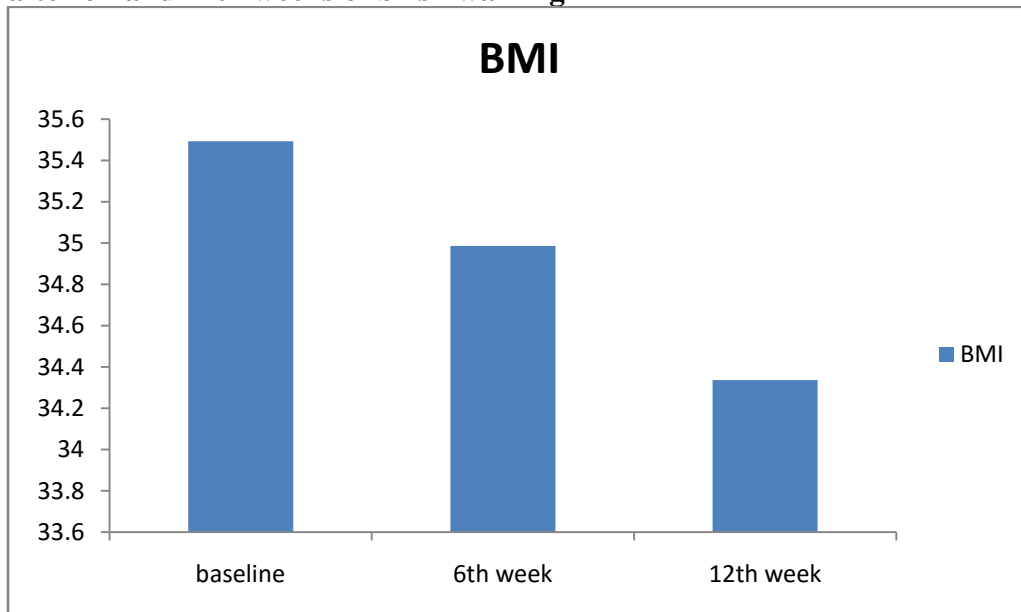
M=mean, SD= standard error and SE= standard error

Observation on table 4:2:2 shows changes due to training between week zero and the 6<sup>th</sup> week as well as between the 6<sup>th</sup> and 12<sup>th</sup> week. The changes are presented in the figure below:

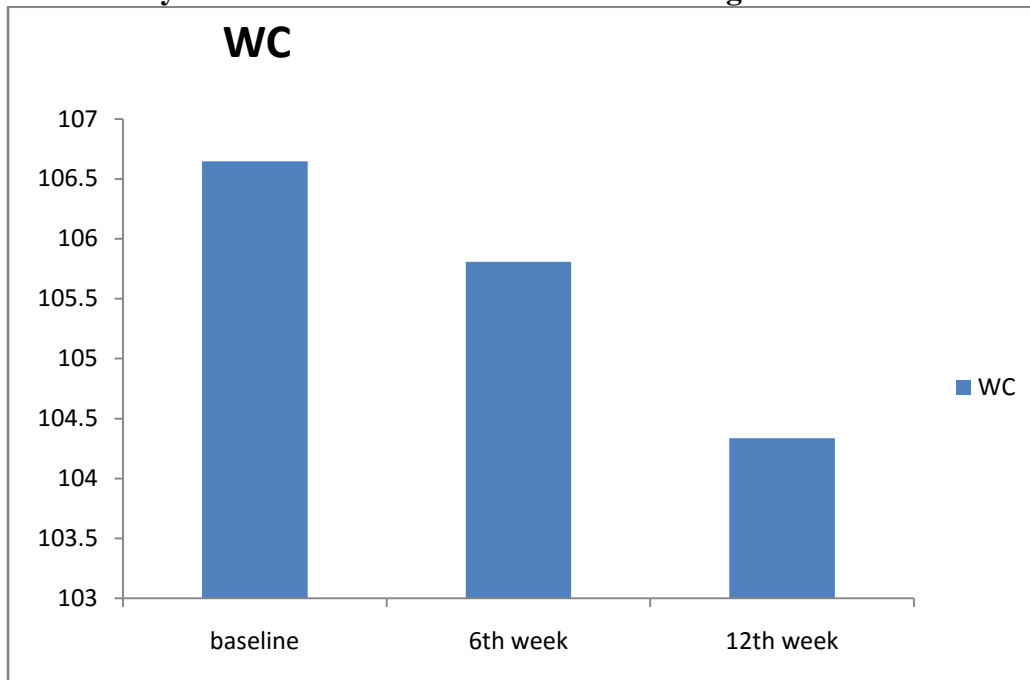
**Fig. 4:2:2a Changes in the mean values of participants' TBW at base-line, immediately after 6th and 12th weeks of brisk walking**



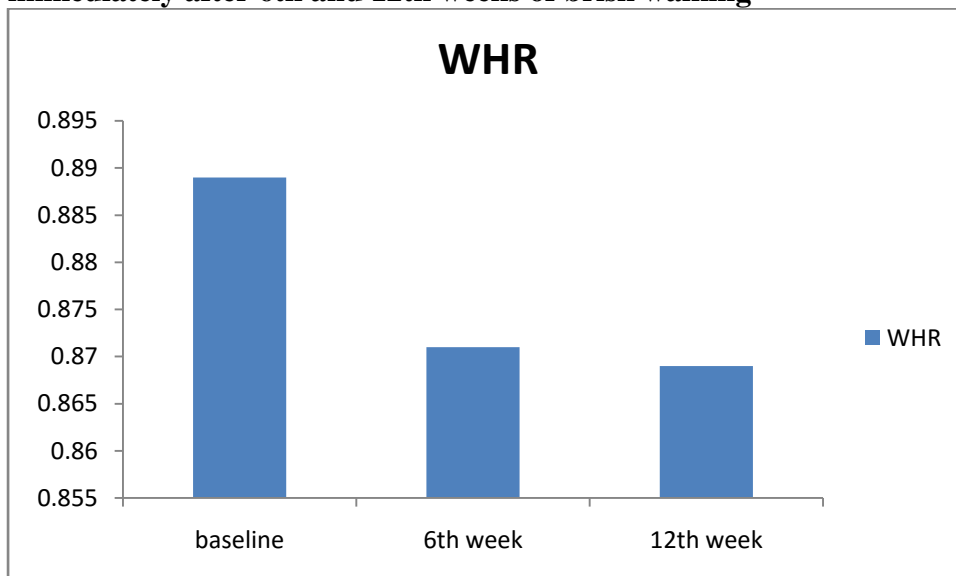
**Fig. 4:2:2b Changes in the mean values of participants' BMI at base-line, immediately after 6<sup>th</sup> and 12th weeks of brisk walking**



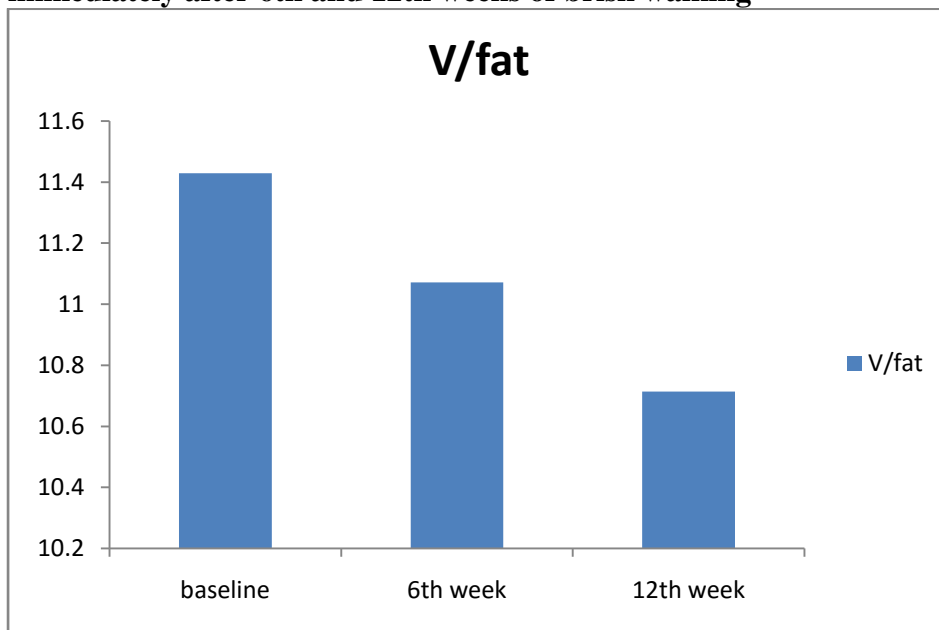
**Fig. 4:2:2c Changes in the mean values of participants' waist circumference at base-line, immediately after 6<sup>th</sup> and 12th weeks of brisk walking**



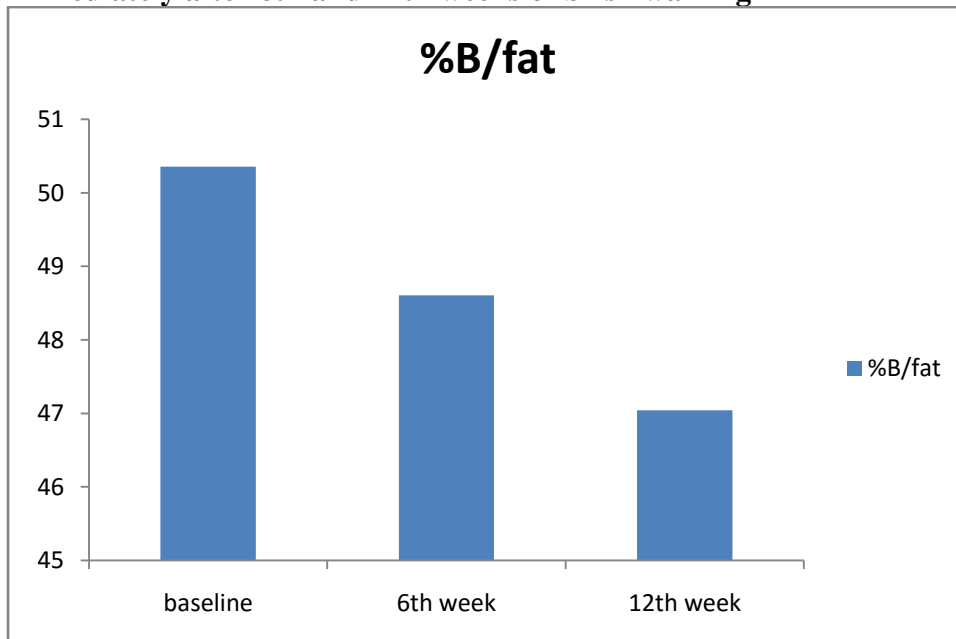
**Fig. 4:2:2d Changes in the mean values of participants' waist-hip-ratio at base-line, immediately after 6<sup>th</sup> and 12th weeks of brisk walking**



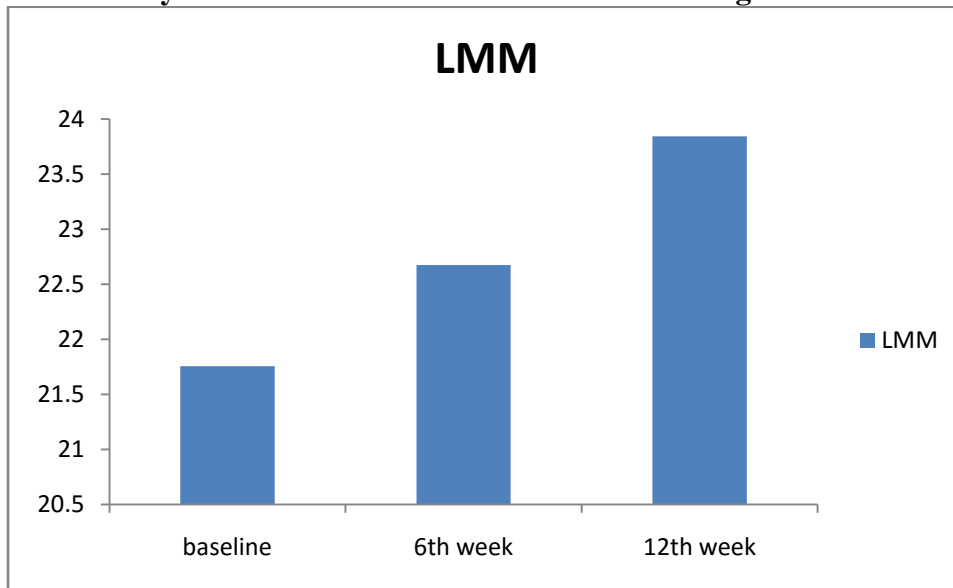
**Fig. 4:2:2e** Changes in the mean values of participants' visceral fat at base-line, immediately after 6th and 12th weeks of brisk walking



**Fig. 4:2:2f** Changes in the mean values of participants' percent body fat at base-line, immediately after 6th and 12th weeks of brisk walking



**Fig. 4:2:2g Changes in the mean values of participants' lean muscle fat at base-line, immediately after 6th and 12th weeks of brisk walking**



#### **4.2.3 Testing of Hypotheses**

In order to assess the effect of the training programme on the selected variables, the data collected was analyzed in accordance to the stated hypotheses.

**Major hypothesis:** The major hypothesis for this study states that: There was no significant effect of brisk walking on anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

**Sub hypothesis 1:** There is no significant effect of brisk walking on total body weight of obese female adults in Kaduna metropolis, Nigeria

In order to find out whether the effect of brisk walking on the total body weight was statistically significant, the data collected at base-line, immediately after the 6th and 12th weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:3a.

**Table 4:2:3a Repeated-measures ANOVA on total body weight of obese female adults at base-line, immediately after 6th and 12th weeks of brisk walking**

Source		Sum of Squares	df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	64.896	2	32.448	80.010	.000
	Greenhouse-Geisser	64.896	1.970	32.934	80.010	.000
	Huynh-Feldt	64.896	2.000	32.448	80.010	.000
	Lower-bound	64.896	1.000	64.896	80.010	.000
	Sphericity Assumed	10.544	26	.406		
Error(Training_Period)	Greenhouse-Geisser	10.544	25.616	.412		
	Huynh-Feldt	10.544	26.000	.406		
	Lower-bound	10.544	13.000	.811		

Calculated F (2, 26) = 80.010, P = 0.005), critical F (2, 26) = 3.3690 ≤ 0.05,

Table 4:2:3a: presents the results of the Repeated-measures ANOVA on the TBW of the participants used in this study. An observation of the results showed that brisk walking had significant effect on TBW of the participants with calculated F (2, 26) = 80.010, P = 0.005) and critical F (2, 26) = 3.3690 ≤ 0.05. To locate where the significant effect lies, post-hoc test was conducted and the results is presented in table 4:2:3b

**Table 4:2:3b LSD Multiple comparison (pair wise) on total body weight of the obese female adults used in this study**

Variable	(I)	(J)	Mean	Std. Error	Sig
repetition	*.The mean difference was significant at the 0.05 level.				repetition
	Difference(I – J)				
TBW (Kg)	Week 0	Week 6	1.314*	.253	.001
		Week 12	3.036*	.241	.000
	Week 6	Week 0	-1.314*	.253	.001
		Week 12	1.721*	.227	.000
	Week 12	Week 0	-3.036*	.241	.000
		Week 6	-1.721*	.227	.000

Post hoc tests using the Bonferroni correction confirmed this position for all the values as



documented in table 4:2:3b. There was significant reduction in the mean value between week zero and 6th week as well as between the 6th and the 12th weeks of brisk walking. Therefore, the null hypothesis which states that there was no significant effect of brisk walking on the total body weight of obese female adults in Kaduna metropolis, Nigeria was rejected.

**Sub hypothesis 2:** There was no significant effect of brisk walking on body mass index of obese female adult in Kaduna metropolis, Nigeria.

In order to find out whether the effect of brisk walking on the body mass index was statistically significant, the data collected at base-line, immediately after the 6th and 12th weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:4a.

**Table 4:2:4a Repeated-measures ANOVA on body mass index of obese female adults at base-line, immediately after 6<sup>th</sup> and 12th weeks of brisk walking**

Source		Sum of Squares	df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	9.396	2	4.698	57.576	.000
	Greenhouse-Geisser	9.396	1.775	5.295	57.576	.000
	Huynh-Feldt	9.396	2.000	4.698	57.576	.000
	Lower-bound	9.396	1.000	9.396	57.576	.000
Error(Training_Period)	Sphericity Assumed	2.122	26	.082		
	Greenhouse-Gewasser	2.122	23.069	.092		
	Huynh-Feldt	2.122	26.000	.082		
	Lower-bound	2.122	13.000	.163		

Calculated F (2, 26) =57.576, P = 0.005), critical F (2, 26) = 3. 3690 ≤ 0.05,

Table 4:2:4a: presents the results of the Repeated-measures ANOVA on the BMI of the participants used in this study. An observation of the results showed that brisk walking had significant effect on BMI of the participants with calculated F (2, 26) =57.576, P = 0.005)

and critical  $F(2, 26) = 3.3690 \leq 0.05$ . To locate where the significant effect lies, post-hoc test was conducted and the results are presented in table 4:2:4b

**Table 4:2:4b LSD Multiple comparison (pair wise) on body mass index of the obese female adults used in this study**

Variable	(I) repetition	(J) repetition	Mean Difference(I – J)	Std. Error	Sig
BMI (kg/m <sup>2</sup> )	Week 0	Week 6	.507*	.113	.002
		Week 12	1.156*	.121	.000
	Week 6	Week 0	-.507*	.113	.002
		Week 12	.649*	.087	.000
	Week 12	Week 0	-1.156*	.121	.000
		Week 6	-.649*	.087	.000

\*.The mean difference was significant at the 0.05 level.

Post hoc tests using the Bonferroni correction confirmed this position for all the BMI values as documented in table 4:2:4b. There was significant reduction in the mean BMI value between week zero and 6th week as well as between the 6th and the 12th weeks of brisk walking. Therefore, the null hypothesis which states that there was no significant effect of brisk walking on the body mass index of obese female adults in Kaduna metropolis, Nigeria was rejected.

### **Sub hypothesis 3**

There was no significant effect of brisk walking on waist circumference of obese female adults in Kaduna metropolis, Nigeria.

In order to find out whether the effect of brisk walking on the waist circumference was statistically significant, the data collected at base-line, immediately after the 6th and 12th

weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:5a

Table 4:2:5a Repeated-measures ANOVA on waist circumference of obese female adults at base-line, immediately after 6th and 12th weeks of brisk walking

	Source	Sum of Squares	Df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	43.432	2	21.716	50.982	.000
	Greenhouse-Geisser	43.432	1.891	22.969	50.982	.000
	Huynh-Feldt	43.432	2.000	21.716	50.982	.000
	Lower-bound	43.432	1.000	43.432	50.982	.000
Error(Training_Period)	Sphericity Assumed	11.075	26	.426		
	Greenhouse-Geisser	11.075	24.581	.451		
	Huynh-Feldt	11.075	26.000	.426		
	Lower-bound	11.075	13.000	.852		

Cal.  $F(2, 26) = 50.982$ ,  $P = 0.005$ , crit.  $F(2, 26) = 3.3690 \leq 0.05$ ,

Table 4:2:5a: presents the results of the Repeated-measures ANOVA on the waist circumference of the participants used in this study. An observation of the results showed that brisk walking significantly reduced the waist circumference of the participants with calculated  $F(2, 26) = 50.982$ ,  $P = 0.005$ ) and critical  $F(2, 26) = 3.3690 \leq 0.05$ . To locate where the significant effect lies, post hoc test was conducted and the results is presented in table 4:2:5b.

**Table 4:2:5b LSD Multiple comparison (pair wise) on waist circumference of the obese female adults used in this study**

Variable	(I) repetition	(J) repetition	Mean Difference(I – J)	Std. Error	Sig. <sup>b</sup>
WC (cm)	Week 0	Week 6	.836*	.255	.018
		Week 12	2.450*	.267	.000
	Week 6	Week 0	-.836*	.255	.018
		Week 12	1.614*	.216	.000
	Week 12	Week 0	-2.450*	.267	.000
		Week 6	-1.614*	.216	.000

\*.The mean difference was significant at the .05 level.

Post hoc tests using the Bonferroni correction confirmed this significant position for all the values as documented in table 4:2:5b. There was significant decrease in the mean WC value between week zero and 6th week as well as between the 6th and the 12th weeks of brisk walking. Therefore the null hypothesis which states that there was no significant effect of brisk walking on the waist circumference of obese female adults in Kaduna metropolis, Nigeria was rejected.

**Sub-hypothesis 3** which states that:

There was no significant effect of brisk walking on waist-hip-ratio of obese female adults in Kaduna metropolis, Nigeria.

In order to find out whether the effect of brisk walking on the waist-hip-ratio was statistically significant, the data collected at base-line, immediately after the 6th and 12th weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:6a.

**Table 4:2:6a Repeated-measures ANOVA on waist-hip-ratio of obese female adult at base-line, immediately after 6th and 12th weeks of brisk walking**

Source		Sum of Squares	df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	.000	2	.000	.085	.919
	Greenhouse-Geisser	.000	1.032	.000	.085	.783
	Huynh-Feldt	.000	1.040	.000	.085	.785
	Lower-bound	.000	1.000	.000	.085	.775
Error (Training_Period)	Sphericity Assumed	.055	26	.002		
	Greenhouse-Geisser	.055	13.412	.004		
	Huynh-Feldt	.055	13.516	.004		
	Lower-bound	.055	13.000	.004		

F cal. (2, 26) = .085, P = 0.005, F crit. (2, 26) = 3. 3690 ≤ 0.05

Table 4:2:6a presents the results of the Repeated-measures ANOVA on the waist – hip ratio of the participants used in this study. An observation of the results showed that brisk walking had no significant effect on the waist-hip-ratio of the participants with calculated  $F(2, 26) = .085, P = 0.005$  and critical  $F(2, 26) = 3.3690 \leq 0.05$ .

Therefore, the null hypothesis which states that there was no significant effect of brisk walking on the waist-hip ratio of obese female adults in Kaduna metropolis, Nigeria was accepted.

#### **Sub hypothesis 4:**

There was no significant effect of brisk walking on visceral fat of obese female adults in Kaduna metropolis, Nigeria.

In order to find out whether the effect of brisk walking on visceral fat was statistically significant, the data collected at base-line, immediately after the 6th and 12th weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:7a.

**Table 4:2:7a Repeated-measures ANOVA on visceral fat of obese female adults at base-line, immediately after 6th and 12th weeks of brisk walking**

Source		Sum of Squares	Df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	.919	2	.459	.127	.881
	Greenhouse-Geisser	.919	1.030	.892	.127	.735
	Huynh-Feldt	.919	1.038	.885	.127	.737
	Lower-bound	.919	1.000	.919	.127	.727
Error(Training_Period)	Sphericity Assumed	94.159	26	3.622		
	Greenhouse-Geisser	94.159	13.395	7.030		
	Huynh-Feldt	94.159	13.495	6.978		
	Lower-bound	94.159	13.000	7.243		

Cal.  $F(2, 26) = .127, P = 0.005$ , crit.  $F(2, 26) = 3.3690 \leq 0.05$ .

Table 4:2:7a: presents the results of the Repeated-measures ANOVA on the visceral fat of the participants used in this study. An observation of the results showed that brisk walking had no significant effect on visceral fat of the participants with calculated  $F(2, 26) = .127, P = 0.005$  and F critical is  $F(2, 26) = 3.3690 \leq 0.05$ .

Therefore the null hypothesis which states that there was no significant effect of brisk walking on the visceral fat of obese female adults in Kaduna metropolis, Nigeria was accepted.

### **Sub hypothesis 5**

There was no significant effect of brisk walking on percent body fat of obese female adults participants in Kaduna metropolis, Nigeria.

In order to find out whether the effect of brisk walking on percent body fat was statistically significant, the data collected at base-line, immediately after the 6th and 12th weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:8a.

**Table 4:2:8a Repeated-measures ANOVA on percent body fat of obese female adults at base-line, immediately after 6th and 12th weeks of brisk walking**

Source		Sum of Squares	df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	76.972	2	38.486	18.120	.000
	Greenhouse-Geisser	76.972	1.623	47.429	18.120	.000
	Huynh-Feldt	76.972	1.821	42.264	18.120	.000
	Lower-bound	76.972	1.000	76.972	18.120	.001
	Sphericity Assumed	55.221	26	2.124		
Error(Training_Period)	Greenhouse-Geisser	55.221	21.098	2.617		
	Huynh-Feldt	55.221	23.676	2.332		
	Lower-bound	55.221	13.000	4.248		

cal.  $F(2, 26) = 18.120$ ,  $P = 0.005$  and  $F$  crit. is  $F(2, 26) = 3.3690 \leq 0.05$

Table 4:2:8a: presents the results of the Repeated-measures ANOVA on the percent body fat of the participants used in this study. An observation of the results showed that brisk walking significantly reduced the per-cent body fat of the participants with calculated  $F(2, 26) = 18.120$ ,  $P = 0.005$  and  $F$  critical is  $F(2, 26) = 3.3690 \leq 0.05$ . To locate where the significant effect lies, post hoc test was conducted and the results is presented in table 4:2:8b

**Table 4:2:8b: LSD Multiple comparison (pair wise) on per-cent body fat of obese female adults used in this study**

Variable	(I) repetition	(J) repetition	Mean Difference(I – J)	Std. Error	Sig
%B/fat	Week 0	Week 6	1.750*	.571	.027
		Week 12	3.314*	.646	.001
	Week 6	Week 0	-1.750*	.571	.027
		Week 12	1.564*	.408	.006
	Week 12	Week 0	-3.314*	.646	.001
		Week 6	-1.564*	.408	.006

\*.The mean difference was significant at the .05 level Post hoc tests using the

Bonferroni correction confirmed this significant position for all the values as documented in

table 4:2:8b. There was significant decrease in the mean % B/fat value between week zero and 6th week as well as between the 6th and the 12th weeks of brisk walking.

Therefore, the null hypothesis which states that there was no significant effect of brisk walking on the per-cent body fat of obese female adults in Kaduna metropolis was rejected

### Sub hypothesis 6

There was no significant effect of brisk walking on lean muscle mass of obese female adult participants in Kaduna metropolis, Nigeria.

In order to find out whether the effect of brisk walking on lean muscle mass was statistically significant, the data collected at base-line, immediately after the 6th and 12th weeks was analyzed using repeated- measures ANOVA; the results of which is presented in table 4:2:9a.

**Table 4:2:9a Repeated-measures ANOVA on lean muscle mass of obese female adults at base-line, immediately after 6th and 12th weeks of brisk walking**

Source		Sum of Squares	df	Mean Square	F	Sig.
Training_Period	Sphericity Assumed	27.015	2	13.507	12.025	.000
	Greenhouse-Geisser	27.015	1.761	15.341	12.025	.000
	Huynh-Feldt	27.015	2.000	13.507	12.025	.000
	Lower-bound	27.015	1.000	27.015	12.025	.004
Error(Training_Period)	Sphericity Assumed	29.205	26	1.123		
	Greenhouse-Geisser	29.205	22.893	1.276		
	Huynh-Feldt	29.205	26.000	1.123		
	Lower-bound	29.205	13.000	2.247		

Cal.  $F(2, 26) = 12.025$ ,  $P = 0.005$  and  $F$  crit. is  $F(2, 26) = 3.3690 \leq 0.05$

Table 4:2:9a presents the results of the repeated - measures ANOVA on the lean muscle mass of the participants used in this study. An observation of the results showed that brisk walking had significant increase on lean muscle mass of the participants with calculated  $F(2, 26) =$



12.025 P = 0.005) and F critical is F (2, 26) = 3. 3690 ≤ 0.05). To locate where the significant effect lies, post - hoc test was conducted and the results are presented in Table 4:2:9b

**Table 4:2:9b: LSD Multiple comparison (pair wise) on lean muscle mass of obese female adults used in this study**

Variable	(I) repetition	(J) repetition	Mean Difference(I – J)	Std. Error	Sig
LMM	Week 0	Week 6	-.957*	.343	.046
		Week 12	-1.964*	.466	.003
	Week 6	Week 0	.957*	.343	.046
		Week 12	-1.007	.382	.062
	Week 12	Week 0	1.964*	.466	.003
		Week 6	1.007	.382	.062

\*.The mean difference was significant at the .05 level

Post hoc tests using the Bonferroni correction as documented in Table 4:2:9b below also showed that there was significant increase in the lean muscle mass between week zero and 6th week as well as between the week zero and the 12th weeks, but no significant increase was recorded between 6th week and the 12th weeks.

Therefore, the null hypothesis which states that there was no significant effect of brisk walking on the lean muscle mass variable of obese female adults was rejected

### 4.3 Discussion

Physical activity is a vital part of a comprehensive weight loss and weight management programme (Melam *et al.*, 2016). Exercise programme counteract the aberrant metabolic profile associated with obesity directly and through body fat loss (Irwin, Yasui, Ulrich, Bowen, Rudolph, Schwartz, Yukawa, Aiello, Potter & McTiernan, 2003).). Exercise increase the insulin sensitivity, stimulates fat metabolism and causes reduction in extra fatty weight (Irwin, *et al.*, 2003). Studies have indicated that brisk walking and other aerobic exercise are the best methods for controlling and reducing weight (Marandi *et al.*, 2013 and Melam *et al.*,

2016). This study was designed to examine the effect of brisk walking on anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

The findings of this study revealed significant decrease in the total body weight after 12 weeks of brisk walking. In line with this, a study conducted to investigate the effect of moderate intensity walking program on weight maintenance in premenopausal obese women resulted in accelerated weight loss and decrease the waist circumference (Fogelholm, Kukkonen-Harjula, Nenonen & Pasanen, 2000). Also, a study was conducted on regular exercise of walking in sedentary obese women, using body weight and body mass index (BMI), as a tool to investigate the effects on the body parameters. The study involved 30 obese sedentary women (age:  $36.93 \pm 11.10$  years; height:  $157.50 \pm 4.73$  cm, body weight:  $77.89 \pm 10.98$  kg), 8 weeks, 5 days per week, at exercise intensity of 75% HRmax. Results reported that the difference in body weight and BMI values along with other body composition indices were statistically significant ( $p < 0.05$ ) (Zileli & Özkamçı, 2016).

The findings of this study also revealed significant decrease in the body mass index of obese female adults after 12 weeks of brisk walking. This is in agreement with Hong *et al.* (2014) whose study recorded significant effect of walking at 50-60% of each individual's maximal oxygen uptake, 3 times per week for 12 weeks on visceral fat, BMI and waist circumference of middle aged Korean women. Azeem (2011) has also reported a significant reduction in BMI and waist and hip circumferences of obese males following a 12-week brisk walking programme at a frequency of 5 times per week, 45 min per session. This decrease may be attributed to the fact that brisk walking is an aerobic exercise that causes increase energy expenditure thereby creating energy balance for weight loss. The study finding was also in agreement with the findings of Shenbagavalli and Mary (2008), Marandi *et al.* (2013) and Zileli and Özkamçı (2016), who reported that moderate intensity walking reduces body mass index of obese women.

The result of this study equally showed that brisk walking had significant effect on waist circumference which was in line with the findings of Fogelholm *et al.* (2000) which showed that including a moderate-intensity walking programme in a weight maintenance program accelerated weight loss and decreased waist circumference. Melam *et al.* (2016) have also demonstrated that brisk walking for 45 min, 5 days per week for 10 weeks significantly reduced BMI, waist and hip circumferences of North Indian women. These findings corroborated with the work of other researchers; Brill *et al.* (2002) on Hispanic women, Hu *et al.* (2004) among middle aged Finnish women; NHS (2015) it was suggested that exercise is an effective tool in reducing waist circumference. The reduction of waist circumference is of particular clinical important since the increased risk of insulin resistance, diabetes, metabolic syndrome and mortality is associated with excess abdominal adiposity (Chen *et al.*, 2016).

Unlike body mass index and waist circumference, the current study did not demonstrate significant effect of brisk walking on waist-hip ratio. This is in agreement with a study conducted by Matthew, Fernandes, Sreedharan and Ahmed (2012), on the relationship between physical activity, BMI and WHR among middle aged women in a multi-ethnic population. The result showed no significant difference in BMI and WHR of the subjects who participated in moderate intensity physical activity. It was explain that increased weight reduces the overall metabolic energy expenditure in middle aged women, and the increased percent body fat (without weight gain) was responsible for lack of reduction in WHR of the participants in spite of the physical activity. The absence of significant decreases in waist-hip ratio in the current study could have also been attributed to insufficient stimuli compared to the different training loads reported in other studies that have indicated a significant reduction on waist-hip (Lee Mi-Ra & Wan-Soo 2006), Marandi *et al.* (2013).

Published data on the effect of exercise training intensity on body composition and regional body fat are mixed (Irving *et al.*, 2012, Willis *et al.*, 2012, Dobrosielski, *et al.*, 2013, Vissers

*et al.*, 2013 and Hong *et al.*, 2014). Exercise has been shown to reduce visceral adipose tissue (VAT) in obesity, independent of weight loss (Dobrosielski, *et al.*, 2013). A study was conducted to assess the effect of exercise training intensity on abdominal visceral fat and body composition reported significant reduction in abdominal visceral fat ( $p < 0.001$ ) with high intensity exercise training compared to low intensity exercise training and control groups (Irving *et al.*, 2012). Slentz *et al.* (2004), reported that low-amount/moderate-intensity and low-amount/vigorous-intensity endurance training (i.e., activity equivalent to ~12 miles·week<sup>-1</sup> of walking or jogging) were equally effective in reducing % body fat, fat mass, waist circumference, and abdominal circumference in previously sedentary, overweight, middle-aged adults. They also reported that high-amount/vigorous intensity endurance training (activity equivalent to ~20 miles·week<sup>-1</sup> of jogging) was more effective in reducing % body fat and fat mass compared to the two low-amount training groups (Slentz *et al.*, 2004). The result of this study showed no significant effect of brisk walking on the visceral fat of the experimental group. This contradicts the reports from Willis *et al.* (2012), Dobrosielski, *et al.* (2013), Vissers *et al.* (2013) and Hong *et al.* (2014), whose studies reported significant effect of aerobic exercise on visceral adipose tissue (VAT). According to Gunen (2007) and Vissers *et al.* (2013), a strong association exists between physical activity level and improved cardiovascular disease risk factors, independent of weight reduction. Reduction of visceral adipose tissue may play a pivotal role in the pathophysiological mechanisms of this association. Therefore, it was of great clinical interest to know if brisk walking was suited to reduce visceral adipose tissue because this could be an important clinical target, independent of weight loss, which was often difficult to achieve and maintain. It should be realized that high intensity exercise training was likely associated with slightly greater exercise energy expenditure and total energy expenditure than low intensity exercise training.

Brisk walking was also observed to significantly reduce the percent body fat of obese female participants used in this study. Chaudhary *et al.* (2010) 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 significant reduction of body fat percentage. In a research conducted to determine the effect of isolated walking training programme on percent body fat among obese female students from various departments of Annamalai University, Tamil Nadu, India; the results showed significant reduction in percent body fat, (Narayani *et al.*, 2010). A more recent study also demonstrated a similar trend of reduction in percent body fat following 12 weeks of aerobic exercise (30 - min walking on the treadmill at 60% of heart rate reserve) (Ho *et al.*, 2012). The results of this study further agreed with the reports of Marandi *et al.*, 2013, Chen *et al.*, 2016 and Melam *et al.*, 2016) where beneficial effects of brisk walking on percent body fat were documented.

The findings of this study demonstrated that brisk walking has a positive effect on lean muscle mass. This finding is consistent with previous studies where aerobic exercise led to increased lean muscle mass (Marandi *et al.*, 2013, Chen *et al.*, 2016 and Melam *et al.*, 2016). A study conducted to examine the effect of walking exercise at 50 – 75% of maximal heart rate, 3 days per week for two months among obese young women suffering from bulimia nervosa recorded a significant result not only on the BMI and percent body fat but also on the lean muscle mass (Habibzadeh & Dneshmandi, 2010).

While this study did not show any significant effect of brisk walking on the WHR and V/Fat of obese female adults, positive effects on BMI, WC, % body fat and LMM were observed.

Although there was significant effect of training on the variables it was observed that the participants were still obese. This implies that short term body weight normalization is too aggressive a target and slow steady gains over time are more appropriate and realistic. Programs should target long-term weight reduction. Even limited levels of weight loss may

have significant positive influences toward health improvement and risk factor management in the presence of hypokinetic diseases. Maintenance of exercise is a predictor of long-term weight management and of prevention of regain (Matthew & McQueen, 2009).

## CHAPTER FIVE

### 5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Summary

Physical activity is a vital part of a comprehensive weight loss and weight control programme. It can decrease abdominal fat, increase cardiorespiratory fitness and lead to weight loss in overweight and obese adults.

Obese persons may benefit by starting a simple walking program to shed pounds and increase overall fitness. Brisk walking at an individual level proved 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 obese individual. This study, therefore, was conducted to assess the effect of brisk walking on anthropometric and body composition indices of obese female adult in Kaduna metropolis, Nigeria.

The study involved purposive selection of 17 obese female adults between the ages of 40 and 50 years who had no contraindication to participate in the training.. There were three attritions leaving fourteen participants. The participants went through brisk walking for 45 – 65 minutes, three alternate days per week for 12 weeks and they were tested before the training commenced as well as at the end of the 6th and 12th weeks of the training period. The data thus collected were statistically analysed using descriptive and inferential statistics according to the stated hypotheses.

The major findings of the study are as follows:

- i. There was significant reduction of TBW (cal.  $F(2, 26) = 80.010$ ,  $P = 0.005$ , crit.  $F(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults in Kaduna metropolis.

- ii. There was significant reduction of BMI (cal.  $F(2, 26) = 57.576$ ,  $P = 0.005$ , crit.  $F(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults in Kaduna metropolis.
- iii. There was significant reduction of waist circumference (cal.  $F(2, 26) = 50.982$ ,  $P = 0.005$ , crit.  $F(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults of Kaduna metropolis.
- iv. There was no significant reduction of waist-hip-ratio (cal.  $F(2, 26) = .085$ ,  $P = 0.005$ ,  $F$  crit.  $(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults of Kaduna metropolis.
- v. There was no significant reduction of visceral fat (cal.  $F(2, 26) = .127$ ,  $P = 0.005$ , crit.  $F(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults of Kaduna metropolis.
- vi. There was significant reduction of percent body fat (cal.  $F(2, 26) = 18.120$ ,  $P = 0.005$  and  $F$  crit. is  $F(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults of Kaduna metropolis.
- vii. There was significant increase in the lean muscle mass (cal.  $F(2, 26) = 12.025$ ,  $P = 0.005$  and  $F$  crit. is  $F(2, 26) = 3.3690 \leq 0.05$  due to brisk walking among obese female adults of Kaduna metropolis.

## 5.2 Conclusions

On the basis of the findings of this study, the following conclusions were made:

1. Brisk walking was effective in producing significant reduction of total body weight of obese female adults.in Kaduna metropolis, Nigeria.
2. Brisk walking was effective in producing significant reduction of body mass index of obese female adults.in Kaduna metropolis, Nigeria.



3. Brisk walking was effective in producing significant reduction in the waist circumference of obese female adults.in Kaduna metropolis, Nigeria
4. Brisk walking was not effective in producing significant reduction in the waist-hip ratio of obese female adults.in Kaduna metropolis, Nigeria
5. Brisk walking was not effective in producing significant reduction of the visceral fat of obese female adults.in Kaduna metropolis, Nigeria
6. Brisk walking was effective in producing significant reduction of the percent body fat of obese female adults.in Kaduna metropolis, Nigeria
7. Brisk walking was effective in producing significant increase in the lean body mass of obese female adult.in Kaduna metropolis, Nigeria.

### **5 3 Contribution to knowledge**

Excessive body fat is associated with increased metabolic risk and its measurement is important in implementing curative and preventive health measures (Ranasinghe, Gamage, Katulanda, Andraweera, Thilakarathne and Tharanga, 2013). Lack of regular exercise training as been identified as among the major risk factors affecting normal body composition and anthropometric indices of an obese individual; (Adaramaja and Olarenwaju, 2008; Shehu *et al.*, 2010; WHO 2010; WHO Fact Sheet, 2016. It is clear that increase in body fat affects health, however, regular exercise can help reduce body fat as well as protect against chronic diseases associated with obesity (ACSM, 2016). Previous studies reported significant effect of aerobic exercise on the anthropometric and body composition indices but there was no account on the obesity level post intervention

Based on the conclusion of this study, this study contributed to knowledge that although there was significant effect of 12 weeks training on the variables of the obese female adult, it was observed that the participants were still obese. This implies that short term body weight normalization is too aggressive a target and slow steady gains over time are more appropriate

and realistic. Programs should target long-term weight reduction. Even limited levels of weight loss may have significant positive influences toward health improvement and risk factor management in the presence of hypokinetic diseases. Maintenance of exercise is a predictor of long-term weight management and of prevention of regain (Matthew & McQueen, 2009).

#### **5.4 Limitations of the study**

This study had the following limitations;

1. Dietary variation affects body composition and the physiological responses of obese individuals to exercise. It was not possible to control the dietary intake of the participants. However, all participants were given dietary counsel prior to the training.
2. Physical activity levels outside the formal walking exercise programme affects the physiological responses to training. It was not possible to control the physical activity level of the participants outside the training programme. However, all the participants were instructed not to engage in any extra physical activity outside the routine work out of this research.

#### **5.5 Recommendations**

On the basis of the findings of this study, the following recommendations were made:

1. Brisk walking should be prescribed for the modification of anthropometric and body composition indices.
2. Brisk walking as a mode of aerobic exercise should be engaged by obese female adult for fitness and improvement of their general health.

3. Obese female adults should be enlightened through public lectures by an exercise and sport science specialist on the need to engage in brisk walking as a weight management programme.

## **5.6 Suggestions for further Studies**

1. This study was conducted on obese women between the ages of 40 and 50 years, another study may be conducted on obese post-menopausal women or adolescents.
2. This study was restricted to only brisk walking aerobic exercise; study may be conducted to assess the effect of resistance exercise and brisk walking programme among obese adult women.
3. This study was carried out on with restriction to moderate intensity of brisk walking; a comparative study may be conducted to compare the effect of high intensity and moderate intensity levels of brisk walking.
4. Other study may be conducted to assess the effect of brisk walking with dietary modifications.

## REFERENCES

- Adaramaja S. R. & Olarenwaju I. T. (2008). Sedentary lifestyle of rural and urban people of Kaduna State: The need for exercise. *Journal of Nigerian Association of Sports Science and Medicine* (X) 1.pp77
- Adebayo R.A., Balogun M.O., Adedoyin R.A., Obas horo-John O.A., Bisiriyu L.A., Abiodun O.O. (2014). Prevalence and pattern of overweight and obesity in three rural communities in Southwest Nigeria. Diabetes. Metabolic Syndrome. *Obesity. Targets Therapy*. 7: 153-15.
- Adenoyi M. M. (2014). Effect of Step Aerobics on Overweight/Obese Female Teachers in Okene Local Government Area of Kogi State, Nigeria. *Unpublished Master's Thesis*, Ahmadu Bello University, Zaria, Nigeria
- Ahima R.S. (2006). Adipose tissue as an endocrine organ. *Obesity (Silver Spring)* 14 Supply 5: 242S–249S.
- Ahima R. S. (2010). Metabolic Basis of Obesity. Pp 12- Google Book Result. Accessed from <https://books.google.com.ng/books?isbn=1441916075>. Retrieved on December 12, 2016,
- Al-Saif A. & Alsenany S. (2015). Aerobic and anaerobic exercise training in obese adults. *Journal of Physical Therapy Science*; 27(6): 1697–1700.
- Akarolo-Anthony S. N., Willett W. C., Spiegelman D. & Adebamowo C.A. (2014). Obesity epidemic has emerged among Nigerians. *Biological Medicine. Central Public Health*. (14): 455 doi: 10.1186/1471-2458-14-455.
- American College of Sports Medicine (2013). ACSM Manual: Body Composition. *American College of Sports Medicine Guidelines*: (4); 62-72.
- American College of Sports Medicine (2015). Physical Activity 360. Accessed from <http://www.physicalactivity360.org/> Retrieved January 12, 2016
- American College of Sports Medicine (2016). Obesity and Exercise. [www.acsm.org](http://www.acsm.org)>Home>Public Information
- American College of Sports Medicine (2018). Exercise New guidelines. Flashcards/ Quiziet. <http://quiziet.com.>acsm-exercise-newguidelines>
- American Heart Association (2016a). Recommendations for Physical Activity in Adults. Accessed from [www.heart.org/FitnessBasics/American-Heart-Association](http://www.heart.org/FitnessBasics/American-Heart-Association). Retrieved January 13, 2017.
- American Heart Association, (2016b). Moderate to Vigorous - What is your level of intensity? Accessed from [www.heart.org](http://www.heart.org)>FitnessBasics>Moderate. Retrieved January 13, 2017,
- Arslan F. (2011). The effects of an eight-week step-aerobic dance exercise programme on body composition parameters in middle-aged sedentary obese women. *International Sport Medicine Journal*; 12: 160–8.

- Azeem K., (2011). Effect of Twelve Weeks Brisk Walking on Blood Pressure, Body Mass Index and Anthropometric Circumference of Obese Males. *International Journal of Medical Health, Biomedical, Bioengineering and Pharmaceutical Engineering* 5: (11)
- Banwat M.E., Chingle M.P., Lar L.A., Damib N., Zoakah A.I. (2012). Pattern of obesity among chief executives of public and private organizations in Jos, Plateau state, Nigeria. *Nigerian Journal of Basic Clinical Science* 9: 18-22.
- Bigaard J., Tjonneland A., Thomsen B.L., Overvad K., Heitmann B.L. & Sorensen T.I. (2003). Waist circumference, BMI, smoking, and mortality in middle-aged men and women. *Obesity Research Journal*; 11(7): 895-903
- Block P., & Kravitz L., (n.d.). The “Talk Test” Study Reviewed: In Persinger, R., Foster, C., Gibson, M., Fater, D.C.W., & Porcari, J.P. (2004). Consistency of the talk test for exercise prescription. *Medicine & Science, Sports & Exercise*. 36 (9), 1632-1636.
- Borg G. (1998). Borg’s Perceived Exertion and Pain Scales. *Human Kinetics Publication, Champaign, IL, United State*. Pp51
- Brill J. B., Perry A. C., Parker L., Robinson A. & Burnett K. (2002). Dose-response effect of walking exercise on weight loss. How much is enough? *International Journal of Obesity*. 26 (11); 1484-1493.
- Centre for Disease Control (2015). About BMI in Adult. Accessed from <http://www.cdc.gov/chronicdisease>. Retrieved January 12, 2016.
- Centre for Disease Control (2015b). Measuring Physical Activity Intensity: Physical Activity/Basics., Accessed from [www.cdc.gov/measuring/](http://www.cdc.gov/measuring/). Retrieved 10th November, 2017.
- Centre for Disease Control (2015c). Physical Activity for Everyone: Measuring Intensity: Perceived Exertion. Accessed from [www.cdc.gov/exertion.htm](http://www.cdc.gov/exertion.htm). Retrieved 12, December, 2017
- Centre for Disease Control (2015d). Measuring Physical Activity Intensity: Physical Activity/Basics. Accessed from [www.cdc.gov/measuring/](http://www.cdc.gov/measuring/). Retrieved 12, December, 2017.
- Centre for Disease Control and Prevention (2015e). Adult Obesity: Causes and Prevention. Accessed from [www.cdc.gov/obesity/adult/causes.html](http://www.cdc.gov/obesity/adult/causes.html). Retrieved 12, December, 2017.
- Centre for Disease Control (2016). General Physical Activities Defined by Level of Intensity. Accessed from [https://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA\\_Intensity\\_table\\_2\\_1.pdf](https://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_Intensity_table_2_1.pdf) Retrieved January 15, 2017,
- Chan H. T. H., (2018). The Borg Scale of Perceived Exertion/ The Nutrition Source. Accessed from <https://www.hsph.harvard.edu/borg-scale72> (3): 175-191. doi:10.1016/j.maturitas.2012.04.004. Retrieved 19<sup>th</sup> of August, 2018
- Chang S. H., Beason T. S., Hunleth J. M. & Colditz G. A. (2012). A systematic review of body fat distribution and mortality in older people. *Maturitas*

- Chaudhary S., Kang M. K. & Sandhu J. S. (2010). The effects of aerobic versus resistance training on cardiovascular fitness in obese sedentary females. *Asian Journal of Sports Medicine*. 1(4): 177–184.
- Chen C. K., Ismail N. S. & Al – Safi A. A. (2016). Effect of brisk walking and resistance training on cardio-respiratory fitness, body composition and lipid profile among overweight and obese individuals. *Journal of Physical Education and Sport* 16 (3): 957 – 963. Doi.10.7752/jpes 2016.03151.
- Chukwuonye I. I., Chuku A., John C. Kenneth Arinze Ohagwu, K. A., Imoh M. A., Isa S. E., Ogah O.K, & Oviasu E. (2013) Prevalence of overweight and obesity in adult Nigerians- a systematic review. *Dove Press. Diabetes, Metabolic Syndrome, Obesity: Targets and Therapy* (6): 43–47. doi: 10.2147/DMSO.S38626
- Ciocan,L.(2016).BodyFatDistributionFactors.Accessedfromwww.Howtoadvice.Com/Bodyfatdistribution. Retrieved April 2, 2016.
- DahiruT. & Ejembi C. L. (2013). Clustering of cardiovascular disease risk-factors in semi-urban population in Northern Nigeria. *Nigerian Journal of Clinical Practice*.16: (4) Pp 511-516. doi: 10.4103/1119-3077.11690
- Dehghan M. & Merchant A. T. (2008). Is bioelectrical impedance accurate for use in large epidemiological studies? *Nutrition Journal* (7) 26. doi:10.1186/1475-2891-7-26
- De Koning L., Merchant A.T., Pogue J., & Anand S.S. (2007). Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. *European Heart Journal*; 28: 850-6.
- De Souza e Silva M.J., de Souza Rabelo A., Vale R.G., Ferrão M.L., Gonçalves L.C., de Sá Rego Fortes M. & Dantas E. (2009). Effects of two kinds of aerobic training on body fat content and serum lipid profile in cadets. *Biomedical Human Kinetics*; (1): 72–5.
- Despres J.P. (2006). LemieuxI Abdominal obesity and metabolic syndrome. *Nature*; 444:8817.
- Despres J.P. (2007). Cardiovascular disease under the influence of excess visceral fat. *Critical Pathway of Cardiology*.6 (2):51-9
- Ding D., Roger K., Van der Ploeg H., Stamatakis E. & Bauman A. (2015). Traditional Risk Behaviors and All-Cause Mortality in Middle- Aged and Older Adults: Evidence from a Large Population- Based Australian Cohort. *PLOS Med*. 12 (12):doi10.1371/ *Journal of Public Medicine* 12 (12):1001917
- Dobrosielski D.A., Gibbs B.B., Chaudhari S., Ouyang P., Silber H.A. and Stewart K. (2013). Effect of exercise on abdominal fat loss in men and women with and without type 2 diabetes. *British Medical Journal*. (3)11. doi:10.1136/bmjopen-003897
- Donnelly J. E., Blair S. N., Jakicic J. M., Manore M. M., Rankin J. W. & Smith B. K.(2009). American College of Sports Medicine. American College of Sports Medicine position stand: appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medical Science & Sports Exercise*; 41(2): 459–471.

- Ehrman J, Gordon P., Visich P., and Keteyian S. (2013). Exercise prescription for obese patients. An excerpt from *Clinical Exercise Physiology*, (3<sup>rd</sup> Ed). *Human Kinetics*. <http://www.humankinetics.com/excerpts/exercise-prescription-for-obese-patients>.
- Fadupin G.T., Adeoye A., Ariyo O. (2014). Lifestyle and nutritional status of urban school teachers in Ibadan, Nigeria. *Nigerian Journal Nutritional Science*. 35(1): 86-94.
- Farlex Partner Medical Dictionary, (2012). Obesity. Accessed from <http://medical-dictionary.thefreedictionary.com/obesity>. Retrieved January 9, 2017.
- Falsarella G. R., Gasparotto L. P.R, Barcelos C.C., Coimbra I. B., Moretto M. C., Pascoa M. A., Ferreira T.C.B.R.. & Coimbra A. M.V. (2015). Body composition as a frailty marker for the elderly community. *Clinical Intervention for Aging*; 10:1661-1667. Doi: 10.2147CIA.S84632
- Farzad S., Fatemeh A., Salehi M., & Nojomi M. (2012). Association of waist circumference, body mass index \ and conicity index with cardiovascular risk factors in postmenopausal women. *Cardiovascular Journal of Africa*; 23(8): 4.
- Free-Dieting (2015). The Different Types of Body Fat. Accessed from [www.freedieting.com/body\\_fat\\_gain.htm](http://www.freedieting.com/body_fat_gain.htm). Retrieved 11<sup>th</sup> of July 2017.
- Foster-Schubert K.E., Alfano C.M., Duggan C.R., Xiao L., Campbell K.L., Kong A., Bain C.E., Wang C.Y., Blackburn G.L., & McTiernan A. (2012). Effect of diet and exercise, alone combined, on weight and body composition in overweight-to-obese post menopausal women. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 7<sup>th</sup>ed. *Obesity (Silver Spring)*. 20(8):1628-38. doi: 10.1038/oby.2011.76.
- Fogelholm M., Kukkonen-Harjula K., Nenonem A. & Pasanen M. (2000). Effect of walking training on weight maintenance after a very low – energy diet in premenopausal obese women. *Archive of Internal Medicine* 160: 2177-2184.
- Gaba A. (2016). The effect of brisk walking on postural stability, bone mineral density, body weight and composition in women over 50 years with a sedentary occupation: a randomised controlled trial. *BioMedical Central for Womens Health*. (16): 63. Doi: 10.1186/s12905-016-0343-1.
- Gallagher D., Heymsfield S.B., Heo M., Jebb S.A., Murgatroyd P. R., Sakamoto Y. M. (2000). Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. *American Journal of Clinical Nutrition*; 72(3): 694-701
- Giovanni De P. & Franco S. (2013). Obesity as a Major Risk Factor for Cancer. *Journal of Obesity*. Doi: 10, 1155/2013/291546
- Gunen E. A. (2007). Effect of Aerobic Dance on Selected Cardiovascular Disease Risk Factors of Overweight/Obese Nigerian Adult. *Unpublished Ph.D. Dissertations*, Ahmadu Bello University, Zaria Nigeria.
- Habibzadeh N. & Daneshmandi H., 2010. The Effects of Exercise in Obese Women with Bulimia Nervosa. *Assian Journal of Sports Medicine* 1(4): 209-213. DOI: 10, 5812/asjasm.34829

- Haffner, S. M. (2007). Abdominal adiposity and cardio-metabolic risk: do we have all the answers? *American Journal of Medicine*;120 (suppl): S10–6.
- Hansen E., Hajri T., Abumrad N.N. (2011). Is all fat the same? The role of fat in the pathogenesis of the metabolic syndrome and type 2 diabetes mellitus. *Journal of Surgery*; 139(6):711-716. Doi:10.1016/J.SURG.2005.10.018
- Heyward V. H. (2010). Advance Fitness Assessment & Exercise Prescription. (6<sup>th</sup> Ed.). *Human Kinetics* Pp. 84-92 .
- Hills A.P. & Byrne M. P. (2004). Physical activity in the management of obesity. *Science Direct* 22(4); 315- 318 doi.1...*Obesity*.
- Hoeger W. W. K & Hoeger S. A. (2015). Principles and Labs for Physical Fitness. <https://books.google.com.ng/books>
- Hong H., Jeong J., Kong J., Lee S., Yang S., HaC., & Kang H. (2014). Effect of walking exercise on abdominal fat, insulin resistance and serum cytokines in obese women. *Journal of Exercise Nutrition Biochemistry*, 18(3):277-285. Doi:10.5777/jenb.2014.18:3:277-285
- Hu G., Tuomilehto J., Silventoinen K., Barengo N. C., Peltonen M. & Jousilahti P. (2005). The effects of physical activity and body mass index on cardiovascular, cancer and all-cause mortality among 47212 middle aged Finnish men and women. *International Journal of Obesity* 29, 894-902. Doi:10.1038/sj.ijo.0802870;
- Hunter G. R., Brock D. W., Byrne N. M., Chandler-Laney P. C., Corraat P. D., & Gower B. A. (2010). Exercise Training Prevents Regain of Visceral Fat for 1 Year Following weight loss. *Obesity*. (Silver Spring)18(4)690-5
- Iloh G., Amadi A.N., Nwankwo B.O., Ugwu V.C. (2011). Obesity in adult Nigerians: a study of its pattern and common primary co-morbidities in a rural Mission General Hospital in Imo State, South-Eastern Nigeria. *Nigerian Journal of Clinical Practice*.14(2): 212-18
- Irving B. A., Davis C. K., Brock D.W., Weltman J. Y., Swift D., Barrett E. J., Gaesser G. A., & Arthur Weltman A., (2008) Effect of exercise training intensity on abdominal visceral fat and body composition. *Medical Science and Sports Exercise*; 40(11): 1863–1872. doi: 10.1249/MSS.0b013e3181801d40
- Irwin M. L., Yasui Y., Ulrich C. M., Bowen Rudolph R. E., Schwartz R. S., Yukawa M., Aiello E., Potter J. D. & McTiernan A.(2003). Effect of Exercise on Total and Intraabdominal Body Fat in Postmenopausal Women. A Randomised Control Trial. *Journal of American Medical Association*; 289(3):323-330
- Jakicic J.M., Clark K., Coleman E., Donnelly J.E., Foreyt J., Melanson E., Volek J.,& Volpe S.L.(2001). American College of Sports Medicine position stand: appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Medical Science Sports Exercise*; 33(12): 2145– 2156.



- Janssen I., Katzmarzyk P.T., Ross R. (2002). Body mass index, waist circumference and health risk. Evidence in support of current National Institute of Health Guidelines. *Archives of Internal Medicine*; 162: 2074-2079
- Jeukendrup A. & Gleeson M. (2010). Normal ranges of body weight and body fat. An excerpt from Sport Nutrition, 2<sup>nd</sup> Ed. *Human Kinetics*.
- Kaur S. & Walia I. (2007). Body mass index, waist circumference and waist hip ratio among nursing students. *Nursing and Midwifery Research Journal*, 3 (2).
- Kaur K., Kaur J. & Puri N. (2016). Study of Relationship of anthropometric measurements with blood pressure among endogamous groups of Punjab & Haryana. *Journal of Applied Medical Sciences*; 4(2C):540-545
- Kavak V., Pilmanc M., & Kazoka D, (2014). Body mass index, waist circumference and waist-to-hip ratio in the prediction of obesity in Turkish teenagers. *Collegium Antropologicum* 38 (2):445-51
- Kent, M. (2005). Oxford Dictionary of Sports Sciences and Medicine (3<sup>rd</sup> ed.). London Oxford University press.
- Klein S., Allison D. B., Heymsfield S. B., Kelley D. E., Leibel R.L., Nonas C., & Kahn R. (2007). Waist Circumference and Cardiometabolic Risk: A Consensus Statement from Shaping America's Health: Association for Weight Management and Obesity Prevention; NAASO, The Obesity Society; the American Society for Nutrition; and the American Diabetes Association. doi:10.2337/dc07-9921 *Diabetes Care*. 30(6); 1647- 1652
- Kulie T, Slattengren A, Redmer J, Counts H, Eglash A ,& Schrage S. (2011) Obesity and Women's Health: An Evidence-Based Review. *Journal of American Board Family Medicine*. 24 (1); 75-85. Doi:10.3122/jabfm.2011.01.100076
- Laskowski E. R. (2012). The Role of Exercise in the Treatment of Obesity. *Science Direct* 4 (11):840 - 844. doi10.1 Exercise and Sports for Health Promotion.
- Lee Mi-Ra R.N., Wan-Soo K. (2006). The Effect of Brisk Walking versus Brisk Walking Plus Diet on Triglycerides and Apolipoprotein B Levels in Middle – aged overweight / Obese Women with High Triglyceride Levels. *Journal of Korean Academy of Nursing* 36(8); 1352-1358
- Le'Doux L., (2011). Change Your Lifestyle – Change Your Life!  
<https://books.google.com.ng/books>. Retrieved 16<sup>th</sup> September, 2017
- Liu Y., Tong G., Tong W., Lu L. & Qin X. (2011). Can body mass index, waist circumference, waist-hip ratio and waist height ratio predict the presence of multiple metabolic risk factors in Chinese subjects? *Journal of Public Health*. 11: 35. Doi: 10.1188/1471-2458-11-35
- Makama F. (2010). Etiology and Pathophysiology of Diabetes Mellitus.  
[http://EzineArticles.com/expert/Funom\\_Makama/604511](http://EzineArticles.com/expert/Funom_Makama/604511). Retrieved March 11, 2016.

- Marandi S. M., Abadi N.G. B., Esfarjani F., Mojtahedi H. & Ghasemi G. (2013). Effects of Intensity of Aerobics on Body Composition and Blood Lipid Profile in Obese/Overweight Females. *International Journal of Preventive Medicine* 4(1): S118–S125.
- Matthew A. & McQueen, M. D. (2009). Exercise Aspects of Obesity Treatment. *Ochsner` Journal*. Fall; 9(3): 140–143. Retrieved from [www.ncbi.nlm.nih.gov/NCBI/Literature](http://www.ncbi.nlm.nih.gov/NCBI/Literature)
- Mathew A., Fernandes S., Sreedharan J. & Ahmed M. (2012). Relationship between Physical activity, BMI and WHR among middle aged women in a multiethnic population: A descriptive study. *Gulf Medical Journal*, ASM: 1(SI): S169-S173
- Medical Brief, (2015). Exercise for post-menopausal women. African's Medical Media Digest. Accessed from <http://www.medicalbrief.co.za/archives/exercise-for-postmenopausal-women/> Retrieved March 16, 2016,
- Melam G. R., Alhusaimi A. A., Buragadda S., Kaur T. & Khan I. A. (2016). Impact of brisk walking and aerobics in overweight women. *Journal of Physical Therapy Science* 28(1): 293 – 297. Doi. 10.1589/jpts.28.293.
- Narayani U., & Sudhan Paul Raj R.I. (2010). Effect of Aerobic Training on Percentage of Body Fat, Total Cholesterol and HDL-C among Obese Women. *World Journal of Sports Sciences* 3(1): 33-36.
- National Institute of Health, (2012). What causes overweight and Obesity? Accessed from <http://www.nhlbi.nih.gov/health/health-topics/topics/obe/cause> Retrieved March 14, 2017.
- National Heart Lung and Blood Institute, (2016). Assessing Your Weight and Health. From [https://www.nhlbi.nih.gov/health/educational/lose\\_wt/index.htm](https://www.nhlbi.nih.gov/health/educational/lose_wt/index.htm). Retrieved January 12, 2017,
- National Health Services (2015). Is a brisk walk better for losing weight than going to the gym? Accessed from [www.nhs.uk/news/2015/11\\_November/pages/Is-a-brisk-walk-better-for-losing-weight-than-going-to-the-gym.aspx](http://www.nhs.uk/news/2015/11_November/pages/Is-a-brisk-walk-better-for-losing-weight-than-going-to-the-gym.aspx). Retrieved March 5, 2016,
- National Population Commission of Nigeria web, National Bureau of Statistics (web) (2007). Accessed from <https://www.citypopulation.ng>. Retrieved August 16, 2018
- National Obesity Forum, (2016). Waist Circumference. Accessed from. [www.nationalobesityforum.org.uk/.../171-waist-circumference.html](http://www.nationalobesityforum.org.uk/.../171-waist-circumference.html) Retrieved April 3<sup>rd</sup>, 2016
- Ness-Abramof, R. & Apovian, C. M. (2008). Waist circumference measurement in clinical practice. *Nutrition in Clinical Practice*; 23 (4): 397-404.

- Nicklas B. J., Wang X., You T., Lyles M. F., Demons J., Easter L., Berry M. J., Lenchik L., Carr J. J. (2009). Effect of exercise intensity on abdominal fat loss during calorie restriction in overweight and obese postmenopausal women: a randomized, controlled trial. *American Journal of Clinical Nutrition*. 89 (4); 1043-1052
- Oda E (2008). The metabolic syndrome as a concept of adipose tissue disease. *Hypertension Research* 31: 1283–1291.doi:10.1091/hyper.31.1283
- Oladimeji A. M., Fawole O., Nguku P. & Nsubuga P. (2012) Prevalence and factors Associated with hypertension and obesity among civil servants in Kaduna, Kaduna State. *Pan African Medical Journal* 18(1): 13
- Omron Healthcare, Inc. (2008). *www.omronhealthcare.com*
- Persinger R, Foster C., Gibson M, Fater D.C., & Porcari J. P. (2004). Consistency of the talk test for exercise prescription. *Medical Science Sports Exercise*. 36 (9): 1632-6.
- Pischon T., Boeing H., Hoffmann K., Bergmann M., Schulze M.B. & Overvad P. H.K., et al. (2008) General and abdominal adiposity and risk of death in Europe. *New England Journal of Medicine* 359: 2105–2120
- Popkin B.M., Adair L.S., Ng S. W. (2012). Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews*, (70): 3–21.
- Qiao Q, & Nyamdorj R. (2010). Is the association of type II diabetes with waist circumference or waist-to-hip ratio stronger than that with body mass index? *European Journal of Clinical Nutrition* 64(1): 30-4.
- Ranasinghe C., Gamage P., Katulanda P., Andraweera N., Thilakarathne S. & Tharanga P. (2013). Relationship between Body mass index (BMI) and body fat percentage, estimated by bioelectrical impedance, in group of Sri Lankan adults: a cross sectional study. *Bio- Medical Central Public Health* 13-797. doi:10.1186/1471-2458-13-797.
- Rogers R. (2015). Aerobic Exercises for Obese People. Accessed from <http://www.livestrong.com/article/100431-aerobic-exercises-for-obese-people/> Retrieved February 15, 2016
- Rother, K. J. (2007). Diabetes Treatment – Bridging the divide *The New England Journal of Medicine Review* 356 (15) 1499-500.
- Sagiv M. S., (2012). Exercise Cardiopulmonary Function in Cardiac Patients. <https://books.google.com.ng/books>
- Sanya A. O., Ogwumike O. O., Ige A. P. & Ayanniyi O. A., (2009). Relationship of Waist-Hip-Ratio and Body Mass Index to Blood Pressure of Individual in Ibadan North Local Government. *African Journal of Physiotherapy and Rehabilitation Sciences* 1(1)7-11

- Science Daily (2017). Accessed from [www.sciencedaily.com/terms/adipose\\_](http://www.sciencedaily.com/terms/adipose_). Retrieved 11<sup>th</sup> July, 2017
- Shehu R.A., Abdullahi A. A. & Adekeye D. S. (2010). Sedentary lifestyle and wellness in Kaduna State, Nigeria. *EthnobiolEthnoed*, 4(1): 15-19.
- Shenbagavalli A. & Mary R. D. (2008). Effect of Aerobic Training on Body Mass Index on Sedentary Obese Men. *Journal of Exercise Science and Physiotherapy*, 4 (2): 125-128
- Slentz C.A., Duscha B.D., Johnson J.L., Ketchum K., Aiken LB., Samsa G.P., Houmard J.A., Bales C.W., & Kraus W.E., (2004). Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRIDE--a randomized controlled study. *Archive of Internal Medicine.*; 164(1):31–9. [PubMed]
- Srikanthan P., Seeman T.E., & Karlamangla A.S. (2009). Waist-hip-ratio as a predictor of all cause mortality in high-functioning older adults. *Annals of Epidemiology*, 19,724-731.[information/articles/.../obesity-and-exercise](http://information/articles/.../obesity-and-exercise).
- Taylor R. W., Jones I. E., Williams S. M. & Goulding A. (2000). Evaluation of waist circumference, waist to hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19years. *American Society for Clinical Nutrition*72 (2): 490-5
- Vazquez G., Duval S., Jacobs D.R. Jr., & Silventoinen K. (2007). Comparison of body mass Index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis. *Epidemiological Review*; 29:115-28.
- Vissers D., Hens W., Taeymans J., Baeyens J.P., Poortmans J. & Gaal L.V. (2013). The Effect of Exercise on Visceral Adipose Tissue in Overweight Adults: A Systematic Review Meta-Analysis. *Journal of Public Medicine -NCBI* 8(2). doi: 10.1371/journal.pone.0056415.
- Wahab K.W., Sani M.U., Yusuf B.O., Gbadamosi M., Gbadamosi A., & Yandutse M. (2011). Prevalence and determinants of obesity - a cross-sectional study of an adult Northern Nigerian population. *International Archive of Medicine* .4: 10
- Waist Size Matters (2016). Obesity Prevention Source: Harvard T.H. Chan School of Public Health. Retrieved January 12, 2016, from <http://www.hsph.harvard.edu/obesity-prevention-source/obesity-definition/abdominal-obesity/>.
- Wang J., Thornton J. C., Bari S., Williamson, B., Gallagher D., Heymsfield S. B., & Pierson R. N. (2003). Comparisons of waist circumferences measured at 4 sites. *American Society for Clinical Nutrition* 77(2); 379-384.
- Warren M., Schreiner P.J., & Terry J. G. (2005).The relationship between visceral fat

- measurement and Torso level: Is one level better than the other? *American Journal of Epidemiology* 163 (4). Doi:10.1093/aje/kwjo49
- Weil Richard, (2015). Aerobic Exercise: Health and Disease Prevention. Accessed from [http://www.medicinenet.com/aerobic\\_exercise/article.htm](http://www.medicinenet.com/aerobic_exercise/article.htm). Retrieved February 15, 2016,
- Welborn, T.A. & Dhaliwal, S.S. (2007). Preferred clinical measures of central obesity for predicting mortality. *European Journal of Clinical Nutrition*, 61; 1373-1379.
- Williams D., McArdle, F. I., Katch V. L. (2010) <https://books.google.com.ng>
- Willis L. H., Slentz C.A., Bateman L.A., Shields A.T., Piner L.W., Bales C. W., Houmard J.A., & Kraus W.E. (2012). Effect of Aerobic and or resistance training on body mass and fat in overweight or obese adults. *Journal of Applied Physiology* 113(12)1831-1837.
- World Bank Gender Statistics (2015). Nigeria –Adult obesity prevalence, female -1960-2014 <https://Knoema.com>>....Health. World Data Atlas>Nigeria.
- World Health Organization (1999). Definition, Diagnosis, and Classification of Diabetes Mellitus and its Complications. *Report of a WHO Consultation. Department of Non communicable Disease Surveillance, Geneva.*
- World Health Organization (2008). Waist Circumference and Waist–Hip Ratio: *Report of a WHO Expert Consultation Geneva, 8–11 December 2008.* Geneva, Switzerland: WHO Press; 2011. Retrieved Feb 22, 2016.
- World Health Organization (2010a). Global Strategy on Diet, Physical Activity and Health: What is Moderate-intensity and Vigorous-intensity Physical Activity? <http://www.who.int/dietphysicalactivity/en/> Retrieved Feb 22, 2016.
- World Health Organization (2010b). Global Status Report on Non communicable Diseases: *Burden; Mortality, Morbidity and Risk factors.* (1); Pp 1- 31
- World Health Organization (2016a). Global Strategy on Diet, Physical Activity and Health Accessed from <http://www.who.int/dietphysicalactivity/en/>. Retrieved on Jan 12, 2016
- World Health Organization (2016b). Obesity and Overweight. Accessed from <http://www.who.int/mediacentre/factsheets/fs311/en>. Retrieved on Jan 12, 2016
- World Health Organization (2017). Physical Activity. Accessed from [http://www.who.int/topics/physical\\_activity/en/](http://www.who.int/topics/physical_activity/en/) Retrieved on Jan 12, 2017
- Zhang X, Shu X.O., Yang G, Li H., Cai H., Gao Y. T., & Zheng W. (2007). Abdominal adiposity and mortality in Chinese women. *Archive of International Medicine*; 167: 886-92.
- Zhang C., Rexrode K.M., van Dam R.M., Li T.Y. & Hu F. B. (2008). Abdominal obesity and

the risk of all-cause, cardiovascular, and cancer mortality: sixteen years of follow-up in US women. *Circulation*; 117: 1658-67.

Zileli R. & Özkamçı H. (2016). Walking Exercises In Obese Women. Effects on Some Body Parameters. Accessed from <http://www.academia.edu/19087119> Retrieved October 19, 2016.

## APPENDICES

### Appendix A



**DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION**  
**AHMADU BELLO UNIVERSITY, ZARIA - NIGERIA**  
**(OFFICE OF THE HEAD OF DEPARTMENT)**

VICE CHANCELLOR: **Professor Ibrahim Garba**, B.Sc., M.Sc., (ABU); Ph.D. (London); D.I.C.  
HEAD OF DEPARTMENT: **Professor M. A. Suleiman**, N.C.E. (OYSCE); B.Sc. (UNICAL); M.Sc, Ph.D, (ABU)

P14EDPE9011

Date: 4th August, 2017

The Chief Medical Director,  
Barzu Dikko Teaching Hospital,  
Kaduna,  
Kaduna State

Dear Sir/Madam,

**INTRODUCTORY LETTER FOR DATA COLLECTION: SAIWO, Omolara**  
**Ekugbe (P14EDPE9011)**

The bearer is a postgraduate student of the above named Department and University. She is conducting a research on the “**Assessment of the Effect of Brisk Walking on Anthropometric and Body Composition Indices of Obese Female Adults in Kaduna Metropolis, Nigeria**” in which your Organization/Centre will be used.

In this regards, I wish to request for your kind permission and co-operation to allow her access to the required facilities to collect the data for her research.

Your assistance is highly solicited please.

Thanking you,

Yours faithfully,

Prof. E. A. Gunen  
(Chairman, Supervisory Committee)

## Appendix B



### BARAU DIKKO TEACHING HOSPITAL KADUNA STATE UNIVERSITY

Lafiya Road, P.O. Box 9727, Kaduna, Kaduna State, Nigeria.

Chief Medical Director (CMD)  
**PROF. ABDULKADIR MUSA TABARI**  
MBBS, FMCR, FICS

Chairman, Medical Advisory Committee (CMAC)

**DR. SILAS TOKAN BADUKU**

MBBS, FWACS, FMCR, FICS

Director of Administration

10<sup>th</sup> October, 2017

Omolara Ekugbe Saiwo,  
Dept. of physical & Health Edu,  
ABU Zaria.

Your Ref: P14EPE9011

Phone: 08028333853

Fax: -

E-mail: -

larasaiwo@gmail.com

Dear Saiwo,

HREC Reference Number: 17- 0020

Project title: "Assessment of the effect of Brisk walking on selected Anthropometric and body composition indices of adult female obese in Kaduna Metropolis, Nigeria".

Protocol number: 17-0020-1

Thank you for submitting the above research project for single ethical review. This project was considered by the Barau Dikko Teaching Hospital, Health Research Ethics Committee [BDTH HREC] at its meeting held on the 30<sup>th</sup> August, 2017.

I am pleased to advise you that the BDTH-HREC has granted ethical approval of this research project. The nominated participating site/s in this project is/are:

Barau Dikko Teaching Hospital Facilities

[Note: If additional sites are engaged prior to the commencement of, or during the research project, the Coordinating Principal Investigator is required to notify BDTH-HREC. Notification of withdrawn sites should also be provided to the BDTH-HREC in a timely fashion.

The approved documents include:

Document	Version	Date
"Assessment of the effects of Brisk walking on selected Anthropometric and body composition indices of adult female obese in kaduna Metropolis, Nigeria".	1	25 <sup>th</sup> August, 2017

Approval of this project from BDTH-HREC is valid from 30<sup>th</sup> August,2017 to 30<sup>th</sup> December, 2017 subject to the following conditions being met:

#### BDTH BOARD OF MANAGEMENT:

Air Cadre E.K. Jekoda (Rtd) (Board Chairman) Prof A. Musa Tabari (Member) Pharm. Aisha J. Musa (Member) Prof. B.A Chindo (Member) Dr. Fatima A. Kera (Member) Alh. Muhammad S. Dalhatu (Member)  
Prof. A. A. Achafa (Member) Alh. Muhammad I. Sulaiman (Member) Dr. Yusuf Nadeha (Member) Alh. Muhi'd Mahumud Shunibi (Member) Dr. T. Silas Raduku (Member) Prof. M. Nasir Sambo (Member)



- The Coordinating Principal Investigator will immediately report anything that might warrant review of ethical approval of the project.
- The Coordinating Principal Investigator will notify the BDTH-HREC of any event that requires a modification to the protocol or other project documents and submit any required amendments in accordance with the instructions provided by the HREC.
- The Coordinating Principal Investigator will submit any necessary reports related to the safety of research participants in accordance with BDTH-HREC policy and procedures.
- **The Coordinating Principal Investigator will report the BDTH-HREC and notify the HREC when the project is completed at all sites.**
- **The Coordinating Principal Investigator will notify the BDTH-HREC if the project is discontinued at a participating site before the expected completion date, with reasons provided.**
- The Coordinating Principal Investigator will notify the BDTH-HREC of any plan to extend the duration of the project past the approval period listed above and will submit any associated required documentation.
- The Coordinating Investigator will notify the BDTH-HREC of his or her inability to continue as Coordinating Principal Investigator including the name of and contact information for a replacement.

**This letter constitutes ethical approval only.** This project cannot proceed at any site until separate research governance authorization has been obtained from the CEO or delegate of the institution under whose auspices the research will be conducted at that site.

Should you have any queries about the BDTH-HREC's consideration of your project please contact Admin officer, Barau Dikko Teaching Hospital, Lafia Road Kaduna.  
The BDTH HREC wishes you every success in your research.

Yours faithfully,



**Dr. J G Makama**  
Chairman  
BDTH HREC This HREC is constituted and operates in accordance with the National Health Research Ethics Committee (NHREC)

## Appendix C



### DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION AHMADU BELLO UNIVERSITY, ZARIA - NIGERIA (OFFICE OF THE HEAD OF DEPARTMENT)

VICE CHANCELLOR: **Professor Ibrahim Garba**, B.Sc., M.Sc., (ABU); Ph.D. (London); D.I.C.  
HEAD OF DEPARTMENT: **Professor M. A. Suleiman**, N.C.E. (OYSCE); B.Sc. (UNICAL); M.Sc, Ph.D, (ABU)

P14EDPE9011

Date 06-09-2017

The Zonal Coordinator,  
Ahmadu Bello Sports Commission,  
Constitution Road,  
Kaduna.

Dear Sir/Madam,

**INTRODUCTORY LETTER FOR DATA COLLECTION: SA  
Ekugbe (P14EDPE9011)**

The bearer is a postgraduate student of the above named Department is conducting a research on the "Assessment of the Effect Anthropometric and Body Composition Indices of Obese Fem Metropolis, Nigeria" in which your Organization/Centre will be used.

In this regards, I wish to request for your kind permission and access to the required facilities to collect the data for her research.

Your assistance is highly solicited please.

Thanking you,

Yours faithfully,

Prof. E. A. Gunen  
(Chairman, Supervisory Committee)

## Appendix D

The Presidency



# FEDERAL MINISTRY OF YOUTH AND SPORTS

NORTH WEST ZONE HEADQUARTERS  
Ahmadu Bello Stadium, P.O. Box 234 Kaduna. 08034359536

FMYS/NWZ/off/91/Vol. III/514

8-09-2017

Saiwo O.E (P.T),  
Physical and Health Dept.,  
Ahmadu Bello University,  
Zaria.

Dear Sir,


### Re: PERMISSION TO USE THE TRACK

With reference to your letter on the above subject matter dated 6<sup>th</sup> September, 2017, I am directed to convey the approval of the Zonal Coordinator for the use of the track during the aforementioned period.

We consider of great benefit to humanity and our contribution in promoting healthy living and well being.

We wish you success in your present and future endeavour.

Best Sporting Regards,

  
Ogunleye E. Kayode  
For : Zonal Coordinator



## Appendix E



### Committee on Use of Human Subjects for Research

Directorate of Academic Planning & Monitoring

Ahmadu Bello University, Zaria

Director: Professor M. I. Sule B Pharm, MSc, PhD, (ABU), MPSN Tel: 08036184581

Chairman: Prof I. H. Nock, B.Sc,M.Sc (ABU), PhD (NewDelhi) 08065425450 | Secretary: U. D. Abdullahi, 08034619772

Appl No.: ABUCUHSR/2017/Physical & Health Edu. /002

4<sup>th</sup> August, 2017

Approval No: ABUCUHSR/2017/002

Prof. E.A. Gunen  
Department of Physical & Health Education,  
Faculty of Education,  
Ahmadu Bello University,  
Zaria.

Sir,

**PROVISIONAL APPROVAL OF RESEARCH TITLED "ASSESSMENT OF THE EFFECT OF BRISK WALKING ON SELECTED ANTHROPOMETRIC AND BODY COMPOSITION INDICES OF OBESE FEMALE ADULT OF KADUNA METROPOLIS"**

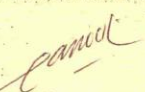
This is to convey the provisional approval of the ABUCUHSR to you for the aforesaid study domiciled in Department of Physical and Health Education of the Ahmadu Bello University. The approval is predicated on the assumption that you shall maintain and cater for the study subjects as indicated in your application.

Monitoring of the Research by spot checks, invitations, interactions with the subjects any other means the Committee deems fit shall be undertaken at the convenience of the Committee.

This approval can and shall be revoked should a significant breach in the terms and condition of the approval occur. It is hence your responsibility to ensure that the agreed terms are maintained to the end of the Study.

The said approval shall be posted on the ABUCUHSR Page on the University's website.

Note upon completion of the research, ethical clearance certificate will be issued.

  
Prof. I.H. Nock  
ABUCUHSR Chairman

Cc: Director, DAPM  
Director, IC SICT  
Dean, Faculty of Education  
HOD, Physical and Health Education  
Prof. A.A. Udon

## Appendix F

Physical Activity Readiness  
Questionnaire - PAR-Q  
(revised 2002)

# PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
<input type="checkbox"/>	<input type="checkbox"/>	1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you feel pain in your chest when you do physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	3. In the past month, have you had chest pain when you were not doing physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you lose your balance because of dizziness or do you ever lose consciousness?
<input type="checkbox"/>	<input type="checkbox"/>	5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
<input type="checkbox"/>	<input type="checkbox"/>	7. Do you know of <u>any other reason</u> why you should not do physical activity?

**If  
you  
answered**

### YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

### NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

#### DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- if you are or may be pregnant — talk to your doctor before you start becoming more active.

**PLEASE NOTE:** If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

**Informed Use of the PAR-Q:** The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

**No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.**

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME \_\_\_\_\_

SIGNATURE \_\_\_\_\_

DATE \_\_\_\_\_

SIGNATURE OF PARENT \_\_\_\_\_  
or GUARDIAN (for participants under the age of majority)

WITNESS \_\_\_\_\_

**Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.**



© Canadian Society for Exercise Physiology [www.csep.ca/forms](http://www.csep.ca/forms)

## Appendix G

### INFORMED CONSENT

In order to assess the effect of moderate intensity aerobic training on body composition indices of obese female adults in Kaduna metropolis, Nigeria, the undersigned hereby voluntarily consents to engaged in brisk walking exercise.

#### **Explanation of the training.**

The training program will be conducted at the Muritala Mohammed Stadium, Kaduna. The experimental group will have three training sessions every week, on alternative days for duration of twelve weeks. The group will carry out brisk walking exercise at an intensity which will progressively be increased to 60% - 70% maximum heart rate, for 45 - 60 minutes. The training sessions will be designed to hold in the morning between the hours of 6.30 and 8.00 a.m. Body composition evaluation will be carried out at the beginning of the training (week zero), mid way (week six) and at the end of the training (week twelve).

#### **Benefits**

This exercise and evaluations will allow us assess your body composition and their changes to the exercise program. The results will be used to prescribe a safe, sound and effective exercise program for you. Records will be kept confidential unless you consent to release the information.

#### **Discomforts**

As customary to beginning trainees, you may experience some discomfort from muscle soreness and weakness of the body, but this will only last for sometimes. These discomforts can be minimized by performing adequate warm up and cool down prior to taking the exercise. The training program will progressively conducted to enable steady adaptation to the exercise.

**Inquiries**

Questions about the exercise program are encouraged. If you have any question or need any additional information, please ask us to explain further.

**Freedom of Consent**

Your permission to permission to perform this exercise is strictly voluntary. You are free to stop the exercise at any point, if you so desire.

**Attestation**

I have read this form carefully and i fully understand the exercise procedures that I will perform and the discomforts. Knowing these and having had the opportunity to ask questions that have been answered to my satisfaction, I consent to participate in the exercise program.

.....  
Name of Participant

.....  
Signature and Date

.....  
Phone No

.....  
Name of Witness

.....  
Signature and Date

.....  
Phone No

Adapted from Heyward, 2008.



## Appendix H

NOTICE!!

NOTICE!!

NOTICE!!

DO YOU CONSIDER YOURSELF OVERWEIGHT OR OBESE?

DO YOU WANT TO GET IN BETTER SHAPE?

OBESITY AND OVERWEIGHT PREDISPOSES TO HYPERTENSION, TYPE 2  
DIABETES MELLITUS, STROKE, CANCER ETC,

IF YES TO THE ABOVE QUESTIONS;

PLEASE CONTACT MRS SAIWO ON THESE NUMBERS;  
08028333853, 08133081414, 08098556839

FOR FREE COUNCELLING AND MANAGEMENT @ BARAU DIKKO TEACHING  
HOSPITAL, LAFIA ROAD, KADUNA.

SANARWA!!

SANARWA!!

SANARWA!!

KINA DA KIBA KO CIWON KIBA?

KINA SO KI RAGE?

KIBA BA CIWON KIBA SUNA HAIFAR DA CIWON SIGA, HAWAN JINI,  
MUTUWAR BARIN JIKI DA CIWON DAJI.

IN TAMBAYOYIN NAN HAKANE

A TUNTUBI MRS SAIWO A WADANNAN;  
08028333853, 08133081414, 08098556839

DON KABIN BAYANI DA SHAWARWARI A BARAU DIKKO TEACHING ASIPITU,  
KADUNA.