EFFECT OF A PHYSICAL ACTIVITY INTERVENTION ON BODY SIZE DISSATISFACTION IN BLACK SOUTH AFRICAN WOMEN

By

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Supervisor

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DECLARATION

I, Nkhensani Precious Golele declare that this Dissertation is my own, unaided work. It is being submitted for the degree of MSc (Med) in Sport and Exercise Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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(Signature of candidate)

________________day of_____________________20________________in_____________

DEDICATION

I wish to dedicate this dissertation to:

My adorable son, Blessing and his father Nicholas Baloyi

My parents, Colen Golele and Mashudu Ramalivhana

My brother, Victor Golele and daughter Rhulani

PUBLICATIONS ARISING FROM THE RESEARCH

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STUDENT'S CONTRIBUTION TO THE PUBLICATION PRESENTED IN THE DISSERTATION

The student and supervisor developed the conceptual design. The student collected the data for this study. The student designed an exercise programme and managed the intervention group. The student contributed to data management for the project.

All authors of the manuscript have approved the inclusion of it in the dissertation (Appendix H).

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ABSTRACT

Introduction: The greatest population of black South African women is considered inactive when compared with .with their white counterparts. Physical inactivity remains a significant concern in black South African women increasing risk of non-communicable diseases and perceptions of body size. Pressure from family and friends increase the risk of dissatisfaction in black South African women. The aim was to determine effects of physical activity intervention on body size dissatisfaction.in a sample of black South African women. **Methods**: An experimental study conducted in black South African women aged 18 years and older (n=115). Data were collected on anthropometry (body mass index (BMI), waist and hip circumferences) and blood pressure. A standardized questionnaire determined socioeconomic status (SES); Stunkard silhouettes were used for body size dissatisfaction. The Global Physical Activity Questionnaire was used for physical activity. The study included n=66 females for the control group and n=49 for the intervention group. The intervention was a supervised walking programme for 12 weeks . Paired sample t-test determined changes in anthropometry and physical activity from baseline to follow-up. Statistica version13.2 was used for statistical analysis. **Results**: Total sitting time was positively associated with BMI:β: 0.18, P=0. 0001. Women who wanted to be fatter were 12.12%, 4.54% were content and 83.3% wanted to be leaner. Total Moderate Vigorous Physical Activity (MVPA) was positively associated with body size (MVPA β= 0.14, P= 0.0001). **Conclusion**: Body size dissatisfaction increased with BMI in the intervention group. There was an improvement in anthropometry and blood pressure following physical activity intervention.

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LIST OF ABBREVIATIONS AND ACRONYMS

- BMI: Body mass index
- BP: Blood pressure
- cm: Centimetre (s)
- DBP: Diastolic blood pressure
- FID: Feel–minus–Ideal score
- GPAQ: Global physical activity questionnaire
- HC: Hip circumference
- kg: Kilogram (s)
- LBM: Lean Body Mass
- m^2: Metre (s) squared
- MET (s): Metabolic equivalent (s)
- Min/week: Minute (s) per week
- MVPA: Moderate vigorous physical activity
- NCD:Non- Communicable disease
- PA: Physical activity
- PAD: Perceived and actual weight status
- SBP: Systolic blood pressure
- SES: Socio–economic status
- USA: United States of America
- WHO: WC: Waist circumference
- World Health Organization

PREFACE

Body image depends on psychological factors, socio-cultural factors such as friends and family and not forgetting media which influences the perception of one's body size (1). Regular physical activity impacts positive results such as reduced risk of hypertension, depression (psychological benefits) and obesity in young people, females in particular (2). More research can be done focusing on women on the relationship between physical activity, fat mass, and body image (3).

The above captured the essence of this research which was to investigate the effects of physical activity intervention on body size dissatisfaction in black African women. Research on the related aspects focused more on descriptive and cross-sectional studies that dwelt much on using questionnaires to determine physical activity level and anthropometry. Therefore, an interest in finding out what physical activity intervention can do to the perception of body image in black women who are employed and are exposed to different areas of environment and display various cultural norms emerged.

There was a concern that 63% of South African women were sedentary due to lack of participation in physical activity (4). Physical inactivity was outlined as the leading global epidemic problem accounting for a higher risk of non-communicable diseases and body size dissatisfaction(5). Body Mass Index was thought to increase with body size dissatisfaction in women increases the risk of obesity (3). Research indicated that 70% of women were overweight and obese indicating body mass index of greater than 30 kg/m^2 (6).

It would be interesting to examine the changes that follow physical activity intervention with body size dissatisfaction. Also, to observe the changes that arises from physical activity intervention with BMI as the indicator of obesity and body size dissatisfaction. The findings of this study aid in the literature of black South African women and physical activity intervention.

STRUCTURE OF THE DOCUMENT

This dissertation comprises of the following chapters:

- Chapter 1: Background and introduction
- Chapter 2: Literature review
- Chapter 3: Methods
- Chapter 4: Results
- Chapter 5: Publication arising from the study
- Chapter 6: Discussion
- Chapter 7: Conclusion and recommendations for future studies

CHAPTER 1: BACKROUND

1.1. INTRODUCTION

Body size dissatisfaction refers to the degree a person is content with their self-perception of body size as measured by the feel-minus ideal index(7) . Moreover, body size dissatisfaction affects people of all age and come as a concern of negative thoughts and feelings (7). The perception of body size was influenced by family, friends, and acquaintances, shaping how women perceived their body image (8). Negative feedback about appearance and external pressure from traditional beliefs of body shape also resulted in unhealthy eating and physical inactivity (9).

Psychosocial factors determined body shape perception as a public health concern in women of different ethnic groups (10). Furthermore, a study found that body size perception affected women of all age groups, with the influence of culture and social media causing a feeling of inadequacy (11). Another study indicated that women in high-income countries, for instance, United States of America (USA), were considered attractive when they were lean (12). However in African culture having a larger body size was associated with a healthy lifestyle, beauty, and high social status (13). The risk of overweight and obesity was influenced by the perception of body image in black South African women (14).

South Africa was one of the African countries with a high level of physical inactivity (15). However, in comparison with other ethnic populations, black South African women were less physically active and had higher proportion not achieving enough physical activity to lower the risk of overweight and obesity (5). Black Women residing in urban sub-Saharan African regions were at a higher risk of accumulating insufficient physical activity than those residing in rural settings (15). In that manner, Physical inactivity became one of the main reasons for higher levels of overweight and obesity in urban populations (16). Black South African women residing in urban areas spent less time walking compared with women who were residing in rural areas who Performed more manual labour/chores such as fetching water and collecting wood (5)

Evidence on the patterns of physical activity and body size dissatisfaction were limited from African populations especially in black women. The primary purpose of this dissertation was, therefore, to determine whether a simple and accessible intervention of physical activity had an influence on body size dissatisfaction and risk of obesity in a group of black South African women working in a South African university. The research is of importance as the information would aid in addressing the high prevalence of obesity and excessive weight gain in African women who traditionally prefer larger body size.

1.2. Problem statement

Body size dissatisfaction in women is becoming a public health concern as it contributes to less participation in physical activity and weight gain. The reason behind poor participation in activity is cultural in African populations (17). This may partly explain the increased prevalence of overweight and obesity in African women. The transition of modern life, change of economy, changes in dietary intakes and physical activity patterns, has resulted in an increased burden of NCDs (18). This comes as a result of less participation in physical activity due to less energy. Little is known about body size dissatisfaction and physical activity in black South African women, thus creating a gap of the depth of knowledge in the involved population. Again, more studies on body image perception were investigated in children and adolescents. Therefore, the current study focused on examining the effects of physical activity intervention and the changes thereof, with follow-up anthropometry and body size dissatisfaction in black South African women.

1.3. Aim

This study aimed to determine whether an intervention of physical activity will influence body dissatisfaction, blood pressure, and the anthropometric profile of a group of black South African women.

1.4. Objectives

1. To determine baseline physical activity, psycho-social profile and anthropometry of black South African women
2. To examine the changes in these measures following the intervention of supervised physical activity
3. To determine whether a change in physical activity is associated with follow-up anthropometry and body size dissatisfaction
4. To determine whether physical activity influences resting blood pressure, particularly in those with existing elevated resting blood pressure

1.5. Hypothesis

A change in baseline physical activity will influence follow-up body size dissatisfaction, anthropometry and resting blood pressure.

1.6. The significance of the study

This study may help determine whether it is important to include physical activity interventions as part of the health and wellness programme for female employees of South African universities.

1.7. Definition of terms

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Body size dissatisfaction

Body size dissatisfaction refers to the degree a person is content with their self-perception of body size as measured by the feel-minus ideal index (7).

Physical Activity

Physical activity refers to any bodily movement produced by skeletal muscles that require energy expenditure (19).

Obesity

Obesity is defined as body mass index greater than or equal to 30 kg/m^2 (20).

Anthropometry

The study of the measurement of the human body based on the dimensions of bones, muscles, and adipose tissue (21).

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

Non-communicable diseases(NCDs) such as hypertension, type 2 diabetes and other cardiovascular diseases were increasing worldwide having a strong association with physical inactivity (22). . South Africa was considered to be one of the highest ranked inactive countries in sub-Saharan Africa. (22). It was indicated that 63% of South African women lived a sedentary lifestyle (23). Thus, physical inactivity remained a significant public health concern for increasing the risk of NCDs. Regular physical activity participation declined in our modern society, with only 10.8% of black South African women participating in physical activity (4). This decline in physical activity resulted in a higher prevalence of NCDs in black South African women.

Obesity was considered one of the risk factors of NCDs associated with poor physical activity participation (24). It was estimated that more than one billion adults were overweight and obese in countries facing the nutrition transition, such as China and Brazil (25). In these countries, more than 70% of women and a third of men were overweight and obese displaying body mass index of greater than 30 kg/m^2 (6). Moreover, various factors played a significant role in the prevalence of obesity in South Africa and other countries facing development and economic transition such as community level, lifestyle behaviour social factors (26).

The preference of large body size in black South African women would be promoted by socio-economic status which then influenced lifestyle behaviour commonly associated with obesity (27). Also, psychosocial factors also displayed a significant role on body shape leading to body size dissatisfaction. The history of culture in African population played a significant role on how women viewed their body sizes influenced by community surroundings, family and friends relationships which in turn affected personal perceptions and attitude concerning body image (28). In an African culture, having a larger body size and being overweight was associated with high social status, beauty and absence of diseases, although in high-income countries depending on different ethnic groups women were considered attractive and healthy when they were lean (10, 11). However, the intervention of physical activity was assumed to influence body size perception. In other words, an improvement in body image perception and body composition notably change in Body Mass Index (BMI) including body fat and muscle mass were affected positively by physical activity intervention (17, 29). It was, therefore, essential to understanding the cultural norms of African populations with regular physical activity participation and body size perception in women. An investigation towards body image in countries facing non-communicable diseases due to economic transition was therefore necessary to include in making comparisons.

2.2. Conceptual framework

Shown in Figure 1 is the conceptual framework(30) that shows how various factors lead to body size dissatisfaction in women. The influence of body size dissatisfaction in women is dependent on psycho-social factors. Pressure from family and friends, self-perception and attitude are the determinants of why women perceive their bodies differently(31). Socio-cultural factors also influence the perception of body image in a contrary manner. For instance, in black society, a woman is considered fit and healthy when she is fat and big while thinness is associated with illness and being unhappy (32). These factors in turn, affect the dietary behaviour of these women causing a change in their lifestyle behaviour. For most of them, opting to participate in physical activity is not a better option instead. Most women fall into low physical activity group (33). Physical activity decreases with age (34). As a result, BMI status increases in these women due to the insufficient expenditure on energy and consumption of food which is processed and high in energy. A decrease in physical activity, in turn, leads to the outbreak of non-communicable diseases like diabetes, hypertension, cardiovascular diseases and obesity. Obesity is considered the main global concern was accounting for many deaths worldwide.

The prevalence of obesity was linked to urbanization in Sub-Saharan Africa leading to increased factors such as physical inactivity (35). Smoking and excessive alcohol consumption are also risk factors for non-communicable diseases and negatively alter the health of women. Negative feelings of body size can also lead to one engaging in unhealthy lifestyle behaviour as a way of changing either from a positive perception about body image or negative feeling. Due to transition in South Africa, there has been a shift in the socio-economic status resulting in urbanization (36). Being financially stable and affording to move from rural to urban settings are driving factors for the transition. . This transition causes a change in sedentary behaviour, and this can lead to excessive weight gain causing obesity. There is limited data that focus on interventional studies in black women and physical activity. Therefore, the purpose of this study is to investigate whether physical activity intervention can affect anthropometry and body size perception in black women.

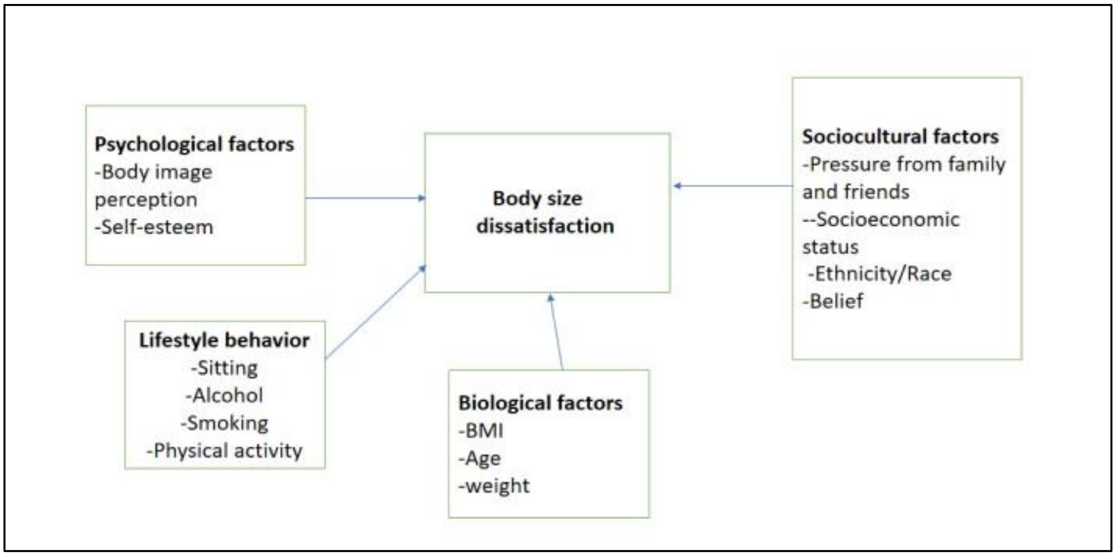

Figure 1: Conceptual framework of the association between psychosocial, lifestyle behaviour and body size dissatisfaction in women.

2.3. Body size dissatisfaction in black African women

Body image was considered a multidimensional aspect including the way people viewed their body size and how they felt about it (26). These dimensions were the determinants of whether women preferred to be thin or fat, promoting energy intake and output across age, gender and social class (37). Body image was considered one of the psycho-social factors that affect the status of weight (38). As a result, thin women may overestimate their body size while those who are overweight and obese may be unaware that their body weight is high (38). Thus, overweight and obese women overestimate or underestimate their body size and can result in dissatisfaction with personal body image (39). Further, body image perception and weight status were influenced by culture and social factors (40, 41).

Cultural perceptions played a significant role in body size in African women (28). Obesity was associated with body image dissatisfaction particularly in black African women who perceive larger body sizes as ideal body size (42). A change in physical activity patterns and dietary intakes of fatty foods contributed to the prevalence of overweight and obesity which in turn led to the perception on how black South African women viewed their body image when compared to their counterparts (24). Furthermore, an investigation indicated that some women overweight black women viewed themselves as overweight and some associated thinness with sickness. In African cultures, eating food high in fat and energy such as animal fats, chocolates, soft drinks and fried food was considered luxurious as it became easily accessible and consumable in high contents (24). Consumption of these food content resulted in overweight women with high social status (43).

A study conducted in black South African men and women indicated a different perception between women who were obese and had not experienced any chronic health conditions as they believed that being overweight is considered normal and healthy and had no interest in the willingness to lose weight (32). About 38% of black females were highly dissatisfied with their image while white females had a 16.7% dissatisfaction (17). The implication of body size suggested that black females were more concerned about physical appearance than their white counterparts.

A South African study revealed that black South African women who were overweight had an undesirable feeling towards obesity (44). The fear of fatness expressed by black South African women had more exposure to the western ideal of thinness (45)Evidence indicated that body image was associated with physical inactivity and obesity which played a role in the development of eating disorders, especially in adolescence and youth over a lifetime (46, 47).

Black women who were physically active had a better perception of their body image compared with the sedentary, suggesting that psychosocial factors influenced how women perceived their body image (10, 17). Black South African women may have a different perception of ideal beauty compared with other population groups due to cultural standards that accept beauty in different ways (48). The same findings were outlined in a study that focused on Socioeconomic Status and BMI concerning perception to body image (49). Again lower perception of overweight was found in low Socioeconomic Status and contribute to an unhealthy lifestyle (50). The media also influenced how African females perceived themselves. Thus, frequently media encouraged a desire for thin bodies while in the African culture women were considered beautiful and adorable if they had larger body size (11).

A negative appearance orientation was identified in women who had misconceptions about their body weight and were identified as overweight or obese (51). In black South African women, obesity was associated with positive outcomes such as attractiveness, beauty, and wealth (28). In some parts of sub-Saharan Africa, obesity and overweight were associated with a sign of happiness and success(52). Body size dissatisfaction was more considerable in black women who had a higher BMI than women who were lean (53). Increasingly, more black women were dissatisfied with their body size compared with BMI-matched white women (14). Studies on body image perception were mostly investigated in children and adolescents. Further, little evidence is available on body size dissatisfaction and physical activity in employed black South African women.

2.4. Obesity in black African women

Obesity was defined as having an excessive body fat especially in the abdominal area resulting in an increased BMI of ≥ 30.0 kg/m^2 (20).

Obesity is also a risk factor of NCDs such as diabetes, hypertension, cardiovascular disease and a public health concern worldwide. (24).

Further, Due to nutritional transition, the prevalence of overweight and obesity called for concern in developed and developing countries (12). Globally, It was reported globally that more than one billion adults were overweight increases the chances of many individuals being obese especially in countries facing economic transition such as Brazil and China (54). For instance, in the United States of America, 60% of black women were obese twice the status of non-Hispanic white women (55). Moreover, socio-economic factors, limited availability of weight management resource was strongly associated with the prevalence of obesity (56). Besides, a study conducted in Nigeria reported the prevalence of overweight and obesity by 26.8% and 6.5% (57).

Over the past three decades, BMI was observed to have risen steadily across African regions with accelerated trends for BMI in black South African women than in men (58). Moreover, these estimates were observed to be higher in the Northern and Southern Africa than other regions where BMI prevalence was lower (58). Thus BMI ranged to be higher in women by up to 20.2 $kg.m^2$ in Ethiopia, 27.3 $kg.m^2$ in Egypt and 30.6 in Madagascar (58). Furthermore, a definite trend in BMI was observed in the last decades in the Southern African countries (59). The sub-Saharan African countries were observed to have a high prevalence of obesity linked to urbanization, changes in lifestyle risk factors, physical inactivity and shoddy practices of diet (35).

The prevalence of obesity in South Africa was reported to be on the rise from 57% in 2002 to 65% in 2012 which was expected to be on the rise after (60). The South African stats released in 2016 indicated that 70% of women and a third of men were overweight and obese indicating body mass index of greater than 30 kg/m^2 (6). The South African government's strategic plan reported an overall proportion of adult South Africans who were overweight in the absence of effective interventions to be very high and likely to be on the rise by 10% in 2020 (61). Indeed, the overall resulted in increased mortality from NCDs and caused premature mortality (62). The prevalence of overweight and obesity in black South African women was high (69.3%) in sub-Saharan African which aided as a risk factor for hypertension (63). Various factors do play a role in the epidemic of obesity in South African and other developing populations such as community level, lifestyle behaviour and social factors (26).

Socioeconomic inequalities has been previously shown to be associated with the prevalence of obesity in South Africa and is a growing trend on the risk of obesity (59).
High socioeconomic status was demonstrated in white women who had a high-income distribution and increased BMI than those in low strata of socioeconomic, however, there was an exciting finding in black women with tertiary education indicating a high SES (59). The increment of BMI in black South African women came because of moving from rural areas to

urban settings leading to adaptation of consuming more processed foods and less energy expenditure (64).

Non-communicable diseases such as type 2 diabetes, hypertension, and heart diseases were thought to be high in other countries, but instead, they have become the most prevalent conditions affecting people of all age groups and gender in South Africa (65, 66). Moreover, rapid urbanization proliferated the changes in traditional diets and physical inactivity (67). Thus, providing access to consumption of foods high in fats and promoting sedentary lifestyle through different advancements aimed at easing life and occupation (67). Black South African women living in rural arears were found to be more obese than their white counterparts residing in urban settings (63)

(68). The prevalence of obesity in South African women was high with black women being mostly at risk by 62% and revealed low levels of physical activity energy expenditure and low fitness level indicated by a self-reported habitual physical activity (69). A study investigated the presence of overweight and obesity by 37.3% and 17.3% in black South African females respectively , and 45.5% of the sample were considered to have a healthy BMI (25 kg.m^2) (70). Furthermore, black South African women with normal BMI were physically active than the women who were inactive, overweight group(70). Moreover, differences in the prevalence of obesity were between different ethnic groups were due to social inequalities (71).

The classification of weight status using BMI was used as a simple method to classify women who are underweight, overweight and obese.

Table 1.BMI categories used to classify women who are at risk of underweight and obesity.

BMI(kg/m^2)	Classification
<18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
30.0-34.9	Obesity class I
35.0-39.9	Obesity class II
≥40	Obesity class III

(*Adapted from American College of Sports Medicine, 2010)*

2.5. Blood pressure and physical activity in black South African women

Having elevated systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥90 mm Hg was regarded a global public health concern (27). The highest prevalence of hypertension globally was found to be in the African region at 46% of adults aged 25 and above while in the Sub Saharan Africa, hypertension was common (more than 70%) varying between urban and rural arears (72). However, a trend of hypertension was observed in South Africa. A study reported that more than 6.2 million South Africans had elevated blood pressure (66). Other studies showed that black South African women had a higher proportion of hypertension compared with other population groups (73, 74). The prevalence of hypertension was shown to increase in urban black population due to urbanization and technological advancement (75) . Also, it was reported that increased blood pressure was associated with higher BMI and physical inactivity noticeably in women between the ages of 25-64 years respectively (76). In general, an association between physical inactivity and elevated blood pressure was observed to be high.

Elevated blood pressure was estimated to be the leading cause of many deaths and disability in South Africa and the most commonly diagnosed condition (13.1%) in primary health care (77). The rate of hypertension was estimated to be 79% in females of 50 years and older associated with physical inactivity and limitation in activities of daily living(78). Females in high SES statuses had elevated blood pressure despite the awareness on the consequences that comes with unhealthy lifestyle (36).

Black population had a high risk of hypertension than the white ethnic group which attributed to the difference in body fatness and fat distribution with black South African women having more peripheral fat than white women for a given body mass index (79, 80). Baseline systolic and diastolic blood pressure showed an increase of 48.1% from 41.8% with follow-up body composition derived measures (BMI, hip and waist circumference) with no physical activity (81). However, another study showed significant effects of aerobic exercise in a reduction of hypertension thereby increasing the level of antioxidants (82). A reduction of resting blood pressure was also found in individuals with elevated resting blood pressure through participation in moderate to vigorous physical activity. Another study also found that aerobic exercise reduced blood pressure in both hypertensive and normotensive women (83). Another study indicated a decrease in blood pressure and BMI (84). In addition, there was a significant decrease in systolic blood pressure with physical activity participation in a group of black South African females (85).

The following is a table showing blood pressure classifications.

Table 2.Blood pressure classifications

Classification	SBP (mm Hg)	DBP (mm Hg)
Normal	≤120	80
Prehypertension	>120-139	80-89
Hypertension stage 1	140-159	90-99
Hypertension stage 2	≥160	≥100

Adapted from American College of Sports Medicine, 2010)

2.6. Socioeconomic status in black African women

Socio-Economic Status was defined as the class of an individual measured by a combination of income, education, and occupation (86). Although South Africa was classified as one of the developing countries, many households were still facing the dilemma of poverty with economic changes, low educational level and urbanization especially in black population (87). Black South African women generally are in lower SES groups compared with white women ((35). Thus, an increase in the risk of NCDs and other cardio metabolic conditions were observed. Black South Africans were compromised regarding access to health care, education and the capacity of earning under the law of apartheid which regarded as the primary concern in South Africa (35).

Women with higher income and low physical activity participation were at a higher risk of high BMI associated with high energy intake in this regard, especially in black South African women forming an index of obesity in this ethnic-population (5). Moreover, this was influenced by tradition, physical activity participation and the stigma that allowed women to be homemakers and responsible for family wellbeing (88). Various factors like Socio-cultural, environmental and behavioural factors contributed to the high prevalence of obesity in black South African women (35). Socio-Economic Status was higher in individuals who first adopted lifestyle changes leading to higher BMI compared with other groups (89). Many reasons for not participating in physical activity were investigated in women who were both married and unmarried with family commitment, lack of energy, financial constraints and busy work schedule being the contributing factors (90).

2.7. Association of physical activity with body size perception in African women

Physical activity refers to any bodily movement produced by contraction of skeletal muscles that result in a substantial increase over resting energy (52).

The WHO stepwise surveillance using a standard instrument of Global Physical Activity Questionnaire (GPAQ) yielded a growing trend of physical inactivity (91). It was recommended that engaging in at least 150 minutes of moderate-intensity activity per week or 75 minutes of vigorous-intensity activity per week or an equivalent combination of moderate- and vigorous-intensity activity was healthy (91).

Physical inactivity was considered one of the risk factors for chronic diseases responsible for mortality worldwide with up to 9% of deaths (22). South Africa was the third physical inactive country with about 51.1% of the population which is inactive (22). Most importantly, it was investigated that 63% of South African women are sedentary (4). Physical inactivity remained a significant public concern which increased the risk of non-communicable disease and body size dissatisfaction (5). A study conducted in urban black South African women indicated that daily sitting time was associated with cardio-metabolic diseases (92).

In 2015 the risk of obesity in black South African women had risen by 62% (69). This population group displayed low patterns of physical activity, energy expenditure, and fitness level, indicated by self-reported habitual physical activity (69). Moreover, 58% of South African women aged 50-59 years of age were considered physically inactive (79) . This incidence led to an increased risk of non-communicable diseases associated with poor health, lower life expectancy and quality of life for this group (93). A significant trend of low physical activity patterns was shown in women of different ethnic groups (94). In fact, only 10.8% of black females participated in the regular physical activity, indicating changes in lifestyle behaviour in modern society (4). A similar pattern was found globally.

Another study also found that physical inactivity, smoking, elevated blood pressure and obesity are the primary health indicators for the development of cardiovascular diseases globally (93). A decline in physical activity emerged because of many factors. Socioeconomic status, culture, environmental and psychosocial determinants contributed to this incident in women (95). In an African society, a woman was considered healthy, fit and being treated well when she appeared big and firm (96). On the contrary, being thin was associated with unhappiness and illness (10). Due to this effect, self-perception of body image played a significant factor in black women (10). The human body was considered integral in the formation of a woman's identity and self-concept in a societal perception (97).

Given the conscience of body size dissatisfaction, it was provided that individual's thoughts and attitude towards a perception of body image be as a result of environmental and cultural influences(8). A study on body dissatisfaction outlined family relationships as one of the factors that influenced the perception of body size in females (98). The desire of becoming thin failed in many women due to eating habits and small patterns of physical activity (99). However, the desire to lose weight seemed to have an existence in women who perceived themselves as overweight and who were aware of the dangers that rose with excessive body weight (29).

Black South African females residing in urban area were observed to be less physically active when compared with the rural dwelling females (4). It was suggested that they had higher physical activity levels due to the activities they did which required walking and carrying light loads from one place to another (100). These activities included walking to and from workplaces and other gatherings which also prevented sedentary behaviour determinants (100). An investigation done on black South African adults indicated an association between physical inactivity and sitting time (101). Habitual physical activity declined in our modern society, with only 10.8% of black South African women reported to participate in physical activity due to changes in use of technology (4). Again, low physical activity participation was observed in women by 78.27% (102). Thus, the decline in physical activity and change of lifestyle led to a higher prevalence of NCDs in the African population.

The preference of big body size in black South African women was promoted by cultural beliefs which influenced lifestyle behaviour commonly associated with obesity (103). Furthermore, the barriers to physical activity in black South African women included socio-economic status and culture contributed to the prevalence of obesity in South Africa (35). In another study, women perceived themselves as too cumbersome and desired to lose weight, others were satisfied with their body image, and others showed concerns about how they looked and wanted to be thin or gain weight (10, 29). Socio-cultural factors played a role in the attitude towards body weight and their preferences for fitness levels, culturally valued as a sign of health, beauty, and happiness (104). A study based between the old and young black professional women indicated a high level of significance on BMI and percentage body fat in the older generation of women than in young women (105).

The preference of big body size in black South African women was sought to be promoted by socio-economic status influenced by lifestyle behaviour commonly associated with obesity (27). Prevalence of obesity and overweight in black South African women was higher (58.5%) than mixed ancestry with 52%, white 49.2% and Indians with 48.9% because of environmental factors cultural beliefs around fatness (106). Studies from African countries revealed that being lean was associated with illness and being overweight signified good health, beauty and high social status(106, 107). Furthermore, participation in physical activity was found to be affected by lack of support from family, friends, and acquaintances (108).

Table 3. Effects of Physical activity intervention on body size dissatisfaction in African women

Reference	**Criteria used**	**Study design**	**N**	**Age (years)**	**Country & Ethnicity**	**Findings**
Mintem et al. (4)	The Stunkard Scale,	Birth cohort study	4100 women	22-23 years	Brazil/females	-Prevalence of body dissatisfaction was 64%
Mchiza et al. (8)	Stunkard silhouettes	Birth cohort study	201 women	9- 12 years	South Africa/mixed women	Mother-daughter chose similar silhouettes to represent body size.
Lepage et al. (29)	State self-esteem scale	Intervention	61 females	19 years	African American	Exercise showed positive effect on body size dissatisfaction
Kruger et al. (10)	FFQ, QFFQ, and PAI	longitudinal	1040 women	15-55 years	South Africa/black	- The rate of obesity was high with 28.6 % - A positive association was found between household income and measures of obesity.
Mkhonto et al. (118)	Anthropometric measurements and physical activity	Cross-sectional	830 women	20–95 years	South Africa/black	-Anthropometric measurements showed that a high percentage of women were obese.

Larsen et al. (72)	Aerobic exercise for six weeks	experimental	N/A	N/A	Aarhus University	Tai chi decreased blood pressure in elderly women.
Smit et al. (104)	PWC_{170}	Cross-sectional	3273 subjects	30 and 60 years	South Africa/mixed	-Women showed low physical activity participation by 75%
Smit et al. (82)	Health Risk Assessment (HRA) and Monitored Health Risk (MHM).	Cross-sectional observation survey	6524 women	18 - 64 years	South Africa/mixed	physical activity participation decreased (78.27%)
Vurgun et al. (26)	Aerobic exercise for ten months	experimental	45 women	25 and 20 middle-aged women	South Africa	-A decrease in body mass, body fat, waist-to-hip ratio, and improvements in body image satisfaction
Tshabangu et al. (87)	A health and lifestyle questionnaire	cohort	226 women	N/A	South Africa	- There was an improvement in Physical activity pattern.
Gradidge et al. (101)	10-years follow-up	longitudinal	430 women	18 years and older	South Africa/black females	Body composition measurements increased over ten years (p<0.0001)
Pillay et al. (98)	12 weeks intervention	Pilot study	25 women	21-49 years	South Africa	Improvement in clinical measures was observed.
Vugun et al (102)	14 weeks aerobics training	experimental study	45 Middle-aged women	36-45 years	Turkey	Regular aerobic exercise had a positive effect on body image satisfaction of middle- aged women.
Zeeelie et al (	10 weeks physical activity intervention	Intervention	194 adolescents	15-19 years	South Africa	There was a decrease in blood pressure and BMI.

2.8. Change in physical activity associated with follow up anthropometry and body size dissatisfaction in African women.

Body size perception was potentially influenced by physical activity intervention (29). Again, it was indicated that exercise improved body image through its effects on body composition, particularly body fat and muscle mass (17, 29). This finding was supported by data from a South African study that showed participation in an exercise intervention which included aerobic and strength training had significantly better improvements in body composition in comparison with those who did not (29). A positive body image perception showed an improvement with physical activity intervention (29). A study on the effects of regular aerobic exercise on physical characteristics, body image satisfaction and self-efficacy of middle-aged women was shown (109). This research suggests that a provision of physical activity intervention can be of significance. The physical activity led to a change in the perception of body size as well as body composition (29). Furthermore, this physical activity could lead to a reduction of non-communicable diseases.

A study conducted in Gauteng province indicated a higher rate of physical activity pattern in women residing in informal settlements than urban-dwelling women (92). The activities included fetching water, collecting wood, household chores, cooking and walking for work daily (92). This suggested a reduction in many hypokinetic diseases although their lifestyle behaviour placed them at risk of developing health problems not related to physical activity. Improvements in body composition (i.e., body weight, BMI, waist circumference, percentage body fat), and resting blood pressure were observed following the intervention of physical activity which may have a reduction on the risk of hypokinetic diseases (110). A study supports that body size perception can be influenced significantly with physical activity intervention (29). Furthermore, exercise was observed to have a positive effect on women regardless of their level of body dissatisfaction in women (31)

2.9. Summary

It has been found during literature review that psycho-social factors influence body ssize dissatisfaction. Women can perceive their body image as either being positive or negative. This may depend on immediate community influences due to culture and its customs as well as the surrounding environment. Through development and advancement of technology use, human move less when compared in the past, thus most individuals do not meet the recommended physical activity that one should engage in per day or at least in a typical week. Physical inactivity has become a leading risk factor in the prevalence of non-communicable diseases across different ethnic populations with a high level of physical inactivity in black African women. However, body size perception can potentially be influenced with physical activity intervention as well as a change in anthropometry following a supervised activity.

CHAPTER THREE: METHODOLOGY

31. Setting

The study was conducted at The University of Venda, situated in Thohoyandou, Limpopo province, South Africa. It is on the western side of Thohoyandou (Block P-West), 3.4 km from the Khoroni hotel & Convention and Venda plaza. Thohoyandou town is the administrate Centre of Thulamela and Vhembe District municipality and is known for being the former capital of the Bantustan of Venda. It covers a density area of 1600km^2. The population development of Thohoyandou comprises of 89,427 people with population figures of 42,286 for males and 47,141 for females.

3.2. Study design

An experimental intervention study design was used to determine whether physical activity influences body size dissatisfaction.

3.3. Population and sampling

The total number of the University of Venda includes 662 employees. The study consisted of female employees aged 18 years and older who were employed by the University of Venda. The total population of female employees is 394. The human resources department assisted with the recruitment of participants by sending invites via email to the entire institution led by the employee health and wellness practitioner who also motivated all women to participate in this study. The required sample size was calculated as 132 (66 experimental and 66 control group) females determined using the Slovin's formula (111). Furthermore, women with diagnosed high blood pressure, on medication and willing to take part in the study were included. A request to participate in the study was sent via email to potential volunteers, and those who responded were screened telephonically to ensure they met the criteria for participation. Those who participated in physical activity and attended the recommendations for exercise in a typical week (150 minutes) were excluded from the study. Women who met the criteria provided informed consent were recorded down and were randomly selected into control and experimental group respectively.

3.3.1. The randomization of participants in control and intervention groups

All participants were informed of the study and educated on what was going to occur in the control and intervention groups. Selection of participants was made using a randomization list which consisted of even and odd numbers. Females randomized under even numbers formed part of the intervention group, and those under odd numbers were part of the control group to meet the required number of participants for each group. The randomization of participants was completed by research assistants who were not involved in the entry of data to prevent biased selection.

3.3.2. Inclusion criteria

All females whether satisfied or dissatisfied with their body size and employed by the University of Venda formed part of the study. All potential participants were aged ≥18 years. Employees with diagnosed high blood pressure and on medication, furthermore willing to take part in the study were included in the study to determine the effectiveness of physical activity on blood pressure management. All females employed by the institution were requested via email and handed information letter for voluntary participation.

3.3.3. Exclusion criteria

Women who were under 18 years of age and not employed by the institution were excluded from the study. Pregnant women excluded from the study due to the changes that occur like rapid weight gain within a short period during the stage could have altered the results.

3.4. Procedure for data collection

Potential participants were given information about the study via email and hand delivery. The objectives of the study, methodology, and detail around what was expected of the participants were explained. Participants signed a consent form and completed baseline assessments. Data was collected during the participant's free time and common lunch breaks. Baseline demographic information, physical activity questionnaire, socioeconomic status, body size dissatisfaction, and anthropometry were collected. Women who were randomly selected for the physical activity intervention participated in a supervised exercise during their free time. The intervention lasted for 12 weeks. Both control and experimental groups had follow-up data collection at the end of the 12 weeks.

3.5. Measures

2.5.1. Anthropometry

Body mass was measured using a digital scale (Seca, Hamburg, Germany) to the nearest 0.01kg. Height was measured using a stadiometer (PHR, USA) in cm. Slim guide calliper (Body care, UK) was used to measure the following skinfold site: triceps, chest, midaxillary, subscapular, suprailiac, abdomen, front thigh, to the nearest mm (109). Triceps was measured vertically on the posterior upper arm. The chest was measured between the armpit and the nipple. Midaxillary measured in a vertical fold at the level of the xiphoid process of the sternum. Subscapular was measured at the back of the trunk next to the shoulder girdle. Suprailiac was taken in a diagonal in line superior to the iliac crest. Abdominal was measured in a straight line next to the navel. The front thigh was measured in the front leg between the knee and the hip joint. Total body fat was calculated using the skinfold equation for females(109). All anthropometric measurements were taken twice, and the average was recorded.

Waist circumference was measured while standing, arms at the sides, feet together and abdomen relaxed. The horizontal measure was taken at the narrowest part using a cloth tape in centimetres (101). WHtR was used to determine central obesity together with BMI as it is simple to predict the early health risk associated with central obesity in women. It was calculated by diving waist size by height. A waist measurement less than half a height was determined as the predator of the risk of obesity.

Hip circumference was made in the same position just below the gluteal line (112). All measurements were carried out with the help of qualified research assistants who received training before data collection and intervention. Again, the research assistants had relevant qualifications in human movement studies and were trained in data collection procedure.

3.5.2. Blood pressure

Blood pressure was measured using Omron BP monitor (M6, Europe). Participants were in a seating position, their left arm relaxed and supported at heart level in a quiet room after they had been asked to sit and relax on a chair for 5 minutes (109). The cuff of the monitor was wrapped around the upper arm and aligned with brachial artery. Three measurements were taken, and an average of the latter two trials was recorded (51). Hypertension was defined as systolic (SBP) ≥ 140 mm Hg and diastolic blood pressure (DBP) ≥ 90 mm Hg (20)

3.6. Questionnaires

3.6.1. Demographic characteristics, socio-economic status, and educationSocio-economic status, marital status, and the highest level of education were determined (see Appendix C). Participants were asked to choose their marital status as married, single or divorced. The highest level of education was determined by asking participants occupation and monthly salary range. A self-administered household SES questionnaire suitable to be used in African population was used to assess household socioeconomic status (SES) (113). The survey was based on the ownership of the following 12 household items and ranked in order of value radio (01): computer (02). Refrigerator (03), washing machine (04), television (05), telephone (06), mobile phone (07), internet (08) electricity (09), satellite television (DSTV), (10) car (11), Microwave (12), (television satellite). The twelve household were then ranked in order of value and an overall SES score was calculated using the ranks to determined total SES score (ranging from 0 to 78) for each participant(114). Again, participants' occupations were classified as academic, administrative, finance, maintenance, security, and groundwork and cleaning services. These classifications were then used to determine whether participants' occupations involved low, moderate and vigorous physical activity. The salary ranges ranked from a minimum of R 5000.00 to greater than R20 000.00 in a typical month based on occupation and level of education.

3.7. Physical activity and sitting time

The Global Physical Activity (GPAQ) was used to determined physical activity level (see Appendix D). This Questionnaire collects information on physical activity behaviour including activity at work, travel to and from places as well as recreational activities (115). The GPAQ analysis criteria were used to categorize the active and the inactive groups. This instrument was validated for use in the black South African population. Total moderate-vigorous physical activity (MVPA) in minutes per week (mins/wk) was used to obtain time taken when traveling leisure and occupation. MET-minutes per week were calculated by combining physical activity hours per activity and metabolic-equivalent (MET). A value of four was given for Moderate activity and a value of eight was allocated for vigorous physical activity MET value of four and a value of eight. The MET-minutes was used based on the World Health Organisation (WHO) guidelines. Participants who were categorized as active in the GPAQ categories were those who met moderate physical activity for a total of 150 minutes per week or 75 minutes of vigorous intensity physical activity reaching 600 metabolic minutes per week of moderate-vigorous physical activity (MVPA) (116). Women who did not meet the specified criteria were considered as inactive.

3.8. Body size dissatisfaction

Stunkard 9 silhouettes charts were used to assess body size dissatisfaction (see Appendix E) (117). In this measure, the silhouettes were presented to the participants and asked to choose the one closest to their own body and the one representing their ideal size. Body size dissatisfaction was determined by asking participants to select the image that displayed how they wanted to look. The ideal body size was determined by subtracting the desired body shape by the current body size. Participants were requested to identify the silhouette that most closely resembled their current body size as well as the silhouette that resembled their ideal body size to determine FID score. Positive FID score indicated the desire to be thinner; negative FID stated the desire to be bigger, while zero counts were satisfaction with body size. An FID index score that was close to zero represented less body size dissatisfaction was suggested by zero FID while, -1 or higher than +1 showed greater body size dissatisfaction.

Body size discrepancy was determined by calculating perceived scores from actual weight status known as perceived actual discrepancy (PAD). The nine silhouettes were used to find out the score with actual BMI. BMI codes for the perceived weight status silhouettes which were coded using measured BMI classification as silhouette 1 and 2 (underweight), 3-5 (norms weight), 6 and 7(overweight),8 and 9 (obese). The equation used was PAD score = actual BMI – estimated BMI represented by silhouettes. Favourable ratings showed an underestimation of actual body size; negative score indicated the overestimation of actual body size and zero scores indicated accurate perception of weight.

3.9. Physical activity intervention

The physical activity intervention was based on previous studies of African women showing a change in body size perception (118). It was focused on supervised aerobic exercise for12 weeks on 66 participants. The researcher together with research assistants monitored the entire exercise session to ensure consistency and that the participants were performing the activities correctly. To ensure compliance, participants were given a motivational talk on health and wellness each week by the researcher. The frequency was three days per week, with duration of 30 minutes. The participants in the intervention group were required to attend the walking programme on a weekly basis from 09 January to 31 March 2017. The nature of plan was based on previous evidence highlighting that walking is common amongst African populations and adds more to accumulated weekly MVPA than the occupation- and recreation-related physical activity(29). Using treadmills (Jkexer Sprint 9875A), the walking intervention took place during lunch breaks and few hours before knock-off time at the Human Movement Sciences gymnasium, University of Venda. Further, given the limited time for lunch breaks (≤1 hour), a duration of 30 minutes was agreed upon by the authorities of the university and the participants to provide ample time to reach the venue and change into appropriate clothing. Furthermore, the intervention was done on the same days, different times between lunch break (13h00-14h00) and 15h45-17h15.

Participants were divided into a group of 12 each to accommodate the number of treadmills available at any one time. The Participants resting blood pressures were measured on arrival followed by a period of light stretching before starting the 30-minute walking programme. Women with diagnosed hypertension and on medication were closely monitored for exaggerated blood pressure during exercise by the researcher to ensure safety precaution. The researcher had a management plan in place for the individuals involved. A moderate intensity was ensured by walking speed and RPE scale for exertion. Moderate intensity was ensured by walking speed (5 to 5.5 km/h), RPE (4-8/10), and gradient (0.5 -1.5 degrees) throughout the intervention. The participants were monitored throughout the activity for any exaggerated physiological changes by qualified research assistants. Hydration with water was encouraged, and the ambient room temperature was kept at 18 degrees Celsius. All participants were asked to wear comfortable proper attire. Monitoring of blood pressure, exercise sessions, warm up and cool down sessions were done with the help of trained research assistants. Weather conditions did not affect the programme as it was conducted indoors. The control group (66 participants) did not form part of the intervention. However, the baseline and follow-up data collection waves were the same as the experimental group. At the final stage of the intervention, only 49 participants from the experimental group managed to complete the intervention. Those who dropped out were because of relocation from one place to another due to occupation and expiration of contracts. The following exercises were included in the intervention (Table 4):

Table 4: Exercise protocol for the intervention group

Frequency	Day 1 Monday	Day 2 Tuesday	Day 3 Wednesday
Intensity (using Borg's RPE scale)	Moderate-vigorous	Moderate-vigorous	Moderate-vigorous
Time	30min	30min	30min
Mode of exercise	Walking	Walking	Walking

3.10. Pilot study

A pilot study was undertaken with 10 participants not included in the survey to ensure the reliability of data. Thus, all measurements and questionnaires were administered a week apart, followed by statistical analyses to determine reliability. Also, the technical error of measurement for the various methods was being carried out during this period. The variables, weight, height, BMI, SBP and DBP showed a strong positive correlation ($r= 1$) with a statistical significance of $P< 0.0001$. Waist was positively correlated at $r= .62$ ($P< 0.0001$) and hip had a positive correlation of $r= .91$ ($P< 0.0001$)

3.11. Data analysis

Statistica 13.2 (Tulsa, USA) was used for statistical analyses. Paired sample t-test was used to determine the changes in anthropometry and physical activity from baseline to follow-up. The correlation of changes in physical activity pattern with follow-up anthropometry and body size dissatisfaction was determined in univariate analyses. Those physical activity domains that were significant ($p \leq 0.05$) were inserted into a regression model with potential confounders (age, BMI, education, marital status and socioeconomic status) to determine the influence of physical activity with anthropometry and body size dissatisfaction.

Multiple linear regression analyses were used to determine the association between the physical activity and body composition variables. The dependent variables included anthropometry (waist circumference, BMI, systolic and diastolic blood pressure. Data were presented as beta coefficients, and significance was accepted at $p < 0.05$. The independent variables included in the model were age, sitting time, total MVPA, work MVPA, leisure MVPA and walking for travel. The results of the regression models are reported as standardized β values to facilitate comparisons of the associations between the variables.

3.21. Ethical consideration

Ethical clearance was applied for and granted by the Human Research Ethics Committee, the University of Witwatersrand (Medical) (ethics certificate number: M160518 (see Appendix G). Permission to collect data from employees at the university was requested from the principal of the University of Venda (See Appendix F). A consent form and information sheet were given to the participants and explained how data was carried out (see Appendix A and B). Codes were used instead of participant names to protect individual data. Analysis of data was done as a group to ensure the privacy of individual participants. Only the researcher and supervisor had access to the raw data, which was stored in a secure location.

CHAPTER FOUR: RESULTS

4.1. Characteristics of the participants

A total of 115 participants working at the University of Venda were recruited for this study. The control group included 66 participants, with a mean age of 37.3 ± 8.78 years. The intervention group consisted of 49 participants and their mean age was 44.4 ± 12 years. The participants were divided into different occupation types including academic (n=48), administrative (n=34), and n=33 were in maintenance or ground work. Only 11.5% women were employed for less than a year and the rest had been employed for more than 1 year. Looking at the SES score, 16.1% were in low SES, 12.65% were classified under moderate SES and 71.25% were in high SES. Women who owned a car were 73.4% and 26.6% used a public transport and had to walk to the bus stops. Moderate vigorous physical activity was lower in women who owned a car compared to the women who walked for travel. 15% of the women consumed alcohol. This had an impact on body weight changes and body mass index.

4.2. Anthropometry and blood pressure for the control group

There was a significant increase in anthropometric variables. Mean BMI increased from 31 ± 7.0 at baseline to 32.8±7.0, P=0.0001. This showed an absolute change in BMI by 1.8$^{\triangle}$ (P=0.0001). There was an absolute change in waist circumference by 1.5$^{\triangle}$ however hip circumference and WHtR indicated a significant change (P<0.0001).
A difference in SBP, DBP and MAP with p=0. 0001 was indicated with blood pressure indicating a positive change in measures at baseline and follow-up.

Table 5. Baseline and change characteristics in anthropometry, blood pressure and physical activity for the control (n=66) and intervention group (n=49).

Variables	Control group[b]	Intervention group[b]	P-value[¶]	Control group△	Intervention group△	P-value between pre-post test
Age (years)	37.3 ± 8.77	44.3 ± 11.54	N/A	N/A	N/A	N/A
Anthropometry						
Weight (kg)	81.8 ± 17.7	85.9 ± 20.72	0.26	+2.76 ± 1.15	-2.07 ± 2.51	<0.0001
Height (cm)	1.62±0.54	1.62±0.54	0.000	1.62±0.54	1.62±0.54	<0.0001
BMI ($kg.m^{-2}$)	31 ± 6.57	32.8 ± 7.25	0.18	+1.05 ± 0.44	-0.80 ± 0.96	<0.0001
WC (cm)	94.73 ± 17.0	93.8 ± 16.5	0.78	+1.73 ± 1.48	-1.50 ± 2.02	<0.0001
Hip (cm)	112.0 ± 14.3	114.8 ± 13.96	0.39	+1.93 ± 1.05	-2.18 ± 3.20	<0.0001
WHtR	58.4 ± 10.6	58.0 ± 9.75	0.86	+1.07 ± 0.92	-0.92 ± 1.25	<0.0001
LBM	29.4±5.86	29.6±6.51	0.75	+0.81 ±0.34	-1.28±4.85	<0.0001
% Body fat	48.5±6.1	49.6±7.40	0.51	+2.08±1.94	-2.5±1.42	<0.0001
Blood pressure						
Systolic BP (mmHg)	112.3 ± 15.6	118.0 ± 17.5	0.17	+4.64 ± 2.26*	-4.02 ± 3.01	<0.0001
Diastolic BP (mmHg)	73.7 ± 10.6	74.1 ± 12.7	0.46	+4.94 ± 2.10	-2.37 ± 2.40	<0.0001
Mean arterial pressure (mmHg)	91.3 ± 11.2	88.7 ± 13.4	0.28	+4.83 ±1.87	-2.92 ± 1.93	<0.0001
Pulse pressure (mmHg)	46.6 ± 11.7	43.9 ±11.7	0.23	-0.30 ± 2.28	-1.65 ± 3.75	<0.0001
Physical activity						
Total MVPA (mins/week)	20(10.40)	45 (20, 130)	<0.0001	0 (-8, 3)	176(125.180)	<0.0001
Sitting time (mins/day)	480 (420-600)	360 (240, 480)	<0.0001	0(0,120)	0 (-60, 0)	<0.0001

Data presented as mean ± SD for anthropometry and blood pressure. Physical Activity data presented by median and interquartile. BMI (Body Mass Index); WC (Waist Circumference); WHtR (Waist to height ratio); SBP (systolic blood pressure); DBP (diastolic blood pressure); MAP (Mean arterial pressure); PP (Pulse pressure). [b](baseline); [p](post); △ (Absolute Change).

4.3. Physical Activity for the control group

There was a significant difference in total work, leisure, sitting time, moderate and vigorous physical activity. Total physical activity minutes per week showed a significant of (P=0.0001, see Table 6) with follow-up intervention.

Table6. Baseline and post demographic characteristics for the control group (n=66)

Variables	Control group[b]	Control group [p]	P-Value between Pre and post test	Absolute change△	Absolute P-Value
Age (years)	37.3 ± 8.78	37.3 ± 8.78	N/A	N/A	N/A
Anthropometry					
Weight (kg)	82 ± 18.0	84.6 ±18.0	< 0.0001	2.6	<0.0001
BMI (kg/m^2)	31 ± 7.0	32.8 ± 7.0	< 0.0001	1.8	<0.0001
WC (cm)	94.7 ± 17.0	94.5 ±17.16	< 0.0001	-0.2	<0.0001
WHtR	58.4±10.1	59.4±10.7	<0.0001	1	<0.0001
Hip (cm)	113 ± 14	114.5 ± 14.17	< 0.0001	1.5	<0.0001
Blood pressure					
SBP (mmHg)	122.3 ± 15.1	126.1 ± 14.73	< 0.0001	15	<0.0001
DBP (mmHg)	7.1 ± 10.1	80.6 ± 10.1	< 0.0001	7	<0.0001
MAP (mmHg)	91.3 ± 11.2	96.9 ±10.1	< 0.0001	5.6	<0.0001
PP (mmHg)	46.6 ± 11.7	46.33 ±11.28	0.286	-0.27	0.31
Physical activity					
Total work (moderate-vigorous physical activity)	0 (0.0)	0 (0.0)	< 0.0001	0	< 0.0001

(mins/wk)					
Total walking for travel (mins/wk)	14 (10-25)	15 (10-20)	< 0.6	1	< 0.0001
Total leisure (moderate-vigorous physical activity) (mins/wk)	480 (405-600)	0 (0-0)	< 0.0001	480	< 0.0001
Sitting time (hrs./day)	480 (405.600)	600 (480.660)	< 0.0001	120	< 0.0001
Total vigorous physical activity (mins/wk)	0 (0.0)	0 (0.0)	< 0.0001	0	< 0.0001
Total moderate physical activity (mins/wk)	20 (10.40)	16.50 (10.30)	< 0.0001	-3.50	< 0.0001
Total moderate-vigorous physical activity (mins/week)	20 (10.40)	16.50 (10.30)	< 0.0001	-3.50	< 0.0001

Data presented as mean ± SD for anthropometry and blood pressure. Physical Activity data presented by Median and interquartile. BMI (Body Mass Index); WC (Waist Circumference); WHtR (Waist to height ratio); SBP (systolic blood pressure); DBP (diastolic blood pressure); MAP (Mean arterial pressure); PP (Pulse pressure). [b](baseline); [p](post); [△] (Absolute Change-calculated by using the follow-up value minus baseline value).

4.4. Body composition for the intervention group in black women

There was a significant difference indicated by comparison of baseline and follow-up results with P<=0.0001 for anthropometric variables (see table 7). There was a decrease in waist circumference, hip circumference and BMI, respectively. A decrease in systolic and diastolic blood pressure was observed (P=0.0001).

Table 7. Baseline and post demographic characteristics for the intervention group (n=49)

Variables	Intervention group[b]	Intervention group [p]	P-value between pre and post test	Absolute Change△	Absolute P-value
Age (years)	44.4 ± 11.5	44.4 ± 15	N/A	N/A	N/A
Anthropometry					
Weight (kg)	85.9 ± 2.7	84.2 ± 2.21	< 0.0001	-1.7	<0.0001
BMI (kg.m^{-2})	33 ± 7.3	32.1 ±7.3	< 0.0001	-0.9	<0.0001
WC (cm)	94 ± 16.5	92.34 ± 16.2	< 0.0001	-1.66	<0.0001
Hip (cm)	114.5 ± 13.5	113 ± 15.0	< 0.0001	-2.0	<0.0001
WHtR	58.0 ± 9.8	57.12±10.0	< 0.0001	-0.88	<0.0001
Blood pressure					
SBP (mmHg)	118.0 ± 18	114.0 ± 17.2	< 0.0001	-4.0	<0.0001
DBP (mmHg)	74.1 ± 13.0	72.1 ± 12.1	< 0.0001	-2.0	<0.0001
MAP (mmHg)	89 ± 13.4	86 ± 13.0	< 0.0001	-3.0	<0.0001
PP(mmHg)	44.0 ±12.0	42.33 ± 12.0	< 0.0001	-1.67	<0.0001
Physical activity					
Total work (moderate-vigorous physical activity) (mins/wk)	0 (0-27)	0 (0-10)	< 0.3	0	<0.0001

Total walking for travel (mins/wk)	20 (10-30)	20 (20-3)	< 0.05	0	<0.0001
Total leisure (moderate-vigorous physical activity) (mins/wk)	0 (0-80)	180 (180-480)	< 0.0001	180	<0.0001
Sitting time (hours/day)	360 (240-480)	360 (240-480)	< 0.7	0	<0.0001
Total vigorous physical activity (mins/wk)	0 (0-0)	0 (0-0)	< 0.0001	0	0.03
Total moderate physical activity (mins/wk)	45 (20-90)	200 (192-234)	< 0.0001	155	<0.0001
Total moderate-vigorous physical activity (mins/week)	42 (201-135)	210 (195-240)	< 0.0001	168	<0.0001

Data presented as mean ± SD for anthropometry and blood pressure. Physical activity data presented as median and interquartile. BMI (Body Mass Index); WC (Waist Circumference); WHtR (Waist to height ratio); SBP (systolic blood pressure); DBP (diastolic blood pressure); MAP (Mean arterial pressure); PP (Pulse pressure). [b](baseline); [p](post); △ (Absolute Change- calculated by using the follow-up value minus baseline value.

4.5 Body size discrepancy for the control group

At baseline, 12.12% of participants wanted to gain weight (negative FID score), 4.54% were content (Zero FID score) with their body image and 83.33% wanted to be learner (Positive FID score; see table 8). Mean BMI at baseline was 21.21±2.1 and 1.18±.4.4 at follow-up for participants who wanted to gain weight. There was no change in BMI, waist circumference and percentage body fat with intervention.

Table 8. The association of feel–minus–Ideal score with anthropometry for the control group (n=66)

Variables	**Participants who wanted to be fatter**	**Participants who were content with their body size**	**Participants who wanted to be leaner**	**P -value**
Proportion in each FID Group (%)[b]	12.12 %; n=8	4. 54 %; n=3	83.33%; n=55	
Age(yrs.)	29.8 ± 2.9	39.33 ± 12.14	38.3 ± 8.1	N/A
BMI ($kg.m^{-2}$) [b]	21.21 ± 2.1	28.8 ±7.60	32.1 ± 5.67	< 0.0001
BMI ($kg.m^{-2}$)$^{\Delta}$	1.18 ± .44	0.7 ± 0.41	1.4 ± .44	0.3
WC (cm) [b]	71 ± 5.45	93 ± 27.5	94 ± 14.4	< 0.0001
WC (cm) $^{\Delta}$	0.87 ± 2.89	0.98±.0.1	1.89 ±1. 17	0.1
Hip circumference(cm) [b]	91.52 ± 6.9	107 ± 23.7	116 ±12	< 0.0001
Hip (cm) $^{\Delta}$	1.37 ± 0.50	2.3 ± 1.51	1.98 ± 1.07	< 0.24
Weight (kg) [b]	56.23 ± 3.42	76.37 ± 16.9	85.1 ± 15.73	< 0.0001

Weight (kg)$^{\Delta}$	3.14 ± 1.18	2.02 ± 0.96	2.74 ± 1.15	0.3
LBM(kg) ^{b}	41.54 ± 2.82	47.5 ± 4.26	49.1 ± 5.1	< 0.0001
LBM(kg)$^{\Delta}$	0.92 ± 34	0.59 ± 0.28	0.80 ± 0.34	0.3
Fat percentage (%)^{b}	19.21 ± 1.87	27.1 ± 8.3	30.71 ± 4.58	< 0.0001
Fat percentage (%)$^{\Delta}$	1.5 ± 2.37	3.22 ± 0.96	2.09 ± 1.91	0.4

Data presented as mean ± SD and p<0.05.BMI (Body Mass Index); WC (Waist Circumference); ^{b}(baseline); ^{p}(post); $^{\triangle}$ (Absolute Change- calculated by using the follow-up value minus baseline value); LBM (Lean body mass); FID (Feel minus ideal).

4.6. Body size discrepancy for the intervention group

The proportion of participants who wanted to be fatter, leaner and those who were content with their body size did not change significantly at follow-up intervention. There was a high FID score of participants who wanted to be leaner (83.67%) compared to the women who wanted to gain weight (4.08%). (See table 9).

Table 9. The association of feel–minus–Ideal score with anthropometry for the intervention group (n=49)

Variables	**Participants who wanted to be fatter**	**Participants who were content with their body size**	**Participants who wanted to be leaner**	**P -value**
Proportion in each FID Group (%)^{b}	(4.08%) n=02	(12.24 %) n=06	(83.67%)n= 41	
Age(years)	34.5 ± 3.53	37.6 ± 15.1	45.8 ± 10.82	N/A
Weight (kg) ^{b}	55 ±.14	62 ±15.85	90 ±18.26	< 0.0001
Weight (kg)$^{\Delta}$	-3.5. ±1.84	-3.9. ±11.58	-5.6. ±13	< 0.0001

BMI (kg.m^{-2}) ^{b}	22 ± 2.45	24 ± 4.72	34 ± 6.9	< 0.0001
BMI (kg.m^{-2})$^{\Delta}$	-0.57 ± 0.47	-0.45 ± 0.52	-0.85 ± 1.01	0.6
WC (cm) ^{b}	70 ± 1.41	73 ± 10.78	97 ± 14.33	< 0.0001
WC (cm) $^{\Delta}$	-1.48 ± 72	-1.33 ± 1.64	-1.51 ± 2.128	0.9
Hip (cm) ^{b}	96.5 ± 2.13	99.18 ± 8.27	118.1 ± 12.7	< 0.0001
Hip(cm) $^{\Delta}$	-1.5 ±.73	-0.99 ± 0.89	-2.38 ± 3.44	0.5
LBM(kg) ^{b}	42.49 ± 4.9	42.61 ± 6.26	51.5 ± 6.96	< 0.0001
LBM(kg)$^{\Delta}$	-0.36 ± 0.43	-1.46 ± 5.29	-1.46 ± 5.29	0.8
Fat percentage (%)^b	19.25 ±5.91	31.71 ± 4.31	31.71± 4.31	<0.0001
Fat percentage (%)$^{\Delta}$	-2.08 ± 1.25	-2.59 ± 1.46	-2.59 ± 1.46	0.5

Data presented as mean±SD and p<0.05.BMI (Body Mass Index); WC (Waist Circumference); ^{b}(baseline); ^{p}(post); $^{\triangle}$ (Absolute Change (calculated by using the follow-up value minus baseline value); LBM (Lean body mass). FID (Fee minus ideal).

4.7. Perceived and actual weight status for control group

For baseline PAD scores, 27.27% of participants overestimated their actual body size, while those who underestimated actual body size were 50%, also comparing to 22.72% who accurately perceived actual body size. .

Table 10. The association of perceived and actual weight status scores with anthropometry for the control group (n=66)

Variables	Participants who underestimated actual body size	Participants who accurately perceived actual body size	Participants who overestimated actual body size	P -value
Proportion in each PAD Group (%)[b]	(50 %) n=33	(22.72 %) n=15	(27.27%)n=18	
Age (yrs.)	39.1 ± 8.11	37.53 ± 8.79	30.67 ± 7.41	N/A
Weight (kg) [b]	31.1 ± 1.38	83.59 ±19.39	61.3 ± 8.28	< 0.0001
Weight (kg)[Δ]	3.1±1.38	2.53±92.2	2.9±1.31	0.2
BMI ($kg.m^2$) [b]	33.9 ± 2.9	31.52 ± 6.92	22.35 ± 3.34	< 0.0001
BMI ($kg.m^2$) [Δ]	1.18 ± 0.52	0.95 ± 0.35	1.05 ± 0.49	0.1
WC (cm) [b]	103 ± 9.91	95.32 ±17.82	73.68 ± 6.81	< 0.0001
WC (cm)[Δ]	1.9 ± 1.33	1.74 ± 0.98	1.22 ±2.94	0.5
Hip (cm) [b]	117 ± 6.6	114 ± 15.54	96 ± 4.9	< 0.0001
Hip (cm) [Δ]	2.0 ±1.13	1.96 ±.99	1.43 ±1.12	0.3
LBM(kg) [b]	50 ± 4.54	49.46 ± 6.83	44.14 ± 2.88	< 0.0001
LBM(kg)[Δ]	0.91 ± 0.41	0.74± 0.27	0.9 ± 0.38	0.1
Fat percentage (%)[b]	31.1 ± 2.93	29.8 ± 5.98	21.52 ±4.25	< 0.0001
Fat percentage	2.21 ± 1.18	1.81 ± 2.42	2.84 ±0 .62	0.3

(%)$^{\Delta}$				

Data presented as mean±SD and $p<0.05$.BMI (Body Mass Index); WC (Waist Circumference); ^{b}(baseline); ^{p}(post); $^{\triangle}$ (Absolute Change calculated by using the follow-up value minus baseline value); LBM (Lean body mass); PAD (Perceived Actual Discrepancy).

4.8. Perceived and actual weight status intervention group

For body size discrepancy in the intervention group, 57.14% of women underestimated their body size indicating a negative PAD score and a desire to be learner when comparing with the FID scores (83. 67%). Again, 10.20% overestimated their actual body size (Positive PAD score) while 32.65% (Zero PAD score) of women accurately perceived their body size. T There were no significant changes of waist circumference, lean body mass, total body fat and hip circumference at follow-up (refer to table 11).

Table 11. The association of perceived and actual weight status scores with anthropometry for the intervention group (n=49**)**

Variable	**Participants who underestimated actual body size**	**Participants who accurately perceived actual body size**	**Participants who overestimated actual body size**	**P -value**
Proportion in each PAD Group (%)^{b}	(57.14%)n= 28	(32.65%) n=16	(10.20%) n=05	
Age(yrs.)	47 ± 11.1	43 ± 11	40 ± 21.2	N/A
Weight (kg)^{b}	84.1 ± 15.1	88.1 ± 24.1	65.31± 6.1	0.2
Weight (kg)$^{\Delta}$	-3.2 ± 10.22	-. -5.1 ± 17.4	. -3.2 ± 5.49	0.1
BMI (kg.m^{2})^{b}	33.43 ± 6.4	33 ± 8.21	26.1 ± 1.3	0.4
BMI	-0.87 ± 0.9	-0.73 ± 0.99	-0.63 ±.11	0.8

(kg.m^2)$^{\Delta}$				
WC (cm) ^{b}	93.4 ± 13.5	95.4 ± 20.1	80 ± 4.21	0.4
WC (cm) $^{\Delta}$	-1.7 ± 2.43	-1.33 ± 1.6	0.0 ± 1.47	0.4
Hip (cm) ^{b}	115.3 ± 11.13	115 ± 16.1	101 ± 14.1	0.3
Hip (cm) $^{\Delta}$	-1.82 ± 2.50	-2.49 ± 3.87	-2.5 ± 0.71	0.7
LBM(kg) ^{b}	48.3 ± 5.14	52 ± 9.2	41.24 ± 3.74	0.7
LBM(kg)$^{\Delta}$	-2.9 ± 7.2	-0.58 ± 0.81	-0.46 ± 0.1	0.5
Fat percentage (%)^{b}	29.1 ± 5.94	30.11 ± 7.26	27.5 ± 5.30	0.8
Fat percentage (%)$^{\Delta}$	-2.23 ± 1.2	-2.65 ± 1.6	-3.71 ± 1.53	0.2

Data presented as mean±SD and $p<0.05$.BMI (Body Mass Index); WC (Waist Circumference); ^{b}(baseline); ^{p}(post); $^{\triangle}$ (Absolute Change -calculated by using the follow-up value minus baseline value); LBM (Lean body mass). PAD (Perceived Actual Discrepancy).

The FID score was positively correlated with sitting time. MVPA and total travel physical activity was negatively correlated with the FID. The PAD score was positively correlated with total work and total leisure-time physical activity (mins/week). There was no significance difference in participants who wanted to leaner and total moderate vigorous physical activity.

Table 12. The correlation between physical activity measures and body size variables following an intervention. .

variables	Sitting time(mins/day)	Total work(mins/wk)	Total MVPA(min/wk)	Total Mod(mins/wk)	Total Vig (mins/wk)	Total Travel (mins/wk)	Total leisure (Mins/wk)
FID positive	0.12(0.42)	0.15(0.29)	0.00(0.95)	0.09(0.53)	-0.03(0.82)	0.02(0.87)	-0.03(0.82)
FID Negative	-0.21(0.15)	-0.01(0.42)	-0.11(0.44)	-0.11(0.44)	-0.06(0.65)	-0.06(0.66)	-0.60(0.65)

FID Zero	-0.00(0.96)	-0.10(0.49)	0.05(0.68)	-0.03(0.81)	0.07(0.59)	0.01(0.93)	0.07(0.59)
FID Score	0.12(0.40)	-0.06(0.68)	-0.13(0.36)	0.05(0.72)	-0.13(0.36)	-0.00(0.99)	-0.12(0.38)
PAD Score	0.08(0.57)	0.06(0.65)	0.03(0.18)	0.03 (0.79)	0.01(0.90)	0.01(0.94)	0.01(0.90)

Data presented as correlation co-efficient and (P-Value) with statistical significance at P<0.05.FID (Feel minus ideal);PAD((Perceived Actual Discrepancy).

There was a positive correlation for the feel minus ideal in the pre-test, while a positive correlation was observed in the post test results. Regarding PAD score, a positive correlation was shown in the post -test. In the control group, both FID and PAD scores were inversely relationship in the pre-test. There was a significance difference of body size in the pre and post results indicating a change in the scores.

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Table 13. Change in FID and PAD scores of participants from pre to post-test

Variables	Pre-test r(p- value)	Post-test r(p-value)
	Intervention group (n=49)	
FID$^{\Delta}$	-.47(.00)	. 14(.31)
PAD$^{\Delta}$	-.55(.00)	1.00(.00)
	Control group (n=66)	
FID$^{\Delta}$	-.45(.00)	.21(.07)
PAD$^{\Delta}$	-.76(.00)	. 43(.00)

Data presented as correlation (r) and P-value (P<0.05);FID (Feel minus ideal);PAD(Perceived actual discrepancy);Δ(Change in variables).

4.9. Multivariable linear regression analyses

Multivariable linear regression analyses were conducted using a backward stepwise analysis approach to manually to remove independent variables until those variables with p<0.05 remained (see Table 14). It can be observed in model 1 that total sitting time β=0.23, P= 0.0001 and total SESβ= 0.16 (0.0001) was positively associated with waist circumference, while baseline β= -0.38, P= 0.0001 and absolute total MVPA β= -0.56, P= 0.0001 showed an inverse relationship.

In model 2, total sitting time was positively associated with BMI β= 0.18, P= 0.0001 (Indicating a higher risk of obesity, wherelse a negative association was shown in total MVPA baseline β= -0.42, P= 0.0001 and change in physical activity β= -0.61, P= 0.0001. Change in FID score showed a significant difference between change in BMI 0.30 (0.0001) and age β= 0.21, P= 0.0001 at baseline. Again, this relationship indicated that a change in FID was associated with higher BMI status (see model 3, table 10). A change in PAD score was associated with total sitting time and total MVPA β= 0.14, P= 0.0001, thus indicating a positive significant difference in participants who underestimated their actual body size.

There was a negative association in participants who overestimated their actual body size β= -0.46, P= 0.0001 (model 4). Change in BMI was positively associated with change in systolic β= 0.23 (0.0001) and diastolic blood pressure β= 0.24 P= 0.0001 However, a negative association was observed in total MVPA β=-0.65, P= 0.0001 and change in blood pressure both at baseline and follow-up results for both control and intervention group (refer to table 14).

Table 14. Backward stepwise multivariable linear regression models for changes in physical activity associated with follow-up anthropometry, body size dissatisfaction and blood pressure.

Model number	**Dependent variable**	**Independent variables**	**Beta coefficients (β) (P-value)**
1	WC$^{\Delta}$	Total sitting$^{\Delta}$	0.23 (0.0001)
		Total MVPA^{b}	-0.38 (0.0001)
		Total MVPA$^{\Delta}$	-0.56 (0.0001)
		Total SES score	0.16 (0.0001)
2	BMI$^{\Delta}$	Total sitting$^{\Delta}$	0.18 (0.0001)
		Total MVPA^{b}	-0.42 (0.0001)
		Total MVPA$^{\Delta}$	-0.61 (0.0001)
3	FID$^{\Delta}$	BMI$^{\Delta}$	0.30 (0.0001)
		Age ^{b}	0.21 (0.0001)
		Participants who wanted to be leaner	-0.34 (0.0001)

4	PAD$^{\Delta}$	Total sitting$^{\Delta}$	0.14 (0.0001)
		Total MVPA$^{\Delta}$	0.14 (0.0001)
		Participants who underestimated actual body size	0.38 (0.0001)
		Participants who overestimated actual body size	-0.46 (0.0001)
5	SBP$^{\Delta}$	BMI$^{\Delta}$	0.23 (0.0001)
		SBP^{b}	-0.15 (0.0001)
		Total MVPA^{b}	-0.34 (0.0001)
		Total MVPA$^{\Delta}$	-0.65 (0.0001)
6	DBP$^{\Delta}$	BMI$^{\Delta}$	0.24 (0.0001)
		DBP^{b}	-0.11 (0.0001)
		Total MVPA^{b}	-0.36 (0.0001)
		Total MVPA$^{\Delta}$	-0.61 (0.0001)

Data presented as beta coefficient(p-value); Δ-Absolute change- calculated by using the follow-up value minus baseline value; MVPA (Moderate vigorous physical activity);b (Baseline); SES (socio economic status); SBP (systolic blood pressure); DBP(diastolic blood pressure).

CHAPTER FIVE: WALKING AS A COST-EFFECTIVE MEANS OF INFLUENCING ANTHROPOMETRY AND BLOOD PRESSURE IN AFRICAN WOMEN.

(Accepted for publication in the journal of African Health Sciences)

5.1. Introduction

The obesity pandemic continues to increase in developing low and middle income and sub-Saharan African (SSA) countries, while in more affluent countries the prevalence of overweight and obesity seems to have plateaued (119). Women are noticeably more affected than men, and in the SSA region, black South African women appear to have the highest prevalence of the disease. Consequently, obesity-related non-communicable diseases (NCDs) such as hypertension are increasing in this group. A study of black South African women living in Soweto suggests that risk factors for NCDs are driven by the obesity crisis (120). Other countries in the sub-Saharan African region are experiencing a similar increase in obesity-related diseases, symbolic of countries moving through a nutrition transition (121).

South Africa like most SSA countries is experiencing rapid urbanisation, with those migrating to urban centres adopting behaviours acknowledged to be associated with overweight and obesity. Although, these and other determinants of the disease have been highlighted in previous studies,(35). Limited evidence on strategies to reduce the risk of obesity and related NCDs is available. In low resource settings such as South Africa, access to behaviour change strategies is very limited, indicating the need for more cost-effective solutions. However a systematic review on the health benefits of active travel conducted in developed countries has shown that walking can significantly improve health outcomes (122). The main aim of this study was therefore to determine whether walking, a domain of physical activity, has a similar effect in SSA countries. This study was carried out in a sample of university-employed, Limpopo province residing black South African women, who are known to have a high prevalence of overweight and obesity (123).

5.2. Methods specific to the publication

This randomized control trial was conducted at the University of Venda, located in the Limpopo province, South Africa. Permission to conduct the study was given by the Human Research Ethics Committee (medical), University of the Witwatersrand (ethics certificate number: M160518). The initial screening included 394 eligible women, aged ≥18 years and employed at the university, 132 of women signed a written consent and agreed to volunteer to participate in the study. The list of women was given to research assistants to conduct distance randomisation of participants into a control (n=66) and intervention group (n=66). The intervention group underwent a 12-week, supervised walking programme, 3 days/week, and 30 minutes, during the common lunch-time period to avoid disrupting usual work activities. The control group did not receive any treatment during the 12-week trial period. Pregnant, illiterate or injured women were not included in this study.

A questionnaire was used to determine education status (completion of high school, work-type (academic, administrative, or other (e.g. maintenance, security guard, cleaner, and healthcare). Monthly income was recorded; however individual ownership of household assets was used as the primary measure of socioeconomic status (SES). These included ownerships of the following 11 assets, ranked according to value: (11) motor vehicle, (10) satellite television, (9) electricity, (8) internet subscription, (7) mobile phone, (6) telephone, (5) television, (4) washing machine, (3) refrigerator, (2) computer/laptop, (1) radio. A total SES score was generated from these household assets (x/66).

Body mass was measured using a digital scale to the nearest 0.01kg (Seca, Hamburg, Germany). Stature was measured using a stadiometer (PHR, USA) to the nearest cm. Body mass index (BMI) was calculated as weight (kg)/height $(m)^2$. Waist and hip circumference (cm) were measured while standing, arms at the sides, feet together and abdomen relaxed. Waist-to-Height ratio was calculated. Systolic and diastolic blood pressure was measured with the participant in a seated position using the Omron BP monitor (M6, Europe). The average of the latter two of three measurements was recorded after the participants had rested for at least 10 minutes. The Global Physical Activity Questionnaire (GPAQ) was used to determine moderate-vigorous physical activity (MVPA) and estimated sedentary behaviour (or sitting time). The GPAQ has been previously validated for use in the South African context. Body size dissatisfaction was determined using a validated tool with nine silhouettes reflecting underweight to morbid obese African women. Participants were asked to point out the image that most closely matched how they perceived themselves, followed by a request to show their ideal body silhouette. A ‘feel’ minus ‘ideal’ score was determined using these scores, with a negative score indicating a desire to be fatter, a positive score signifying a desire to be thinner, and a zero-score illustrating that participants were content with body size. These outcomes were measured in the participants prior to the intervention and within the first week after the trial was completed.

The participants in the intervention group were required to attend the walking programme on a weekly basis from 09 January to 31 March 2017. The nature of programme was based on previous evidence highlighting that walking is common amongst African populations and adds more to accumulated weekly MVPA than occupation- and recreation-related physical activity (120). Using treadmills (Jkexer Sprint 9875A), the walking intervention took place during lunch breaks at the Human Movement Sciences gymnasium, University of Venda. Further, given the limited time for lunch breaks (≤1 hour), a duration of 30 minutes was agreed upon by the authorities of the university and the participants to provide ample time to reach the venue and change into appropriate clothing. Participants’ resting blood pressures were measured on arrival followed by a period of light stretching before starting the 30 minutes walking programme. A moderate intensity was ensured by walking speed (5 to 5.5 km/h), RPE (4-8/10), and gradient (0.5 -1.5 degrees) throughout the intervention. The participants were monitored throughout the activity for any exaggerated physiological changes by qualified research assistants. Hydration with water was encouraged and the ambient room temperature was kept at 18 degrees Celsius.

5.3. Statistical analysis used in the publication

Data were analysed using Stata 14 (USA). Paired t-tests or Wilcoxon matched pairs tests were used to determine intra-group changes in anthropometry, blood pressure and physical activity; while inter-group differences were tested using Independent t-tests or Mann-Whitney U-tests. Using the pre-test blood pressure and anthropometric measures as covariates, analysis of covariance (ANCOVA) was used to determine the differences between the control and intervention groups.

5.4 Results

The participants who dropped out of the intervention group (n=17) during the study were not included in the analysis. The final sample included 115 (49; 42.6% intervention group) participants, with the mean age of the women in the control group being younger than those in the intervention group (44.4 and 37.4 years respectively, $p<0.05$). Most of the participants in the control and experimental groups earned a salary above R10000 per month (100% and 91.8% for the control and intervention groups respectively), and most of the study population were in the moderate socio-demographic stratum as reflected by the SES score (47.4 ± 12.7 and 47.6 ±13.9 in the control and intervention groups, respectively). The occupation types included academics (45.5% vs. 36.7%, control vs. intervention groups), administrative roles (30.3% vs. 28.6%), and a group composed of security, maintenance, cleaning, and healthcare staff members (24.2% vs. 34.7%). The baseline body size dissatisfaction scores in the control group showed that 83.3% wanted to be thinner, 4.6% were happy with their body-size, and 12.1% indicated a desire to be fatter.

The baselines scores were similar to the intervention group ($p>0.05$), and neither changed at follow-up. The anthropometry of both groups was similar at baseline, however anthropometric variables increased in the control group and were reduced in the intervention group. Similarly, blood pressure was similar between the groups at baseline, but was lowered in the intervention group and increased in the control group. Following the intervention, MVPA and sitting time at baseline were higher and lower respectively in the intervention group than in the control group (p<0.05). Sitting time did not change at follow-up, while MVPA increased significantly in the intervention group (p<0.05).

Table 15. Baseline and change characteristics of participants in the control (n=66) and intervention (n=49) groups

Variables	Control group[b]	Intervention group[b]	p-value[¶]	Control group[△]	Intervention group[△]	p-value between groups[†]
Age (years)	37.3 ± 8.78	44.4 ± 11.5	N/A	N/A	N/A	N/A
Anthropometry						
Weight (kg)	81.9 ± 17.7	85.9 ± 20.7	0.26	+2.76 ± 1.15[*]	-2.07 ± 2.51[*]	<0.0001
BMI ($kg.m^{-2}$)	31 ± 6.57	32.8 ± 7.25	0.18	+1.05 ± 0.44[*]	-0.80 ± 0.96[*]	<0.0001
WC (cm)	94.7 ± 17	93.8 ± 16.5	0.78	+1.73 ± 1.48[*]	-1.50 ± 2.02[*]	<0.0001
Hip (cm)	113 ± 14	115 ± 14	0.39	+1.93 ± 1.05[*]	-2.18 ± 3.20[*]	<0.0001
WHtR	58.4 ± 10.6	58.0 ± 9.75	0.86	+1.07 ± 0.92[*]	-0.92 ± 1.25[*]	<0.0001
Blood pressure						
Systolic BP (mmHg)	112 ± 15.6	118 ± 17.5	0.17	+4.64 ± 2.26[*]	-4.02 ± 3.01[*]	<0.0001
Diastolic BP (mmHg)	73.7 ± 10.6	74.1 ± 12.7	0.46	+4.94 ± 2.10[*]	-2.37 ± 2.40[*]	<0.0001
Mean arterial pressure (mmHg)	91.3 ± 11.2	88.7 ± 13.4	0.28	+4.83 ±1.87[*]	-2.92 ± 1.93	<0.0001

Pulse pressure (mmHg)	46.6 ± 11.7	44.0 ±11.7	0.23	-0.30 ± 2.29*	-1.65 ± 3.76*	<0.0001
Physical activity						
Total MVPA (mins/week)	20(10.40)	45 (20, 130)	<0.0001	0 (-8, 3)	176(125.180)*	<0.0001
Sitting time (mins/day)	480 (420-600)	360 (240, 480)	<0.0001	0(0,120)	0 (-60, 0)	<0.0001

Data presented as mean ± SD or median (interquartile range) or present; [b]baseline; △ Mean difference; * Paired t-tests or Wilcoxon matched pairs tests (all p<0.0001); ¶Independent t-tests, or Mann-Whitney U-tests; †ANCOVA model; BMI: body mass index; BP: blood pressure; MVPA: moderate-vigorous physical activity; WC: waist circumference; WHtR: Waist-to-Height ratio

5.5. Discussion

The main finding of this experimental study was that those women who engaged in the 12-week supervised walking programme lowered BMI and other measures of fat, in addition to experiencing decreased blood pressure. In comparison, the women in the group who did not participate in the intervention experienced increases in blood pressure and anthropometry. The sitting time of both groups did not change during the study, however the physical activity profile of the intervention group increased significantly, which is characteristic of the sedentary type of occupation of most of the women in the study.

The body size dissatisfaction findings support those of other studies which show that the majority of contemporary African women want to be thinner,(124) as opposed to earlier studies showing that populations were more attuned to favouring larger body frames. This suggests the readiness of African women for lowering body weight by adopting contextualised public health programmes (124).

Further, our data supports the idea that the required physical activity for optimal health outcomes and the prevention of early cardio metabolic morbidity can be attained through a lifestyle of structured walking performed at moderate pace by using the broadly accepted RPE scale (125).

Strengths of this study include using a cost-effective intervention to address health concerns in a cohort at risk, in addition to the relatively low drop out of the intervention group, possibly attributable to the low physiological demand and acceptability of walking as a form of usual human activity. A limitation of the study might be the confounding positive effect of group activity as shown by the improved emotional and physiological characteristics of older women following a year-long group exercise intervention (126). The use of questionnaires is another limitation worth noting; however, given the limited access to objective measurement, validated self-reported tools will continue to be utilised in the SSA region (124).

5.6. Conclusion

In African women experiencing acculturation toward thinness, walking for exercise is an effective tool for improving anthropometry and lowering the risk of elevated blood pressure. Further study is needed to investigate the sustainability of a walking programme in the growing concern of NCDs-related early mortality.

CHAPTER SIX: DISCUSSION

6.1. Consolidated findings of the dissertation

This dissertation aimed at investigating the effects of physical activity intervention on body size dissatisfaction in black South African women. The objectives of this dissertation and summary findings are highlighted in Table 16.

Table 16. Summary table of objectives and findings

Number	Objectives	Summary of results
1	To determine baseline physical activity, psycho-social profile and anthropometry of black South African women	• There was a positive association in total sitting time and with body mass index β0.18, P=0.0001, and anthropometry
2	To examine the changes in these measures following the intervention of supervised physical activity	• A negative association in baselineβ -0.42, P=0.0001 and absolute -0.61, P=0.0001 moderate-vigorous physical activity. • There was a significant difference in absolute changes in body mass index, waist circumference and percentage of body fat with intervention.
3	To determine whether a change in physical activity is associated with follow-up anthropometry and body size dissatisfaction.	• 4.08 % of women who were in the experimental group wanted to be fatter. • 12.24 % of women wanted were content with their body size. • 83.67% women wanted to be leaner following an intervention.
4	To determine whether physical activity influences resting blood pressure, particularly in those with existing elevated	• There was a significant difference in systolic blood pressure and diastolic

	resting blood pressure.		blood pressure, p =0. 0001) with physical activity.

This was an experimental study done in black South African women. The study involved female participants who engaged in physical activity and those who were in the control group. This was done to determine the difference in results of women who engaged in physical activity and those who did not participate, about body size dissatisfaction for 12 weeks. Women who were involved in physical activity showed lowered anthropometric characteristics (i.e., BMI, total body fat and waist circumference). In comparison, the women who did not participate in the intervention experienced increases in blood pressure and anthropometry. There was no change in sitting time for both groups indicating sedentary occupation for most women in the study. Both control and intervention groups showed dissatisfaction with body size and expressed a desire to be leaner.

6.2. Emerging themes in the dissertation

6.2.1. Obesity in black African women

This study showed baseline and interventional physical activity and body size dissatisfaction results of black South African women population. Looking at baseline BMI classification from the control group, about 57.57% of women were obese, 01.51% underweight, 18.18% were overweight, and 22.72% of women had normal weight. The interventional group revealed 18.36% of women who had normal weight, 22.44% who were overweight and 59.18% of women were obese. The consideration drawn from above results shows a distinct trend of obesity in the South African population (59). This is likely to cause an increase of non-communicable diseases accounting for broad premature mortality in South Africa (62). The same study also found a positive trend in BMI observed primarily in women of the same population group. Another pattern was also discovered in women aged 45-54 who had a BMI higher than 29.2 kg/m^2 and 28.9 kg/m^2 in those aged 55-64 years of age (14).

Excessive weight gain was found to be the leading cause of mortality and morbidity across the globe with half billion adults considered obese (127). This study, by comparison, found a significant weight gain observed in females who also possessed higher BMI status. A survey indicated that South Africa was seen to have a higher prevalence of obesity than most other developing countries (128). A related case was also found in some other countries.
For instance in countries like Cameroon, the prevalence of obesity was estimated to be five times higher in females between 15–34 and 35-44 years of age when compared to men (129). Another study also indicated that among behavioural factors, the trend in BMI increase in women who are non-smokers than those who smoke who tend to lose weight (59).

A significant increase in waist circumference was found in women who did not participate in physical activity while a decrease in this variable was observed in the intervention group. We also found that waist, BMI and WHtR demonstrate a stronger association in predicting individuals who are obese. This is supported by a study which focused on middle-aged adults using body mass index and waist–height ratio in identifying participants who were at high or low risk of this epidemic conditions (130).

Excess body fat is documented as a risk factor for various chronic conditions namely cardiovascular diseases, diabetes, and hypertension (20). Therefore, there is a need to address, make awareness and implement regular physical activity programs in women to prevent premature death and future development of non-communicable diseases. In conclusion, studies on anthropometric measures in an adult population of sub-Saharan African countries are limited. Furthermore, BMI and weight are considered the most common indicators used to assess overweight and the prevalence of obesity(129).

6.2.2. Physical activity and socio-economic status

In this experimental study, physical activity level was determined between the control and the intervention group of women. The World Health Organization defines sufficient physical activity as accumulating a minimum of 150 minutes of moderate exercise per week (20). While using the World Health Organization measure, this study discovered that only 9.56% of women were active and 90.43% were inactive**.** Based on Global Physical Activity measuring criteria, 91.30 % of women were classified as inactive while 8.69 % were active. This may suggest that a high number of black South African women are inactive and do not meet the recommended requirements of physical activity participation. This, in turn, may increase the risk of non-communicable diseases and body size dissatisfaction.
In developed countries, Physical activity contributes significantly from leisure time activity than in developing countries where travel work physical activity are the primary influencers to daily energy expenditure (131). High levels of physical activity were correlated with low rates of BMI with the effectiveness of the intervention.

Walking for travel contributed to weekly physical activity, with an inverse association to sedentary promoting assets including television and motor vehicle ownership.
A study has indicated motor vehicle ownership as part of the sedentary promoting asset (132). This study has found that women who owned a motor vehicle had increased risk of obesity and elevated levels of blood pressure. The economic growth in South Africa has resulted in a high number of individuals who can afford to own a car (133). Urbanization status has also increased in the population that holds a vehicle as well. Thus, in conclusion, suggests a trend in physical inactivity due to vehicle ownership (inactive mode of transport). By comparison, this study found that women who owned a vehicle had less walking time compared to those who did not own a car. This is on par with a study that found an association between sitting time and women who did not own a motor vehicle yet walked more significantly than those who did not own a motor vehicle (134). In high-income countries, the prevalence of physical inactivity was high when compared to lower-income countries (135).

6.2.3 Blood pressure in African women

In the United States of America (USA) and Europe, Black adults have been found to have the highest age-adjusted rates of hypertension among all racial-ethnic groups (136). Again, 43.9% of women were reported to suffer from hypertension amongst other comorbid conditions such as chronic kidney disease and diabetes mellitus when compared with the general population (137). The current study found 27.39 % of women who are hypertensive with low levels of physical activity participation. Moreover, a significant change in blood pressure was observed in the group that was exercising compared to the group that was not participating in physical activity. A study found a high prevalence of hypertension in elderly aged 70 years and older reaching 70% in an urban Tanzanian population (138).

This high prevalence was found to be a result of the lack of awareness about hypertension in the affected population. For instance, the highest awareness rates were found in urban older adults (81%) and North Africa in general (139).

There was a decrease in the number of participants who were at risk of hypertension with supervised physical activity. However, the risk of hypertension increased gradually with BMI, WC, and WHR in women (140). Anthropometric measurements showed that a high percentage of women were significantly overweight and obese with 38.1% of women who were Hypertensive (141).

This emphasizes the positive influence of physical activity on blood pressure. A change in BMI was positively associated with systolic and diastolic blood pressure in the group that took part in physical activity. However, an inverse association was indicated in the group that did not participate in any physical activity with higher rates of BMI. In a high prevalence setting like Africa, it is of paramount significance to describe the detection rate, awareness, treatment, control, and factors that influence the speed of this condition (142)

6.2.4 Body size dissatisfaction in black South African women

The assessment of body image perception has been evaluated in both western and African countries (17). A study has shown that sociocultural factors aid in the risk of obesity in black population (143). In this study, 83.67% of women wanted to be leaner,12.24%were content with their actual body size and 4.08% wanted to gain weight. This means that a high number of women were dissatisfied with their body size.

Next, 10.20% of women in the intervention group overestimated their body size,57.14% underestimated their body size and 33.65% accurately perceived their body image. Unquestionably, this shows a greater significance in women who did not estimate their body size accurately. This finding is on par with what has been investigated in a South African study with 45.3 % of women who were dissatisfied with their body image and 84.5 who did not accurately estimate their body size (14). Moreover, those who were highly dissatisfied with their body size wanted to lose weight and use other weight management strategies. Again, it was stated that half of the South African population constitute 50.8% individual who is overweight or obese with only 12.1% having attempted to lose weight (14). Participants in the intervention group who were overweight and obese had positive FID scores which indicated the desire to be leaner and underestimated their body size (14). We showed a high number of black women who were not content with their body sizes, therefore affecting their BMI status and promoting weight gain. The increase in BMI status was also because of the high Socio-Economic-Status and urbanization which is associated with the risk of non-communicable disease and physical inactivity. Again, we also indicated an increased number of women who were dissatisfied with their body size and wanted to be leaner rather. This suggests that urbanization together with SES plays an essential role in the eating patterns physical activity, and lifestyle behaviour.

Unfortunately, diet was not included in this study to further indicate the results that are examined in the perception of body image in women. The findings of body size dissatisfaction support those of other studies which show that most contemporary African women want to be thinner. This again is backed by our hypothesis which indicated that baseline physical activity would influence follow-up body size dissatisfaction. The group of women who wanted to be leaner had a higher BMI status and waist circumference. Again, women who wanted to be fatter resembled a high BMI status, waist circumference, and body fat. An absolute adverse change was shown in weight, hip circumference, and percentage body fat. In brief, Body Mass Index is a strong predictor of body dissatisfaction in females (144).

6.4.3. Body size dissatisfaction and physical activity in black South African women.

FID was associated with change in BMI ($P<0.05$). The results indicate that as age increases, BMI increases resulting in a high rate of women who were dissatisfied with their body size in both the control and intervention groups. A change in PAD scores was positively associated with total sitting time and total MVPA for the intervention group. The results therefore, indicate that physical activity has a positive effect on body size dissatisfaction. This means that our hypothesis was accepted. Again, implementing a physical activity intervention in a related population group can be of essence in decreasing the risk of non-communicable diseases. In this study, 83.67% of women who were dissatisfied with their body size wanted to lose weight and to be leaner following an intervention. This results are consistent with a study that indicated greater positive improvement of body dissatisfaction in women who were highly dissatisfied with their body image at baseline(31).

Based on the results found in this study, a conclusion can be made on implementing lifestyle physical activity programs for the university employees. Also taking into consideration that most of the occupations performed at a university level require more sitting time which means that less energy is being utilized. As a result, more energy will accumulate in the body and lead to excess weight gain resulting in obesity and other diseases of lifestyle. As a recommendation to the university, a practice of the recommended exercise protocol by the World Health Organization to encourage regular participation in physical activity may be of significance. This can bring more productivity to the university and employees can benefit from reduced health care cost.

6.4. Strengths of the study

The main strength of this study is that it was conducted in a group of African women, adding to the limited data on obesity. Also, the results can form part of the cohort study in black African women with an association between dietary patterns and anthropometry.

6.5 Limitations of the study

The study did not include dietary patterns across the groups which would be of great value when compared with body image and changes in anthropometry. Dropouts due to the relocation of workplace and expiration of contracts decreased the number of participants, especially in the intervention group.

6.6. Future research

The study has identified the following areas that require future research:

1. There is a need to conduct interventional longitudinal studies on physical activity, anthropometry and dietary patterns that will document health outcomes concerning body image.
2. Changes in body weight need to be explored further especially amongst the younger population to determine the influence on eating behaviour and future risk of obesity.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS

7.1. CONCLUSION

This dissertation was focused on investigating whether physical activity intervention influences body size dissatisfaction in black South African women. The findings suggest that physical activity affects body image perception in women. Most women were dissatisfied with their body image and wanted to lose weight. However, due to different cultural practices and pressure from society, it becomes challenging for black women to engage in a regular physical activity. Therefore, there is a need for addressing the importance of daily physical activity in both urban and rural areas across different ethnic groups of women.

Most of the occupation required a lot of sitting time in women who took part in the study. This can be an exciting area of research that can focus on occupational, physical activity as the factor for increased BMI and lower level of physical activity patterns in women of all age group. Lastly, physical activity was observed to influence resting blood pressure especially on those with elevated resting systolic and diastolic blood pressure. This calls for more interventional studies in this area even with the male population group and addressing the need to have an employee exercise program included in the schedule of working hours at the various working environment

7.2. Recommendations

This study has shown the effect of physical activity intervention on body size dissatisfaction, and therefore the following is recommended:

1. Put physical activity programs to support women in changing their perceptions about body image and themselves in workplaces and home settings.
2. Create awareness campaigns on the risk of not engaging in physical activity especially in older women who tend to be at a higher risk of obesity and non-communicable diseases.

3. Educate the community members on the importance of living a healthy lifestyle to prevent the risk of elevated blood pressure and other non-communicable diseases
4. Educate the University and schools on the importance of physical activity participation, body image and non-communicable diseases to decrease the risk of obesity from adolescent-hood and young adult-hood stage. Physical education in schools may be a significant inclusion.
5. Further studies are required to probe more on the effects of physical activity and the dietary patterns as it is one of the factors that influences body size and body mass index, especially in black women.

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8. APPENDICES

Appendix A: Information letter

This information is based on a research project titled **"Effect of physical activity intervention on body size dissatisfaction in black South African women''**. Body size dissatisfaction refers to the degree a person is content with their self-perception of body size as measured by the feel-minus index. The purpose of this study is to determine whether self-perception of body size is influenced by physical activity or not.

Your response is of importance. Anonymity and confidentiality are guaranteed by not needing to enter your names on the questionnaires. Your participation is completely voluntary, and the physical discomforts are no greater than those experienced in usual everyday activity. The intervention is expected to be positive, informative and interesting experience. You may withdraw from the project at any stage. You will be requested to fill in the Physical Activity Questionnaire, and Body dissatisfaction chart at the beginning of the program as well as the last day of the intervention. Measurements will include height, weight, waist and hip circumferences, skinfolds, and blood pressure. . If you are willing to form part of the exercise group, you will be invited to participate in 30 minutes of supervised exercise..

The research may help determine whether it is important to include physical activity programs as part of a health and wellness programs for university employees. You will know your physical activity level and be able to make positive lifestyle changes. Benefits of physical activity include prevention and management of back pain, arthritis, reduce the risk of type 2 diabetes, hypertension and obesity as well as help you in managing stress.

Thank you for considering participating. Should you have any questions, or should you wish to obtain a copy of the results of the survey, please contact (015) 962 8486 or precious.golele@univen.ac.za.

Kind regards,

Precious Golele

Appendix B: Consent form

Title of research project: Effect of physical activity intervention on body size dissatisfaction in black South African women.

Name of principal researcher: Ms. Golele Precious Nkhensani

Department: Centre for Biokinetics, Recreation and Sport Science, University of Venda

Participant's involvement: You are invited to take part in a 12-week physical activity intervention, to evaluate whether it has effect on body size dissatisfaction and other physical and physiological characteristics.

What's involved? This study involves measurements of height, weight, skinfolds, blood pressure, Physical activity level, body dissatisfaction and physical activity intervention.

Risks: The risk and discomfort associated with participation in this study are no greater than those ordinarily encountered in daily life during routine physical examination tests. The intervention is expected to be positive, informative and interesting experience.

Benefits: Your Participation will benefit your overall health and well-being. You will know your physical activity level and benefits of engaging in physical activity which will help you make better future decisions concerning your health and you will also form part of Stats South Africa for Health patterning.

I acknowledge the following:

- I agree to participate in this research project.
- I have read this consent form and the information it contains and had the opportunity to ask questions about them.
- I agree to my responses being used for education and research on condition that my privacy is respected, subject to the following:

- I understand that my personal details will not / may be included in the research / will be used in aggregate form only, so that I will not be personally identifiable (delete as applicable.)
- I understand I have the right to withdraw from this project at any stage.

Name of Participant: _____________________________ Date: _________________

Signature of participant: _______________Signature of researcher: _______________

Witness_____________________________

Appendix C: Demographic questionnaire and data collection sheet

Dear Participant

Please complete the following questions.

1. What is your Age?

2. Marital Status

Single	Married	Divorced

3. What is your main occupation?

4. How many years have you been employed in this role?

5. What is your salary per month? Place an ‘X’ over the appropriate answer.

<R5000	R5000-R10000	R10000-R15000	R15000-R20000	≥R20000

6. Indicate which of the following household items you own. Place an 'X' over the appropriate answer. (You can choose more than one item)

Car	DSTV	TV	Electricity	Radio	Fridge	Washing machine	Computer	Internet	Mobile phone	Telephone	Microwave

7. Do you currently smoke?

Yes	No

7.1 If yes, how many cigarettes do you smoke per day?

8. Do you currently use snuff?

Yes	No

8.1 If yes, how often do you use snuff?

Once per week	2-3 per week	4 or more times per week	2-4 times per month	Once a month

9. How often do you have alcoholic drinks?

Never	Once a month	2-4 times per month	2-3 times per week	4 or more times per week

10. Anthropometric measures

Height (mm)	
Weight (kg)	
Waist circumference (cm)	
Hip circumference (cm)	

11. BLOOD PRESSURE

	1	2	3
Systolic blood pressure (mm Hg)			
Diastolic blood pressure (mm Hg)			

12. Skinfold measurements (mm)

	1	**2**	**Average**
Triceps			
Chest			
Midaxillary			
Subscapular			
Suprailiac			
Abdomen			
Front thigh			

Appendix D: Global Physical Activity Questionnaire

This questionnaire is going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be physically active.

Think about the time you spend you spend doing work, studying/training, household chores, harvesting food, fishing, hunting, seeking employment. In answering the following questions 'vigorous-intensity activities are activities that require hard physical effort and cause large increase in breathing or heart rate, moderate activities are activities that require moderate physical effort and cause small increases in breathing.

	ACTIVITY AT WORK	RESPONSE	CODE
1	Does you work involve vigorous-intensity activity that causes large increases in breathing or heart rate (like carrying or lifting heavy loads, digging, construction at work)for at least 10 minutes continuously?	YES 1 NO 2. If No, go to P4.	P1
2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days____	P2
3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	hours______ minutes________	P3 (a-b)
4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking (or carrying light load or	YES 1 NO 2 If no. go to P7	P4

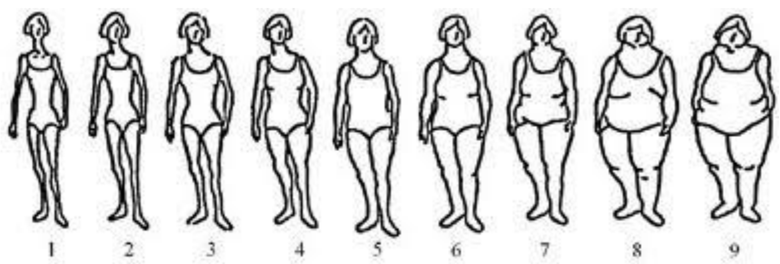
	at least 10 minutes continuously?		
5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days______	P5
6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours______ Minutes______	P6 (a-b)
TRAVEL TO AND FROM PLACES			
The next question excludes the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. Example to work, for shopping, to market or church.			
7	Do you walk, or use a bicycle for at least 10 minutes continuously to get to and from places?	YES 1 NO 2 If no, go to P10	P7
8	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days______	P8
9	How much time do you spend walking or bicycling for travel on a typical day?	Hours______ minutes________	P9 (a-b)
RECREATIONAL ACTIVITIES			
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities(leisure)			
10	Do you do any vigorous-intensity sports,	YES 1	P10

	fitness or recreational activities that cause large increase in breathing or heart rate like running, jogging, soccer or netball for at least 10 minutes continuously?	NO 2 If no. go to P13	
11	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational activities?	Number of days________	P11
12	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours_______minutes_______	P12 (a-b)
PHYSICAL ACTIVITY (recreational activities)contd.			
13	Do you do any moderate-intensity sports, fitness or recreational activities that cause a small increase in breathing or heart rate such as brisk walking, jogging, cycling, and soccer for at least 10 minutes continuously?	YES 1 NO 2 If no, go to P16	P13
14	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational activities?	Number of days______	P14
15	How much time do you spend doing moderate-intensity sports, fitness or recreational activities on a typical day?	Hours_______minutes______	P15 (a-b)
SEDENTARY BEHAVIOUR			
The following question is about sitting or reclining at work, at home, getting to and from work places, or with friends including time spent sitting at a desk, sitting with friends,			

travelling in a car, bus, taxi,. reading, playing cards or watching TV, but do not include time spent sleeping.

16	How much time do you usually spend sitting or reclining on a typical day?	Hours______ minutes_______	P16 (a-b)

Appendix E: Body Size Satisfaction



Please select a silhouette above that best represents the following:

A. Your current body shape   Number___

B. Select a silhouette which you would desire to have. Number___

C. Select a silhouette which your family/friends would want you to have. Number___

Appendix F: Permission Letter

27 June 2016

Ms NP Golele
University of Witwatersrand
School of Therapeutic
Centre for Exercise Science and Sports
Johannesburg
2050

Dear Ms. Golele

Permission to conduct Research at the University of Venda

The Directorate of Research and Innovation has hereby granted you permission to conduct research at the University of Venda.

Project titled: ***Effect of physical activity intervention on body size dissatisfaction in black South African women.***

The conditions are that all the data pertaining to University of Venda will be treated in accordance with the Ethical principles and that will be shared with the University. In addition consent should be sought by you as a researcher from participants.

Attached is our policy on ethics.

Thank you

....

Prof. G.E. Ekosse

Director Research and Innovation

Cc: Prof JE Crafford (DVC Academic)

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2016 -06- 28
Private Bag X5050
Thohoyandou 0950

University of Venda

UNIVERSITY OF VENDA
PRIVATE BAG X5050, THOHOYANDOU, 0950. LIMPOPO PROVINCE. SOUTH AFRICA
TELEPHONE 015 962 8313 / 8504. FAX 015 962 9060
Email: research@univen.ac.za

"A quality driven, financially sustainable, rural-based comprehensive University"

Appendix G: Ethics Certificate

R14/49 Miss Precious Golele

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160518

NAME: (Principal Investigator)	Miss Precious Golele
DEPARTMENT:	Centre for Exercise Science and Sports Medicine (CESSM) University of Venda, Limpopo Province, South Africa
PROJECT TITLE:	Effect of a Physical Activity Intervention on Body Size Dissatisfaction in Black South African Women
DATE CONSIDERED:	27/05/2016
DECISION:	Approved unconditionally
CONDITIONS:	The investigator has the responsibility to obtain ethics clearance from university of Venda before any data may be collected
SUPERVISOR:	Mr Philippe Gradidge
APPROVED BY:	Professor P. Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	04/07/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004,10th floor, Senate House/2nd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/We fully understand the the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated,from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. in this case, the study was initially review in May and will therefore be due in the month of May each year.

Principal Investigator Signature ______________ Date ______________

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix H : Declaration: Student's contribution to article(s) and agreement of co-author(s)

I, NKHENSANI PRECIOUS GOLELE, student no 1241680, declare that this Dissertation is my own work and that I contributed adequately towards research findings published in the article stated below which is included in my Dissertation.

Signature of Student  **Date** 27 March 2018

Name of Primary Supervisor Dr Philippe Gradidge

Signature of Primary Supervisor

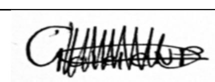
……………………………………………………**Date**…………………………………………………..

<u>**Agreement by co-authors:**</u> By signing this declaration, the co-authors listed below agree to the use of the article by the student as part of her Dissertation. In cases where the student is not the 1st author of a published article, the primary supervisor must explain (under comments) why the student is entitled to use the paper for her degree purposes.

<u>Article 1</u>: Title: Walking as a cost-effective means of influencing anthropometry and blood pressure in African women.

Journal name African health Sciences, year, volume and page numbers:

……………………………………………………………..

Authors	Name	Signature	Date
1st author	Precious Golele		27 March 2018
2nd author	Philippe Jean-Luc Gradidge		
3rd author			
4th author			
5th author			
6th author			

<u>**Comments by primary supervisor**</u>:

………

Appendix I: Turn-it-in Report

1241680:Precious_write_up_edited_29_March_2018_PG.docx

ORIGINALITY REPORT

12%	4%	5%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Venda Student Paper	8%
2	bmcpublichealth.biomedcentral.com Internet Source	1%
3	Gradidge, Philippe Jean-Luc, Shane A. Norris, Lisa K. Micklesfield, and Nigel J. Crowther. "The Role of Lifestyle and Psycho-Social Factors in Predicting Changes in Body Composition in Black South African Women", PLoS ONE, 2015. Publication	1%
4	journals.plos.org Internet Source	1%
5	issuu.com Internet Source	1%
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Appendix J: Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I NKHENSANI PRECIOUS Golele (Student number: 1241680) am a student registered for the degree of MSC(MED) Exercise & SPORT SCIENCE in the academic year 2018.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature: ______________ Date: 29/03/2018