UNIVERSITY OF THE WESTERN CAPE

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EXPLORING THE ASSOCIATION BETWEEN BODY IMAGE, BODY FAT, AND TOTAL CARDIOVASCULAR DISEASE RISK AMONG ADULTS IN A RURAL AND AN URBAN COMMUNITY OF SOUTH AFRICA

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A PhD thesis submitted in fulfilment of the requirements for the degree of Doctor Philosophiae in the School of Public Health, University of the Western Cape

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KEYWORDS

- Obesity
- Excessive body fat
- Body image
- Willingness to loss weight
- Perception
- Cardiovascular disease risk
- Risk score
- Perceived threat
- South Africa
- Township

ABBREVIATIONS

ABI: Attitudinal body image

BAI: Body adiposity index

BF%: Body fat percent

BIA: Bio-electric impedance analysis

BIAS: Body-Image Assessment Software

BMI: Body mass index

BP: Blood pressure

BSQ: Body shape questionnaire

BIDQ: Image Distortion questionnaire

CCM: Causality continuum model

CDIA: Chronic Disease Intitiative for Africa

CHD: Coronary heart disease

CI: Confidence Interval

CVD: Cardiovascular diseases

EBF: Excessive body fat

FAD: 'Ideal'-'Actual' Discordance

FID: Feel-Ideal Difference

FGD: Focus group discussions

FRS: Framingham Risk Score

HBM: Health belief model

LMIC: Low- and middle-income countries

NCD: Non-communicable diseases

NIH: National Institute of Health

NLB: Non-laboratory-based

PBI: Perceptual body image

PURE: Prospective Urban and Rural Epidemiology

PWM: Prototype /Willingness Model

SANHANES: South African National Health and Nutrition Examination Survey

SBP: Systolic blood pressure

SD: Standard deviation

SES: Socio-economic status

SSA: Sub-Saharan Africa

TRA: Theory of reasoned action

USA: United States of America

UWC: University of the Western Cape

WC: Waist circumference

WHO: World Health Organisation

WTHR: Waist-to-hip ratio

ABSTRACT

Background: Obesity is increasing worldwide, and cultural perception of body image is considered an important contributor to the obesity epidemic among black Africans.

Aim: To explore the association between body image perceptions and perceived obesity threat, change in adiposity, and total cardiovascular disease (CVD) mortality risk.

Study Design: This is a mixed-methods study embedded in the PURE longitudinal cohort study involving adults aged 35-78 years in South Africa.

Data Collection/Analysis: This included analysis of baseline cross-sectional data, the conduct of a qualitative study and a cross-sectional follow-up survey. Sex-specific logistic regression models of excessive adiposity were determined. Body image perception indexes were obtained based on 'Feel-Ideal' difference (FID) and 'Feel-Actual' discordance (FAD). Bivariate analyses and analysis of variance were used to determine the relationships between body image and adiposity, annual changes in weight and adiposity. The correlations between body image indexes (FID and FAD) and total 10-year CVD risk score were determined – controlling for possible confounders. Qualitative data was managed with ATLAS-ti software and analysed thematically.

Results: The prevalence of excessive body fat at baseline and at 5-year follow-up based on body fat percent were 96.0% and 79.6% for women, and 44.3% and 62.2% for men respectively. The majority of the obese (85%) and overweight (79%) participants underestimated their weight, and weight discordance status was inversely associated with the willingness to lose weight. Mean total 10-year CVD risk score was 18.7%, and 61% of men and 26% of women with body mass index (BMI) ≥ 25 kg/m^2 had CVD risk scores ≥ 20%. Bivariate analyses indicated that FID and FAD were significantly associated with annual changes in weight and adiposity. FAD index had a significant but weak correlation with total CVD risk score (r = 0.13, p-value = 0.001) when adjusted for covariates.

Conclusion: Body image discordance was associated with an annual change in adiposity, total 10-year CVD risk scores, and there was poor obesity risk perception, and low motivation towards weight loss among predominantly obese black adults with negative body image. Interventions to reduce

obesity need to address negative body image, poor obesity risk perception, self-efficacy and motivation towards weight loss.

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DECLARATION

I, **Kufre Joseph Okop,** hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicated otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the University of the Western Cape to produce for the purpose of research either the whole or any of the contents in any manner whatsoever.

Signature: **Date: February 11, 2017**

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CHAPTER 1

INTRODUCTION

1.1 Background

Obesity is increasing worldwide, particularly in developing countries undergoing nutrition transitions (1–3), and is an independent predictor of cardiovascular disease (CVD), mortality risk and all-cause mortality in many populations (4–8). Increasing evidence indicates that cultural perceptions of body image may be an important contributor to the obesity epidemic among African populations (9–12). The effects of negative body-image perceptions (i.e. distorted perception of one's own body shape or size) on nutrition behaviours and physical activity (11,13), eating habits and attitudes (14,15), psychological effects (14,16), weight gain (12,17,18) and the overall effect of cultural norms on health (19) among individuals of black African descents add credence to this assertion. The commonly known fundamental determinants of obesity – diet, physical activity and socio-economics (20–22) have often been the targets of most intervention efforts; and unfortunately, have not yielded appreciable results over time (23–25). In fact, according to a recent review in the *Lancet*, none of the countries in Africa or those in other global regions has been able to successfully reduce obesity in the past 33 years (2). This makes cultural perceptions of body image an important factor to consider in obesity intervention in the Sub-Saharan Africa context, particularly among the black populations, with cultural stereotypes, who favour large body sizes (26–28).

In South Africa, there is a high burden of obesity among adults (20,29,30) as well as high cardiovascular morbidity and mortality rates attributable to increasing obesity (7,31,32). Also, in many black South African communities, a large (or overweight) body size is socially desirable and believed to be an indication of affluence, good health, happiness, beauty, and influence. These beliefs have not changed over many decades (33–36). Dominant cultural preference for a large body size, the perception of thinness as a disease state, the changing food environment, and nutrition transition have resulted in increasing weight gain among black South African adults (24,30,37). Increasing weight is responsible for increasing hypertensive disease, ischaemic stroke, ischaemic heart disease, and type 2 diabetes among South Africans aged 15 years and older (7). Notably, CVD is the second cause of death in SA after HIV/AIDS/TB rising from about 13.2% in 1997 to 17.8% in 2010 (38).

The dominant cultural perception of weight, increasing obesity and CVD among South Africans is a triplicate problem. This calls for the exploration of the possible effects of negative body image on obesity risk perception, change in body fat (adiposity), and absolute CVD mortality risk as well as its influence on the willingness to lose weight.

The present study was undertaken to explain the possible links between body-image perceptions and i) obesity threat perception and weight-loss intentions, ii) change in adiposity, and iii) total CVD mortality risk in black African adults. The study was guided by the multi-level ecological framework and implemented in three successive phases using a mixed-methods design. The South African arm of the global Prospective Urban and Rural Epidemiology (PURE) study involving the Western Cape and Eastern Cape cohorts was a suitable vehicle to embed this present research. The PURE study is a global longitudinal research project in 25 countries including the high-, low-, and middle-income countries (39). The PURE study seeks to identify population-level factors that drive the development of known risk factors (e.g. obesity, hypertension, physical inactivity, and smoking) for chronic non-communicable diseases. Information on individual and societal factors is envisaged to facilitate the development of appropriate interventions adaptable to a range of communities.

1.2 Study Aim

The aim of this study was to explore the associations between body-image perceptions, and obesity, obesity risk perception, and total cardiovascular mortality risk among adults to inform obesity prevention in the rural and urban settings of South Africa.

The following research questions formed the basis on which the aim of this study was to be derived:

1.2.1 Research questions

i) What are the prevalence and the determinants of excess body fat among black South African men and women living in resource-poor communities?

ii) Does the perception of body image influence percieved threat pof obesity and the willingness to lose weight among obese and overweight adults?

iii) What are the possible relationships between body-image perceptions and change in weight and adiposity (body fat), and total CVD mortality risk among black South African adults?

1.3 Study objectives

The study had five specific objectives, which were addressed in the three respective phases:

1. **Phase 1:** To determine the prevalence and factors associated with excessive body fat in black South African men and women.
2. **Phase 2:** To explore the influence of body-image perception and perceived obesity threat on the willingness to lose weight in obese and overweight adults.
3. **Phase 3:** To (i) describe body image dimensions (‘Feel-Ideal’ difference - FID, and ‘Feel-Actual’ discordance (FAD), CVD risk profiles and total CVD risk score patterns in obese, overweight and normal-weight adults; (ii) determine the effect of body-

image perceptions (size dissatisfaction and weight discordance) on change in weight and adiposity, and the total 10-year CVD mortality risk score; and (iii) determine the factors associated with weight discordance and size dissatisfaction using multivariate logistics regression models.

1.4 An outline of the thesis

This thesis is presented in seven chapters. In Chapter 1, the health-related issues investigated, the study aim, research questions and specific objectives are outlined, while the literature is reviewed in relation to the specific research questions in Chapter 2. The theoretical framework, study designs and methods used to address the specific objectives and the rationale for these methods are provided in Chapter 3. In Chapters 4, 5 and 6, the three study phases, each addressing a set of specific study objectives, are presented. In each of these chapters, the background of the research, methodology, data analyses, findings, and the interpretation of the findings are discussed. In the final chapter, Chapter 7, the summary and recommendations of this thesis are presented.

Three publications listed below (See also Appendix 1) have emerged from this body of work:

i) **Okop KJ**, Levitt N, Puoane T. Factors Associated with Excessive Body Fat in Men and Women: Cross-Sectional Data from Black South Africans Living in a Rural Community and an Urban Township. PLoS One. 2015;10(10):e0140153.

ii) **Okop KJ**, Mukumbang FC, Mathole T, Levitt N, Puoane T. Perceptions of body size, obesity threat and the willingness to lose weight among black South African adults: a qualitative study. BMC Public Health. BMC Public Health; 2016;16(1):365.

iii) **Kufre Joseph Okop**, Naomi Levitt, Thandi Puoane. Weight discordance and not size dissatisfaction is associated with absolute 10-year cardiovascular risk scores among black South African adults. PLOS ONE. (July 2016 – In Press).

CHAPTER 2

LITERATURE REVIEW

2.1 Obesity – distribution, associated morbidity, and prevention

2.1.1 Distribution and prevalence of obesity

Obesity is considered a global epidemic and a leading preventable cause of death worldwide (1,40). Obesity is defined as body mass index (BMI) greater than or equal to 30 kg/m^2. Estimates are that 1.3 billion people will be obese or overweight by 2030 (1), and increasing number of adults (aged 18 years and older) are overweight or obese (41). Figure 2.1 shows the global distribution of overweight (BMI ≥25 kg/m^2) in 2014 among adults aged 18 years and above based on reported global estimates (43). According to the World Health Organisation (WHO), at least 2.8 million people, globally, are believed to die each year as a result of being overweight or obese, and an estimated 35.8 million (2.3%) of global disability-adjusted life year are caused by overweight or obesity (42).

Obesity and overweight are in epidemic proportions in many low- and middle-income countries (LMIC) undergoing nutrition transitions (3). This 'nutrition transition' involves a replacement of traditional high-fibre low-calorie vegetables, fruits and whole grains, with the 'western' high-calorie, but low-fibre animal and plant fats and sugary beverages. Sub-Saharan Africa (SSA), particularly, is steadily moving in this direction of the nutrition transition, with the resulting increase in obesity rates (3,44).

Based on global estimates, obesity has increased substantially among adult populations of many developing and developed countries. In the United States of America (USA) and the United Kingdom (UK), in 2014, obesity and overweight were estimated at 67.3% and 63.4% respectively (42). In SSA, obesity has risen tremendously in recent times

(20,25,45,46). Based on WHO estimates, in 2014, obesity prevalence has risen to 33.6% in Ghana, 33.3% in Nigeria, 26.2% in Kenya, 33.5% in Cameroon, 48.0% in Botswana, 42.9 in Namibia, and 21.8% in Uganda (42). In South Africa, there has been a comparatively higher prevalence of obesity; reaching a national prevalence of 63.9% in 2014 (42).

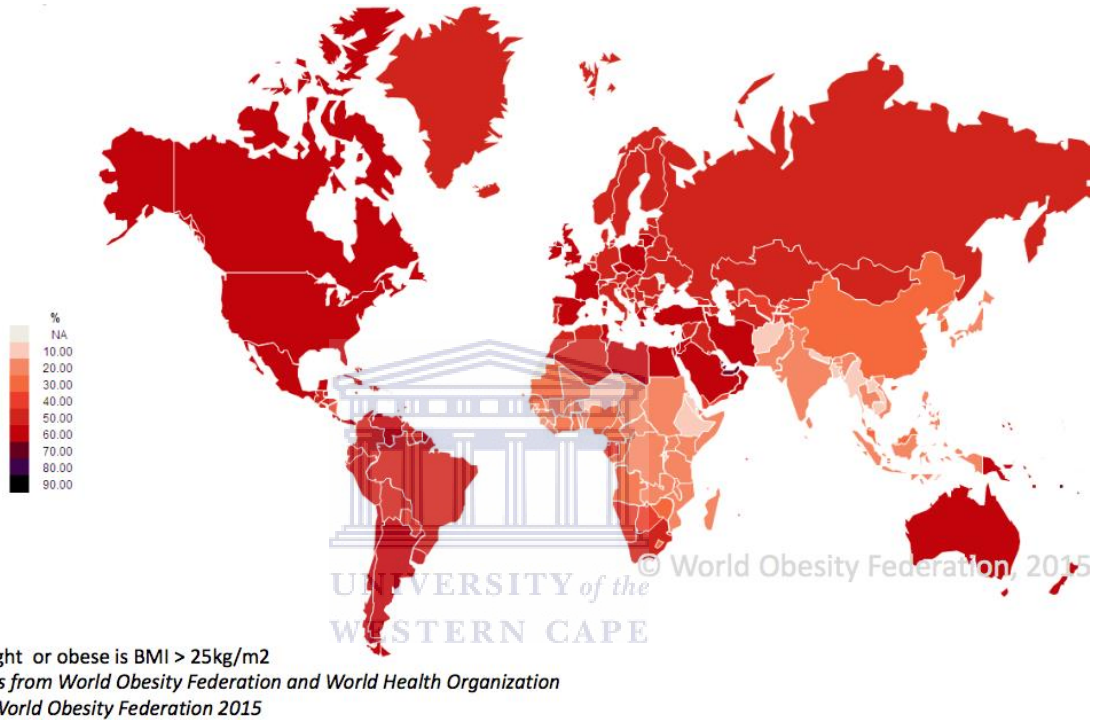


Figure 2.1: The global distribution of obesity/overweight in Adults (19 years and above)
Source: World Obesity Federation (WOF), 2015 (43)

Gender and ethnic disparity in obesity have been reported in many regions of the world (25,41) including Europe, America, Asia and SSA (42). Globally, more women compared to the men are obese (1,47). In 2008, an estimated 205 million men and 297 million women over the age of 20 were obese (48). In South Africa, data from the 2013 national survey report show that more than two-thirds of women were overweight or obese compared to a third of the men (49). The prevalence of overweight and obesity was also shown to be significantly higher in females aged 15-74 years (25% and 40.1%, respectively) than in males (19.6% and 11.6%, respectively) (49). In an earlier study, it was shown that South African black female students were more likely to be overweight or obese than their white counterparts (14,34). Even higher proportions of black men (49.3%) and black women (74.6%) were overweight or obese than the men (45.7%) and women (66%) of mixed ancestry and white women (42.2%) (50). In a cross-sectional study conducted among adults in an urban community in KwaZulu-Natal, 90% was reported to be overweight and obese adults (51).

Obesity is also increasing among adolescents and children, globally, and an estimated 41 million children younger than five years old were obese or overweight in 2014 (41). In Africa the number of children who are overweight or obese nearly doubled from 5.4 million in 1990 to 10.6 million in 2014 (41).

2.1.2 Factors that drive obesity and overweight globally and in sub-Saharan Africa

Obesity and overweight results from chronic energy imbalance and accumulation of fat, often as a result of dietary and physical activity behaviours, shaped by the genetic susceptibility, changing food environment, cultural, environmental and socio-economic factors (20,22,27). Many studies have linked cultural perceptions about body image with increased body weight and obesity especially among Africans. However, body image has been somewhat overlooked when considering packaging of obesity interventions in Africa (27,28,34,44). The forces that drive obesity and its outcomes, globally, and in SSA in particular, can be grouped into three, i.e., proximal, distal, and intermediate factors (including cultural perception) based on a multi-level ecological framework – the causality continuum model (CCM) shown in Figure 2.2 (44). These forces which are classified as *'Upstream'* (distal), '*Downstream'* (proximal), and intermediate factors are discussed in this section. Particular attention is given to the effect of cultural perception (intermediate forces) on obesity and possible CVD mortality risk.

Proximal factors

The proximal factors that drive obesity can be considered as the behavioural (including increased calorie intake, and physical inactivity), socio-economic and biological (genetics) factors that influence obesity and its outcomes (3,44). These factors are propelled by globalisation and rapid urbanisation. *Increased intake of calories* has been commonly linked with the development of obesity and overweight (52,53). Globally, there is an increasing consumption of high-calorie foods as more countries undergo the nutrition transition (3,37,54). This is the trend in developing countries including those in SAA. Particularly, in South Africa, in addition to reported high consumption of large food portions (28). According to Euromonitor, the total fat and oils consumed in SA increases by 33.3% betweeen 199 and 2012 reaching nearly 10.0 kg.capita/year (55). Recent studies also indicate that increasing proportions of sugar-sweetened beverages are consumed at higher annual rates in South Africa than in other SSA countries (56,57).

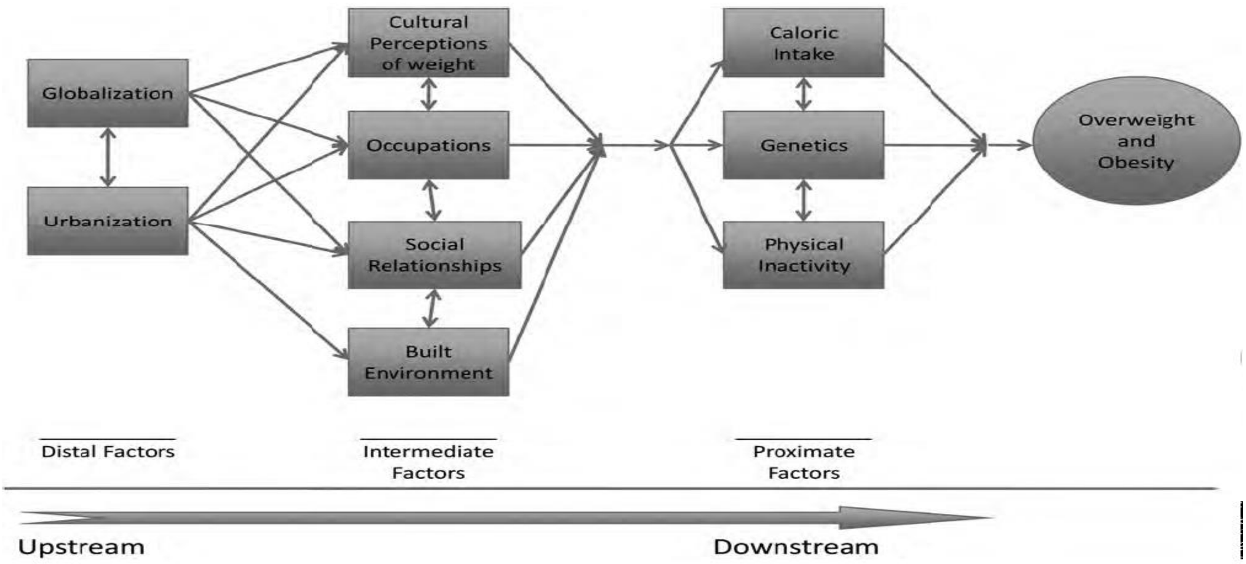


Figure 2.2: A causality continuum model (CCM) for obesity in sub-Saharan Africa. Source: *Scott et. al, 2012* (44).

Increasing physical inactivity is directly related to caloric imbalance and weight gain globally. The level of physical activity has changed dramatically during the past decades. Television viewing, video and computer games as leisure-time activities have replaced physical exercise or outdoor-activities (58,59). The WHO reported that in 2010, 23% of adults, aged 18 years and older, were insufficiently physically active (men 20% and women 27%), and overall, younger adults were more physically active than the older ones (59). In South Africa, nearly half of the population is reported as insufficiently physically active including adolescents (20).

Rapid economic transition and increasing urbanisation, with advancement in technologies that make work and play more sedentary, is responsible for the increasing physical inactivity levels and decreasing hours of rest (28,37,60). Physical activity levels have been shown to decrease in the adolescent men and women in studies conducted in Ghana (61), Nigeria (62), and South Africa (63).

Evidence from other studies showed that socio-economic status has a direct impact on the levels of physical activities that people engaged in. For an example, in South Africa, physical activity level was higher among the affluent people compared to their lower social-class counterparts (28,63). In addition, built environment impacts on physical activity, particularly in poor settings. This is because, in most poor-resource townships and rural areas (such as in South Africa), there is not enough space or playground for playing or jogging, and most of the streets are poorly lit. Moreover, the available community parks often become crime-stricken and discouraging for physical activity (28).

Genetics play an important role in energy storage and expenditure (64). Genes have been shown to influence the urge to overeat, increase the capacity to store fat, and reduce the ability to expend dietary fat (44,65). Lombard *et al*. (2012) had reported possible association of appetite-regulation genes with BMI among black South African adolescents. Notably, the environmental factors impact on genetics, and the interaction between environment and genes can create additional risk for overweight and obesity (66). This is seen in the increased risk of developing obesity in later life, because of epigenetic changes in the metabolic function caused by exposure to under-nutrition in early life or in utero (67). Genetics, as well as globalisation, and increasing consumption of high calorie-dense imported food in most SSA countries, coupled with the high rates of under-nutrition make these countries vulnerable to obesity.

Distal factors

These are 'fundamental' or macro-level factors related to social and economic factors and include globalisation and urbanisation, which influence and shape the food environment, and impose food choices and nutrition habits alien to traditional African settings. Because of globalisation, luxury foods' such as meat, fried foods, soft drinks, butter, mayonnaise, sugar, bottled beer, tinned food and cheese are being consumed in greater quantities in many developing countries than in past decades (57,68). With increasing urbanisation, the 'white peoples' food' becomes more available and 'junk food' is affordable and more easily accessed than a healthy diet to most people (28,69). The high prevalence of obesity across developing regions is believed to be accelerated by the nutrition transition, food insecurity, and access to unhealthy food (3,70,71).

Intermediate factors

Intermediate factors are societal factors, mainly socio-cultural and environmental factors, which include cultural perceptions of body weight, social and community influence, occupations, and built environment (21,28,44). These forces mediate the relationship between proximate and distant forces. This study focused on cultural perceptions as one main key intermediate factor.

Cultural perception of body weight, though often overlooked, is believed to contribute to the development, maintenance and change in lifestyle and health behaviour patterns that can lead to change in weight (27,44). Cultural perception of body image is increasingly considered to be an important contributor to the obesity epidemic among African populations (9,10,12,27,72,73). Research evidence shows that negative body-image perception impact on nutrition behaviours and physical activity (13,14), eating habits and attitudes (14,15), psychological effects (14,16), and weight gain (12,17,18), especially among individuals of black African descent.

Across SSA, there is a universal preference for a 'fat' or overweight body size for women (9,72). In the Southern region of Nigeria, young women are placed in 'fattening rooms' to prepare them for marriage (74). In African communities, a newly married woman is expected to put on enough weight to prove to the in-laws and the community members that the husband takes good care of her (28). Additionally, in many black South African communities where large (or overweight) body size is culturally desirable and believed to be an indication of affluence, good health, happiness, beauty and influence, there is unabated desire and preference for 'fatness' or overweight body images (33–36). This dominant cultural preference for larger body sizes, perception of thinness as a disease state, coupled with the changing food environment, rapid urbanization and nutrition transition is considered the cause of increasing weight and sustained obesity among South African adults (24,28,30,37). Obesity is a problem in Africa, as the cultural stereotypes, poor socio-economic and adverse environmental factors are common place in its communities (21,28).

Cultural perception of body weight does not only lead to increasing body weight, but is associated with many risk factors for CVD. For example, negative body-image perceptions have been associated with increasing inactivity, weight gain, changing pattern of smoking, depression and anxiety (75–77). Various studies have implicated body-image perceptions as contributing to the increasing CVD risk factors, such as obesity, sustained weight gain, physical inactivity, and adverse nutrition behaviour (12–14,78). Although many have indicated the the effect of body-image perceptions on weight control behaviours, the association between body image and CVD mortality risk among individuals has not yet been explored.

On the other hand, *social and community influences* are societal norms, values and practices that can impact on behaviours and obesity. Such influences include rituals and social gatherings, as they promote consumption of a diet high in fat and sugar as well as intake of larger food portions (28). Other community influences include the belief that a woman is treated well by her husband if she is overweight, and that being thin is a sign of ill health or HIV and TB infections (79).

Occupation, has a role to play in obesity, globally, as there is a shift in activity-based occupation (such as agriculture) to the sendentary type of work (in the office or not having any occupation) because of urbanisation, increasing technology, or economic recession (21). In a study conducted in Cameroon, obesity increases as jobs become more professional (80). In another study in Ghana, women who worked on the farm were found to be significantly less likely obese compared to those who had no occupation (81).

The *Built environment* which refers to the places in which people live, work, play and eat, plays a critical role in energy consumption (diet) and energy expenditure (physical activity) (44). The built environment especially in urban areas or townships can play role in increases in overweight and obesity (61,82). Living in townships often involves less walking to get to schools, shopping centres and work, and to fetch water and fuel than in rural areas. Particularly in poor-resource settings in SSA, the growing townships often lack pedestrian sidewalk, recreation parks and playground, coupled with crime and safety issues that often discourage physical activity.

In summary, the intermediate factors, particularly, cultural perceptions about weight is believed to influence the fundamental factors that drive obesity – such as physical inactivity, and adverse nutrition. This makes perception about body image and its effects on obesity, an important focus of this study.

Having looked at the distribution, prevalence and the composite factors that drives obesity globally and in SSA, the subsequent section discusses the effect of obesity, and highlights the prevention strategies implemented so far.

2.1.3 Cardiometabolic co-morbidities associated with excessive body fat

Obesity is a risk factor for cardiovascular diseases (CVD), diabetes, and many cancers. The effect of obesity on rising CVD morbidity and mortality, globally and in South Africa, as well as its effect on diabetes, and metabolic syndrome are discussed in this section.

2.1.3.1 Obesity and coronary heart disease and heart failure

Obesity is associated with an increased risk of coronary heart disease (CHD) in men and women (83,84). A cohort study in the USA involving 119,038 men and women found that the risk of developing CHD for those with a BMI ≥30 kg/m^2 compared with BMI 18.5-22.9 kg/m^2, was 2.14 for men and 2.48 for women (85).

The national burden of disease study for South Africa, attributed over 60% of ischaemic heart disease and stroke to excess body weight in adults aged 20 years and older in 2000 (7). The recent national burden of disease study in 2013 showed that non-communicable diseases (NCDs), mainly CVD and type 2 diabetes, were responsible for the high burden of death (86). In South Africa, ischaemic heart disease remained the leading cause of death in 2013 for men and women with an age-standardisation death rate of 89 per 100 000 population in the Western Cape Province and 103 deaths per 100 000 in the Eastern Province (86). Although black adults were less likely to be diagnosed with coronary artery disease (6% vs. 38%), they were more likely to be diagnosed with heart failure than individuals from any other race (54% vs. 45%) as found in a cohort study in this South African community (87).

In a previous report from the INTERHEART Africa Study, about a decade ago, black South Africans, who were found to have risk factors such as central obesity, smoking and hypertension or type 2 diabetes, were at risk of developing acute myocardial infarction (88). In 2016, 11 years later, might be anticipated that the risk of CHD or any related CVD in this population would be higher, particularly with increasing levels of urbanisation, obesity, and adverse environmental and socio-cultural factors.

2.1.3.2 Obesity and hypertension

Obesity, particularly abdominal obesity, is strongly associated with high blood pressure and CVD (89). Most individuals with high blood pressure are overweight or obese, including children and adolescents (90–92) and adults (93–96). Hypertension was about six times more frequent in obese than in optimal weight adults as reported in a previous study involving a million American men and women (97). Previously, in the Framingham study, adjusted relative risks for developing hypertension in a long-term follow-up were reported to be 1.48 and 1.70 for overweight men and women and 2.23 and 2.63 for obese men and women, respectively (98). Moreover, individuals with hypertension have a two- to three-fold increased risk for all CVD events combined compared with non-hypertensive individuals (99).

The association between obesity and hypertension has also been commonly reported in South Africa and other countries (96,100,101). Data from the South African National

Nutrition and Health Examination Survey (SANHANES) 2013 showed that 65.7% of obese or overweight participants had hypertension (49). Eighty percent of hypertension cases in South African women, aged 30-59 years, were attributable to excess body fat (7). Findings from a recent study revealed a higher prevalence of hypertension (73%) among older South African adults, aged 50 years and above (100). Increasing prevalence of hypertension has been reported among black South African adults, although Steyn and colleagues (96), in an earlier study, reported that rural black women had a significantly decreased risk of hypertension when compared to white women. Peer and co-investigators (102) in a re-analysis, reported an increasing rate of hypertension among urban black adults from 21.6% in 1990 to 35.6% in 2008/2009, and a strong association of obesity with hypertension in this population. Consequently, there is a high prevalence of CVD risk factors and metabolic disorders in black South African adults attributable to the combined obesity and hypertension burden (103,104).

2.1.3.3 Obesity and type 2 diabetes

An estimated 592 million people are living with type 2 diabetes globally (105), and currently, 90% of adults with type 2 diabetes are overweight or obese (106). Approximately 7.1 million Africans suffered from diabetes in 2000, with most of them having excess weight, and this figure is expected to rise to 18.6 million by 2030 (107). Overweight and obese people have added pressure on their body's ability to use insulin to properly control their blood-sugar levels, therefore, they are more likely to develop diabetes (108). The surge in obesity and diabetes, globally, has changed the trajectory of the chronic disease epidemic, particularly that of CVD. This poses a threat to the health and economic development in the developing and developed countries alike (109).

Obesity is associated with type 2 diabetes in both men and women of all ethnic groups (110). In England, 12.4% of people, aged 18 years and older, with obesity had diabetes, which is five times more than people with optimal weight (106). The risk of type 2 diabetes increases with the level of central adiposity (103). Men with a raised waist circumference (WC) were five times more likely to have diagnosed diabetes than those without; and women were about three times more likely to have this diagnosis (106). In addition, overweight, obesity, and diabetes worldwide, including in low- and middle-income countries have been significantly linked with soft drink consumption (111,112).

In South Africa, data on the diagnosed diabetes at national level is sparse. However, self-reported diabetes prevalence was reported to be higher among people who had a BMI >30 kg/m^2 than those with a lower BMI (49). In a previous re-analysis of the South African Demographic Health Survey data in 2000, over 90% of type 2 diabetes among South African women, aged 30 years and older, was attributed to a BMI >21 kg/m^2 (7). Black South African women were found to be twice more likely to present with type 2 diabetes than white women. A recent study also reported associations between body fat distribution and insulin resistance in black and white South African women (113).

2.1.3.4 Excess body weight and cardiovascular mortality

Strong evidence has linked obesity with increasing CVD (95,114). For instance, obesity and overweight are considered the fifth leading risk factor for death globally, and are responsible for 23% of the ischaemic heart disease burden, 44% of the diabetes burden, and between 7% and 41% of the cancer burden (48). As discussed in previous sections of this thesis, obesity is a potent mortality risk factor (115,116). Increased weight level and weight changes have independent effects on total mortality, and adjustment for confounders like smoking and the exclusion of subjects with pre-existing and subclinical disease do not alter the associations (117).

In contrast, and unexpectedly, in some studies the association between weight loss and increased risk of cardiovascular mortality has been reported (115,117,118). For instance, studies on the association between obesity and total mortality, and cardiovascular events in patients with coronary artery disease have shown contradictory results, which has been regarded as a paradox (95). Romero-Corral *et al.* (2006) reported that overweight (BMI 25-29.9) individuals had the lowest risk for total (0.87 [0.81-0.94]) and cardiovascular (0.88 [0.75-1.02]) mortality when compared with normal weight (BMI >24.9) individuals (115). Obese patients (BMI 30-35) had no increased risk for total mortality (0.93 [0.85-1.03]) or cardiovascular mortality (0.97 [0.82-1.15]). However, individuals with severe obesity (BMI ≥35) did not have increased total mortality but had the highest risk for cardiovascular mortality (1.88 [1.05-3.34]). The authors posit that this paradox of obesity and good cardiovascular outcome among overweight and obese people can be explained by the lack of discriminatory power of BMI to differentiate between body fat and lean mass. Body fat percent (BF%) and waist circumference have been shown to indicate increasing risk among obese and overweight patients.

This thesis, therefore, intends to establish CVD-risk score levels based on body image and adiposity levels. The effect of body image on CVD risk in men and women will also be determined.

2.1.4 Prevention strategies for obesity and overweight

Over the years, interventions to control obesity have not yielded appreciable results in many countries and regions of the world (2). This is probably due to the diverse nature of the ecological drivers of obesity. Since obesity is mostly attributable to an imbalance between energy intake and energy expenditure among all age groups, multidisciplinary therapeutic strategies have been considered (69). These strategies are expected to include community-based health promotion and nutrition education, psychological and family therapy interventions, in addition to lifestyle/behaviour modification, exercise programmes.

Setting-specific interventions, which target communities, families and households, have been shown to have the potentials of addressing the complex drivers of obesity, including cultural perceptions about weight (119,120). Efforts to prevent obesity in the black African population, for an example, should begin at an early age, before children adopt norms and values that often impact on obesity (28). There is need to re-inforce practices that can reduce the tendencies to prefer gaining weight among the overweight individuals. Community-directed interventions which target cultural ideologies around body image are important in addressing culturally motivated weight gain (9,11,36).

Having discussed the drivers of obesity in populations, the subsequent aspect of this thesis highlight how body image is considered an important contributor to the obesity epidemic among African populations. The overview and scope and the effect of body image on behaviours, energy balance and health, and how these can impact on CVD risk factors are also discussed.

2.2 Body image: overview and scope

Body image is considered an important contributor to the obesity epidemic, particularly among black African populations. In this section, the definition and importance, scope and dimensions of body image are discussed.

2.2.1 Definition and importance of body image

Body image is regarded as the subjective sense people have about their bodies; their perceptions and attitude towards their physical appearance and weight (34,72,121). Perception of body size can be defined as the accuracy of an individual’s judgment of their size brought about by the way they see themselves (9,122,123). On the other hand, a person’s attitude is defined as a learned predisposition in a consistent favourable or unfavourable manner with respect to a given attitudinal object (124). An individual’s attitude influences his or her behaviour, and there is a link between knowledge and practice (125,126).

The study of body image is a diverse field, and research over the last three decades has increased leading to clinical solutions for weight-based psychological and nutrition disorders, globally (9,127). Body-image perception can be positive or negative, and is influenced by individual and environmental factors (122,128,129). In this way, one could feel negatively or positively about your size or body, or feel thin, overweight or obese. A negative body image is a distorted perception of one’s own shape or size and of parts of one’s body, which is different from how they really are (9,72). A body of evidence in the last two decades has linked body image with weight control outcomes, nutrition behaviours and health disorders (9,12,72). Specifically, a distorted perception of one’s body image can result in low self-esteem (14), emotional distress, anxiety, depression (130), unhealthy dieting habits, eating disorders (14,122), and risky sexual health (131,132). On the other hand, a positive body image is strongly associated with healthy behaviour outcomes, such as improved physical activity, healthy eating, weight control and sexual satisfaction (13,78,133).

Body image dissatisfaction defined as the subjective evaluation of one's own body size or weight, have been shown to predict the onset, severity, and treatment outcomes of eating disorders in black Africans and Americans (35,122,134,135). Body size dissatisfaction is considered important in the context of exploring possible strategies that can harness the effect of positive body image in obesity control. Identifying individuals who are dissatisfied (or otherwise) with their overweight status, and using them as advocates for weight loss in communities with a predominantly obese population, can be considered as an essential strategy for obesity control in resource-poor settings (9).

2.2.2 Scope of body image covered in this study

Social, environmental, cultural, familial, and psychological norms are responsible for moulding beliefs about fatness and the awareness of the societal "ideal" body shape, as dictated by dominant culture in a society (72,136). Body image is, therefore, a multifaceted construct consisting of a variety of dimensions that are based on societal precedents (127). Culturally-specific concepts of body image are found in many regions of the globe. For instance, body-image perceptions differ among Africans, Asians, Americans and Aboriginals (9,16,35,137,138), and even within specific races or ethnic groups (72,121). What is considered a culturally or socially desirable body size or weight among Africans and African-Americans is different from what is considered desirable or acceptable among Asians and Europeans (15,72,121,139). For example, the western culture has an obsession with being thin, and such body image ideals are the reasons for two in three European girls and one in two boys (12-17-year-olds) limiting their food intake (140). The reverse is the case for many African populations (10,27,72,141); many black Africans, particularly the women, place a high value on large body sizes (33,123). In South Africa, the vast cultural diversity resonates with dominant social norms and values which strongly attribute a large body size to affluence, wealth, strength, good health and happiness, especially in black South African communities (27,133,141). This is in contrast to the situation in Europe, where overweight women take drastic steps to lose weight (121).

Over the years, many empirical studies have examined body image in populations (9,141–144). In black populations, for example, studies have shown that overweight and obese African women underestimate their body sizes (10,11,27,36,123), probably because overweight is considered a 'normal' socially desirable weight status. Studies conducted among African-Americans had hypothesised that underestimation of body size by obese women may be linked to increased self-efficacy and positive self-image (9,121). According to Schwartz and Brownell, "*understanding body image is important to specifying the social and psychological experience of being obese, the medical consequences of psychological issues, and the psychological contributors to the aetiology of obesity, but also to providing care*" (9).

The scope of body image covered in this study is mainly on the perception constructs among black Africans, and particularly in settings where large body sizes and shapes are considered culturally and socially desirable. This thesis specifically explores body-image perceptions in black South African men and women and the possible relationships between body image, and obesity risk perception and the willingness to lose weight. The patterns of body image and relationship with CVD-risk scores in relation to age in obese and non-obese adults are also considered. The thesis, in addition, examines the relationships between body image and (i) change in weight, (ii) change in adiposity (BMI, BF%, and WC) over time, and (iii) total 10-year CVD mortality risk score.

2.2.3 Body image dimensions

As already described in sub-sections 2.2.1, many studies have examined body image in populations over the years, but their findings are complex and sometimes inconsistent (11,12,27,72,145). However, some consistency exists in the construct of the components of body image considered in most of these studies. Body image is mostly described using two main components: (i) perceptual body image (PBI); and (ii) attitudinal body image (ABI). The key aspects of these two components and how they were scored among black populations have been documented (34,72,123,146). From this literature, there are two key aspects of PBI: (i) perceived body size and (ii) perceived ideal body weight, and three aspects of ABI: (i) body size satisfaction, (ii) body weight satisfaction and (iii) feeling of attractiveness. The procedures often used to estimate perceptual and attitudinal body image indexes and the hypotheses used to derived extent of body image (or weight) dissatisfaction are presented in Appendix 2.

Attitude-perception questions and Stunkard Body Image Rating figures are commonly used to assess body image among black populations (27,34,72). The Body Image Rating figures index is a subjective measure of body fat and self-perceptions of body image. The instruments and techniques used to assess body-image perception are described in details in sub-section 2.6 of Chapter 2. Key among these methods are the use of (i) silhouettes (pictorial construct) to describe body size/image perceptions (123,146) and (ii) structured questions (narrative construct) to describe weight perceptions (27,73,129). This study used both the pictorial and narrative constructs to assess body-image perceptions.

2.3 Effect of body image on nutrition behaviours, obesity, and CVD risk factors

2.3.1 Body image versus nutrition behaviours, physical activity and smoking

The impact of cultural practices and preferences (including body-image perceptions) on health outcomes have been reported in a few studies (9,19,135). Body-image perception has been reported to influence a number of health indicators including physical activity, body weight, adiposity, and nutrition disorders such as bulimia, and binge eating (16,140,146,147). Physical activity has been influenced by body-image perceptions among women with excess weight in South Africa (28,148). This is related to the social norms which tag the overweight status as a *normal size*, whereas a thin size (or optimal weight) is most often regarded as that of an illness. Thereby, making most overweight persons avoid doing physical exercise, which can cause one to lose weight. In addition, a negative body image has been associated with many negative health behaviours and outcomes including psychological disorders. Smith and Joiner (139) reported that body image discrepancy specifically predicted a drive for thinness and bulimia symptoms. Binge-eating disorders and bulimia have been reported in adolescents and adults with a high dissatisfaction with body size among Africans and African-Americans (14,15,146).

There is also strong evidence that body image is a potential modifiable characteristic associated with health outcomes which impact on cardiovascular health. According to recent findings from a multi-country study in Europe, positive body image (positive attitude towards one's body) and a high autonomous motivation (choice and self-determination) were associated with weight loss. A negative body image and low motivation, on the other hand, were associated with weight gain (149,150).

Body-image perception can also impact on energy balance (i.e. balance between energy intake and energy expenditure) which can lead to weight gain over time (65), particularly among those who prefer an overweight size. The possible effect of body image on energy balance and obesity is discussed in detail in sub-section 2.5.2.

Body image has also been linked with smoking. Previous studies conducted among with non-African populations have reported increasing smoking patterns among adolescents, young adults and women with body image discrepancies (75–77). A negative body image was predictive of smoking, and self-perception of body image was reported to play a role in the initiation and maintenance of smoking behaviour (76). In addition, perceiving oneself as overweight was positively associated with smoking in female adolescents (77), and low-self esteem was predictive of current smoking in adults (75). There is a lack of literature on the association between body imge and smoking among black Africans.

2.3.2 Body image, and energy balance and obesity

Obesity is regarded as a nutritional disorder that occurs as a result of imbalance in energy intake and expense in an individual (65). According to the energy balance definition, the basic components of energy balance include energy intake, energy expenditure and energy storage (151). Body weight can change only when energy intake is not equal to energy expenditure over a given period. Energy taken in the form of protein, carbohydrate, fat, and alcohol by humans, is expended through physical activity and the resting metabolic rate. The latter is the amount of energy necessary to fuel the body at rest, and the thermic effect of food, which is the energy cost of absorbing and metabolising food consumed.

Physical activity is the most variable component of energy expenditure (65,152). The inaccurate body-image perceptions favouring large body size (as seen among black South African adults) can invariably lead to increased demand for and intake of high volumes of food, and increasing inactivity as well (152). This can be as a result of desire to gain weight or maintain overweight status in order to maintain a culturally acceptable body size or shape. Also, the nutrition transition and modern lifestyles encourage a sedentary lifestyle, and intake of sweetened beverages and high-energy food, especially in poor communities. Based on energy balance, the energy intake of many people, particularly among those with a negative body image, in socio-economically poor settings would be higher than the energy expenditure. This situation leads increasing weight as a result positive energy imbalance (65). In most resource-poor environment, maintaining a healthy body weight for most people would require motivation for cognitive skills to help overcome biological tendencies to overeat and be inactive in order to match energy intake with energy expenditure (14,60,136). The key cognitive skills needed in our study setting would have to do with how to address negative body-image perceptions and discourage satisfaction with overweight body sizes or status.

2.3.3 Body image perception and increasing obesity in black South African communities

Body size perception is associated with a change in weight over time as reported in a few studies (12,18). In a study conducted among 3,665 young adults in the USA, obese women who perceived themselves as obese lost significant weight (based on their BMI) annually, while those who perceived themselves as having a normal weight gained significant weight (12). In another study conducted in the USA, women who underestimated their weights had gained 0.31 kg/annum, whereas those who accurately estimated their weight had lost weight annually (144).

In South Africa studies have not only linked a body image percpetion with adverse food consumption patterns but also with weight and physical inactivity, particularly among black Africans (141,153). A negative body image (i.e. perceiving self to smaller or larger than expected) is associated with high BMI levels among adults in South Africa (14,27,37). Also, recent studies conducted separately in black urban communities in Cape Town and Durban further confirmed that overweight and obesity are still regarded as a 'disease' of perception in communities (11,36,51). These studies revealed that most of the obese and overweight women in both communities still prefer an overweight body image. Similarly, in Kenya, more than half (53%) of obese and overweight adults underestimated their weight and had preferred being overweight compared to their current sizes (10). However, recent studies among South Africans have also reported otherwise. For instance, the desire for smaller body sizes have been reported among black adolescents and adults (36,141). The sustained culture-driven positive perceptions towards overweight (or fat) sizes among black South African adults have been described as a challenging aspect of obesity prevention (27,33,67). It is believed that desire for overweight size or large body image among black Africans do not only contribute to increasing the risk of obesity, but also can inhibit the motivation for appropriate weight control behaviours (11,27,36). Black South African women in the rural and urban communities have been ovdertime reported to have lesser tendencies to see themselves as overweight even if they were (33,51,143). In contrast, being thin or having a lower overweight size, is often perceived as ill-health and associated with HIV and TB infections (27,79). This misperception is regarded as a risk marker for weight gain.

Information on body-image perceptions and attitudes towards weight can help health professionals formulate effective strategies and develop relevant health education programmes for the control of obesity.

2.3.4 Body image, and cardiovascular disease risk among adults

The relationship between body-image perception and perceived threat of heart disease was examined among African-American women and the results revealed a low correlation between these two variables (154). In this small study sample of 148 women, those who evaluated themselves as more attractive and who were more preoccupied with their weight had lower levels of perceived susceptibility to heart disease (R^2 = 16.0%).

Previous studies had reported that black African women with a negative body image compared to other ethnic groups had an excess adiposity (27,28,34). They were also at higher risk of CVD risk factors, such as type 2 diabetes, hypertension, and dysmetabolic syndrome (103,116,155). In addition, a negative body-image perception has been linked to CVD risk factors, such as increasing inactivity, changing pattern of smoking, depression and anxiety, particularly among black African women (75–77). Therefore, it is very likely that body-image perceptions have the potential to directly or indirectly increase health risk including CVD risk, particularly in settings where there are strong social and cultural values for large or overweight bodies.

Research that examines the relationship between body-image perceptions, and health risk including weight control behaviours, and absolute CVD mortality risk among black African adults are therefore needed. Data from such research are important to inform the development of appropriate strategies for evidence-based community-level obesity prevention interventions, and for setting-specific risk assessment and care. The next sub-section of this thesis gives further detail on the CVD mortality risk in situation populations in nutrition transition.

2.4 Increasing cardiovascular disease risk in populations in nutrition transition

2.4.1 Cardiovascular disease mortality among populations in nutrition transition

A significant 80% of CVD mortality occurs in LMIC (156) much of which are going through phases of nutrtion transition. In Africa, CVD is the second leading cause of death (157). CVD mortality is also attributable to the increasing cardiovascular-related risk factors, and lack of access to health-care services and inefficient screening (158). The increase in morbidity and mortality from CVD is a great public health concern especially in resource-scarce settings with limted access to clinical care.

Most developing regions under nutrition transition are characterised by high prevalence of overweight and obesity, and NCDs (2,3,153). In fact, obesity is an independent risk factor for CVD (6,7) and CVD risks have been documented even in obese children (159,160). The dual problem of rising obesity burden and CVD is an enormous public health challenge, especially in Africa, where the health-care systems are weak and burdened by the HIV/AIDS crisis.

In South Africa, for instance, there is are increasing CVD morbidity and mortality (24,86). This can be linked with with its perculiar nutrition transition status characterised by sustained obesity (153). . In 2013, CVD was estimated to be the second cause of death (17.8%) after HIV/AIDS and TB (38.9%), with death proportions attributable to CVD in men and women, aged 25-49 years, estimated at 32-43% (86). Also, obesity is associated with numerous comorbidities, such as CVD, type 2 diabetes, hypertension, certain cancers, and sleep apnoea (20). For instance, 68% of hypertensive disease, 45% of ischaemic stroke, 38% of ischaemic heart disease, and 87% of type 2 diabetes are attributable to excess weight (7).

In 2013, nearly 20% of the South African population was classified as having 'high CVD risk' (32). A more recent report by Peer and colleagues shows a high prevalence of metabolic syndrome among the black population of Cape Town (161). A high level of CVD risk factors (up to 56%) among predominantly obese black South Africans was reported in Soweto, a black township community (162). This high CVD risk and increasing CVD cases in black South Africans has been linked to a high obesity rate in this population. The situation has triggered public health advocacy for an urgent action to reduce the obesity epidemic in resource-poor South African communities so as to mitigate its associated serious consequences (82,103,163).

2.4.2 The effect of weight change on cardiovascular risk

There is increasing evidence that a change in weight (on its own) in addition to increased BMI has a significant impact on cardiovascular risk factors such as diabetes (164,165) and hypertension (96,101). A, increased weight level and weight change have significant independent effects on total mortality even when adjusted for confounders like smoking

(117). Gaining more than 5 kg of body weight increased the risk of developing diabetes by 1.9 times (164).

Fortunately, weight-loss interventions have been shown to have a beneficial effect on diabetes, hypertension and physical activity. For an example, a Diabetes Prevention Programme randomised clinical trial demonstrated that weight loss through lifestyle intervention could prevent or delay the onset of type 2 diabetes in a high-risk population with impaired glucose tolerance. For every kilogram of weight lost, the risk of diabetes was reduced by 16% (166). Also, change in weight (based on BMI) was found to be an independent predictor of diabetes in postpartum Korean women (164).

In general, weight loss has been associated with many health benefits besides the reduction. These include lower levels of cardiovascular risk factors such as blood pressure, lipids, and glycaemia. Lower abdominal obesity increases adiponectin levels and insulin sensitivity, and lower incidence of new-onset type 2 diabetes in subjects with impaired glucose tolerance or impaired fasting glucose when combined with physical activity (4,9,115,118). Notably obesity-related hypertension and physical activity are improved among those who loses weight and maintained an optimal weight over a substantial period of time (99,166).

However, some observational studies have documented the contrary, indicating that weight loss is associated with increased mortality risk (118). Four recent epidemiological studies on population-based cohorts followed over time, compared weight stability or weight increase during the first few years of follow-up, after an initial assessment of weight loss (117,118,167,168). Interestingly, in these studies, stable optimal weight when compared with either weight loss or weight increase over time was associated with lower cardiovascular risk and mortality.

A positive association between adiposity (BMI and WC) and CVD risk factors has been determined among South Africans and other populations (67,88,169). However, data on the relationship between body image, and changes in adiposity, and absolute CVD mortality risk score among black adults, have not been published. Establishing the relationship between body image, and change in weight and CVD risk can help us understand how specific body weight measures relate to body image and absolute CVD risk in the study population. This information will be useful for developing community-based obesity intervention strategies targeting poor-resource settings.

2.5 Summary: obesity, body image and CVD risk

In summary, obesity is increasing worldwide leading to increasing CVD mortality in the developing world, and the cultural perception of body image is considered an important contributor to the obesity epidemic, particularly, among black Africans. Obesity and overweight are shown to increase globally, and are disproportionately affecting more women than men, in Africa and other regions. The obesity epidemic which has increased the trajectory of NCDs in most developing countries is driven by a set of three forces which include distal, intermediate and proximal forces.

Notable, among the distal forces, are urbanisation and globalisation that fuel the nutrition transition and influence the food- and built environment. The proximal factors that drive obesity include behavioural or lifestyle (dietary behaviours and physical inactivity), genetics, and socio-economic factors. Cultural perception of body image is a key intermediate factor believed to influence obesity directly or indirectly. This is because, body image dissatisfaction has been shown to impact on proximal or fundamental factors that drive obesity, including physical inactivity and increase calorie intake amongst Africans. The increasing trend in obesity in most developing countries particularly SSA, can largely be attributed to the effects of the changing food environment, food insecurity, and dominant cultural perception about body weight/size (44,153).

Based on the above analyses, obesity can only be effectively addressed through integrated and multi-sectoral efforts including a careful consideration of the dynamics of societal or cultural stereotypes and environmental factors. Empirical evidence that outline proven strategies that can be used to address the forces that drive obesity is important for a sustainable control of obesity, and mitigation of its impact.

The relationship of body image and health risk factors dscussed above form the basis on which this research enquiry was imposed – to explain the relationships among body image, change in body fat (or adiposity), risk perception, and CVD mortality risk.

In order to understand how the variables of concern in this study, namely, obesity, body image and CVD mortlaity risk scores can best be assessed or measured, there is the need to further review the common methods of assessment so far used and the issues regarding these methods. These are discussed in details in the succeeding sections (Sections 2.6 and 2.7).

2.6 Methodological issues: Estimating obesity, and body image

This thesis focuses on three health parameters, i.e. obesity, body image, and cardiovascular mortality risk. In this section, the methods often used to estimate these three parameters and their limitations are discussed in detail.

2.6.1 Obesity (adiposity) assessment and health-risk appraisal

2.6.1.1 An overview of adiposity measures in population studies

Traditionally, adiposity measurement is based on a simple conventional BMI measure (weight in kilogram divided by the square of the height in metres). Other conventional measures, such as WC, BF%, waist-to-hip ratio (WTHR) and skin folds as well as the body adiposity index (BAI) and waist-to-height ratio (170–172) are also used to assess adiposity. The more precise and sophisticated adiposity measures, regarded as the gold-standard, are available and include underwater weighing, dual-energy X-ray absorptiometry. However, Near Infrared Interactance measure has been shown to be less optimal aong black Africans (173). The use of the gold-standard measures is, however, not feasible in most population studies in developing countries because of high cost and capacity issues (173). This makes it necessary to use simple adiposity measures that are feasible and cost-efficient in resource-poor settings. Complementary adiposity measures, such as WC, BF% and WTHR have been recommended, in addition to BMI, for assessing adiposity and health risk in populations (174,175).

2.6.1.2 Body fat percent, waist circumference, other adiposity measures and health-risk appraisal

Body fat is vital to basic bodily functions, such as body temperature regulation, vitamin storage and joints maintenance, but increased adiposity is associated with CVD risk (7,176,177). Body fat percent defined as the amount of body fat as a proportion of body weight is a predictor of high CVD risk and has been reported to be associated with higher risk CVD risk even in young children (169). Body fat percent, WC and WTHR have been recommended as complementary measures of total adiposity and are considered as good parameters for assessing health risk in populations (175,178). Body adiposity index (BAI) calculated from the hip circumference and height has also been proposed as a useful parameter for assessing BF% and obesity (179), but BAI is ineffective in predicting CVD and CHD (180).

A recent 15-year prospective study involving 4175 Australian males (180) found WC and WTHR primarily used to assess central adiposity to be significant predictors of CVD and

CHD mortality. Expectedly, reducing excess levels of body fat have been shown to reduce the risk of certain conditions, such as high blood pressure, heart disease, diabetes and cancer (181).

Body fat percent measured by bio-electric impedance analysis or dual-energy X-ray absorptiometry has proved to be a reliable alternative measure of actual body fat when compared to BMI (175,182). BMI is reported to misclassify obesity in men and women, especially of African and Hispanic descent, with differing fat-free mass compared to Caucasians (175,182). A recent study by Kruger and colleagues showed that for black South Africans, a BMI cut- point of 22 kg/m^2 for men and 28 kg/m^2 for women identify those at cardiometabolic risk, whereas a BMI of 30 28 kg/m^2 underestimates risk (183). On the other hand, BF% has been shown to be strongly associated with CVD risk among predominantly non-black populations (88,178).

Furthermore, an earlier study reported that an elevated BF% increased cardiovascular risk at low BMI values among Malays, Indians and Chinese living in Singapore (184). Also, studies found that WC predicted mortality risk better than BMI in African, Asian and European populations (185,186), making the WHO suggest that WC could be used as an alternative to BMI (187,188). Consequently, BF% and WC are considered as two leading complements to BMI for assessing CVD risk. Comparing obesity levels using BF% and WC, and determining the correlation between BF% and BMI in a population-based cohort in South Africa would inform a more appropriate body fat classification among black adults in this population. This study used WC, BF% and WTHR measures along with BMI in assessing adiposity and for comparison with body-image perceptions.

2.6.2 Estimating body-image perceptions and issues for consideration

2.6.2.1 Techniques for measuring body-image components

Body image is considered a multi-dimensional construct (121,189). Assessment of body image such as body image dissatisfaction or satisfaction, body weight distortion, affective reactions, and perceptual discrepancies or discordance, therefore, requires multi-dimensional techniques (121,190). An important consideration in the assessment of body image is ensuring that the measure under consideration most appropriately measures or indexes the particular dimension of body image of interest (e.g. body image dissatisfaction or weight distortion) (121,127).

Over 40 instruments for measuring body image are documented (189–191), all of which assess body image based on four techniques: (i) figure preferences, (ii) questionnaires (123,127,129), (iii) video projection, and (iv) computer-aided measurement techniques (192–194). With figure preferences, the use of silhouettes is the most commonly used method. Using the figure preference, body image is often measured by asking participants to rate their current and ideal body shape using a series of depictions or silhouettes. The difference between these two values is the measure of body dissatisfaction. This method, however, has been indicated to be only subjective in measurng perceived weight or size. A combination of appropriate multi-dimensional methods can help ascertain body image dimensions which are essential for health research and intervention (9,127).

Questionnaires are also commonly used for measuring body image. One example of a questionnaire is the self-reported Body Shape Questionnaire (BSQ) validated by Cooper et al. (195). Other body image questionnaires include a 9-item Multidimensional Body-Self Relations Questionnaire (MBSRQ) (196,197), Body Area Satisfaction Scale, and Body Image Distortion questionnaire (BIDQ) (196).

With the computer-aided and video projection techniques, participants are shown a series of images flashing before them; each image is a picture of them but show either increased weight or decreased weight. The participants then self-report which of the pictures they 'feel like' and which of them they would most likely want to be. An example of the computer-aided body image measurement technique, is the Body-Image Assessment Software (BIAS) (194). BIAS evaluates body image distortions and body dissatisfaction via the on-screen presentation of a scale image which can be modified by the subject in its different components. This can be run on any computer with Windows and Microsoft Access and allows for data to be recorded and exported for analysis using applications data management software such as SPSS.

Many factors, such as gender, ethnicity, culture, and age, should be taken into account when measuring body image (9,127). For these reasons, setting-specific and gender-focused instruments have been developed for assessing body-image perceptions (189,190). Mciza and colleagues developed and validated the instrument for measuring body image and body weight dissatisfaction among black South African females aged >15 years (123). This instrument was shown to have a high reliability of 0.87 for the population.

2.6.2.2 Estimating body image discrepancy indexes

Pictorial and narrative constructs of body-size/shape perception have been strongly recommended for body-image studies in populations (121,127). With the pictorial construct, each cohort participant is given body image rating figures from which they are to choose the silhouette that most closely resembled how they looked ('feel' body image) and how they would like to look ('ideal' body image). The narrative constructs used structured questions related to body weight assessment. The details of body image data collection procedures using the two constructs are explained in detail in Chapter 6 of this thesis, 'Study design and methods' sub-section 6.2.

This study used the (i) pictorial construct (silhouettes) to describe body-size/image perception (26,146) and (ii) narrative construct (structured questions) to describe weight perceptions (27,123). Three specific body-image dimensions, i.e. (i) body-size dissatisfaction, (ii) discordance in weight status, and (iii) perception about own weight, were considered for the study. The choice of these methods was based on their proven validity and appropriateness in measuring body-image perceptions (34,127).

2.6.2.3 Body-image estimations: inconsistent results in literature and the way forward

Studies have shown that obese and overweight African women commonly underestimate their body weight. Puaone *et al*. (33) reported that nearly 15% of women in an SA township community self-reported that they were normal size, whereas up to 53% of them were either overweight or obese. Mciza (34) reported that mothers and adolescent girls in South Africa underestimated their weight/sizes. Previous studies confirmed underestimation of body size among females in Kenya (10), Nigeria (198), Seychelles (146), and Ghana (145). Although studies have shown that overweight/obese women in many settings underestimated their weight, other studies have reported the contrary, especially among individuals of non-African descent. For instance, white African women and adolescents over-estimated their weight (34,133,136), but most often more African men overestimated their body sizes than the women of the same weight category (11,123,199). On the other hand, some studies documented that normal and overweight adults self-reported their perceived body weight accurately to their measured body weight (10,141,146).

Researchers have argued the possible reasons for these conflicting results on body image self-assessment. Many believe that results of body image self-assessment would mainly depend on the instruments or methods of measurement, the setting (cultural or location), and gender and age of participants interviewed (34,127,190,196).

In this area (self-assessment of body weight/size among obese), it is difficult to summarise the literature, because there are findings to support the three different conclusions: obese individuals overestimate, underestimate and accurately estimate their body size. The inconsistent results across the literature, according to Schwartz and Brownell, are potentially because of the different methods of measurement and study samples, which vary on important dimensions (9). The differences in results could also be as a result of participants' weight status. For example, people within a normal weight range versus people at the weight extremes, or people who are currently losing weight versus people at a stable weight as well as clinical versus community-based study participants. Socio-cultural factors may be another reason for inconsistent results across the literature with regard to over-, under- and accurate estimation of body size in obese populations (9,146,200).

Considering Schwartz and Brownell's views, the important question is not whether average obese individuals are accurate or inaccurate in their ability to judge their body size. It is, however, what the perceived body image means to them, and how it affects their lives. Moreover, it is believed that underestimation of body size by obese women may be linked to increased self-efficacy and positive self-image (9). Findings in the olders studies such as the study by Collins *et al*. (1983) suggest that individuals who overestimated their body sizes were also the most likely to drop out of a weight-loss intervention (201). However, a reduction in the overestimation rate, after being enrolled for treatment, suggests an association between self-efficacy in making healthy changes and perceiving one's body closer to the societal norm (9,201).

From the above discussions, appropriate, evidence-based information on weight estimation that will support intervention is critical. To address the inconsistency in results, researchers strongly recommend using a homogenous sample population segregated by sex, and weight category, as well as appropriate validated body-image measurement techniques (9,34,127). This approach is lacking in many body-image studies, including those conducted in black African communities.

This thesis employed both quantitative and qualitative methods to attempt to assess body image and weight discordance efficiently, taking into consideration, the segregation of the participants by sex, weight and location.

2.6.2.4 Key issues to consider in measuring body image

The field of body image has experienced considerable growth especially in the last 40 years (127,129). Body image is a multifaceted construct consisting of a variety of measured dimensions (127), as pointed out in previous sections. For these reasons, researchers have advocated for a more consistent conceptualization of body image and the utilisation of appropriate measures in specific contexts to engender more valid comparisons across disparate body-image studies (127). For better research outcomes, it has been recommended that body-image studies should use multiple measures of components and assess the validity and reliability of such measures in their study samples (9,127). Multiple measures will help describe the many components of body image more appropriately, and reliability will support the interpretation of the findings. For this study, three body-image dimensions – body-size perception, weight discordance estimation, and attitude towards own weight – were considered and used to assess body image.

2.7 Estimation of CVD-risk mortality scores

2.7.1 Importance of CVD-risk scores

Limited resources are available in most LMIC, where less than US$27 per head is spent on health care each year compared to $3727 in high-income countries (202,203). Therefore, finding low-cost strategies for the prevention of CVD have become a priority. One key strategy is the development of assessment tools for the estimation of total cardiovascular risk in primary care. This well-established prevention strategy relies on multivariable risk prediction models to identify those at high risk to target specific behavioural or drug interventions (32,204).

The traditional approach to the treatment of CVD relies on the presence or absence of a single risk factor, such as hypertension, diabetes or hyperlipidaemia without considering the multiplicative effects of composite CVD risk factors (157,205). This traditional approach has been shown to be less efficient in identifying and managing CVD patients, as a combination of several slightly elevated risk factors leads to a much higher absolute (or total) risk than one raised risk factor (206,207). Total CVD mortality risk, which is an estimate of the combined effects of all risk factors, is, therefore, increasingly considered the most appropriate CVD risk estimation (204,207).

Consequently, rigorous primary CVD-prevention guidelines recommended total cardiovascular risk estimates (scores) as a cost-effective strategy to identify high- and low-risk patients. However, laboratory testing is almost impractical in LMIC and even costly in high-income countries (32,207,208). Fortunately, non-laboratory CVD-risk screening tools have been developed and found to be cost-effective in primary health care in many resource-poor countries, including South Africa (32,161,209). This tool uses a CVD-risk estimation model that includes non-blood-based parameters, such as BMI (instead of lipids or HDL), in addition to the commonly known CVD risk factors, age, sex, systolic blood pressure (SBP) as well as smoking, diabetes and hypertensive status.

2.7.2 CVD-risk estimation in populations

Researchers from the Framingham Heart Study, in the USA, were the first to develop the risk estimation algorithm (204). The Framingham Heart Study was the first epidemiological study to prospectively collect population-based data on the association between risk factors and the occurrence of fatal and non-fatal cardiovascular events (204). The sex-specific Framingham risk score (FRS) models were developed from a cohort of 3969 men and 4522 women aged 30-74 years and free of CVD at the time of their examination between 1968 and 1987 (204). The participants in this cohort were monitored for 12 years for the development of CVD events or death. A sex-specific CVD-risk prediction model, based on CVD-predictor variables, cholesterol, high-density lipoprotein cholesterol or BMI, SBP, antihypertensive medication use, current smoking, and diabetes status, was used to generate 10-year risk scores based on the CVD-risk profile of D'Agostino et al., (204) for use in primary care. These variables and the beta-coefficients used in the risk score equation for the laboratory and non-laboratory measures are presented in Table 2.1. Status of cigarette smoking was based on self-report, whereas diabetes and antihypertensive medication use by the participants were ascertained by self-report and physical assessment of their medication prescriptions, SBP was measured, and BMI calculated based on height and body weight.

These risk-assessment tools can be categorised into the laboratory or non-laboratory predictors based on the Framingham risk estimation models. Both these models have the ability to identify men and women who are at high-risk for CVD. The CVD-risk estimation for primary health care uses a cheaper non-laboratory-based risk screening model that includes BMI instead of lipids, in addition to smoking status, age, sex, diabetes, SBP, and hypertensive drug use.

Table 2.1: Non-laboratory-based predictors (regression coefficients and hazard ratios)[a]

Men* (10-year Baseline Survival: So(10) = 0.88431)				
Variable	**Beta****	**p-value**	**Hazard Ratio**	**95% CI**
Log of Age	3.11296	<.0001	22.49	(14.80, 34.16)
Log of Body Mass Index	0.79277	<.0066	2.21	(1.25, 3.91)
Log of SBP if not treated	1.85508	<.0001	6.39	(3.61, 11.33)
Log of SBP if treated	1.92672	<.0001	6.87	(3.90, 12.08)
Smoking	0.70953	<.0001	2.03	(1.75, 2.37)
Diabetes	0.53160	<.0001	1.70	(1.37, 2.11)

Women* (10-year Baseline Survival: So(10) = 0.94833)				
Variable	**Beta****	**p-value**	**Hazard Ratio**	**95% CI**
Log of Age	2.72107	<.0001	15.20	(8.59, 26.87)
Log of Body Mass Index	0.51125	<.0609	1.67	(0.98, 2.85)
Log of SBP if not treated	2.81291	<.0001	16.66	(8.27, 33.54)
Log of SBP if treated	2.88267	<.0001	17.86	(8.97, 35.57)
Smoking	0.61868	<.0001	1.86	(1.53, 2.25)
Diabetes	0.77763	<.0001	2.18	(1.63, 2.91)

SBP – Systolic Blood Pressure
[a] *Extracted from D'Agostino et al, 2008* ((204)
The 10-year risk for women can be calculated as $1\text{-}0.94833^{exp(\Sigma\beta X - 26.0145)}$ *where ß is the regression coefficient and X is the level for each risk factor; the risk for men is given as* $1\text{-}0.88431^{exp(\Sigma\beta X - 23.9388)}$
** Men or women; **Estimated regression coefficient*

A comparison of absolute non-laboratory-based CVD risk from 13 cross-sectional studies conducted in South Africa (between 1998 and 2008) with six laboratory-based Framingham study CVD-risk scores, showed that up to 92% of men and 97% of women were characterised as ‘high’ or ‘low’ risk by both models (32).

In addition, the INTERHEART risk score has been used most recently to predict the risk burden in a population (158). In a recent multi-country population-based study, the INTERHEART risk score for risk burden was highest in high-income countries and lowest in low-income countries (84,158). However, within each stratum of risk score, the rates of major cardiovascular events and of deaths were highest in low-income countries, intermediate in middle-income countries and lowest in high-income countries. The authors believe that this finding indicates that influences other than risk factors are important in determining outcomes at the country level. For the community level outcomes, however, the contributing factors could include cultural influences (e.g. body-image perceptions), educational level, marital status, access to health services and medications, and weight change in the population.

2.7.3 Weakness of the CVD-risk scores estimation

Although the CVD-risk estimation tool has been used for CVD-risk assessment in primary health centres, limitations of the total cardiovascular risk models have been reported (84,204). For example, the models do not incorporate all CVD risk factors such as physical activity, stress, depression, and substance abuse, which are also considered as possible risk factors. They also do not consider the duration of exposure to a risk factor and do not include relevant family history (210). However, the non-laboratory risk model has a high correlation coefficient in comparison with a model for which physical activity, dietary factors and psychosocial factors (stress, depression) were considered (84).

On account of age being a powerful determinant of short-term risk, i.e. the 10-year absolute risk estimate, the risk estimation models have been criticised because they strongly favour treatment of the elderly compared to young individuals [168, 289]. For cardiovascular risk management in women, factors beyond the risk scores, including medical and lifestyle history, family history of CVD, markers of preclinical disease, and other conditions need to be considered when determining the intensity of preventive therapy. Recommendations also include a lower cut-point for defining high-risk in women as ≥10% 10-year risk for all CVD compared to the traditionally ≥20% 10-year risk estimate that is utilised (84,211). These considerations were taken into account in this study, as total (or absolute) CVD risk scores were described based on three categories, i.e. low (<10%), moderate (10.0-19.9%) and high (≥20%). Some steps were also taken to describe the pattern of CVD mortality risk in men and women based on their weight categories and body image to understand the pattern of CVD and body image by gender.

In addition, it can be noted that the risk-assessment tools are primarily applicable to populations of European origin, thereby raising critical questions on their universal applicability. Therefore, further assessments are necessary to determine the optimal methods for assessing high-risk individuals in developing regions, where 80% of the global CVD burden occurs (207). The development of accurate ethnic- and region-specific risk tools for developing regions thus should be prioritised (206).

In summary, the strategy for CVD prevention advocates the adoption of a total cardiovascular risk approach as the strategy to inform decisions for initiating drug treatment, rather than the management of individual risk factors (37). Appropriate action according to the level of risk must guide treatment (212).

2.8 Summary

In this chapter, the literature relating to the drivers and health impact of obesity were reviewed. The influence of body image on weight gain, lifestyle and nutrition behaviours, and the effects on CVD risk factors were emphasised. Furthermore, this chapter outlined the methods of assessment of adiposity (obesity), body image indexes, and CVD mortality risk scores, and their strengths and weaknesses. The methods such as WC, BIA, and BF% which complement the conventional BMI, and which are feasible, and cost-efficient in resource-poor settings were used to estimate obesity in this study. The recommended narrative and pictural constructs often used to assess body-image perceptions indexes were employed (127,213). The non-laboratory-based CVD-risk model was shown to present an easy-to-use cost-effective and reliable tool for screening of at-risk populations [206, (209,214). In the following chapter, the theoretical framework, the designs and methods for this study are discussed.

CHAPTER 3

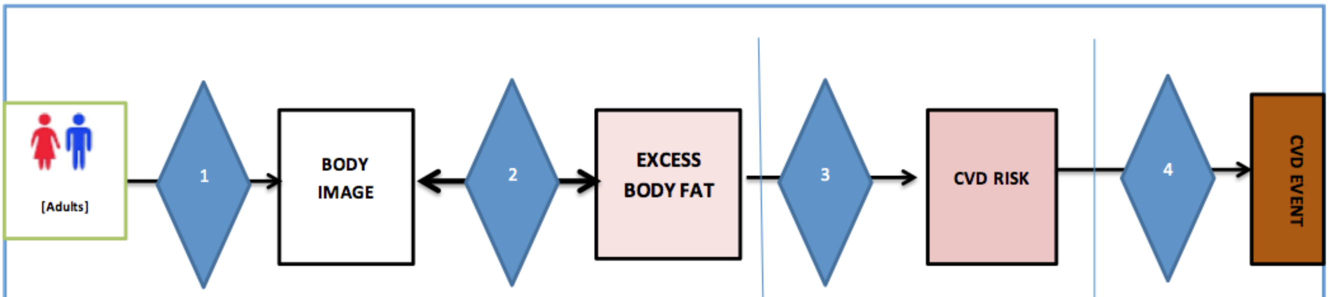
THEORETICAL FRAMEWORK, RESEARCH DESIGNS AND METHODS

This chapter presents the theoretical framework for which the study designs, methods, data analyses and presentations were built upon. Theoretical frameworks have been used to describe phenomena, and to explain how several factors or variables are related with the identified health problem and the research questions, using relevant concepts, theories and models (44,215).

3.1 Theoretical Framework

This study used an multi-level ecological framework (Figure 3.1) adapted from the causality continuum model for obesity (CCM) (44) to explain the possible relationships among biological (excess body fat), environmental and socio-cultural (body image) factors and CVD mortality risk. Many factors, i.e. biological, cultural, socio-economic, environmental and behavioural factors contribute to obesity, and the interactions among these factors are complex (20,24,44).

Furthermore, the growing consensus for an ecological framework in social science and public health research is imperative in advancing the understanding of the multi-level contextual forces that drive obesity and cardiovascular disease, and supporting the designing of appropriate interventions (20,44,216,217). The above assertions make this framework valuable in exploring the possible relationships among body image, obesity, perceived threat, and CVD risk score, which is the focus of this study.



FACTORS			
Proximal	Socio-economic Socio-demographic	Social network support Disease Gender Age Occupation	Tobacco & food policy regulations Physical activity/Sports
Intermediate	Environment Socio-cultural factors Prototypes Nutrtion transition	Physical activity, Diet, & Genetics Cultural perceptions Build environment Psyhcological factors Availability and Access to 'food' Cognitive factors	**Modifiable Risk Factors:** Physical activity, Diet, Tobacco, Higher Blood Pressure, Daibetes Status, Psychological factors **Non-Modifiable Risk Factors:** Age, gender, family history **Body Image discrepancy**
Distal	Urbanization, Socio-economics		

FIGURE 3.1: Ecological framework showing the possible relationships among body image, obesity and CVD mortality risk and event

The study also used the prototype willingness model (PWM), which incorporates other behaviour change models and theories such as the health belief model (HBM), theory of reasoned action (TRA), and social reaction constructs to explain the influence of body size perception on perceived threat and weight-loss intention; which is explained in detail in Chapter 5 sub-section 5.1.

As a foundation, it is important to explain, in some detail, the CCM from which the framework for this study was constructed. CCM is an ecological framework (Figure 2.2) used to conceptualise the determinants of overweight and obesity in SSA (44). This model (CCM) is of high importance as it illustrates the interacting factors at the continuum from individual-, community-level (or social and physical environment) to the global marketplace, in shaping the trends in overweight and obesity. Based on this framework, there are three contributing forces that drive the obesity epidemic, i.e., *distant* (upstream forces), *intermediate*, and *proximate* (or downstream) forces.

As outlined by Scott *et al*. (2012), *distal* forces include macro-level 'fundamental' causes related to social and economic factors and include globalisation and urbanisation, which influence the food environment. *Intermediate* forces include community-level influences, particularly cultural perceptions of body image, built environment (the places people live, work, play and eat), occupations and social relationships. These factors have a direct impact on individual behaviours and health outcomes, especially in SSA (14,36,44,153). *Proximate* forces, which include individual-level behaviours, such as diet, physical activity and genetics, influence health outcomes, which are often the most targeted in interventions in SSA countries. Although the intermediate forces mediate between the proximal and distal forces, and impact on the individual level in the aetiology of obesity, they are less frequently targeted in obesity interventions, unlike proximal factors (44).

The ecological framework adapted for this study attempts to further explain the possible links relating to body-image perceptions, excess body fat and CVD mortality risk, taking into consideration the interplay among ecological factors at the individual level (44). One assumption was that the intermediate factors, particularly cultural perceptions of body size/weight, could impact significantly on body fat (obesity) and CVD mortality risk in a population with similar proximate and distal factors. The specific assumption was that body-image perception, especially among adults in resource-poor communities with similar cultural and socio-economic status and built environment, could impact indirectly on obesity. This, in turn, would have an impact on the absolute (total) CVD mortality risk at the individual level. This assertion is possible since body-image perceptions can trigger certain weight control behaviours and health outcomes that could in turn impact on individually modifiable CVD risk factors. On this basis, the impact that body image could have on weight-loss intention, change in body fat (obesity) and, in turn, on absolute cardiovascular mortality risk of individuals, was examined in this thesis.

Empirical evidence has shown that health behaviours are often shaped by a complex interplay of determinants at different levels (218,219). Cultural perceptions of body image, though often overlooked, are shown to contribute greatly to the development, maintenance or change in health behaviour patterns that can lead to disease risk (27,44). For an example, cultural perceptions of body image have been found to influence attitudes and perceptions about body sizes and shape among South African men, women and adolescents (23,34,141). Body image perceptions also influence individual eating attitude and self-esteem (14,143), and attitude towards exercise (27). These behaviours or attitudes might be intended towards achieving culturally valued norms (e.g. large or thin body image).

In many black communities in Africa, dominant cultural norms exist that favour a large body image as ideal body image, particularly among women (34,72). Preference for a large body image in communities where this is socially desirable would hypothetically lead to the intentions and behaviours that can promote this body image in such communities. Intention, according to the *theory of planned action* is the cognitive representation of a person's readiness to perform a given behaviour, and is considered to be the immediate antecedent of behaviour (124). Intentions to maintain large (or overweight) bodies would most likely induce the willingness to gain weight. Furthermore, behaviour is often influenced by the interaction between personal (cognitive – self-efficacy, affective, morbidity and genetics, among other things), social and environmental factors and the underlying distal forces on behaviour and vice versa – reciprocal determinism (220). The process is complex and determined not only by multiple factors but also by factors at multiple levels multiple levels (218).

Social, environmental, cultural, familial and psychological factors are responsible for moulding beliefs about fatness and their awareness of the societal “ideal” body shape as dictated by the dominant culture in the society (72,136). Moreover, the perception of health risk or threat of weight-related disease can be influenced by subjective norms, prototypes (significant persons) and socio-cultural factors (221). For instance, in a community where the majority is overweight, or overweight is assumed to be inherited, and thin or normal weight individuals are socially stigmatised, weight gain behaviours would likely supersede perceived health risk (9,14). Although many might be aware of the health consequences of overweight, the decision to control body weight would be dependent on personal values, self-efficacy and the influence of subjective norms (36). Consequently, in a situation where normative and cognitive values agree (in relation to low self-efficacy), an individual’s intention to adopt behaviour prescribed by the community might not be restrained. In that case, intentions to overeat, indulge in unhealthy eating, and exhibit a sedentary lifestyle, or use tobacco (as a weight-control measure) can be influenced by the social, environmental and personal factors.

Based on the study framework, body-image perceptions would affect certain weight-control behaviours and health outcomes. Consequently, adverse behaviours in the presence of multiple risk factors would result in increased levels of absolute CVD risk, and ultimately, consequent CVD event (84). Figure 3.2, shows a schema developed to further explain the possible relationships among social-cultural, environmental and individual-level factors, and behaviour intentions and cardiovascular risk. This framework is used to facilitate the understanding, analyses and interpretation of possible relationships between body-image perception, and obesity and CVD risk, taking into consideration the ecological factors.

In summary, based on this framework, body-image perception status of an individual adult is an outcome of the cultural perceptions of body weight or size, and the combined effect of the socio-cultural, environmental and personal (individual-level) factors. The effect of these factors on an individual would determine the level of body satisfaction or otherwise, depending on gender, body weight and ethnicity (9,21,34). Body image perception can be either negative or positive (i.e. a positive or negative attitude towards one's body) and can manifest as weight discordance (i.e. over-estimation or under-estimation of weight status).

The interplay among the environmental and individual factors and behaviour change factors can affect behaviour outcomes. The individual-level factors (obesity status, gender, age, self-efficacy, self-image, lifestyle) and socio-economics can, in turn, influence body image, and affect behaviour outcome, such as willingness to control weight. Taking the Prototype Willingness Model (PWM) into consideration, attitude, perceived susceptibility, the social norms and the influence of significant others would affect behaviour intentions (221). Therefore, PWM was used to guide the analysis and explanation of the linkage relating to body size perception, obesity threat and the willingness to lose weight among adults. The PWM as applied in this study is presented in Chapter 5 of this thesis under the introduction section.

This study assumes that an individual's body image status can influence the probable modifiable risk factors (lifestyle, hypertension and obesity status, high blood pressure, and excess weight) and would influence the total cardiovascular mortality risk. On the whole, the relationships between body image and CVD risk may differ based on the non-modifiable factors (age, sex and family history) and whether the individual is currently obese or overweight or of optimal weight (9,121). Most probably, dissatisfaction with current body weight (i.e. believing this weight is 'very large' and needs reducing) or weight discordance (underestimating of own weight) by an obese woman, could trigger some positive weight control behaviours and resultant positive weight outcome. This, in turn, would have an appreciable impact on the total CVD risk score.

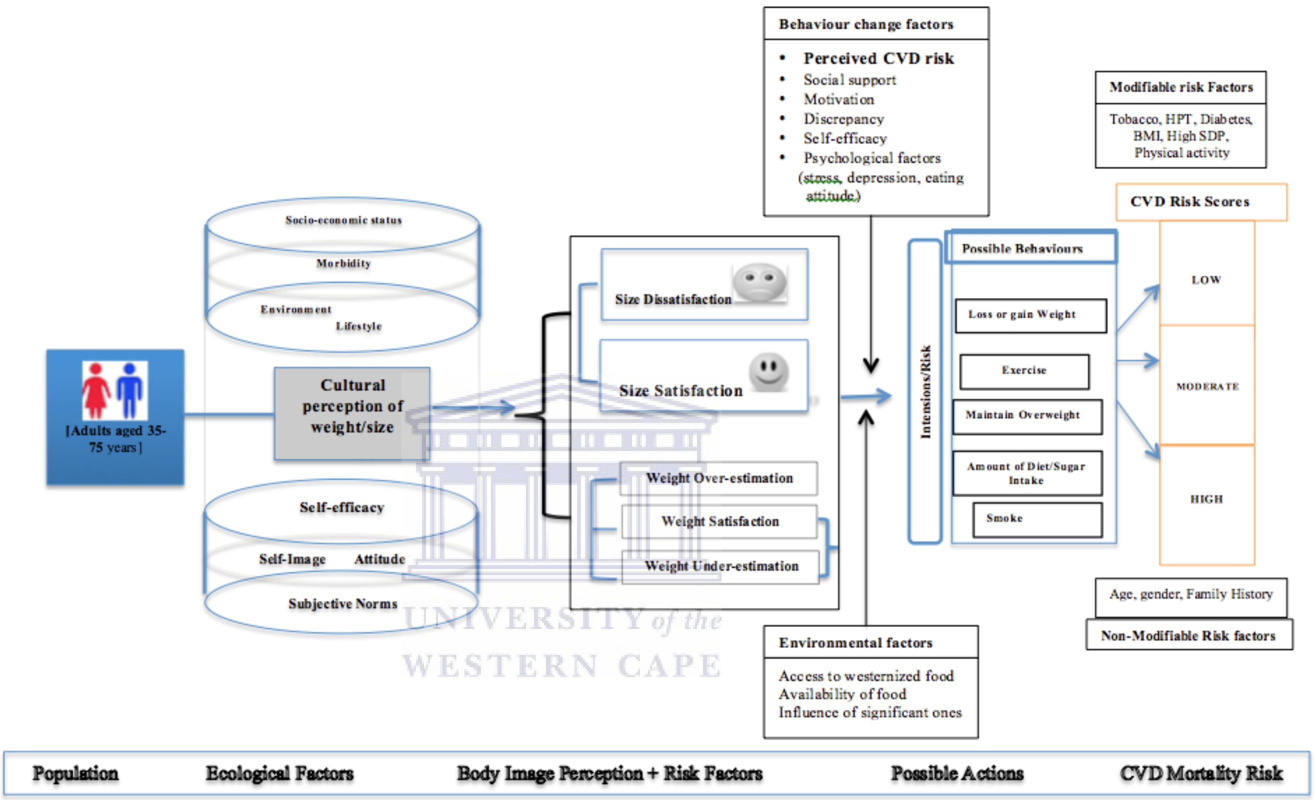


Figure 3.2: Schema of an ecological framework illustrating the relationships among body image, obesity, and total CVD risk

Alternatively, an obese man, for an example, who is highly satisfied with his obese size may underestimate his weight, and most probably not be likely to take appropriate steps to lose weight. Possible behaviours or actions may include planned inactivity and a sedentary lifestyle, eating excess fat/sugary diet, and increased intake of tobacco and alcohol (14,36). This situation would likely impact on the absolute CVD risk levels of the obese or overweight person. For instance, the perception of obesity risk, which can be defined as one's perceived vulnerability and threat to overweight or obesity, has been shown to impact negatively on weight loss and lifestyle behaviours (121,222).

Based on the above reasoning, it is possible that a negative or positive body image may impact on an individual's absolute CVD risk score, if it could impact on physical activity, obesity and other CVD risk factors. This assertion is based on findings from a recent multi-country study conducted in Europe which found that positive body image together with motivation and self-efficacy resulted in good weight and physical activity outcomes (149,150).

In addition, the perception of obesity-related CVD mortality risk/threat and morbidity among obese or non-obese adults can also mediate between body-image perception and possible weight control behaviour. Therefore, it is important to investigate if perceived obesity threat would lead to an intention to lose weight, particularly among excessive weight adults. This study, therefore, used qualitative and quantitative study designs to explore the influence of body-image perception on perceived obesity-related CVD threat and intention to lose weight among men and women. Factors associated with body image discrepancies in the study sample were also investigated to inform targeted community-based intervention for CVD. In this study, the relationships among cultural perception of body image, risk perception and total CVD mortality risk among black South African adults were ascertained.

3.2 Study setting and population

This study was conducted in two communities involved in the on-going multi-country PURE study in South Africa (shown in Figure 3.3). The PURE study cohort was established in 2009/2010 in two communities, i.e. (1) Langa, an urban settlement in the

Western Cape Province, and (2) Mount Frere, a rural community in the Eastern Cape Province.

Langa has an area of 17.306 km^2 with an estimated population of 59,667 of which 99.6% are black Africans and its population growth is by reason of migration (mostly from the rural Eastern Cape). Like any other black township in Cape Town, most residents in Langa live below the poverty line with an average monthly household income of R2,144 (about US$150) and the majority (male 44% and female 56%) are unemployed (223). Langa is grouped into three development areas – “old Langa”, “the Zones” and “the hostels” – which mirror the socio-economic status (SES) of the residents (old Langa s considered to have higher SES and is better established with amenities, while the hostels have the lowest SES).

Mount Frere is located in the Alfred Nzo district in the Eastern Cape covering a total area of 14.74 km^2, with an estimated population of 7,655 and density of 519 km^2 of which 99.79% are black. The district is entirely rural. Most of the residents live below the poverty line and earn an average monthly income between R1001 and R2500 (about US$70-175) with an unemployment rate of 76.02% (223). At the time of the study, there were no designated street names, and houses were in clusters and areas were divided according to the clan heads.

About 81% of the total population (55 million) of South Africa are black Africans (224), and the majority live in the black-dominated resettled townships or rural communities. The effect of the prolonged segregation and inequalities prior to the democratic transition in 1994, has caused the black communities to be economically challenged – with very limited employment opportunities (225). This has resulted in migration from those rural communities to the more affluent cities and towns, and which continues today (224).

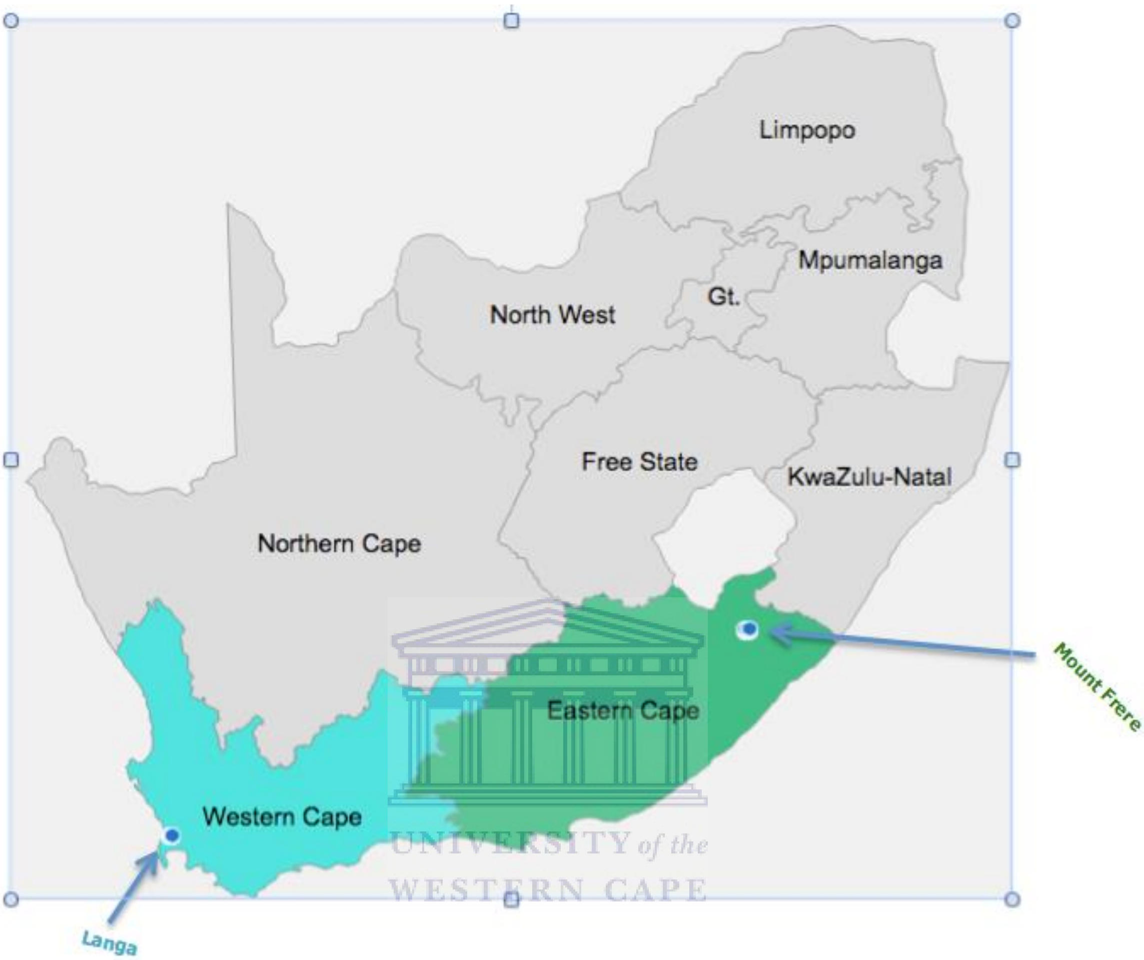


Figure 3.3: Map of South Africa showing Langa community (in Western Cape) and Mount Frere (in Eastern Cape)

3.3 Study designs and methods

This was a mixed-method study embedded in the PURE study Cape Town cohort. The PURE cohort comprises men and women aged ≥35 years. The study was conducted in the following three phases, each employing a different method: (1) analysis of secondary data; (2) qualitative exploration of body-image perception with Stunkard body image figures (BIF); and (3) cross-sectional survey. The overall study design and contributions of the candidate are presented in Figure 3.4.

During Phase 1, baseline cross-sectional data from 1220 PURE study cohort participants were analysed to determine the socio-demographic, lifestyle and psychological factors associated with overweight and obesity (specific Objective 1). During Phase 2, a qualitative method was used to explore the body-image perceptions, perceived obesity risk, and weight-loss intentions among men and women; to address study objective 2. Obese and non-obese cohort and community members participants (separated groups of men and women of similar age categories) were purposively selected for group discussions and body image explored using body image scaled fissures. In Phase 2, the study design was guided by the prototype willingness model (PWM), which is explained in detail in Chapter 5, sub-section 5.1. Following the implementation of Phase 2, a cross-sectional survey was undertaken (as Phase 3) to investigate the relationships among body image and body fat percent, and change in adiposity, and 10-year CVD risk among men and women in the study. The three phases were implemented in order to address the specific study objectives. The candidate was involved in all the phases of the study as project co-ordinator, researcher and supervisor.

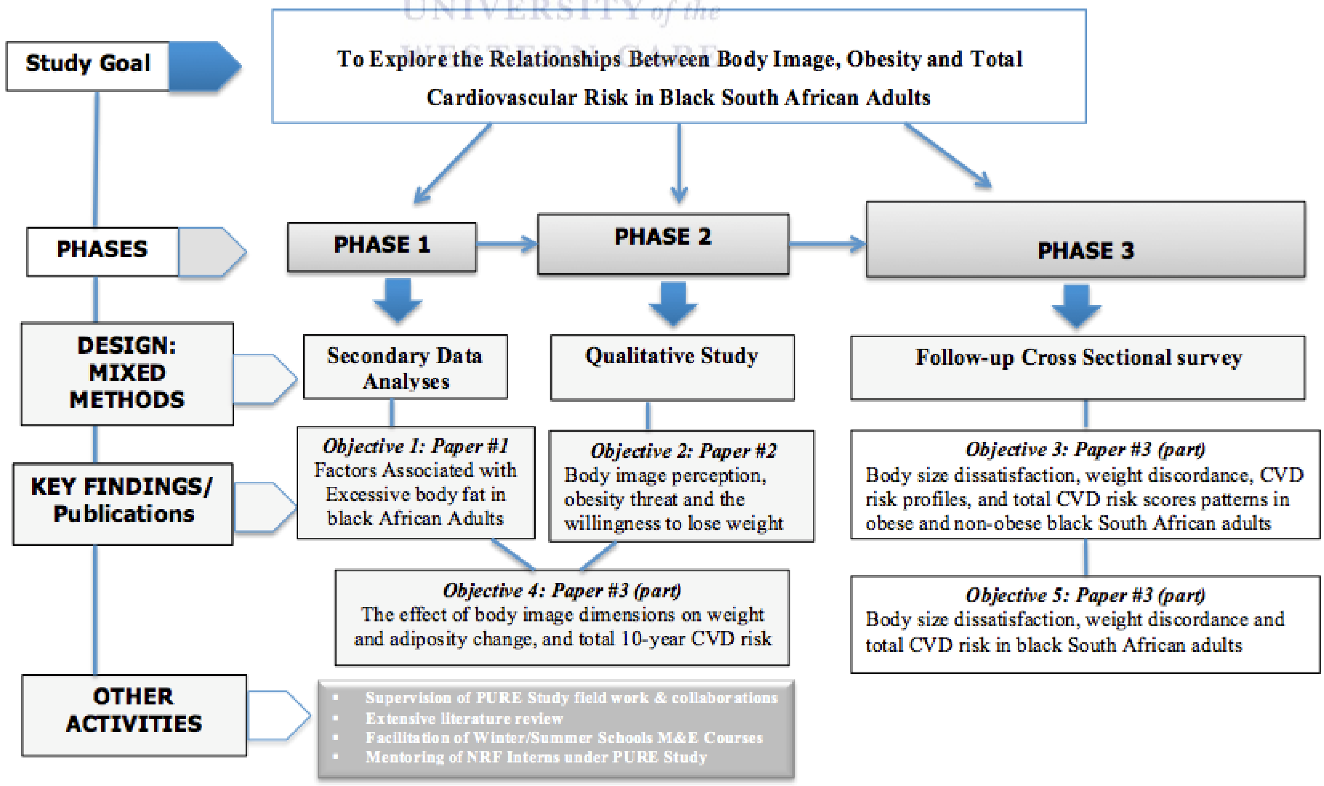


Figure 3.4: Study design and contributions of the candidate

3.3.1 Rationale for the mixed-methods approach

The use of mixed methods for this study was informed by the need to appropriately examine and describe in context the possible relationships among body-image perceptions, body fat (obesity) and cardiovascular risk in the study population. Mixed methods involving qualitative and quantitative interviews have the advantage over a single method used independently because it enhances understanding of the context and validation of the measured variables and their relationships (226,227).

A combination of study methods (quantitative and qualitative exploration) was considered most appropriate to address the different research questions that the study set out to answer (228). Analysis of secondary data, cross-sectional survey, and focus group discussions (FGD) were chosen as the study designs since they have been proven to be effective for obesity and body image studies in black African populations (34,141,229). For this study, the integration of quantitative and qualitative data and the explanatory models facilitated a better understanding and interpretation of the results (226). In addition, structural equation modelling (or mediation analyses) which is outside the scope of this thesis was considered for further results dissemination.

3.4 Phase 1: Determination of prevalence and determinants of excessive body fat

3.4.1 Study design

Secondary data analysis was carried out. The data used for this phase were obtained from the PURE study baseline data collected in 2009/2010.

3.4.2 Sampling procedure

Participants for the current study were purposely selected from the existing cohort of the PURE study. The criteria involved selecting one community each from resource-poor rural and urban settings of South Africa.

For the main PURE study, the sampling procedure was as follows:

In Langa, a systematic sampling technique was used to select every second household in the three already identified development areas of “old Langa”, “the Zones” and “the hostels”. In Mount Frere, the absence of designated streets had precluded the possibility to use the systematic sampling approach for selecting participants. Consequently, cluster sampling of houses in selected villages under the clan heads in Mount Frere was undertaken. From the selected households, eligible member(s) aged 35-75 years were recruited.

3.4.3 Data collection

Interviews (at baseline) were undertaken using validated questionnaires adapted internationally from the INTERHEART and INTERSCORE studies for the PURE study. Anthropometric measurements were taken using standard protocol procedures for the study, which has been reported previously (39). During this study, data on participants’ socio-demographic characteristics, anthropometry (weight, height, waist circumference (WC), and hip circumference), medical history and risk factors were analysed to address objective 1.

3.4.4 Data analysis

Body mass index (BMI) was calculated in kg/m^2 and the standard cut-offs for BMI and WC obesity recommended by WHO, and the commonly used body fat percent (BF%) cut-offs (33, 32) were used to describe normal and excess body adiposity (or excess body fat). A BMI of 18.0-24.9 kg/m^2, 25.0-29.9 kg/m^2 and ≥30.0 depicted normal weight, overweight and obesity, respectively. BF% of 30-35% and ≥36% (for women), and 21-25% and ≥26% (for men) represented overweight and obesity, respectively (174). The corresponding normal body weight categories were taken as values less than overweight. A WC >88 cm in women and >102 cm in men indicated central obesity.

The data analysis was done using STATA 22 and SPSS. Descriptive statistics of participant characteristics including overweight (BMI ≥25) and obesity (BMI ≥30) were calculated. Gender-specific logistic regression analyses were used to ascertain factors associated with overweight and obesity (excessive body fat) to address the study objective 1. The detailed analyses procedures are presented in Chapter 5, sub-section 5.2.

3.5 Phase 2: Exploring the perceptions about body image, obesity risk and weight loss

3.5.1 Rationale for qualitative enquiry

The quantitative methodology on its own is not efficient to proffer interpretation of the social realities considering the different contexts and complexities, and hence qualitative inquiries are often needed to complement these. Body image and obesity are social paradigms and they require qualitative research to deal with for better interpretation of the realities (230,231). The belief is that a holistic research assumption of '*no quantification without qualification*' is critically important. As measurements of social facts hinge on categorising the social world, social activities, therefore, need to be distinguished before any frequency or percentage can be attributed to any distinction (231). In addition, qualitative enquiry enhances interpretations with context. Although quantitative research reaches its conclusions quasi-automatically, qualitative research has strengths in interpretations of realities quantified.

3.5.2 Sampling procedure

Obese and non-obese men and women in the cohort and other members of the community were purposively selected for the qualitative interview (focus group interviews). The criteria for the selection were: participant should be an existing PURE study partivipant, or a member of the PURE study Township or rural community; and should be aged 30-70 years. Participants for the FGD were recruited by the field workers with the help of the community leaders and members in each of the two communities. Some of the urban participants were approached for participation in the FGD during physical measurement sessions, usually conducted in groups at designated centres. In the rural communities, cohort participants in adjoining streets were approached to participate in a focus group in a household that accepts to host the group.

3.5.3 Data collection

Focus group discussions

Information on body-image perceptions and attitudes, obesity risk perception and weight control decisions were collected during the follow-up survey in 2014/2015 to address objective 2 (Phase 2). FGD were undertaken with separate groups of women and men based on weight category to explore perceptions about body image, obesity risk perceptions, and weight control decisions in the obese and non-obese groups. A total of 13 FGD were conducted with purposively selected separate obese and non-obese men and women groups. Eight FGD were undertaken in the urban township and five in the rural community. Body image perceptions were further explored using Stunkard figures during the discussions. Group discussions were facilitated in the local language (isiXhosa) and audio-recoded. Detailed procedures of the focus group discussion facilitation, validity measures undertaken and data coding and analyses are discussed in Chapter 5, section 5.2. The FGD guide is attached in Appendix 3. Because of the similarity in the preliminary findings of the FGD data in the urban and rural locations, findings from only the urban community FGD are reported in this thesis.

Prior to the group discussions, participants' weight and height were measured using calibrated scales and a height meter. For these measurements, they were wearing light clothing, standing erect and without shoes. Each participant's BMI was calculated in kg/m^2 and their weight categories determined using standard cut-offs (188). Participants were then classified into normal (or optimal) weight (BMI 18-25 kg/m^2), overweight (BMI 25-30 kg/m^2) and obese (BMI ≥30 kg/m^2) groups based on their BMI.

Rigour

Some steps were taken to ensure validity and reliability of the study. Detailed steps that were taken to ensure rigour in this qualitative study are presented in Chapter 5, sub-section 5.2. The goal of the qualitative study was to obtain sex-specific and weight-based information regarding body image, risk perception and weight control intentions. In order to achieve this goal, the focus groups were organised based on gender and weight status to facilitate comparison of the views of the groups. This is of importance since the findings are expected to support the provision of targeted interventions.

Two trained indigenous research assistants with experience in community-based qualitative research facilitated the group sessions in the local Xhosa language, and developed the transcripts. Data were validated during coding, analyses and interpretation. Furthermore, the triangulation method (232) was used to enhance results of the qualitative research. In that way, findings from the FGD were compared and contrasted with the quantitative data to provide a more credible explanation of the concepts under investigation.

3.5.4 Data coding and analysis

Atlas.ti software was used to facilitate coding and organisation of the themes for analysis. Because of time constraints and resources, qualitative data from the urban location were analysed. Data were analysed using the inductive thematic analysis approach (233). Transcripts were first hand-coded, and an initial coding framework was developed based on the identified categories and sub-themes that emerged from the data. The PWM framework guided the data coding process. In this analysis, we coded the participants' attitude (i.e. perceived vulnerability and threat), their subjective norms and prototypes, and examined how these components impact on their behaviour, intention and willingness. The coding was guided by the PWM and the themes were obtained inductively (234). Codes with similar themes were grouped to form sub-themes. To obtain greater abstraction, sub-themes addressing similar concepts were further grouped to form the final themes. The themes and data analyses procedures adopted are discussed in detail in Chapter 5, sub-section 5.2.

ATLAS.ti is a powerful workbench for the qualitative analysis of large bodies of textual, graphical, audio, and video data offering a variety of tools for accomplishing the tasks associated with any systematic approach to unstructured data. In the course of the qualitative analysis, ATLAS.ti helped in exploring the complex phenomena hidden in the data. For coping with the inherent complexity of the tasks and the data, ATLAS.ti offers a powerful and intuitive environment that keeps one focused on the analysed materials (235). It offers tools to manage, extract, compare, explore, and reassemble meaningful pieces from large amounts of data in creative, flexible, yet systematic ways (236).

3.6 Phase 3: The association among body image, adiposity and total CVD risk

3.6.1 Study design and sampling procedure

A cross-sectional follow-up study design was undertaken to collect information on body image, body fat (adiposity) and the 10-year CVD risk score among adults aged 35 to 78 years. The study initially intended to interview all eligible PURE study cohort participants at year-4follow-up. However, time constraints and limited resources only allowed 963 (78%) of the existing cohort participants, who consented to participate in the sub-study, to be interviewed between March 2014 and July 2015. During this phase, a total of 1036 (83%) existing cohort participants were interviewed in the rural and urban communities. Of these, 63 were excluded because of a lack of complete data on body image and physical measurements.

3.6.2 Questionnaire development and validation

The structured body shape questionnaire (BSQ), with a section on CVD risk assessment was developed for data collection based on the adapted BSQ of Mciza (34,195). This questionnaire also had adapted aspects of the validated 'Attitude and Belief Questionnaire' used by Matoti-Mvalo and Puoane (79). Subjective questions were inserted with corresponding statements to further validate key questions asked. Participants were given three options (agree, uncertain and disagree) from which to select an answer for each statement (in Sections B & C of the questionnaire). The questionnaire was pre-tested among 10 isiXhosa-speaking adults in Langa and the results guided the modification for use in the study settings. The final version of the structured questionnaire had three subsections, (i) perception, (ii) attitude and (iii) perceived consequences of body image and control of overweight.

3.6.3 Data collection

In this third phase, information on body-image perceptions, CVD risk factors and lifestyle behaviours and medical history were collected during a cross-sectional survey. In addition, anthropometric measurements including height, weight, and body fat (using a bio-electric impedance analysis (BIA) device) and waist circumference were taken based on the standard procedures in the main study protocols (39). The questionnaire was administered during the PURE study follow-up survey between June 2014 and July 2015. Five trained research assistants undertook the data collection under the supervision of the researcher.

Blood pressure (BP) measurements were taken at short intervals using *Omron* BP devices and averages recorded as actual BP measures. In addition, baseline physical measurements (weight, height, WC) were obtained from the PURE study baseline dataset for analysis and comparison purposes. Procedures adopted for the interviews, anthropometry, CVD risk scores and body-image perception measurements are discussed in detail below.

Interviews

Face-to-face interviews were conducted with men and women using an interviewer-administered structured questionnaire (Appendix 4). The Stunkard Figures rating scale validated by Mciza et al. (123) and adapted for use among the South African population was used to objectively collect information on body-image perceptions. Sex-specific Stunkard Figures rating scale with figures, ranging from very thin (1) to grossly obese (8) were presented to the participants to select a figure corresponding to the questions. This was done to rate perceptions and attitudes of participants about body image and overweight/obesity. Interviews were conducted with the only willing participant(s) in each sampled household.

Anthropometry and blood pressure measurements

Anthropometric measurements were recorded using the standardised protocol adapted for the PURE study. Height was measured to the nearest 0.10 cm using a height metre with the subject standing erect. Weight was measured with a calibrated digital weighing scale (a-300 Precision Health Scale), set at "0" (zero) prior to each measurement. These measurements were taken with subjects wearing light clothing and without shoes. WC was measured with the subject standing erect with the abdomen relaxed and arms at the sides. Each WC measurement was carefully taken over the minimally-clothed/unclothed abdomen at the smallest diameter between the costal margin and the iliac crest (39). In addition, systolic and diastolic BP measurements were taken on the left arm with the participant seated using Omron BP measuring device. The average of two measures constituted the actual BP.

Body fat and body composition

Body fat percent and other body composition such as total body water, bone mass, and visceral fat were recorded using the standard BIA device (Tanita Ironman body composition monitor BC-554, Tanita Corporation 2009, UK). To ensure accuracy, readings were taken with participants standing erect with clean soles of the feet and heels correctly aligned on the measuring platform. The subjects' height, age, and sex were entered into the device for analysis and the respective body compositions were recorded. Pregnant women and individuals with an electronic medical implant were exempted from BIA measurement with Tanita BIA device as stipulated in the operation manual. This study was mostly concerned with BF%.

Cardiovascular risk scores estimation using Framingham cardiovascular risk equations

Each study participant was evaluated for total CVD risk using the D'Agostino Framingham Heart Study equation to estimate an individual's 10-year risk for a CVD event (204). To obtain a total 10-year risk score for each participant based on the BMI, sex-specific equations based on six non-blood based risk factors (i.e. age, sex, SBP, diabetes, treated for hypertension status, and BMI (instead of lipids)) were entered into

CVD disease prediction equations to generate the CVD scores. The following detail linear equations were used:

The Linear equation (L) were computed for each participant based on sex, where:

Equation 1: $L_{(men)}$ = (3.067 x log of age) + (1.93303 x log of SBP) [if treated for hypertension] + (1.99881 x log of SBP) [if not treated for hypertension] + 0.65451 [if smoker] + 0.0 [if non-smoker] + 0.57367 [for diabetes status] + 0.79277 x log of BMI.

Equation 2: $L_{(women)}$ = (2.32888 x log of age) + (2.76157 x log of SBP [if treated for hypertension] + (2.82263 x log of SBP [if not treated for hypertension] + 0.52873 [if smoker] + 0.0 [if non-smoker] + 0.0.69154 [for diabetes status] 0.51125 x log of BMI.

The individual risk score is an estimate of the probability of a cardiovascular event occurring in ten years, taking into account CVD outcome, duration of follow-up, population of interest, and predictors. CVD risk score was used as a continuous variable and described in a dichotomous category (‘high’, and ‘low’) to aid analyses. The CVD-risk scores form the outcome (dependent) variable, which is used to test a possible relationship with independent variables such as body image and BF% to determine how body image and BF% contribute individually or together to CVD risk among men and women. A conventional threshold for CVD risk (10-20%) was used as the optimal or the normal risk CVD level. A risk score of ≤20% was considered as ‘low’, and ≥20 as ‘high’ risk (32,237).

Perception of body size

To measure body-size perception and weight discordance, the study participants were asked to select a figure that closely resembled their body size status from a set of silhouettes – the Body Image Figure Rating Scale ranging from the very thin to very heavy (10,34). Participants' perceived body image ('Feel' size) as selected from the body image silhouettes was compared to their perceived 'Ideal' size to determine how accurately an individual perceives their body image. Further, individuals were asked to select the silhouette that resembles the 'ideal' size they wanted to look like from the same set of silhouettes. The FID index determined by subtracting the score of the silhouettes is then used to determine an individual's attitude towards their own body size (34,146). Feel-actual discordance (FAD) index was also obtained by subtracting the measured ('Actual' weight) score from the corresponding measured (BMI weight) from the 'feel' weight. FAD indicates the discordance in self-assessed weight for each participant.

3.6.4 Data analysis

The analyses for this phase of the study was based on the 963 PURE study cohort participants for which data were collected at year-4 follow-up. Descriptive statistics were reported using frequencies, means and standard deviations (SD), and bivariate analyses were undertaken. P-value <0.05 at 95% confidence interval (CI) was used as the statistical significant level, unless otherwise stated. The analyses were restricted to the 920 PURE cohort participants with no known CVD event; 43 participants with known CVD were excluded. This sub-sample represents approximately 75% of the existing PURE study cohort participants.

Participants' weight, adiposity (body fat) categories and CVD-risk profiles by sex and location were determined, and CVD-risk scores were compared in the obese and non-obese participants. Adiposity categories in the study were based on BMI, WC, BF%, and WTHR standard cut-offs (170). Student t-tests were used to establish the difference in the continuous variables and chi-square tests for the categorical variables. One-way analyses of variance (ANOVA) and chi-square tests respectively were used to determine the patterns of 10-year CVD risk and body image (FID and FAD) categories based on the age of participants. The prevalence of body image based on adiposity were presented graphically, with significant levels determined at p>0.05 based on chi-square tests.

The associations among body-image perceptions (FID and FAD) and weight and adiposity were determined using Pearson's *r* coefficient. Scatter plots were used to show the relationship between body image and weight change over time. Partial correlation analysis was used to determine the correlation between FID, FAD and 10-year absolute CVD-risk score, controlling for the modifiable risk factors. Logistics regression models were used to determine the factors associated with body image (i.e. discordant weight status and size dissatisfaction). Full details of the data analyses are presented in Chapter 6, section 6.2 under 'Data analysis'.

3.7 Ethics considerations

Approvals for this study and that of the Cape Town arm of the global PURE study (in which this study is nested) were obtained separately from the Senate Research Committee) of the University of the Western Cape. The study was explained to participants with the aid of an information sheet (Appendix 5) written in the participants' local dialect, isiXhosa. For all participants irrespective of whether they were literate or not, the interviewer verbally explained the purpose and nature of the project. Every participant who gave verbal consent to participate in the study was asked to complete and sign a consent form (see Appendix 6). Individuals who were involved in focus group discussions also signed the consent form (see Appendix 7) and promised not to share information discussed with persons who were not in the group. Participants were made to understand that their participation in the study was voluntary and that they could withdraw at any time without providing any reason. No expected harm was implied to the study participants. All participants were informed that the research was for a PhD study and that information acquired through the research would be shared with them prior to public dissemination. Anonymity and confidentiality were duly observed throughout the study. Names and signatures only appeared on the consent forms signed by the participants. All collected data were stored in a safely locked locker at the University of the Western Cape, School of Public Health and data are accessible only to the researcher and the research supervisors to preserve the confidentiality of all the participants. Findings from this study are to be published in accredited peer-reviewed journals to inform discourse on setting-specific intervention on obesity and CVDs.

CHAPTER 4

PREVALENCE AND FACTORS ASSOCIATED WITH EXCESSIVE BODY FAT IN BLACK SOUTH AFRICANS

Abstract

Objective: To determine the factors associated with excessive body fat among black African men and women living in rural and urban communities of South Africa.

Methods: This is a cross-sectional analysis of data from the Prospective Urban and Rural Epidemiology (PURE) study, Cape Town, South Africa, which was conducted in 2009/2010. The study sample included 1220 participants (77.2% women) aged 35-70 years for whom anthropometric measurements were obtained and risk factors documented through face-to-face interviews using validated international PURE study protocols. Sex-specific logistic regression models were used to evaluate socio-demographic, lifestyle and psychological factors associated with three excessive body fat indicators, namely, body mass index (BMI), waist circumference (WC) and body fat percent (BF%).

Results: The prevalence of excessive body fat based on BF%, WC and BMI cut-offs were 96.0%, 86.1% and 81.6% for women respectively, and 62.2%, 25.9% and 36.0% for men respectively. The significant odds of excessive body fat among the currently married compared to unmarried were 4.1 (95% CI: 1.3-12.5) for BF% and 1.9 (95% CI: 1.3-2.9) for BMI among women; and 4.9 (95% CI: 2.6-9.6), 3.2 (95% CI: 1.6-6.4) and 3.6 (95% CI: 1.9-6.8) for BF%, WC and BMI respectively among men. In men and women, age (<50 years) was inversely associated with excessive BF% and less-than-a-college education was inversely associated with excessive BMI and WC. Tobacco smoking was inversely associated with all three excessive adiposity indicators in women but not in men.

Unemployment, depression and stress did not predict excessive body fat in men or women.

Conclusion: The sex-differences in the socio-demographic and lifestyle factors associated with the high levels of excessive body fat in urban and rural women and men should be considered in packaging interventions to reduce obesity in these communities.

Findings presented in this chapter have been published in a peer-reviewed journal.

Okop K J, Levitt N, Puoane T. Factors Associated with Excessive Body Fat in Men and Women: Cross-Sectional Data from Black South Africans Living in a Rural Community and an Urban Township. PloS One. 2015;10(10):e0140153.

4.1. Introduction

Obesity has become a global epidemic with an estimated 1.3 billion overweight or obese adults estimated by 2030 (1). It is a leading preventable cause of death worldwide (156). Obesity is prevalent in most low- and middle-income (LMIC) countries under transition and it is associated with increasing CVD risk and related health complications (7,25,32). In South Africa, the prevalence of overweight and obesity (referred to as excessive body fat in this paper) has increased steadily over time, reaching 56% in 2002 [6] and65% in 2012 [7]; with black African women living in urban townships and some rural communities the most affected. Excess body weight was the cause of 78% of type 2 diabetes, 68% of hypertensive disease, 45% of ischaemic stroke, and 38% of ischaemic heart disease cases among adults in South Africa (7). Information on the factors associated with excessive body fat in black African women and men living in rural and urban communities are of critical importance for the development of community-specific obesity prevention strategies in these settings.

The South African black population is experiencing adverse challenges of urbanization and nutrition transitions (67,238,239). In South Africa, obesity is driven mainly by socio-economic and socio-cultural factors including childhood and adult poverty (21,22,67), attitudes about obesity (27), as well as dietary and physical activity behaviours and genetic susceptibility (20,153). The high rate of overweight and obesity is likely to be sustained in this population due to changing lifestyles (20,239), changing food environment (20,153,240) and inherent cultural perceptions of body image (27,141) especially among women.

In most regions of the world (including SSA), recent data indicate high prevalence of excess body weight, with obesity (BMI $\geq$30 kg/m^2) far higher than overweight among adults, when compared with earlier reports (1,25,163). Similarly, the recent South African National Health and Nutrition Examination Survey (49) indicated a substantial variability in overweight and obesity prevalence among adults population based on sex and rural-urban location. For example, overweight/obesity among individuals aged 15 years and above was highest in urban formal (36.0% males and 66.4% females) compared to rural formal locality (23.5% males and 62.3% females). Higher trends of obesity were also reported in urban informal areas compared to the rural informal areas, among boys and girls (49). The sex differences in the burden of overweight or obesity in rural and urban communities may be due to setting-specific factors that may be sex-specific.

While obesity remains a significant public health concern in South Africa, there is however little or no evidence of innovative preventive strategies, diagnosis, and/or treatment in the resource-poor urban and rural communities. This might be due partly to the lack of appropriate community-level sex-specific information that could support the development of cost-effective setting-specific prevention strategies. Also, in South Africa, no study has assessed the sex-specific factors associated with three measures of excessive adiposity viz. BF%, WC and BMI in black African men and women. Ascertaining sex-specific factors associated with excess body fat based on different adiposity indicators among adults living in rural and urban communities of South Africa is of importance, as a combination of standard body weight measures is recommended for objective assessments of obesity and health risks associated with obesity (178,241,242).

Previous studies reporting on determinants of obesity had focused mainly on physical activity, diet and socioeconomic factors (21,22,27,153,163). Many of these studies were conducted in one specific setting, and usually used body mass index (BMI) and or waist circumference (WC) to assess obesity and health risk, and excluded body fat percent

(BF%) measure – which estimates actual body fat more accurately. Moreover, very limited data on BF% obesity among adults in South African communities is however available.

This present study focused on BF% and WC as indicators which complement BMI as proxies for assessing obesity and health risks (175,178). Although BMI is the established clinical measurement to estimate CVD risk associated with excess bodyweight, evidence showed that BF% and WC represent better indicators of metabolic (242) and CVD risks (178,241,243) than BMI. A previous study involving white and African American adults also reported that WC and BF% were significantly associated with metabolic syndrome (244). Moreover, it is commonly reported that BMI cut-off values often used to diagnose obesity have high specificity but low sensitivity to identify adiposity; and do not identify half of the people with high BF% (174,182). Data from large cross-sectional studies involving Africans indicated that BMI compared to WC and BF% under-estimates obesity particularly in overweight individuals (178,182), and therefore misses those with high risk of cardiometabolic risk factors related to elevated central adiposity.

Body fat percent (BF%) is the proportion of body fat per amount of weight. It is an established standard measure forbody fat meaureoften used for health risk appraisal (241,242).

Rush *et al* (2007) in a study among urban African and Europe women reported a relationship between BF% and BMI which varies with ethnicity (245). Also, the study showed that central fat mass in black SA were lower than that in European SA women (P<0.001). This is linked possibly to the differences in central fat mass and muscularity (245). However, this study and other do not inlcude African men.

Furthermore, some associations and or variations in health-related risk have been reported between BF%, WC and BMI. A study by Phillips and her colleagues in 2013 had reported that men and women classified as obese by BF% displayed significant cardiometabolic risks (insulin resistance, pro-inflammatory, pro-thrombotic, and proatherogenic profile) than those classified as obese by BMI (242). On the other hand, WC has been traditionally used as a measure of central obesity (178,241,242), and WC correlates closely with with BMI waist/hip ratio and (185). Also, an earlier study conducted among South Africans (155), reported that WC was associated with metabolic syndrome (i.e. elevated fasting insulin, triglyceride levels, and low HDL-C levels) in urban black hypertensive women than BMI.

The aim of this study was to ascertain the socio-demographic, psychological factors and lifestyle behaviours that are associated with abdominal (WC-defined) and actual body fat (BF%-defined) and general (BMI-defined) excessive body fat among men and women in a rural and an urban South African communities. In this study, we addressed the following research questions: 1) What proportions of women and men in the rural and urban communities have excessive body fat based on BF%, WC and BMI?; and 2) Does socio-demographic, psychological factors and lifestyle behaviours predict specific excessive body fat indicators differently in men and women living in the rural and urban communities?

4.2. Materials and Methods

4.2.1 Study setting, population and design

This is a cross-sectional analysis of data from 1220 individuals participating in the PURE study, Cape Town study centre, South Africa. The PURE study is a longitudinal multi-country investigation of the relative contributions of societal influences such as urbanization, nutrition, built environment and lifestyle behaviours on obesity and chronic health conditions including heart disease, diabetes and cancer (39).Two communities are involved in the study; Langa, an urban location (referred to as ‘township’) near Cape

Town metropolis, and Mount Frere, a typical rural community located in the Eastern Cape. These are typical resource-poor black-dominated African communities located within different socio-economic environments in transition and with substantial obesity-burden (21,49).

Langa has an estimated population of 52,401 of which 99.1% are black African. The township has grown due to migration of people mostly from the rural Eastern Cape. Like any other black African townships in Cape Town, most residents in Langa live with an average monthly household income of R2,144 (~$200) and over 40% are unemployed (223). The Langa community is grouped into three development areas – "old Langa", "the Zones" and "the hostels" which mirror the socioeconomic status (SES) of the residents (old Langa is considered higher SES and better established with amenities and the hostels represent the lowest SES). On the other hand, Mount Frere is a rural community located in Alfred Nzo district in the Eastern Cape with an estimated 99.8% black African and an estimate population density of 519 km^2. Most residents live below poverty line and earn an average monthly income between R1001-2500 (~$80-$200) with an estimated unemployment rate of over 76% (223).

4.2.2 Sampling procedure

The two communities were purposively selected based on the feasibility of follow-up for a prospective cohort study and for the purpose of urban-rural comparisons. The methods employed for PURE study have been described elsewhere (39). For the urban township, systematic sampling was used to select every second household in the three designated development areas. In Mount Frere (rural community), cluster sampling of houses in selected villages under the clan heads was undertaken, since there were no designated street names. From the selected households in both communities, eligible member(s) were recruited as participants for the cohort study. This paper is restricted to 1220 participants aged 35-70 years who had fully completed required physical measurements. This sample represents 60% of the baseline cohort population. Our preliminary analyses showed that there were very minimal differences in the distribution of participants' characteristics (age, sex, education level, location, and smoking status) between the study sample used for this paper, and the rest of the cohort sub-sample we excluded due to missing physical measurements.

4.2.3 Data collection

Face-to-face interviews were undertaken using validated international PURE study baseline questionnaires. These questionnaires were pre-tested in two South African communities, were then adapted and used to collect information on participants' socio-demographic characteristics, medical history and CVD risk factors between March 2009 and June 2010. Information on the risk factors of interest namely stress, depression, physical activity, tobacco and alcohol use, and history of hypertension were also elicited. Face-to-face interviews were undertaken to collect the needed data.

Exposure variables considered for this study and for which data were collected include (i) socio-demographic variables (age, education, location, and employment status), (ii) self-reported lifestyle factors (physical activity, tobacco smoking and alcohol use), and (iii) psychological factors viz. stress (i.e. feeling irritable, or filled with anxiety at home or at work), and depression (feeling depressed) in the previous 12 months. Other exposure variables considered were self-reported hypertension and unavailability of food at home at any time in the three months preceding data collection. In addition, systolic and diastolic BP measurements were taken on the left arm of a seated participant using a validated Omron automatic measuring device. An average of two measurements constituted the actual BP. Hypertension was defined as taking BP lowering medication and/or BP ≥ 140/90 mm Hg.

Anthropometric and body composition outcomes

Excessive body fat based on three adiposity indicators (viz. BF%, WC and BMI) were the dependent variables. Anthropometric measurements were taken using a standard protocol for the study (39). Height was measured to the nearest 0.1 cm using a standard height meter, and weight was measured to the nearest 0.1kg using a digital weighing scale with subjects wearing light clothing and without shoes. BMI was calculated by dividing weight (in kg) by height (in m^2). WC was measured at the smallest diameter between the costal margin and the superior aspect of the iliac crest using a standard measuring tape. During these measurements, participants stood erect and relaxed, with arms at their side. Gold standard methods for measuring BF% such as underwater weighing and dual energy x-ray absorptiometry (DEXA) are expensive and not always practicable in large field studies or for health risk appraisal. Therefore, proxy measures of body fat percent such as skin fold, sex-specific prediction formula based on BMI, as well as BIA have been used in studies involving black Africans (178,241). For this study, body fat percent (BF%) for men and women were computed individually using Deurenberg *et al*. (246) and used prediction formula for adults – BF% = 1.20xBMI+0.23xage-10.8-5.4; where sex is 1 for male and 0 for female. This formula has been validated elsewhere (246) in studies involving Africans (247). Excessive body fat based on BF%, WC and BMI were the dependent variables.

Standard WHO cut-offs for BMI and WC (171,174), as well as BF% values used to depict overweight and obesity in studies involving Africans (32,34) were considered for this study. BMI of 18.0-24.9 kg/m^2, 25.0-29.9 kg/m^2, and ≥30.0 kg/m^2 depicted normal weight, overweight, and obesity respectively. Cut-off points for BF% and WC validated in studies involving black African populations were adapted from previous studies including SAHANES-2013. Accordingly, BF% of 30-35% and >=36% (for women), and 21-25% and >=26% (for men) represented overweight and obesity categories respectively (34A WC >88 cm in women and >102 cm in men indicated central obesity (7,34). The corresponding normal body weight categories were values less than overweight values for both BF% and WC.

4.2.4 Data analysis

Frequencies and proportions of socio-demographic variables and excessive body fat (EBF) based on BMI, WC and BF% cut-offs were calculated by sex. The differences in EBF and socio-demographic variables between the men and women were determined using chi-square test at 95% significance level. The mean (SD) values for age, height, weight, and BMI, WC, and BF% for the men and women were compared using independent t-test after stratifying by location. The proportions of participants with EBF by sex and locations, as well as by age categories, were presented. For further analyses, each dependent variable was re-coded as a dichotomous, with excess body weight (i.e. overweight and obesity category) denoted as '1' and normal body weight (the reference category) denoted as '0'. First, sex-specific bivariate analyses were undertaken to determine the variables that were significantly associated with each of the EBF indicators (unadjusted). The odds ratios (OR), confidence intervals and p-values for the independent variables were determined. The variables that showed significant level of association ($p<0.05$) with any of the three EBF indicators in the bivariate analyses (viz. location, age, sex, education, employment, tobacco and alcohol use, and hypertension status) and those reported in previous studies [11,12,18] to have significant associations with overweight and obesity (such as physical activity, stress, depression, hypertension, and food unavailability) were considered for multivariate regression analyses. Multivariate logistic regression models were then fitted using a hierarchical (block-wise entry) method to determine the association between independent variables and each of the three EBF indicators, taking men and women as separate cases. The regression analyses produced adjusted odd ratio for each of the independent variables in the models, in relation to the three dependent variables (viz. excessive BMI, WC and BF%). Unemployment and physical activity did not add any significant value to the regression model, as observed in the model fitting statistics (high log-likelihood values) each time they were introduced in the model, and were therefore omitted in the final model. A p-value of <0.05 represented statistical significance. Data was analyzed with SPSS version 22 (IBM Corporation, 2013).

Ethics statement

The research ethics committee of the University of the Western Cape approved the study. Permission to work with the baseline data was obtained from the working committee of PURE study Cape Town Centre, and the Population Health Research Institute of McMaster University, Canada – the headquarters of global PURE study. The study was properly explained to participants with the aid of an information sheet written in participants' local dialect. All participants provided written informed consent by signing a consent form, after accepting verbally to participate in the study. Participants were duly informed that participation in the study was voluntary and one could opt out at any point. Information obtained during the study was kept confidential. No expected harm was implied to the study participants.

4.3. Results

4.3.1 Participants' characteristics and obesity prevalence

The socio-demographic and anthropometric characteristics of the study participants by sex are presented in Table 4.1. There were 278 (22.8%) men and 942 (77.2%) women; 581 (62%) of the women and 159 (57%) of the men were from the rural community respectively. Mean (SD) age of participants was 50 (10) years; 54.5% of the women and 57.2% of the men were aged between 50 and 70 years. The majority of the participants (82%) were unemployed. About 90% of the men and women had either primary or secondary/high school education, or only 3% had tertiary education. Nearly 37% of women and 46% of men were currently married and about one-third of them were never married. Overall, 88.3%, 72.3% and 71.2% respectively had excessive body fat (EBF) based on BF%, WC and BMI cut-offs. Women compared to men had significantly higher prevalence of EBF. The prevalence of excessive body fat (overweight and obesity) based on BF%, WC and BMI cut-offs were 96.0%, 86.1%, and 81.6% for women respectively, and 62.2%, 25.9%, and 36.0% for men respectively.

Participants' mean (SD) age, anthropometric and body fat measures by sex and location are presented in Table 4.2. There were significant differences in height, weight, BMI, WC and BF%, but no significant difference in age between the men and women in both locations. Women in both locations were heavier than men, whereas men were taller. The mean BMI, WC and BF% for women in the rural and urban locations were respectively higher than the standard cut-off for obesity. For the men, mean BF% and BMI were higher than the standard cut-off values for normal body weight.

In addition, women had higher proportions of excessive body fat than men in both the urban and rural settings for all three adiposity indicators considered (Figure. 4.1). For example, in the rural community, the proportion of women with EBF compared to the men was 95% vs. 57% for BF%, 85% vs.17% for WC, and 80% vs. 28% for BMI respectively.

Table 4.1: Socio-demographic and anthropometric characteristics of study participants

	Overall N=1220		Women N=942		Men N=278		p-value^
Variable	n	%	N	%	N	%	
Location							
Urban	480	39.3	361	38.3	119	42.8	
Rural	740	60.7	581	61.7	159	57.2	0.179
Total	1220	100.0	942	77.2*	278	22.8*	
Age (years)							
35-49	548	44.9	429	45.5	119	42.8	
50-59	409	33.5	308	32.7	101	36.3	0.526
60-70	263	21.6	205	21.8	58	20.9	
Education							
None	49	4.0	29	3.1	20	7.2	
Primary	466	38.2	346	36.7	120	43.2	
High school	668	54.8	540	57.3	120	46.0	0.01
College/university	37	3.0	27	2.9	10	3.6	
Employment status**							
No	178	17.7	630	82.1	195	82.6	0.923
Yes	825	82.3	137	17.9	41	17.4	
Marital status							
Never married	441	36.1	347	36.8	94	33.8	
Currently married	475	38.9	346	36.7	129	46.4	0.01
Co-habiting	49	4.0	33	3.5	16	5.8	
Widow/separated	255	20.9	216	22.9	39	14.0	
Percentage body fat[a]							
Normal	143	11.7	38	4.0	105	37.8	
Overweight	193	15.8	126	13.4	67	24.1	0.0001
Obesity	884	72.5	778	82.6	106	38.1	
Waist circumference[b]							
Normal	337	27.6	131	13.9	206	74.1	
Overweight	164	13.4	129	13.7	35	12.6	0.001
Obesity	719	58.9	682	72.4	37	13.3	
Body mass index[c]							
Underweight	28	2.3	8	0.8	20	7.2	
Normal	323	26.5	165	17.5	158	56.8	
Overweight	278	22.8	228	24.2	50	18.0	0.001
Obesity	591	48.4	541	57.4	50	18.0	
Current Tobacco use							
Yes	251	17.7	120	12.7	131	47.1	0.0001
No	1004	82.3	822	87.3	147	52.9	
Current Alcohol use							
Yes	216	20.6	98	10.4	118	42.4	0.0001
No	909	79.4	844	89.6	160	57.6	

*^p-value obtained using chi-square test (at 95% significance level) *The proportions (of men and women) are based on the overall total, 1220 (denominator). All other proportions are column percentages. ^ ** Missing data (n=215) were not included. ;[a & b]Normal, Overweight and Obesity categories are defined by standard WHO cut-offs for BMI and WC[33]; [c]Normal, Overweight and Obesity cut-offs for BF% were taken as<30%, 30-35% and >=36% (for women), and <21%, 21-25% and >=26% (for men) respectively[34].*

Table 4.2: Participants' mean age, anthropometric and body fat measures by sex and location

	Urban			Rural		
	Men	**Women**	**Total**	**Men**	**Women**	**Total**
Number, n	119	361	480	159	581	740
	(mean, SD)			(mean, SD)		
Age (years)^	51.0 (10)	50.0 (10)	49.9 (10)	51.0 (10)	51.0 (10)	51.2 (10)
Height (cm)*	168.5 (7)	157.0 (7)	160.0 (9)	166.9 (7)	156.9 (6)	159.0 (8)
Weight (Kg)*	75.3 (23)	85.7 (24)	83.2 (24)	66.1 (18)	77.5 (21)	75.1 (21)
BMI (Kg/m^2)*	26.6 (8)	34.7 (9)	32.7 (10)	23.7 (6)	31.4 (8)	29.8 (8)
WC (cm)*	91.0 (15)	100.1 (16)	97.9 (16)	83.8(10)	93.2 (17)	91.1 (16)
BF% (%)*	27.4 (10)	47.6 (11)	42.6 (14)	24.0 (8)	44.1 (10)	39.8 (13)

*^No significant difference (p-value >0.05) between men and women in both locations. *Significant difference (i.e. p-value <0.001) between men and women for this particular variable in both rural and urban locations. P-values were based on independent t-test (95% CI).*

4.3.2 Proportions of women and men with excessive body fat

The proportions of women and men with excessive body fat by location stratified by age are presented in Table 4.3. Excessive body fat levels increase with age in women and men in both communities, except for WC in the urban women group. For each of the three age categories considered, EBF based on BF% was highest when compared to abdominal and BMI obesity in both the men and women in the two communities. In addition, EBF using any other methods was not too different between the urban and rural women, but was significantly higher in the urban men at all ages when compared to the rural counterparts.

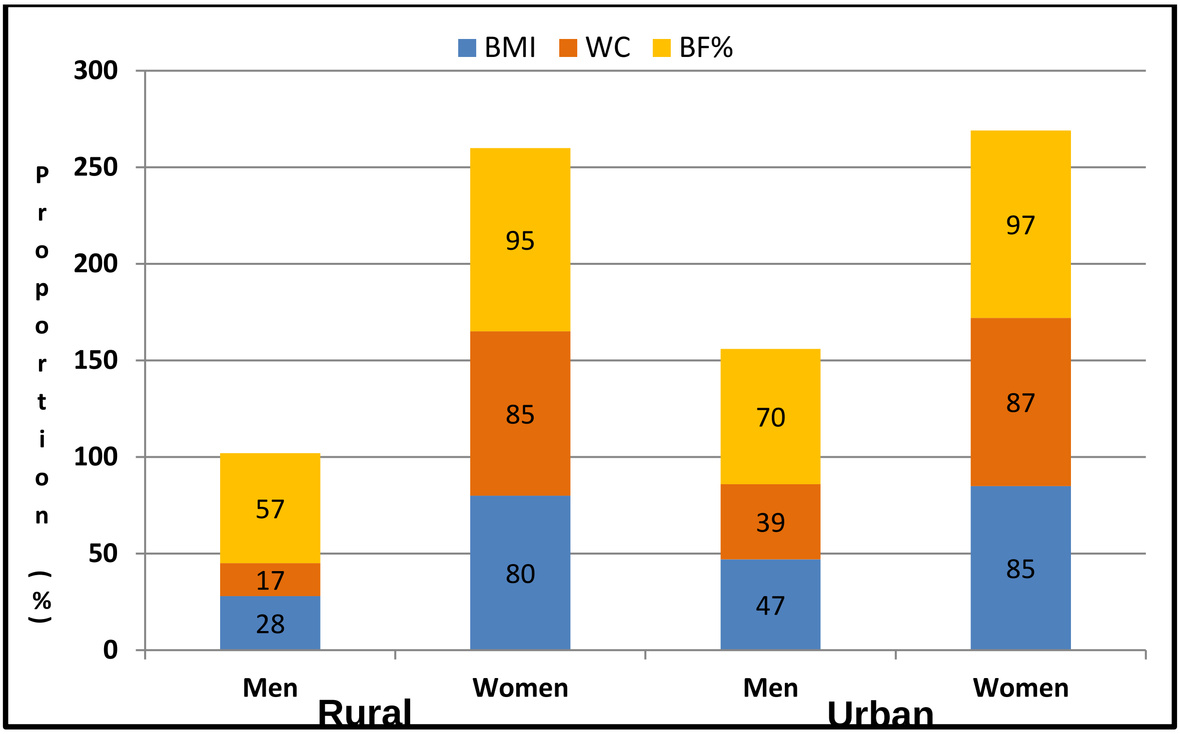


Figure 4.1. Proportions of men and women with excessive body fat by location

Table 4.3: Comparison of proportions of women and men with excessive body fat by location and age category

	Women (N=942)						**Men (N=278)**					
	Urban (n=361)			**Rural (n=581)**			**Urban (n=119)**			**Rural (n=159)**		
EBF Proportions	**Age category**						**Age category**					
	35-49	**50-59**	**≥60**	**35-49**	**50-59**	**≥60**	**35-49**	**50-59**	**≥60**	**35-49**	**50-59**	**≥60**
Number (%)*	173 (48)	120 (33)	68 (19)	256 (44)	188 (32)	137 (24)	50 (42)	46 (39)	23 (19)	69 (43)	55 (35)	35 (22)
EBF (BMI), %	82.1	86.7	86.8	82.0	72.7	78.8	38.0	45.7	69.6	23.2	25.5	40.0
EBF (WC), %	87.9	90.8	86.8	81.3	84.6	90.5	28.0	32.6	69.6	13.0	16.4	25.7
EBF (BF%), %	95.4	97.5	100	91.4	97.3	100	54.0	76.1	91.3	42.0	56.4	85.7

** Proportion of women or men was based on the number of men (or women) in each age category in the rural and urban locations.*
N/B: Age was significantly associated (p->0.05) with all three EBF indicators in women and men. Comparisons were by chi-square test.

4.3.3 Determinants of excessive body fat

The unadjusted odds ratio and 95% confidence intervals (95% CI) for the associations of the socio-demographic psychological and lifestyle variables with EBF is presented in Table 4.4. Based on the bivariate analyses, current marriage status, location and education showed significantly positive association with EBF indicators, whereas lifestyle behaviours namely current alcohol use and tobacco use showed significant inverse association with all three the EBF indicators.

The multivariate logistic regression analyses that show the factors associated with specific excessive body fat indicators among women and men are presented in Table 4.5. The results are presented based on the adjusted odds ratio (OR) at 95% confidence interval for each independent variable in the model. The risk (OR, 95% CI) of excessive body fat among the currently married compared to those not married was 4.1 (95% CI: 1.3-12.5) for BF% and 1.9 (95% CI: 1.3-2.9) for BMI for women; and 4.9 (95% CI: 2.6-9.6), 3.2 (95% CI: 1.6-6.4) and 3.6 (95% CI: 1.9-6.8) for BF%, WC and BMI respectively for men.

Women living in the urban township compared to their rural counterparts were respectively 1.6 times more likely to have excessive BMI or WC, whereas urban men were respectively 2.3 and 3.1 times more likely to have excessive BMI and WC than their rural counterparts. There was however, no significant association between location and excessive BF% for both men and women. Current tobacco smoking was inversely associated with all three indicators of EBF (BF%, WC and BMI) in the women and not in men, whereas current alcohol use and less-than-a-college education respectively showed significant inverse associations with excessive BMI and WC among men only. In addition, men and women aged ≤50 years were less likely to be of excess BF% than those aged>50 years. In contrast, age was not associated with excessive BMI or WC in both men and women. In addition, being hypertensive, or reporting any form of depression or stress had no significant association with any form of EBF neither among women nor men.

Table 4.4: Bivariate analysis, OR (95% CI) for the association of excess body fat with potential determinants by sex

Determinants	Overweight/Obesity (BMI)		Abdominal overweight/obesity (WC)		High body fat/Obesity (BF%)	
	Women	Men	Women	Men	Women	Men
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Socio-demographic						
Currently married: Yes	**0.49 (0.34–0.72)[a]**	**3.31 (1.98–5.52)[a]**	0.79 (0.53–1.17)^	**2.84 (1.6–5.0) [a]**	**4.00 (1.55–10.34)[b]**	**4.47 (2.61–7.65)[a]**
(No)	ref	ref	ref	Ref	ref	ref
Location: Urban	1.37 (0.97–1.95)^	**2.32 (1.41–3.83) [b]**	1.43 (0.96–2.12)^	**3.01 (1.7–5.2)[a]**	1.55 (0.76–3.17)^	**1.77 (1.07–2.92)[c]**
(Rural)	ref	ref	ref	ref	ref	ref
Currently employed: No	0.64 (0.38–1.09)^	**0.47 (0.25–0.92) [c]**	0.76 (0.43–1.36)^	0.65 (0.3–1.3)^	0.60 (0.76–3.17)^	0.68 (0.33–1.40)^
(Yes)	ref	ref	ref	ref	ref	ref
Education						
None/Primary	ref	ref	ref	ref	ref	ref
Secondary-High School	**1.44 (1.03–2.01)[c]**	**0.10 (0.20–0.48) [b]**	1.03 (0.71–1.50)^	**1.90 (1.1–3.4)[c]**	1.63 90.85–3.15)^	**1.83 (1.10–3.05)[c]**
College/University	7.39 (0.99–55.27)^	**0.12 (0.04–0.87) [c]**	4.37 (0.56-32-9)^	**10.24 (2.5–42.2)[b]**	9.10 (3.50–50.01)^	**10.34 (2.10–50.95)[b]**
Age: >50 years	0.95 (0.68–1.32)^	1.57 (0.96–2.58)^	1.77 (0.53–1.66)^	**2.24 (1.2–3.4) [b]**	**4.18 (1.90–9.24)[a]**	**3.21 (1.93–5.32)[a]**
(≤50 years)	ref	ref	ref	ref	ref	ref
Psychological factors						
Stress at home[1]: Yes	1.07 (0.67–1.72)^	1.34 (0.71–2.67)^	1.00 (0.56–1.66)^	0.98 (0.5–2.0)^	0.99 (0.34–2.61)^	1.10 (0.58–2.10)^
(No)	ref	ref	ref	ref	ref	ref
Depression[2]: Yes	0.99 (0.71–1.39)^	**0.56 (0.33–0.95) [c]**	0.82 (0.57–1.19)^	**1.84 (1.0–3.4)[c]**	**0.49 (0.25–0.97)[c]**	**0.51 (0.31–0.84)[b]**
(No)	ref	Ref	ref	ref	ref	ref
Food unavailability[3]: Yes	1.15 (0.78–1.67)^	0.98 (0.53–1.85)^	0.80 (0.54–1.18)^	0.92 (0.5–1.8)^	1.61 (0.73–3.57)^	1.11 (0.60–2.08)^
(No)	ref	ref	ref	ref		ref
Lifestyle						
Current tobacco smoking[d]: Yes	**0.47 (0.30–0.74) [b]**	**0.35 (0.21–0.58)[c]**	**0.47 (0.29–0.75)[b]**	**0.39 (0.2–0.70)[b]**	**0.25 (012.-0.51)[a]**	**0.48 (0.29–0.79)[b]**
(No)	ref	ref	ref	ref	ref	ref
Current alcohol use[d]: Yes	**0.59 (0.36–0.95) [c]**	**0.28 (0.16–0.49)[a]**	0.69 (0.40–1.19)^	**0.26 (0.1–0.5)[a]**	**0.35 (0.16–0.77)[b]**	**0.46 (0.28–0.75)[b]**
(No)	ref	ref	ref	ref	ref	ref
Physical activity*						
Low	1.15 (0.77–1.70)^	1.21 (0.54–2.72)^	0.65 (0.33–1.28)^	1.02 (0.43–2.46)^	0.86 (0.26–2.92)^	1.92 (0.89–4.16)^
Moderate	1.23 (0.86–1.75)^	1.62 (0.81–3.21)^	0.59 (0.31–1.10) ^	1.14 (0.54–2.40)^	0.61 (0.21–1.81)^	1.33 (0.70–2.52)^
High	ref	Ref	ref	ref	ref	ref
Hypertension						
Measured or on treatment						
<90/140 mmHg	ref	ref	ref	ref	ref	ref
≥90/140 mmHg	1.24 (0.97–1.60)^	**0.59 (0.36–0.96)[c]**	1.06 (0.73–1.54)^	**1.95 (1.13–3.36)[c]**	0.86 (0.44–1.67)^	0.70 (0.43–1.14)^
Measured (only)						
<90/140 mmHg	ref	ref	ref	ref	ref	ref
≥90/140 mmHg	**1.52 (1.18–1.96)[b]**	**2.00 (1.19–3.24)[b]**	1.40 (0.96–2.01)^	**2.25 (1.30–3.88)[b]**	**2.09 (1.04–4.20)[c]**	2.01 (1.20–3.36)[b]

ref = reference category (for respective variables)
[a]p<0.0001; [b]p<0.001; [c]p<0.01; ^p>0.05;
[1]reported stress at home, and
[2] any form of depression for at least 3 consecutive weeks in past 12 month;
[3]reported staying sometimes without food at home within last 12 month;
[d]Smoke or consume tobacco products or alcohol at least once a week
**Physical activity based on metabolic equivalent (MET) score/mins: low= MET <600, moderate=MET 600-3000; high= MET >3000).*

Table 4.5: Adjusted odd ratios (95% CI) for association of general, abdominal and percent body fat overweight/obesity with determinants by sex

	Overweight/Obesity (BMI)		Abdominal overweight/obesity (WC)		High body fat/Obesity (BF%)	
Determinants	Women	Men	Women	Men	Women	Men
	AOR* (95% CI)	AOR* (95% CI)	AOR* (95% CI)	AOR* (95% CI)	AOR* (95% CI)	AOR* (95% CI)
Socio-demographic						
Currently married: Yes	**1.90 (1.26–2.85)[a]**	**3.63 (1.92–6.82)[a]**	1.17 (0.76–1.79)^	**3.18 (1.59–6.39)[b]**	**4.08 (1.33–12.53)[c]**	**4.94 (2.55–9.55)[a]**
(No)	ref	ref	ref	ref	Ref	ref
Location: Urban	**1.60 (1.04–2.46)[c]**	**2.30 (1.21–4.51)[b]**	**1.63 (1.01–2.63)[c]**	**3.11 (1.53–6.32)[b]**	2.23 (0.80–6.21)^	1.84 (0.95–3.56)^
(Rural)	ref	ref	ref	ref	ref	ref
Age: ≤50 years	1.06 (0.27–1.56)^	0.88 (0.47–1.67)^	0.80 (0.52–1.22)^	0.57 (0.28–1.16)^	**0.21 (0.08–0.52)[b]**	**0.40 (0.21–0.74)[b]**
(>50 years)	ref	ref	ref	ref	ref	ref
Education						
None[1]-High school	0.72 (0.49–1.06)^	**0.42 (0.21–0.81)[b]**	1.01 (0.65–1.58)^	**0.36 (0.18–0.74)[b]**	0.45 (0.19–1.07)^	0.89 (0.46–1.70)^
College/University	ref	ref	ref	ref	ref	ref
Psychological factors						
Depression[2]: Yes	1.19 (0.80–1.70)^	0.69 (0.35–1.36)^	0.93 (0.62–1.42)^	0.73 (0.62–1.42)^	0.60 (0.27–1.35)^	0.67 (0.34–1.29)^
(No)	ref	ref	ref	ref	ref	ref
Stress: Yes	0.94 (0.57–1.56)^	1.39 (0.63–3.04)^	0.91 (0.51–1.60)^	0.94 (0.48–2.17)^	0.82 (0.41–1.94)^	1.12 (0.53–2.40)^
(No)	ref	ref	Ref	ref	ref	ref
Hypertension						
Measured or on treatment						
<90/140 mmHg	ref	ref	ref	ref	ref	ref
≥90/140 mmHg	1.04 (0.72–1.51)^	1.24 (0.68–2.29)^	1.16 (0.77–1.74)^	1.44 (0.74–2.80)^	0.89 (0.10–0.67)^	1.04 (0.56–1.93)^
Lifestyle						
Current tobacco smoking[3]: Yes	**0.44 (0.29–0.75)[b]**	0.56 (0.30–1.08)^	**0.51 (0.29–0.93)[c]**	0.63 (0.31–1.29)^	**0.26 (0.10–0.67)[b]**	0.61 (0.32–1.19)^
(No)	ref	ref	ref	ref	ref	ref
Current alcohol use[3]: Yes	0.77 (0.40–1.46)^	**0.36 (0.18–0.72)[a]**	0.80 (0.39–1.65)^	**0.31 (0.14–0.67)[b]**	0.44 (0.14–1.44)^	0.77 (0.39–1.56)^
(No)	ref	ref	ref	ref	ref	ref

*Adjusted for all other variables in the model; ref = reference category (for respective variables)

[a] p<0.0001

[b] p<0.001

[c] p<0.01

^p>0.05

[1]Only 4% of the study sample had no education, and where added to any primary & high school education for analyses purpose

[2]Reported being depressed for 2 weeks or more in a row within last 12 months.

[3]Smoke tobacco products or alcohol at least once a week.

4.4. Discussion and Conclusion

This study presented the prevalence of EBF based on three standard adiposity indicators, and further determined the socio-demographic, psychological factors and lifestyle behaviours associated with specific EBF indicators among women and men in the study population. Four key findings were demonstrated. First, there were very high proportions of EBF among women (>81%) for all three adiposity indicators. Moreover, six in every ten men (62%) had EBF based on BF%, compared with about three in ten men (36%) with BMI-defined EBF. Secondly, the proportion of men and women with BF%-defined EBF for all age categories were consistently greater than that of WC and BMI. Thirdly, different socio-demographic, lifestyle and psychological factors predicted specific excessive body fat indicators, with distinct differences by sex. Fourthly, less-than- college education in men, and current smoking status among women were inversely associated with at least two of the EBF indicators considered. These findings and their possible explanations and implications for intervention are discussed in the sections below.

High levels of excessive body fat by sex and location

Excessive body fat in women and men were extremely high, with nine out of 10 women and eight in 10 men with excess BF%. The high proportions of overweight or obesity in our study population is in line with findings of previous studies that reported higher proportions of obesity in women compared to men in South Africa [6,7,12,14] as well as in other developing countries [35]. However, in our study, the level of obesity based on BF%, BMI and WC in men in the communities (rural and urban) was comparatively higher than that reported in other studies in South Africa [6,7,13]. In addition, as age increases, substantially high proportions of men from both the rural community and urban township had excessive body fat for all three adiposity measures considered; with BF% consistently the highest values. These findings suggest that, although obesity is often reported to be higher among South African black women living in urban areas than their rural counterpart [12,14,18], large proportions of both men and women in the rural community are also affected with excess body fat.

In addition, the high proportions of women and men with excessive BF% compared to abdominal (WC) and general (BMI-defined) obesity demonstrates a high burden of obesity in the two communities. The high proportions of excessive BF% among men (62%) and women (96%) cannot simply be explained by the age-related increase in actual body fat mass and the decrease in fat-free mass with age[(36], because BF% overweight/obesity were present in all three age groups considered. These findings are therefore of critical importance, as high BF% is indicative of substantially increased CVD and metabolic risks (37) even in persons with normal BMI (38). Considering therefore the high cardiovascular risk due to excess body fat, and the prevalence of HIV/AIDS and non-communicable diseases on these communities (14), the implementation of comprehensive prevention interventions that has been advocated overtime (18,39) is urgently and critically needed to reduce the serious health consequences of obesity in these communities. Considering that BMI has been reported as an imprecise measure of visceral body fat and cardiovascular risk (19,20), these findings therefore suggest that using BF% and WC in complement with BMI, should be considered more appropriate for assessing excessive body fat and health risk in this population.

Socio-demographic factors as predictors of excessive body fat

Our study found that the socio-demographic factors and lifestyle behaviours predicted specific EBF indicators differently in men and in women. For instance, being married, and living in an urban location had a strong positive association with BMI and WC excess adiposity in men and women, but no significant association with BF%. Also, men and women of younger age (<50 years) and men with moderate education were less likely to have excessive body fat for BF%. Similarly, women who currently smoke were less likely to be excessively fat based on all three indicators, whereas in men, no association was found between smoking and EBF. In addition, there was inverse association between alcohol use and excessive body fat for WC and BF% in men. This later finding is in contrast with findings from two prospective cohort studies in the US which reported inverse relationship between alcohol intake and BMI in women, and no relationship in men (40).

The above findings from this study imply that, individual EBF indicators are predicted by different socio-demographic and lifestyle factors. These factors should be considered in obesity diagnose and

CVD risk assessments. This present study collaborated with the report of a recent review which indicated distinct differences between patterns of determinants (i.e. socio-cultural, environmental and behavioural) of obesity in men and women in SA (12). Specifically, being currently married was significantly associated with all three forms of obesity in men and women, except for abdominal EBF in women. Although reasons for the association between marriage and obesity is not clearly established, marital status has been alleged to alter food consumption behaviours of individuals (13), perhaps due to changing responsibilities and roles after marriage in an African setting. On the other hand, urban location was associated with general and abdominal EBF (not BF%), confirming studies from South Africa (13,15), Nigeria (41) and other LMICs (42). Similarly, urban location has been found in other studies to be associated with increasing body weight in South Africa (7,13), and other countries (35,40,41). The adverse effect of urbanization and globalization (8,16,39) with the resultant adoption of western lifestyles, diet and low physical activity in urban areas largely explains the association between obesity/overweight and urban residence.

Furthermore, there were a number of unexpected findings in this study. The first is the lack of association between education and overweight/obesity among women; whereas in men, less-than-a-college education compared with college education was inversely associated with excessive BMI and WC. Indeed there have been conflicting data regarding the relationship between education and obesity. For instance, an earlier study reported that South African women with no education compared to those with any schooling had higher BMI (6). Another study reported no association between education and risk of overweight/obesity (12). Some studies on the other hand had reported association between education and obesity among black South African women (11,18). The findings from our study, suggest that high education (college or tertiary) status may not have a significant influence on excessive body fat especially among women in these settings.

Secondly, not having food at home (food unavailability) was not associated with EBF for both men and women. Previous study, however reported that South African women who were nutritionally deprived of food during childhood were more likely to be obese (9). Furthermore, the association of obesity and stress and depression had been reported in the United States (43). The lack of association between stress, depression and food unavailability and EBF might be due to the fact that these variables were determined through self-reported method which perhaps is less objective.

Lifestyle vs. excessive body weight

Lifestyle behaviours such as physical inactivity has been reported to be responsible for chronic disease and obesity among South Africans (14,15). However, from our study, physical inactivity was not associated with any EBF indicator neither in men nor women. Similarly, recent studies had also reported lack of association between inactivity and overweight/obesity among South African black adults (12,18). The lack of association between inactivity and overweight/obesity in the aforementioned studies and this present one is believed to underscore the need for objective instruments to measure physical activity rather than self-reported measures (12). Tobacco smoking was inversely associated with all three forms of overweight/obesity in women in our study. This finding is of interest even as a recent large cross-sectional study reported a similar finding of an inverse association between smoking and excess body weight among black South Africans adults in Cape Town (18). However, we need to be cautious when interpreting these results as only cross-sectional data were used. Also, an earlier study in the US had indicated possible association between smoking and weight reduction among adults in some high income countries (44). The positive effect of nicotine on metabolic rate and its effect on the nervous system levels of norepinephrine, dopamine and/or serotonin, which suppress appetite may explain why smokers tend to weigh less than non-smokers (45).

Community-based comprehensive obesity control response needed

Public health response to obesity in South Africa and in many LMIC have had very limited success in tackling the rising prevalence of obesity [1,39]. Community-level prevention interventions focusing on children, adolescents and young adults are needed to urgently address the increasing obesity epidemic in order to reduce obesity-related complications and mortality in South Africa. These interventions aimed at reducing obesity and the high NCD burden among adults in South African communities should take into consideration the social determinants of health, particularly factors such as age, marital status, community location, and socio-economic, environmental and lifestyle factors. In this regard, the South African Department of Health in its current efforts to reduce obesity and NCDs should implement evidence-based prevention interventions that incorporate appropriate community-level and school-based health education and promotion strategies. Focusing only on physical activity and diets interventions without an understanding of the inherent differences in the determinants of obesity in women and men in the different communities can impede long-term obesity prevention programmes successes.

Lastly, investigating a broader scope of predictors of different forms of obesity by sex and in different settings in SA will inform a comprehensive and effective response to obesity epidemic. In this context, we recommend a robust research initiative that examines individual level and ecological multi-level drivers of excessive body weight, lifestyle and metabolic consequences in order to provide evidence for feasible, acceptable, scalable, and cost effective interventions for obesity prevention. Such initiative should be collaborative and multi-disciplinary, and utilizes the already established population-based cohorts to be able to describe the matrix and dynamics of obesity across communities.

Study strengths and limitations

Purposive selection of rural and urban locations for the study precluded generalizability of conclusions in the vast resource-poor South Africa. However, these results will serve as important information to support the design and implementation of obesity control strategies in these communities. Earlier studies that examined obesity and its determinants in these communities had excluded BF%. Importantly, the inclusion of body fat percent in assessing obesity in this population is an advantage as it is believed that BF% measure complements WC and BMI measurements (178,257). However, BF% values used in this study were estimated using sex-specific equations which have a tendency to over-estimate BF% in obese individuals (32). In addition, the majority of the women exceeded the cut-off points for BF% and there was no significant difference in BF% by location (based on Table 4.3). This situation gives some limitation to the applicability findings on bivariate analyses. Also, the use of self-reported rather than objective methods for measuring physical activity, stress and depression might have limited their accuracy. In addition, the HIV positive status might have resulted also in either weight gain or weight loss in the affected participants (14).

Conclusion

This study shows a high prevalence of excessive body fat among men and women in the study communities, which is explained by the socio-demographic factors and lifestyle behaviours. The sex-differences in the factors associated with the high levels of excessive body fat in men and women should be considered in packaging interventions to reduce obesity in these communities.

CHAPTER 5

BODY IMAGE PERCEPTIONS, PERCEIVED OBESITY THREAT AND WEGHT LOSS INTENSIONS AMONG BLACK SOUTH AFRICANS

Abstract

Background: The obesity epidemic is associated with rising rates of cardiovascular disease (CVD) among adults, particularly in countries undergoing rapid urbanisation and nutrition transition. This study explored perceptions of body size, obesity risk awareness, and the willingness to lose weight among adults in a resource-limited urban community to inform appropriate community-based interventions for the prevention of obesity.

Method: This is a descriptive qualitative study. Semi-structured focus group discussions were conducted with purposively selected black men and women aged 35-70 years living in an urban South African township. Weight and height measurements were taken, and the participants were classified into optimal weight, overweight and obese groups based on their body mass index (kg/m^2). Participants were asked to discuss on perceived obesity threat and risk of cardiovascular disease. Information on body-image perceptions and the willingness to lose excess body weight were also discussed. Discussions were conducted in the local language (isiXhosa), transcribed and translated into English. Data was analysed using the thematic analysis approach.

Findings: Participants generally believed that obesity could lead to health conditions such as heart attack, stroke, diabetes, and hypertension. However, severity of obesity was perceived differently in the groups. Men in all groups and women in the obese and optimal weight groups perceived obesity to be a serious threat to their health, whereas the overweight women did not. Obese participants who had

experienced chronic disease conditions indicated strong perceptions of risk of obesity and cardiovascular disease. Obese participants, particularly men, expressed willingness to lose weight, compared to the men and women who were overweight. The belief that overweight is 'normal' and not a disease, subjective norms, and inaccessibility to physical activity facilities, negatively influenced participants' readiness to lose weight.

Conclusion: Low perception of threat of obesity to health particularly among overweight women in this community indicates a considerable challenge to obesity control. Community health education and promotion programmes that increase awareness about the risk associated with overweight, and improve the motivation for physical activity and maintenance of optimal body weight are needed.

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Findings presented in this chapter have been published in a peer-reviewed journal:

Okop KJ, Mukumbang FC, Mathole T, Levitt N, Puoane T. Perceptions of body size, obesity threat and the willingness to lose weight among black South African adults: a qualitative study. BMC Public Health. BMC Public Health; 2016;16(1):365

5.1. Introduction

Obesity would affect more than 1.3 billion people globally in 2030, and is an established risk factor for cardiovascular diseases (CVD), diabetes, and all-cause mortality particularly among adults in countries undergoing rapid urbanisation and nutrition transition (7,88,156,158,238,258). In South Africa (SA), 68% of hypertensive disease, 45% of ischaemic stroke, 38% of ischaemic heart disease, and 87% of type 2 diabetes were attributed to excess body weight, indicated by a body mass index (BMI) greater than 25 kg/m^2 in adults in 2000 (7). As the prevalence of obesity and overweight has increased from 57% in 2002 to 65% in 2012 (7,30,49), the impact of obesity in the South African population is expected to rise considerably.

Numerous factors such as community-level, social and behavioural (mainly sedentary lifestyles combined with excess energy intake) factors are implicated in the sustained obesity epidemic in South Africa and other populations (44,72,153). Community-level influences such as cultural perceptions of body size, the built environment, and social relationships are believed to mediate between the 'fundamental' or distant forces (i.e. social and economic factors, and the proximate forces (i.e. diet, physical activity and genetics) that drive obesity (20,44). The association between the perception of body weight or size and obesity has been explored in many populations (11,15,27,72). In South Africa, for example, body image perception has been associated with obesity particularly among black African women who were dissatisfied with their current body size, but perceived larger body sizes as ideal body size (21,123,141). This negative body image perception has been reported to impact negatively on nutrition behaviours and weight control among black African adults (11,27,67). Body image perceptions have also been reported in SSA (11,44), in the United States (15) and other populations (72,146) to be associated with eating disorders and weight control behaviours. A study conducted in the rural communities of South Africa for instance, indicated that obese and overweight black women were not willing to lose weight; and very few of them had associated the food they consumed with diseases conditions such as diabetes, heart attack, stroke, cancer, or hypertension (27).

As obesity and non-communicable diseases (NCDs) burden in adults and children increases in Africa (24,25), community-based prevention-focused interventions that seek to address the social determinants of health, particularly the socio-cultural, lifestyle and environmental factors have been recommended (11,20,21,25). Previous studies indicated that community-based interventions led to improved physical activity and intake of healthy diet, and reduction in weight among adults and school children (119,259,260). Though studies looked at perceptions of body image in many African settings (11,44,123), information on body image perception, perceived health risk due to obesity and intention to lose weight among men and women in South African communities is limited. While Draper and her colleagues [14] explored the perceptions of body size and weight loss among adults, their focus was only on women, and the study participants were not stratified by weight categories. This study explored the perceptions of body size, obesity risk perception, and the willingness to lose weight in men and women living in a resource-limited urban community, in order to inform appropriate community-based intervention for the prevention of obesity.

Theoretical framework

The Prototype Willingness Model (PWM) was used as the theoretical framework to guide data analysis and interpretation of this study. PWM incorporates the theory of reasoned action (TRA) and social reaction constructs (Figure 5.1), and has been used to investigate the intentions to engage in health-protective and health-risk behaviours in adolescents and adults (221,261,262). Empirical evidence have shown that intentions to adopt a health behaviour or treatment for health conditions (e.g. malaria, diarrhoea, and hypertension) are influenced by perceived threat or severity of such disease or consequent effect (263). Perceived susceptibility and severity of the disease condition, and perceived benefits and barriers (including self-efficacy) substantially accounted for people's readiness to adopt preventive health behaviours (263). In addition, TRA-based studies have shown that intentions are the primary predictors of behaviour (221,261).

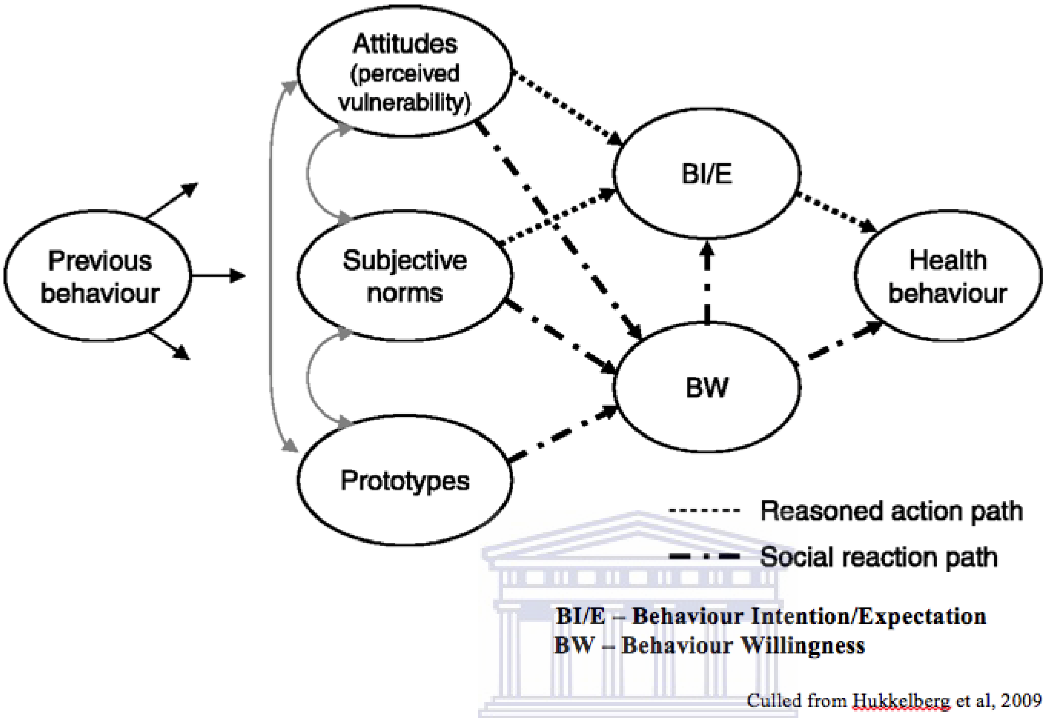

Figure 5.1: Prototype-Willingness Model (PWM)

PWM suggest that previous behaviour influences attitudes, perceived vulnerability, and norms, which affect behavioural intentions and then the health behaviour.

PWM posits that previous behaviour influences attitudes, perceived vulnerability, and norms that affect behavioural intentions and then the health behaviour. This model also holds that 'prototype', influences previous behaviour, and in turn affects willingness for health behaviour. Prototype in this model refers to 'risk images' or personality (i.e. significant persons) whose behaviour can be adopted by some people as 'ideal'. The more positive people's evaluations of the prototype and the greater their perceived similarity to the prototype, the greater will be their inclination to engage in the health-risk behaviour described in the prototype (261). Based on PWM, the perceived threat, the reasoned actions, and the social reactions (prototype formation) together inform behaviour intentions and willingness to adopt health behaviour. This study therefore uses the PWM to investigate the influence of obesity risk perceptions on the intentions to reduce excess body weight.

5.2. Methodology

5.2.1 Study design and setting

This study employed a descriptive qualitative design. Semi-structured focus group discussions (FGD) were used to elicit views regarding perceptions about obesity risk and weight control. This study was conducted in Langa, one of the largest black communities located near Cape Town metropolis with an estimated population of 73,667 (223). Langa is one of the resettlement communities considered to be a typical population in nutrition transition, partly because its growing population is mainly due to migration of people mostly from the rural Eastern Cape post-Apartheid. Like any other black South African townships, most residents in this community live with an average monthly household income of $200 and over 40% are unemployed (223). Further, 47% of men and 60% of women in this community had reported high school or college education (82). Recent data showed that up to 82% of the women and 36% of men aged 35 to 70 years in Langa were overweight or obese based on BMI>25.0 kg/m^2; with only 0.6% underweight (82).

5.2.2 Sampling procedure

Purposive sampling method was used to select participants for the study from an existing Prospective Urban and Rural Epidemiology (PURE) cohort study, which examines cardiovascular risk factors and societal exposures among adults (39,82). The criteria for inclusion in the study were, being a female or male aged 35-70 years; and a resident of Langa community. Adults aged 35-70 years were considered for the study, because of the high burden of obesity in this age category in South African population [8]. Two research assistants approached potential participants during PURE study follow-up interviews conducted in 2014/2015 for possible participation in the study. Participants who gave verbal or signed informed consents were grouped based on age, sex and weight categories, and were invited to a nearby community centre on different days for discussions. Of the 89 participants who consented to participate, 78 (36 women and 42 men) returned for the group discussions. Reasons given for non-participation include having conflicting engagements at the time of the interviews. Participants' height and weight were taken on the day of the focus groups. The underweight (BMI <18 kg/m^2) participants were excluded from the study.

5.2.3 Data collection

Focus group discussions were undertaken with separate groups of women, and men based on weight category. The focus groups facilitation process is discussed in detail in the next sub-section. Prior to the group discussions, participants' heights and weights were measured using calibrated scales and height meter with participants wearing light clothing, standing erect and without shoes. Each participant's BMI was calculated in kilogramme/metres squared, and their weight categories determined using standard cut-offs (188) prior to the group discussions. Participants were classified into normal (or optimal) weight (BMI 18-25 kg/m^2), overweight (BMI 25-30 kg/m^2) and obese (BMI ≥30 kg/m^2) groups based on their BMI. The rationale behind the separation of the groups by gender and weight status was to facilitate the comparison of views regarding obesity risk perceptions, and intention to lose weight in men and women. This could help in the provision of targeted interventions.

Focus groups

Eight focus group discussions (FGD) were conducted between August 2014 and February 2015. Each focus group consisted of 9-14 participants of the same sex, weight and age category. The number of FGD was determined when the saturation of views was theoretically reached. The FGD focused on body image perceptions, belief and attitude about overweight and thinness, perceived threat of overweight and awareness of obesity-related CVD risk. Semi-structured FGD and use of body image rating figures were considered to be appropriate for the study. These methods have been proven adequate in gathering information on perceptions of body size, disease risk and weight-loss among women in this setting (11,27,33). Participants' willingness to control excess body weight was also explored.

A seven-item FGD guide (see Appendix 3) was used to facilitate the group discussions. After obtaining permission from the participants, the FGD were recorded using a digital recorder, and a note-taker documented nonverbal cues and a summary of the discussions. Two indigenous graduate research assistants conducted the discussions in isiXhosa, with guidance from two of the researchers.

The discussions began with general questions on the causes of and susceptibility to obesity. To further explore the perceived threat (or severity) of obesity, participants were asked the question '*Do you think you may be at risk of cardiovascular disease or any health problem at your current weight?'* Since the pilot study we conducted indicated that normal weight groups were less likely to perceive any risk at their current weight, they were asked a follow-up question – '*Do you think you may be at risk of cardiovascular disease or any health problem if you gain more weight*?' This was to enable us compare the views in the obese and non-obese groups objectively. Following this, the sex-specific validated Body Image Rating Figures (BIRF) previously used to assess body size perception and obesity among black Africans (Figure 5.2) were used to explore body size perceptions (10). The BIRF was displayed on an A3-size paper, and each participant was asked to point to the silhouette(s) corresponding to an ideal normal body size for their gender and that of opposite gender during the discussions. Participants were also asked to identify the silhouette most closely similar to their own body sizes. The willingness to lose weight was explored through two questions: i) '*Would you be willing to lose weight (or maintains optimal weight)?',* and *ii) 'What measures have you taken to lose weight (or maintain optimal body weight)?'* Each discussion session took a maximum of 90 minutes. No incentives were given to the participants, but snacks and transport stipend were provided.

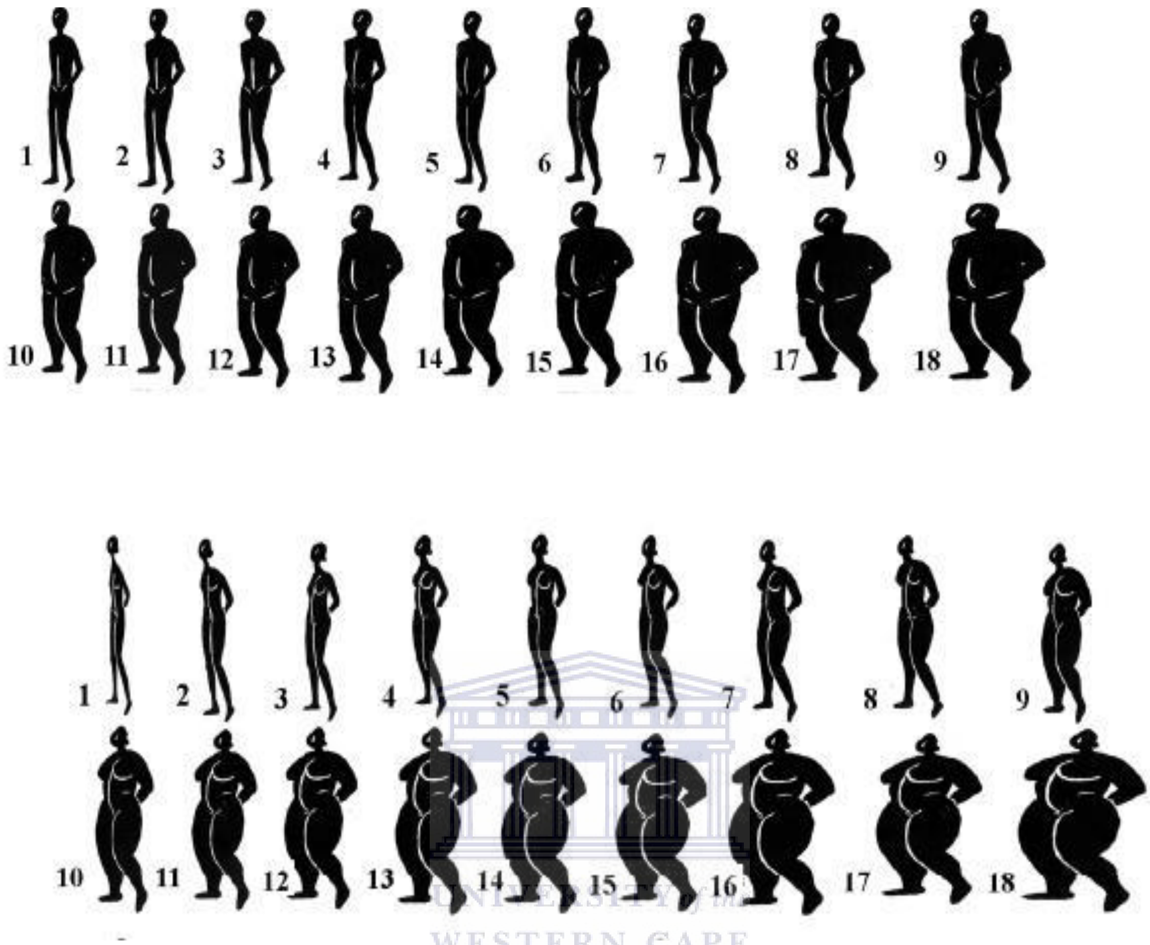

Figure 5.2: Body Image Rating Figures for men and women

(Validated sex specific body image silhouettes used to assess body size perception)

5.2.4 Data coding and analyses

Atlas.ti software was used to facilitate the coding and the organization of themes for analysis. Data was analysed using the inductive thematic analysis approach (233). Transcripts were first hand-coded, and an initial coding framework was developed based on the identified categories and sub-themes that emerged from the data. The PWM framework guided the data coding process. In this analysis, we coded for the participants' attitude (i.e. perceived vulnerability and threat), their subjective norms and prototypes, and explored how these components impact on their behaviour intention and willingness. Although the coding was guided by the PWM, the themes were obtained inductively (234), as we did not use a pre-determined framework to classify themes obtained. Codes with similar themes where grouped to form sub-themes. To obtain greater abstraction, sub-themes addressing similar concepts were further grouped to form the final themes, which were *obesity risk, perception and attitude to body weight, belief/norms, major disease conditions, perceived consequences, and willingness to reduce weight*.

Validity of the study

A number of steps were taken to ensure validity and rigour in the study. The discussions were first transcribed verbatim into isiXhosa, and translated into English. Two local trained research assistants reviewed all transcripts, comparing the transcripts with the respective audio-recorded versions to ensure accuracy in the translations. Three researchers (authors: KJO, FCM, and TM) independently reviewed the transcripts, data analysis process and the emerging themes, and agreed on the final themes and theory. This process was undertaken to reduce potential lone researcher bias and to provide additional insights into themes and interpretations (264). In addition, the summary of the discussions was read to the participants at the end of each group discussion to verify the researchers' understanding of their views.

Ethics Statement

The approval for the study was obtained from the research ethics committee of the University of the Western Cape. The study was explained to participants with the aid of an information sheet written in the local isiXhosa dialect. Every participant who gave verbal consent to participate in the study also completed a consent form. All information obtained during the study is kept strictly confidential.

5.3. Findings

Table 5.1: Focus group participants' age, weight and BMI

Participants groups	Number of participants per group	Number of sessions	BMI (range)	Age range (years)	Weight range (Kg)
Men					
Obese [a]	8	1	36.5-62.9	42 to 70	77.4-96.6
Overweight [b]	10	1	25.5-31.0	36 to 64	65.3-89.2
Optimal weight [c]	10 &14	2	18.3-25.0	35 to 63	45.6-62.3
Women					
Obese [a*]	8 & 11	2	30.8-58.9	39 to 68	89.5-160.7
Overweight [b]	9	1	25.5-30.0	48 to 70	85.5-107.8
Optimal weight [c]	8	1	18.0-24.8	35 to 60	55.8-79.0
Total	**78**	**8**			

[a] Obese (BMI >30kg/m^2); [b] Overweight (BMI 25-30 kg/m^2); [c] Optimal weight (BMI 17-25kg/m^2)
**Obese women groups included those who were considered to be grossly obese (BMI≥50 Kg/m^2)*

The characteristics of the FGD participants are presented in Table 5.1. A total of 78 participants were recruited; 34.6% were obese, 24.4% overweight and 41.0% optimal weight men and women. Findings from the study are summarised in Table 2 and presented under the following five key themes identified from the thematic analyses process: i) perceived causes of overweight; ii) attitude towards thinness and overweight; iii) body size perceptions; iv) perceived obesity threat and CVD risk; and v) willingness to lose weight. In this paper, the participants' views are presented and discussed based on the following groups: Optimal (or normal), Overweight and Obese weight groups. Participants' quotes are labelled based on their corresponding groups as follows: [N-Woman] for an optimal weight woman; [OO-Woman] for overweight women, and [O-Woman] obese women. Similar codes are used for the men, example [O-Man] for an obese man.

5.3.1 Perceived causes of overweight

Participants were aware of the main causes of obesity and had linked obesity with diet, lifestyle and inactivity. In all the groups, participants believed that overweight can result from unhealthy diet behaviours such as eating too much fatty and starchy food, consuming lots of red meat, oil, and fried or junk food.

> *Too much fat is caused by what we eat – like junk food, especially chips and fish, fatty meat, and all those things that are fried.* [N-Man]

> *We eat starch and starch – for example we eat rice and potatoes at the same time. These are the things that add fat to our bodies. The other thing is 'too much oil'- which is not good for our health.* [N-Woman]

Many also believed that, in addition to diet-related causes, overweight/obesity is hereditary, and therefore difficult to control, as captured in the words of two women in the normal weight and obese groups:

> *We have big bones... Overweight is something we inherited; all of us in the family are like this. I do also understand that what we eat also plays a vital role.* [O-Woman]
> *Overweight or skinny – we were created by God to be the way we are. I will never be fat because I have taken after my father as you can see that he is not fat.* [N-Woman]

Among the women, it was a common opinion that women are required (by culture) to be overweight.

> *According to our values and culture, it is important for a woman to have a large body. It makes you to be respected.* [O-Woman]

Some believed that stress, lack of exercise, socio-economic status and poor access to fresh vegetables and fruits could lead to overweight. Only a few participants mentioned other causes – such as too much spices, cow liver, and high acidic food.

Attitudes towards thinness and overweight

There were contrasting opinions on thinness and overweight across groups (Table 5.2), indicating that thinness and overweight have different meanings to the participants. A common opinion was that being thin was not desirable, and overweight size is socially desirable. A thin person was viewed as unhealthy, and one who suffers disease such as HIV/AIDS, TB and cancer. Others consider a thin person as someone who is experiencing lots of physical or emotional stress, or depression, which is believed to impact negatively on his or her eating habit. Statements from the different groups describe these assertions to thinness.

> *If you are skinny you are not healthy. When you are thin, people think you have HIV or TB.* [N-Man]

> *Being thin is not good. When my child is losing weight, I would ask her about the weight that is dropping.* [OO-Woman]

> *Sometimes it could be stress, or worry... Maybe he/she got lots of stress, and too much of stress makes him/her lose weight, and also not eating healthily.* [O-Woman]

Interestingly, a positive attitude about thinness was also expressed. An obese woman gave her opinions:

> *Being thin is good because when you are too fat you are not healthy. What I would like is to 'drop'* (i.e. reduce) *my weight… The health of a person that is thin is not the same as the one that is fat. A thin person is smart and attractive.* [O-Woman]

Although participants in most groups attributed being fat to happiness and affluence, the attitudes of women towards overweight and obesity tended to differ based on their weight category. For instance, the overweight and optimal weight women believed that being 'fat' or overweight is 'normal' and acceptable, provided one does not exceed 'normal' fatness.

Table 5.2: Key themes and participants views

Themes	Obese	Overweight	Normal
Causes of overweight			
Men	• Unhealthy diet/over-eating • Physical inactivity • Socio-economics status • Genetic make-up	• Unhealthy diet, • Lack of physical exercises • Fatness is culturally desirable	• Poor eating habits (junk food) • Cultural events
Women	• Over consumption of food • Eating fatty, junk and sugary foods • Inaccessibility to vegetables and fruits • Stress • Obesity comes with age • Cultural influences	• Stress • Over consumption of food • Eating fatty, junk and sugary foods • Lack of vegetables and fruits • Genetic make-up	• Poor eating habits • Unavailability of organic food • Genetic make-up • Cultural influences
Attitudes towards thinness and overweight			
Men	• Thinness attributed to sickness or disease • Overweight is culturally acceptable • Overweight associated with happiness • Excessive body fat is not desirable	• Fatness attributed to laziness, tiredness and drowsiness • Much fat can be 'unhealthy' • Overweight is culturally acceptable • Overweight associated with happiness	• Being skinny makes you smart, healthy and good shape • Overweight socially acceptable • Overweight associated with happiness and respect
Women	• Overweight denotes good health, dignity, happiness and respect • Thinness indicates sickness, stress, unhappiness • Associates being thin to beauty and attractive to men	• Overweight is considered 'normal' weight/body size • Overweight associated with happiness; Obesity not a problem if inherited • Thin people are stigmatized	• Fatness means happiness • Too much 'fatness' can cause sicknesses
Body size perceptions			
Men	• Unhappy with current weight/size • Uncomfortable with gaining more weight	• Satisfy with body weight • Others desire slim body sizes	• Prefer slim body size • Others desire little increase in weight
	• Larger silhouettes size 7-14 (overweight/obese categories) chosen as ideal normal size for a woman, and smaller silhouettes size 4-9 (normal/overweight) as ideal for a man		
	• Underestimate body size	• Underestimate body size	• Accurately estimate body size
Women	• Perceive current size as 'normal' size • Happy with current body weight/size • Grossly obese desired reduced weight – if reported personal gains of weight loss	• Desire larger body size/weight gain • Desire no weight gain – if previously suffered chronic disease.	• Dissatisfy with current body size • Desire to be overweight
	• Women chose silhouettes size 13-15 (obese) as ideal for a woman and less than size 13 (overweight or normal) for a man • Obesity is associated with women; and 'normal' weight associated with men		
Susceptibility to obesity			
Men	Not applicable*	• Vulnerable if happy and wealthy	• Susceptible to overweight if indulge in overconsumption of food
Women	Not applicable*	• Vulnerable to obesity if indulge in unhealthy eating	• Believe of not being susceptible
Perceived obesity risk and threat of cardiovascular diseases			
Men	• Perceived obesity as threat to health • Obesity leads to chronic conditions – high blood pressure, stroke, diabetes, cancer, and arthritis	• Chronic non-communicable disease, physical impairment, and regular pains • Obesity can lead to heart attack, • Being skinny equated to less or no health problems	• At risk of cardiovascular diseases • Obesity is not good at old age • Being fat leads to hypertension, heart attack, too much sleep
Women	• Obesity is attributed to laziness, sluggishness, stigma, tiredness, difficulty getting size of clothing to buy • Associate obesity to diabetes and hypertension	• Low perceptions of threat • Excessive weight could cause chronic illnesses, and inactivity	• Attributes diabetes, stroke, hypertension and heart attack to overweight
Willingness to lose weight			
Men	• Indicated intention to lose weight	• Desire for personal weight loss, or maintain current body size	• Undertakes job-related physical activities to maintain weight
Women	• Willing to lose weight in order to reduce health risk	• Intention to gain weight/maintain current weight	• Strong intention to gain more weight

** Obese and overweight participants were not asked if they are susceptible to overweight*

If a person is fat (overweight) we usually assume she is happy and has (lot of) *money. It's evident that he/she eats nicely, and a lot, and not having problems…*[OO-Woman]
Being fat is fine, but do not exceed the 'normal fatness', because you will be affected by diseases. [N-Woman]

Younger women (36 to 40 years of age) in the two overweight groups, however, challenged the persistent cultural tolerance of large body size in this community. A 36-year old woman stated her opinion this way:

A woman these days for her health's sake should not be overweight… In the olden days most men used to say that they are dignified when the woman is overweight. That is why we decided to be overweight and ate everything not knowing that we are putting our health in danger. However, I believe things are changing now…" [OO-Woman]

The older men also supported this opinion, as pointed out by a statement made by a 68-year old man.
We used to follow culture, (and) *it was a good thing to be overweight – as it was a sign of respect or happiness'.* [N-Man]

5.3.2 Body size perceptions

There were mixed perceptions about body size among the groups. The participants' perceptions can be summed up in three perspectives. First, the majority of obese and overweight women choose the silohouttes that were smaller than the one equivalent to their weight, believing they are 'normal' or 'moderately overweight'. Consequently, many of them expressed satisfaction with their body size.

I am happy with the body I have now…It is lighter than before; (when) *I was overweight.* [O-Woman]

I don't want it to be fatter than this because now that I have lost some weight, I can feel that my body is light… [OO-Woman]

Second, both overweight and optimal weight women had desired large body sizes, perceiving it as attractive and ‘normal’, whereas their male counterparts desired comparatively smaller sizes (Table 2). The common views among the overweight women and optimal weight men illustrate this point:

> *“This is not my ‘normal’ weight. I would be happy and I will look more attractive, if I can gain more weight.* [N-Woman]

> *I’m happy with the body size I have now. I don’t wish to be overweight …* [N-Man]

Thirdly, obese women generally preferred ‘medium size’ weight (which is equivalent to overweight or moderately obese). On the other hand, obese men desired a reduction in their weight. The participants gave their views as follows:

> *As for me, a large body size is not important. Someone who has a right body size is alright – I mean medium size and not a large size.* [O-Woman]

> *“I would like my body to be ‘slimmer’ than what it is now, because I am sick and unhappy”.* [O-Man]
>
> *I would love to gain weight because with the stress* (I have), *it would be better for me.* [O-Woman]

In addition, the formerly grossly obese participants who had reported losing substantial amount of weight in recent months preferred their present body size, counting the gains of weight loss. The assertion is captured in the words of one of the obese woman aged 65 years:

> *I don’t want to be fatter* (than this), *because now that I have lost some weight, I can feel that my body is light and those parts that were painful are much better.* [O-Woman]

In selecting an ideal body weight, the men chose overweight and obese silhouettes sizes as ideal normal size for a woman and a normal to overweight sizes for a man aged 35 years and above. In contrast, women chose obese sizes as ideal for a woman and normal or overweight for a man.

5.3.3 Perceptions of risk and threat of obesity and cardiovascular disease

There were marked differences in the perceptions of susceptibility and risk of obesity and cardiovascular disease among the groups. The opinions of the women and men in the different groups are stated in these excerpts:

> *I don't think I will ever be fat any more. I was once fat* (or obese) *then I suffered diabetes.* [N-Man]

> *I will not be happy if I can gain weight because I'm diabetic.* [OO-Woman]

In addition, some women in the obese and overweight groups preferred optimal (or normal) weight, alleging that this would help them to avoid diseases. The following opinion from an obese woman points to this assertion:

> *I would like my body not to be skinny and at the same time not to be overweight* (i.e. obese) *but be a 'normal' weight. Because when you are overweight you can easily have high blood pressure and when you are skinny you can easily be attacked by TB and other diseases.* [O-Woman]

Women, particularly those in the obese and optimal weight groups believed obesity is a threat to one's health, whereas those in overweight groups did not perceive possible risk of obesity. The overweight women who had been sick of diabetes, hypertension or other NCDs had expressed perceived risk of obesity. The men in most groups perceived overweight or obesity as a threat to health, alleging that it leads to chronic disease conditions including diabetes and CVDs. Moreover, women were less concerned about the threat of obesity than men partly because of their experience with NCDs and perceived health risks of excessive body weight. The views regarding risk related to obesity were as follows:

You will have many sicknesses when you are overweight (overweight), even those (sicknesses) that you were not suffering from – because of the large body size. [OO-Man]

It is people who are fatter than my size that are at risk of disease – because they can have high blood pressure or heart attack. …they are eating what they are not supposed to eat. [OO-Woman]

Participants generally associated chronic non-communicable diseases such as heart attacks, strokes, diabetes and hypertension with obesity and not overweight. In addition, participants listed some effects of obesity to include: i) physical impairment, ii) sluggishness, iii) regular pains, iv) shortness of breath, v) too much sleep, and vi) the cost of new clothes to replace the undersized ones. Interestingly, the men and women who reported obesity-related complications or had expressed some benefits of personal weight loss, and others who had seen obese relatives sick of debilitating illnesses had also perceived considerable threat of obesity. The participants sum up this notion in the following statements:

My relative who is very fat like me had serious health problems – hypertension, and arthritis. [O-Woman]

No, I don't think I will ever be very fat again because I noticed that I became sick when I was 'overweight' (referring to obesity). [OO-Woman]

When you are fat (obese), *it is easy for you to have heart problems, hypertension, stroke and high cholesterol. I am currently sick of hypertension.* [OO-Man]

I was once fat (obese), then I suffered diabetes. I don't think I will ever be fat any more. You can see an 'overweight' person walking proudly, but (you don't know) *that* (her) *body is painful* (i.e. aching). *I do know it from my experience".* [OO-Woman]

5.3.4 Willingness to lose excess body weight

In most of the obese groups, participants indicated the willingness to lose excess body weight in order to prevent diseases. However, the women in the overweight groups did not express the desire to lose weight. On the other hand, obese/overweight men and the obese women who were sick with NCDs particularly expressed strong desires for personal weight loss.

> *It is good to do some exercises in the morning before you eat. I do run for 30 minutes or an hour in the morning. … But you need to do that every day so that you can reduce your weight.* [OO-Man]

> *I would like to gain more weight... As I have mentioned before, I was weighing 63kg before I got sick, today I can see that I weigh 59 kg. This weight is not making me happy at all. I would like my weight to be at least 60 Kg.* [OO-Woman]

> *It is very important to try and lose weight; do exercise... and check what you eat. Now, I do not sleep immediately after food, I do house chores/work. I have also cut down on my fat meat intake.* [O-Woman]

> *I do not want to be overweight* (referring to obese) *any more. I don't know how I can get rid of it.* [O-Man]

Participants also reported taking some actions to lose weight. These actions, which are presented in Table 5.3, included reducing intake of fatty meat and starchy food, avoiding sleep immediately after meals and engaging in some exercises. Interestingly, overweight women mentioned smoking, and use of slimming medications as ways to lose weight, if they ever get very fat (obese). A young woman aged 36 years gave their opinions as follows:

> *Exercise at the gym is one way to reduce fat. Smoking and slimming can* (also) *help you.* [OO-Woman]

In all groups, no vigorous physical activity was reported among the participants. Self-weighing, and planned clinic visit to check weight were not common practices among the participants. In all the groups, however, participants reported assessing change in their own weight through feeling on their clothes (i.e. tight or loose). An obese woman gave her opinion on physical activity and personal weight assessment as follows:

> *I also saw that I have lost weight looking from my clothing size. I used to wear size 44, but now I am wearing size 38 – I have lost weight.* [O-Woman]

Some barriers to losing weight were listed by the participants in all the groups. These include lack of facilities and place for physical activity, poor perceptions of and motivation for physical activity among women, and lack of access to healthy food such as fruits and vegetables. There were also the complaints about increasing crime rate in the community. Additionally, some women believed that jogging in the street is like 'chasing the air' and perhaps not an approved norm for a woman in this community.

> *But we don't have enough facilities to train. There are no facilities for you to go and exercise so that you can get rid of all that fat – like the white people do.* [O-Man]

> *…some women run in the street as if someone is chasing them. I don't like to chase the air, though chasing that air, I'm told can help make you fit. [OO-Woman]*

Table 5.3: Participants' weight loss practices

Actions taken to lose weight			
Group	**Obese**	**Overweight**	**Normal**
Men	• Reduce intake of starchy food, and fatty meat • Moderate exercises	• Consider moderate physical exercise, brisk walk • Reduce consumption of unhealthy food	• Involved in active work-related physical activity • Some exercises – walk to shops, bust/train stations
Women	• Mild physical exercise, street walk and work, house chores • Voiding sleep immediately after meals • Reduce food portion taken	• Walking, smoking, and use of slimming medications • Avoidance of fatty/junk food	• Stop sleeping after meal, • Vigorous exercise/work • Physical exercise
Both	• Self-weighting at home is uncommon	• Visit clinic for check-up, not in connection with weight check	• No self-weighing at home • Never visit clinic for weight check.

5.4. Discussion and Conclusion

Inappropriate perceptions of risk of obesity

This study revealed that women, particularly those that were overweight did not only underestimate their body sizes, but had low perceptions of the threat of obesity, unlike the obese and overweight men. The overweight women had presumed their weight to be *'normal',* and partly because they had believed obesity not to be a debilitating disease condition like diabetes or stroke. The importance of appropriate perception of risk in improving intention and willingness for health behaviours has been reported in previous studies (221,261). Interestingly, the women and men in all the groups had linked excessive body weight with chronic diseases such as hypertension, diabetes, shortness of breath, heart attack, and stroke. Although most participants understood correctly the causes of obesity and appreciated the possible link between obesity and NCDs, this did not translate to increased risk perceptions or some decisive steps to control body weight, especially among the women. It was however, the obese and overweight women who had been sick of NCDs were the ones who expressed obesity threat to their health. The perception of overweight as less threatening to health, and the social desirability of overweight, particularly among women in this population could present a challenge to weight reduction interventions in this setting.

Possible factors responsible for low perception of obesity risk

The poor perceptions of risk of obesity, especially among healthy obese and overweight women can be largely attributed to the lack of awareness about possible risk of obesity, and the poor perception of severity of overweight/obesity; which have been reported in previous studies conducted in black South African communities (11,27,33). Low perceptions of obesity risk could also be linked to the lack of access to appropriate health information on risk attributed to excess body weight in these communities (20,21). In this study, the participants had linked obesity with diet, lifestyle, inactivity, culture and personal values. Women generally believed that obesity is not a disease, as one who is overweight or obese is not 'sick' unlike a person who is diabetic. This misconception about obesity could explain why overweight women, for instance, did not perceive personal risk of obesity.

Although the prevalence of obesity and NCDs remain high in this population (31), most public health interventions including facility-based health education, and media messages, however, focus mainly on HIV/AIDS and TB and not on obesity and NCDs. Moreover, in this study community, loss of weight is attributed to sickness such as HIV/AIDS. Lack of appropriate health promotion activities hinders access to quality health information and impedes informed health decisions or reasoned actions. The situation in this study community is similar to that in a black community in the USA, for which weight control decisions among obese/overweight black American women were negatively affected, largely because they were not provided with objective health information on weight loss (265), and perhaps, risk of obesity.

The perception of threat of obesity and CVD risk may not only be influenced by the lack of obesity risk awareness and poor personal risk evaluation, but the persisting positive perceptions and attitudes towards large body size in this population. The desires toward weight gain, particularly among women, can be linked to the dominant subjective norms towards large body image of which earlier studies had reported in the rural and urban communities of South Africa (27,33), communities in Kenya (10) and in Nigeria (45) among others. In addition, the socio-cultural norms, personal values and preferences, cultural desirability of overweight, and the stigma attached to thinness (or weight loss) pose as negative influences on risk perceptions among the study participants.

Factors that influence willingness to control weight

Behaviour intentions and behaviour willingness according to PWM, account for actual health behaviour. From these study findings, participant's current body weight, body image perception, economic, and socio-cultural factors influenced the willingness to lose weight. The inadequate risk perception and the unwillingness to lose weight among the overweight women can be explained by the fact that these women did not perceive their body size as overweight, and therefore did not indicate the need for weight loss. Inappropriate body image perceptions as seen in this study, have been shown to hinder the adoption of weight-loss intervention among women in another township located near Cape Town, as reported by Draper and colleagues (11). In contrast, however, findings from a study conducted in Seychelles indicated that accurate estimation of body size led to appropriate weight-control behaviours among adolescents (146).

The report of the use of slimming medications and smoking among the overweight women to maintain weight, can also be a possible explanation for low perceived vulnerability and threat among the overweight women. Findings from a study conducted in a rural South African village in the Kwazulu Natal Province also indicated that not only overweight, but obese black women were unwilling to lose weight. Nevertheless, the majority of these women did not associated poor eating habits to chronic disease conditions such as diabetes, heart attack, stroke, cancer, and hypertension (27). The similarity in the economic and socio-cultural characteristics of this study community to that of the rural Kwazulu natal study community could also explain the seemingly similar trend of unwillingness to lose weight among overweight women in both settings. From the above findings, it could be deduced that although our study community is located within a metropolitan city, urbanization and the socio-economic environment seemed not to influence the cultural norms towards body image and weight control.

Perceived threat of obesity or CVD risk was linked with the willingness to lose weight particularly among participants (i.e. obese women and overweight/obese men) who saw sick obese/overweight relatives experiencing chronic disease conditions. It therefore seems that perception of risk and willingness to lose weight in some individuals were enhanced by observation of persons who were sick of chronic diseases in the neighbourhood, and not merely by the influence of prototypes (i.e. image-consciousness or value placed on fat people), social reactions to subjective norms, and evaluation of expected behaviour outcome as predicted by PWM (221). From this, it can be argued that although subjective norms (social reaction) influences individual's attitude towards a particular health behaviour, personal observation of persons affected by disease and perception of severity of that disease could enhance behaviour intention, perhaps through informed reasoning (261).

Public health implications and recommendations

Findings from this study have important public health implications. The fact that none of the participants go to see a doctor because of their obesity, but only go to see a doctor due to symptoms of conditions related to hypertension or diabetes should be considered a challenge to public health. Since overweight status in this setting is culturally desirable, and the people in this community believe obesity is not a disease, seeking health care for excessive body weight was not considered a priority. Moreover, obesity risk perception (in the obese groups) was common among those who are experiencing or have seen others sick of chronic diseases. Poor risk perception on the part of the people with excess body weight can result in poor personal risk assessment and would affect the intention to seek health care timeously. This may lead to an increase in the number of persons with undiagnosed obesity-related health problems and NCDs.

Interventions that can facilitate appropriate health risk awareness in obesity-burdened communities should be implemented to address the inadequate risk awareness and perceptions. From recent studies, implementing CVD risk assessment (including overweight awareness) and training using community health workers at community levels have been shown to increase awareness and prompt referral of individuals for health care in resource-limited settings in South Africa (266), and Bangladesh, Mexico and Guatemala (214). There is, therefore, the need to include the minimal NCD care package that incorporates CVD risk assessment in the community health-workers' care package as the South African Department of Health launches the primary health care re-engineering programmes in communities (267). Primary health care re-engineering is a model for providing expanded health care to communities through community caregivers working in teams with health professionals in designated catchment areas.

Some of the participants mentioned the lack of healthy food choices such as fruits and vegetables in their local markets. The lack of fruits and vegetables will limit peoples' choices to other food that may not be healthy – as reported in previous study in a community near Cape Town, where junk food and fatty food were consumed as alternatives (33). In this regard, efforts should be made to encourage local food shops or grocery stores to stock healthy food items for access by the people. In addition, the need to develop collaborative initiatives with local communities and state (or provincial government) has been recommended as a strategy to address scarcity of healthy food, and to reduce food insecurity (268,269). Through organised community-supported gardens, community kitchens, farmers' markets and grocery stores, healthy foods can be provided at comparably lower cost for increase access to healthy food (269).

Another issue of public health concern from the study is the poor attitudes, and lack of resources and motivation for physical activity, which could negatively influence intentions to lose or maintain optimal weight in this community. Evidence from a recent study indicated that women with high exercise motivation were three times more likely to lose more than 10% body weight than those who were not properly motivated (270). It is therefore essential to implement community-based physical exercise interventions that have strong motivation for moderate and less vigorous outdoor and indoor exercises.

Lastly, this study indicated that the willingness to maintain optimal body weight might not be a function of perceived threat of obesity or health risk only, but the effect of a number of factors such as attitudes, personal values, perceived built environment, access to health information and influence of strong cultural ideals. Obesity prevention interventions that incorporate appropriate community-level education, health promotion and behaviour change advocacy should, therefore, be implemented to support attitude modification and improved the willingness to control weight. Such interventions should objectively target improving positive body size perceptions, health risk awareness and risk appraisal among obese and overweight adults.

Strengths and limitations of the study

The study used focus groups segregated by sex, stratified by weight categories, and included adults aged 35-70 years for which obesity is highly prevalent among black South Africans (49,82). The segregation of participants by weight groups (optimal, overweight or obese) is believed to have ensured effective discussions on the somewhat sensitive issue about weight management and risk of disease in this setting. The participants were purposively sampled from an urban informal setting in the Western Cape Province, and therefore represent a small proportion of the black population in South Africa. Also, majority (75%) of the participants in this study were unemployed, and of low socio-economic status and education attainment. This could have affected their views and the perceptions about obesity-related health risk as well as their weight-loss intentions.

Conclusion

The study revealed that overweight women did not perceive themselves to be at risk of obesity. The study findings also suggest that, perceptions of severity of and risk of obesity are influenced by interrelated factors most of which discourage weight loss intentions. The low perceived threat and severity of obesity particularly among obese women in this community underscores a considerable challenge to obesity prevention and possible resistance to recommended weight loss interventions. Based on these findings, appropriate strategies to improve awareness of the health risk of overweight are critical. Community-based wellness events could be organised around internationally recognised events like obesity, diabetes and hypertension awareness campaigns. Implementation of community directed health education and physical activity programmes can motivation community members to maintain healthy body sizes. Finally, resources such as non-commercial community sports facilities for physical activities should be considered when planning and implementing obesity interventions in this setting.

So far in this thesis, the first two aspects of the research, which are, i) determining the obesity prevalence and determinants, and ii) exploring body size perceptions and obesity threat and how this affects obesity or weight change, has been addressed. The succeeding chapter therefore looks at the relatioship between obesity, body image, and CVD mortality risk percpetion, and estimated CVD riskscores.

CHAPTER 6

RELATIONSHIP BETWEEN BODY IMAGE, BODY FAT AND TOTAL CVD RISK SCORE IN BLACK ADULTS

Abstract

Background: Increasing evidence indicates that body size perception and underestimation of weight are associated with excess body weight, and excess body weight has been attributable to the cardiovascular disease (CVD) burden. This study examines a 10-year cardiovascular disease mortality risk in relation to body size dissatisfaction and weight discordance in black South African adults.

Method: This is a follow-up cross-sectional study. A total of 920 participants randomly selected from the Prospective Urban and Rural (PURE) study cohorts in two South African communities (rural and urban) were interviewed using validated body image and CVD risk structured questionnaires. Participants' anthropometric measurements, and blood pressure were taken at follow-up using a validated study protocol. Information on medical history were also obtained, and the absolute 10-year CVD risk scores were calculated using non-laboratory-based Framingham risk score equations. Body size dissatisfaction ('Feel'-'Ideal' size Difference – FID), and weight discordance ('Feel'-'Actual' weight Discrepancy – FAD) indexes, and attitude towards weight were obtained using body image pictorial and narrative constructs. Descriptive, bivariate and regression analyses were undertaken using SPSS version 22.

Results: Based on BMI≥25 kg/m^2, 84.1% (95% CI: 81.4-86.8) women and 32.2% (95% CI: 25.9-38.5) men were either obese or overweight. Majority of the obese (85%) and overweight (79%) participants underestimated their weight based on FAD index, and 51%-66% of the sample with excess body weight based on BMI and BF% were not dissatisfied (FID>0) with their body sizes. Mean 10-year CVD risk score was 18.7%, and 61% of men and 26% of women with BMI ≥25 kg/m^2 had CVD risk

scores ≥ 20%. Bivariate analyses indicated that FID and FAD had significant association with annual change in weight and adiposity. FAD index had a significant, but weak correlation with absolute CVD risk score (r=.13, p-value=0.001) when adjusted for covariates, whereas FID showed no significance relationship. Logistics regression models showed that the willingness to loss weight, and perceived CVD threat were significantly associated with size dissatisfaction and weight discordance, whereas socio-demographic factors did not.

Conclusion: High CVD risk levels in adults with excess body weight can be attributed to attitude towards body weight rather than body size dissatisfaction. Community-based health promotion programmes that incorporate body weight and CVD risk assessments, and the motivation for maintenance of optimal weight should be considered in interventions to reduce the high CVD risk among adults in this population.

Findings presented in this chapter have been submitted for publication in a peer-reviewed journal.

Kufre Joseph Okop, Naomi Levitt, Thandi Puoane. Body weight discordance, size dissatisfaction, and total cardiovascular disease mortality risk in black South African adults with obesity. PLOS ONE. July 2016 (under review)

6.1. Introduction

The cardiovascular disease (CVD) burden attributable to obesity and overweight is rising, particularly in the adult populations in developing countries due to increasing rates of obesity in these settings (1,25,29,158). Globally, CVD burden accounts for 17.3 million deaths annually, and is projected to increase to 23.6 million in 2030 (271), and about 80% of the all CVD deaths occur in low-and middle income countries (156,158). In South Africa, with over 65% obesity burden among adults (49), CVD is the second leading cause of death after HIV/AIDS/TB (38) with the proportions of CVD death in women and men age 25-49 years estimated at 32% and 43% respectively (38). Increasing evidence indicates that body size perceptions and underestimation of own weight, besides diet, lifestyle and socioeconomic factors are associated with increasing obesity and overweight in African populations (20,21,34,44,142); and this can impact on absolute CVD risk particularly in adults.

Multiple cardiovascular disease risk factors often occur simultaneously in individuals at risk. These risk factors, interact synergistically resulting in absolute risk levels higher than would be anticipated if one individual risk factor was considered (209,212). This makes absolute CVD risk scores essential in the identification of at-risk individuals for care (32,207). The assessment of absolute CVD risk in primary care using the Framingham Risk Score (FRS) models such as the 10-year total non-laboratory-based (NLb) CVD risk score has been shown to be a cost-efficient strategy of identifying persons at risk (32,204). Interestingly, the non-laboratory FRS estimation is proven to efficiently identify men and women globally at risk like the laboratory-based tests (32,209). This NLb risk estimation is a useful primary prevention tool for CVD risk screening particularly in communities in the low- and middle-income countries where laboratory procedures are almost impracticable and costly (204,209). The NLb FRS tools have been successfully used in many countries including South Africa, Mexico, and Bangladesh to facilitate identification and referral of at risk persons for care (32,214,266).

The modifiable risk factors considered for determining absolute CVD risk in individuals at risk based on the NLb risk model include obesity (or lipids), diabetes, hypertension, systolic blood pressure, lifestyle (e.g. smoking, physical activity), and non-modifiable risk factors such as gender and age (21,84,204). Family history, and psychological factors (e.g. depression, emotional stress) are also considered as CVD risk factors (84) although not considered in the NLb risk model.

Body image is the subjective sense people have about their bodies, encompassing self-perception and attitudes towards their physical appearance and weight (72,129), and is mainly influenced by the social norms and values, culture and ethnicity (9,35,141,190). Body image perceptions, though not usually considered as one of the CVD risk factors, has the tendency to impact on the modifiable CVD risk factors in many African and other populations (121,190,199). For example, negative body image perceptions have been associated with weight gain, sustained obesity, inactivity (14,21,213), adverse eating behaviours, and increasing eating disorders in black African adults (14,16,50), as well as in Malaysians (78) and Italian adults (213).

There is strong social, cultural and economic influences on eating patterns reported among black South African population (143). Also, negative body image has been associated with psychological effects such as depression, anxiety, substance abuse, low self-esteem and emotional stress among black Africans (9,21,190). In SA for instance, overweight black African women tend to be less dissatisfied with their large body sizes (than their white counterparts) making them to desire to gain more weight (141,272). For many black African women, unlike in the western culture (9), being overweight is desirable, and reflects affluence, happiness and respect (34,67). Studies in some other African countries have also indicated that men, women and adolescents prefer large body size – perceiving it as a sign of respect and influence even in the recent times (10,146,273). However, recent studies have reported that young African girls and adolescents prefer thin bodies (15,141,274). Moreover, obesity on it own has been shown to be a precursor of CVD risk factors such as type 2 diabetes mellitus, hypertension, and dysmetabolic syndrome (116). In addition, obesity is known to be an independent risk factor for CVD mortality and death (7,83,275).

From the above, one can infer that obesity and negative body image together can have a synergistic impact on the absolute CVD risk levels among adults, especially in settings where large body image size is highly valued. Two recent studies have reported a possible link between perceived CVD risk and body image perception (36,154). However, the relationship between body image and absolute 10-year CVD mortality risk score has not yet been investigated. This study therefore examines the relationship between body image, adiposity and absolute CVD mortality risk among black African adults living in communities with dominant body image perceptions.

Body image perceptions and its effects on health are not only reported in Africa and low-income countries, but across many African populations in many regions of the globe, including the modern western societies. For example, the preference of larger body sizes among African American adolescents have been reported in the USA (15), and men from France, Brazil and USA also reported a high discrepancies in body weight and image ideals (199). In addition, a large study with 87,418 high school students in the USA, also reported that black African and Hispanic females from low-income households were most likely to underestimate their weight than the Asian/Pacific Islander counterparts (276).

This paper attempts to answer the following research questions: 1) *Is there any relationship between body image (i.e. size dissatisfaction and weight discordance) and 10-year total CVD risk*? 2) *Are there any relationships between body image perceptions and change in weight and adiposity overtime*? 3) *What factors are associated with weight discordance and size dissatisfaction*? Findings from this study will inform the development of targeted interventions to reduce obesity, and support CVD risk assessments in resource-limited communities.

6.2. Study design and Methods

This is a follow-up cross sectional study conducted as part of the Prospective Urban and Rural Epidemiology (PURE) study in Cape Town. The PURE study methodology has been described previously (39,82). In summary, the PURE study investigates the cardiovascular risk factors and environmental exposures in resource-poor black communities. This study was conducted during the fourth year follow-up survey in the two sites of the Cape Town of the PURE study cohorts. These sites are, the rural Mount Frere community in the Eastern Cape, and an urban township, Langa in the Western Cape. The cross-sectional analytical follow-up study was considered important to build on and complement the findings from the previous qualitative study (phase 2) regarding the body size perception, obesity risk perception and cardiovascular risk among obese and non-obese.

6.2.1 Sampling and data collection

A total of 963 existing PURE study cohort participants aged 35-78 were interviewed in the two study communities between June 2014 and July 2015, using interviewer-administered structured questionnaires. The study originally intended to interview all eligible PURE study participants who consented to participate in the sub-study, but due to time constraints and limited resources, 963 (78%) of the existing cohort were interviewed by July 2015. Validated structured body shape questionnaire (BSQ) with CVD risk factors' section was adapted from Cooper et al., 1987 BSQ (195), validated by Mchiza et al. (34) and used to obtain information on body image perceptions and CVD risk factors such as tobacco use and medical history. This questionnaire was pretested among black South Africa adults. Anthropometric measurements including height, weight, and body fat percent (using bio-electric impedance analysis [BIA] device), and waist circumference were taken based on the standard procedures in the main study protocols (39). Blood pressures (BP) measurements were also taken at

10-15 minutes intervals using *Omron* BP devices, and averages recorded as actual BP measures. In addition, baseline anthropometric measurements (weight, height, waist circumference, body fat percent), and CVD risk factors were also obtained from PURE study baseline dataset for comparison purpose.

Body image and its measurement

Three body image dimensions, namely, i) body size dissatisfaction, ii) discordance in weight status, and iii) perception about own weight, known to be valid measures for body image were considered for this study. There are several instruments for assessing body size perception and dissatisfaction, and attitude towards weight. This study used i) silhouettes – pictorial construct – to describe body size/image perception (26,146), and ii) structured questions – narrative construct – to describe weight perceptions (27,123). The choice of these two methods was based on their proven validity and appropriateness in measuring body image perceptions (34,127). Each cohort participants was given Stunkard's body image silhouettes adapted by Mciza et al. (34) on an A3 card. They were to choose out of eight the silhouettes (from thin '1' to grossly obese '8'), the ones that they most closely look or feel like ('feel' body image), and the ones they best would like to look like ('ideal' body image). In addition, participants were asked if they feel their weight to be '*thin*', *average*', '*overweight*' or '*obese*'. The three body image dimensions derived from the two constructs are described as follows:

Body image dissatisfaction: For each participant, 'Feel-Ideal' difference (FID) which indicates body size satisfaction by proxy was obtained by subtracting the 'ideal' body image size number from the perceived or 'feel' body image chosen by each participant. A higher (positive) FID score as shown in previous studies implies increasing *dissatisfaction* with one's body size, and a low (negative) FID score implies the perception that one's body size is too small (129,146,272). To appropriately depict participants' levels of dissatisfaction with their bodies, FID scores were further categorized into three, namely, FID<0 (i.e. 'my size is too small'), FID=0 (i.e. 'I'm satisfied with my size'), and FID≥1 (i.e. 'my size is too large'). Body size dissatisfaction was given as FID>0.

Weight discordance: In addition to body size dissatisfaction measure, each participant's actual or measured weight (based on BMI) was compared with perceived or 'feel' weight to obtained "Feel-Actual Discordance (FAD) score. To achieve this, silhouettes 1-2 and 3-4 were chosen to represent 'thin' and 'normal weight' categories, and silhouettes 5-6 and 7-8 represent 'overweight' and 'obese' categories respectively, and were used to denote the corresponding 'feel' body weight categories chosen by the participants. The possible outcomes of FAD were -7 to +7. It is hypothesized that FAD less than 0 indicates an increase in discrepancy between the 'actual' and 'feel' body weight, showing *underestimation* of own weight. FAD>0 indicates over-estimation of weight, whereas FAD=0 indicates no discordance in weight estimation. FAD has been used to assess body weight satisfaction, and attitude towards weight/appearance in previous studies (127,141).

Body weight perception: A narrative construct was used to elicit participants' perceptions of their own weights (i.e. whether it is considered as '*Thin', 'average', 'somewhat overweight/'overweight', and 'obese'*).

Cardiovascular risk measurement

A 10-year non-laboratory cardiovascular risk score at follow-up was calculated for each participant using the Framingham Risk Score (FRS) equations which denotes absolute risk (5,204). The FRS equations (models) are used to efficiently identify at-risk persons for CVD care (209). The NLb FRS equations were developed by researchers in the Framingham Heart Study (204), and rely on the multiple risk factors namely, age, gender, systolic blood pressure, diabetes mellitus and hypertension treatment status, and BMI (BMI replaces lipids or cholesterol in the laboratory-based model). A risk score of ≥ 20% is considered a 'high risk', and risk score of 10.0 to 19.9% as 'moderate risk'. The FRS equations were written into SPSS syntax and run with the dataset to obtain the sex-based total 10-year CVD risk scores for each participant.

6.2.2 Data analysis

Descriptive statistics were reported using frequencies, means and standard deviations (SD), and bivariate analyses were also undertaken. P-value <0.05 at 95% confidence interval (CI) was used as statistical significant level, unless otherwise stated. Body weight categories in the study were based on BMI, waist circumference (WC), body fat percent (BF%), and waist-to-hip ratio (WTHR) standard cut-offs (170). Only 1.3% of participants were underweight (based on BMI) and were considered with the normal weight participants for data management purpose. The analyses were restricted to the 920 PURE cohort participants with no known CVD event; 43 participants with known cardiovascular diseases were excluded. This sub-sample represents approximately 75% of the existing PURE study cohort participants.

Participants' weight, adiposity, and CVD risk profiles by sex and location, were determined, and CVD risk scores were compared in the obese and non-obese participants. Student t-tests were used to establish the difference in the continuous variables, and chi-square tests for the categorical variables. In addition, one-way analyses of variance (ANOVA) and chi-square tests respectively were used to determine the patterns of 10-year CVD risk and body image (FID and FAD) categories based on age of participants. with the significant levels were $p<0.05$ based on chi-square tests.). BF% ≥22% for men, and BF% >36% (for women) were classified as 'raised BF%' (46), based on the healthy ranges for African populations (277). WC >94cm (for men), and >80cm (women), and WTHR of >0.85 (women), and 1.0 were considered at risk values (170).

Correlations between body image perceptions (FID and FAD) and weight and adiposity were determined using Pearson's *r* coefficient. Scatter plots were also use to show the relationship between body image and weight change overtime. In addition, partial correlation analyse was used to determine the correlation between FID, FAD and 10-year absolute CVD risk score, controlling for age, sex and BMI. Furthermore, multiple logistics regression models were used to determine the factors associated with body image, using discordant weight status and size dissatisfaction as separate dependent variables. For the regression models, discordant weight status was described as any discrepancy in weight estimations (i.e. underestimation or overestimation), and size dissatisfaction as FID>0. The discordant weight status and size dissatisfaction were considered separately in order to explore the factors associated with body size dissatisfaction and discrepancy in weight individually in this population.

6.3. Results

6.3.1 Participants' characteristics, adiposity and CVD profiles

Of the 920 participants, 77% (709) were women. The mean age was 55.8 years, 51% had higher school, and 4% had tertiary education.

Table 6.1: Participants' demographic characteristics

	Total	**Men**	**Women**	**P-value^**
Number of Participants	**920**	**211 (23%)**	**709 (77%)**	
Age (years), mean age=55.8				
<45	177 (19.2)	56 (26.5)	121 (17.1)	0.009
45-59	395 (42.9)	82 (38.9)	313 (44.1)	
60+	348 (37.8)	73 (34.6)	275 (38.8)	
Education*				
None-Any primary	373 (40.5)	83 (41.7)	290 (42.6)	0.70
High School	473 (51.4)	106 (53.3)	367 (53.9)	
Tertiary	34 (3.7)	10 (5.0)	24 (3.5)	
Income (RSA Rand)**				
0 to <2000	714 (77.6)	154 (73.0)	560 (79.0)	0.088
2000-5000	160 (17.4)	44 (20.9)	116 (16.4)	
>5000	21 (2.1)	3 (1.4)	18 (2.5)	
Marital Status†				
Married	356 (38.7)	97 (46.0)	259 (36.5)	
Not married	564 (61.3)	114 (54.0)	450 (63.5)	0.009
Work				
Full-time	60 (6.5)	22 (10..4)	38 (5.4)	
Part time	115 (12.5)	43 (20.4)	72 (10.2)	0.001
Not Employed	570 (62.0)	102 (48.3)	468 (66.0)	
Pension	133 (14.5)	33 (15.6)	100 (14.1)	
Others[f]	42 (4.6)	11 (5.2)	31 (4.4)	
Location				
Rural	380 (41.3)	81 (38.4)	299 (42.2)	
Urban	540 (58.7)	130 (61.6)	410 (57.8)	0.340

^ Comparison of variables by sex obtained by chi-square test. P-value<0.05 is significant.
Variables with some missing data not used in the analyses- *N=880 (40 missing), **N=895 (missing 25)
† Single/divorced/widow. [f] On social grant, or disability grant, or income not mentioned.

Only 19% of the study sample had some form of employment, and 78% earned less than R2000 ($121) per month (Table 6.1). There were significant differences in age, work (employment) and marital status in the men and women. The adiposity and CVD risk profiles of participants by sex and location are presented in Table 6.2. Majority of the women and over a third of the men had excess adiposity in both locations.

Table 6.2: Adiposity and CVD Risk Profiles of the study participants by sex[a] and location[a]

	ALL		**Sex**		**Rural**		**Urban**	
			Men n=211	**Women** n=709	**Men** n=81	**Women** n=299	**Men** n=130	**Women** n=410
		95 % CI	n (%)^					
Adiposity Levels								
Body weight (mean, SD), kg	78.7 (21.3)	77.4-80.1	69.2 (16.5)	81.6 (21.3)	64.7 (16)	78.5 (20.2)	73.1 (18.4)	83.8 (23.0)
BMI (mean, SD)	31.0 (8.8)	30.7-32.2	25.4 (5.0)**	33.8 (7.5)**	23.5 (5)*	31.8 (8)*	25.0 (6)**	33.9 (9)**
BMI: 25.0-29.9kg/m^2 (%)	187 (20.3)	17.7-22.9	38 (18.0)	149 (21.0)	15 (18.5)**	81 (27.1)**	23 (17.7)**	68 (16.6)**
BMI≥25.0kg/m^2 (%)	664 (72.1)	69.3-75.1	68 (32.2)	596 (84.1)	22 (42.6)**	251 (84.0)**	25 (34.6)**	346 (84.4)**
BMI≥30.0kg/m^2 (%)	477 (51.8)	48.6-55.1	29 (13.7)	448 (63.2)	7 (8.64)**	170 (56.9)**	22 (16.9)**	278 (67.8)**
BF% (mean, SD)	39.2 (12.0)	38.3-39.8	25.0 (12.3)	43.3(9.4)	26.2 (8.5	45.0 (8.4)	26.0(12.8)	26.2 (8.5
High BF% (%)[c]	537 (58.4)	55.2-61.6	70 (44.3)	467 (79.6)	32 (47.1)	203 (77.5)	38 (42.2)	264 (81.2)
WC (mean), cm	98.9	97.9-101.2	88.2 (17.5)	102.0 (20.5)	90.6 (13.8)	103.6 (17.7)	86.8 (19.2)	100.8 (22.3)
Raised WC (%)[b]	571 (62.1)	58.9-65.2	57 (34.3)	514 (89.5)	17 (27.9)	234 (94.0)	40 (38.1)	280 (86.2)
CVD Risk Profile								
Treated for BP/Hypertension, n (%)	382 (41.5)	38.3-44.7	51 (24.2)*	331 (46.7)*	16 (19.8)**	131 (43.8)**	35 (26.9)**	200 (48.8)**
Smoked tobacco, n (%)	259 (28.2)	29.1-35.1	123 (58.3)**	136 (19.2)**	43 (53.1)**	13 (4.3)**	80 (61.5)**	123 (30.0)**
Diabetes mellitus status, n (%)	129 (14.0)	11.8-16.3	18 (8.5)*	111 (15.7)*	3 (3.7)*	37 (12.4)*	15 (11.5)	74 (18.0)
Systolic BP (mean, SD)	140.1 (25)	138.4-141.8	137 (25)	141 (24.4)	133.4 (22.3)*	139.2 (25.8)*	138.5 (24.5)**	142.9 (24.2)**
Age (mean, SD)	55.8 (10)	55.1-56.5	54.5 (11)	56.2 (10)	56.3 (11)	56.7 (10)	53.3 (10)*	55.8 (10)*
Absolute CVD risk								
10-year CVD Risk Score (mean, SD)	18.7 (12.3)	18.9-19.5	25.2 (13)**	16.7 (11)**	24.3 (14)**	15.0 (10)**	25.8 (13)**	18.0 (11)**
10-year CVD Risk Score ≥ 20%; x (%)	304 (33.0)	30.0-36.1	123 (58.3)**	181 (25.5)**	43 (53.1) **	60 (20.1) **	80 (61.5) **	121 (29.5) **

[a] Mean differences between this variable and continuous variables were tested using t-test, and that of categorical variables by Chi-square test;
** p-value = 0.001; *p-value =0.01
^'n' is count, '%' is frequency; [b]WC >80cm (women), and >94cm (men); [c] BF% >22% (men), and >35% (women)

The proportions with excess adiposity (obesity/overweight) based on BMI, BF% and WC were 32.2%, 44.3%, and 34.3% for men, and 84.1%, 79.6% and 89.5% for women respectively. Urban men and women had higher mean weight, BMI and BF% compared to their rural counterparts, whereas the rural women had higher mean WC than their urban counterparts.

The CVD profiles indicated that a substantial proportion of women in both the rural and urban communities compared to the men were diagnosed with hypertension (48% vs. 24%), and diabetes (16% vs. 9%), whereas greater proportion of men than women in the rural (53% vs. 4%) and urban (62% vs. 30%) had smoked tobacco. The mean systolic blood pressure (SBP) was 140mm Hg, and women had slightly higher SBP than the men (141 vs. 137 mm Hg). The mean 10-year CVD Risk score for the study was 18.7%, and the proportion with CVD risk scores ≥ 20% (i.e. high risk score) was 33%. Significantly more men than women in both the rural (53% vs. 20%) and urban (62% vs. 30%) communities had CVD mortality risk ≥ 20% ($p<0.05$).

6.3.2 Patterns of CVD risk mortality score and body image dimensions

There were significantly high mean CVD risk score with increasing age category in both men and women, even as body size satisfaction and underestimation of weight remained unchanged with age (Table 6.3). From the study sample, 84% of men and 40% of women aged 60 years and above had risk scores ≥20%. Nearly two in five (45%) women at the time of this study were in the moderate CVD risk score category (10.0-19.9%).

There were high discrepancies in the perceived size and weight status. Only small proportions of the women (37%) and men (15%) were dissatisfied with their body sizes – considering themselves to be '*Too large'*. However, the majority of the men (53%) and women (42%) were not dissatisfied (i.e. satisfied) with their current body sizes (i.e. FID=0). Similarly, majority of the women (76%) and 49% of men underestimated their weight. Neither the body size dissatisfaction or weight discordance was associated with age category ($p > 0.05$).

6.3.3 Comparison of CVD risk scores in obese/overweight and normal weight adults

Obese and normal weight adults were at high CVD risk based on their mean risk scores as shown in Table 6.4. However, the proportions of obese men and women with risk score ≥20%, and ≥30% were higher than that of their normal weight counterparts. Only comparison between moderate and high CVD risks in obese and non-obese women was significantly different (OR 1.19, 95% CI of 0.66-2.16).

Table 6.3: Patterns of Total CVD risk score, and body size dissatisfaction and weight discordance by age category

	Age categories in Years							
MEN	**34-45**		**46-59**		**60+**		**Total**	
		S.E		**S.E**		**S.E**		95% CI
Framingham CVD risk*	**n=56**		**n=82**		**n=73**		**n=211**	
Mean, SE	14.1**	1.00	25.1**	1.1	33.9**	1.7	25.2**	23.4-27.1
Moderate Risk Score (10-19.99%), %	46.4**	0.55	31.7**	0.44	16.4**	0.41	30.3**	24.1-36.5
High Risk Score (≥20%), %	19.6**	1.17	62.2**	1.07	83.6**	1.72	58.3**	51.6-64.9
Body Size Dissatisfaction (FID)	**n=56**		**n=82**		**n=73**		**n=211**	
Too small (Feel-Ideal<0), %	32.1	0.03	32.9	0.41	31.5	0.05	32.2	25.9-38.3
Satisfied (Feel-Ideal=0), %	51.8	0.05	52.4	0.41	54.8	0.04	53.1	46.3-59.8
Too large (Feel-Ideal≥1), %	16.1	0.04	14.6	0.45	13.7	0.02	14.7	9.9-19.5
Feel-Actual Difference (FAD)	**n=56**		**n=82**		**n=73**		**n=211**	
Underestimate (FAD<0), %	55.4	0.04	53.7	0.41	38.4	0.04	48.8	42.0-55.6
Estimate accurately (FAD=0), %	39.3	0.02	40.2	0.43	50.7	0.03	43.6	36.9-50.3
Overestimate (FAD>0), %	5.4	0.01	6.1	0.31	11.0	0.01	7.6	4.0-11.1
WOMEN								
Framingham CVD risk*	**n=121**		**n= 313**		**n=275**		**n=709**	
Mean, SE	8.16	0.53**	15.30	0.51	22.10	0.76	16.72	15.9-17.6
Moderate Risk Score (10-19.99%), %	31.4	0.32**	46.6	0.20	49.5**	0.17	45.1**	41.5-48.8
High Risk Score (≥20%), %	1.7	5.60**	21.7	0.97	40.4**	1.01	25.5**	22.3-28.7
Body Size Dissatisfaction (FID)	**n=121**		**n=313**		**n=275**		**n=709**	
Too small (Feel-Ideal<0), %	22.3	0.02	23.6	0.03	18.9	0.03	21.6	18.6-24.6
Satisfied (Feel-Ideal=0), %	38.0	0.02	43.5	0.03	41.8	0.02	41.9	38.3-45.5
Too large (Feel-Ideal≥1), %	39.7	0.02	32.9	0.02	39.3	0.01	36.5	33.0-40.1
Feel-Actual Difference (FAD)	**n=121**		**n=313**		**n=275**		**n=709**	
Underestimate (FAD<0), %	74.4	0.03	75.1	0.03	76.4	0.04	75.5	72.3-78.6
Estimate accurately (FAD=0), %	24.0	0.02	22.7	0.02	18.9	0.03	21.4	18.4-24.5
Overestimate (FAD>0), %	1.7	0.01	2.2	0.01	4.7	0.02	3.1	1.8-4.4

***** Total CVD risk scores based on Framingham non-laboratory based risk scores; ** p-value=0.00;

Comparison of variables by age obtained by ANOVA and chi-square tests.

N/B: S.E.M express the variation from the population mean, and therefore explains how the mean in a group is closer to the population mean.

^There were no significant difference in FID or FAD and age categories in men and women

The mean 10-year CVD risk score in the obese/overweight and normal weight men and women were 28% vs. 24%, and 47% vs. 37% respectively. Nearly half of the obese women (47%) had moderate CVD risk (10-19%) compared to a third (31%) of men. The odds of high risk score ≥20% in the obese compared to normal weight was 1.19 in men, 1.16 in women.

Table 6.4: Comparison of CVD risk scores in obese/overweight and normal weight[a] adults

	Normal Weight (N)		**Obese/Overweight (OO)**		**p-value±**
MEN					
Framingham CVD risk	**n=144**	**S.E**	**n=67**	**S.E**	
Mean, SE*	24.0	1.1	27.8	1.9	0.001
Moderate Risk Score (10-19.99%), %	43 (29.9)	0.8	21 (31.3)	0.6	0.47
High Risk Score (≥20%), %	82 (56.9)	0.6	41 (61.2)	2.1	
High Risk Score (≥30%), %	31 (21.5)	1.2	19 (28.4)	2.6	0.180
Odds ratio (risk≥20% in the obese/overweight	1.19 (CI; 0.66-2.16)				
WOMEN					
Framingham CVD risk	n=112	S.E	n=597	S.E	
Mean, SE*	14.6	1.0	17.1	0.46	0.001
Moderate Risk Score (10-19.99%), %	41(36.6)	0.32	279 (46.7)	0.13	0.021
High Risk Score (≥20%), %	26 (23.2)	0.30	155 (26.0)	0.86	
High Risk Score (≥30%), %	10 (8.9)	0.96	73 (12.2)	1.12	0.280
Odds ratio (risk≥20% in the obese/overweight	1.16 (CI; 0.72-1.87)				

[a] Based on BMI categories.
± Significant p-values were obtained from comparison between normal and obese/overweight men (or women) with chi-square tests for categorical variables and t-tests for continuous variables
Odds of CVD risk>20% were Overall

The prevalence of body image dimensions based on adiposity levels (BMI and BF%)

There were disparities in attitudes towards weight, body size dissatisfaction (FID), and weight discordance (FAD>0) in the obese and non-obese participants as shown in Figure 6.1(A-C). Moderately high proportions of the study participant (51% and 66%) with excess body weight based on BMI and BF% cut-offs were satisfied with their large body sizes. In addition, 10% of the obese considered their sizes as being '*too small*' (Figure 6.1A). Interestingly, 34% and 49% of the obese (based on BMI and BF% respectively) were dissatisfied with their size; considering their bodies as being '*Too large*'.

The perceived weight status was significantly associated with BMI, BF% and WC. Regardless of BMI or BF% – over 60% of the obese/overweight or optimal weight participants respectively perceived their weight as '*average'* (Figure 6.1B). Based on BMI, 10% of obese, 23% of overweight and 32% of optimal weight adults considered themselves as *'thin'*. Only a third of the obese perceived self as *'overweight'*. These increasing trends in perceptions of thinness between obese and non-obese were similar when BF% weight categories were considered. Regarding weight discordance, and based on BMI, nearly 80% of the obese and overweight underestimated their own weight based on FAD (Figure 6.1C). The corollary was that less than 20% of overweight/obese groups were likely to estimate their weight accurately, compared to 53% in the normal weight group. There were, however, no significant statistical differences (p>0.05) in the comparison between BF% and dissatisfaction or weight discordance.

6.3.4 Body image and change in weight and adiposity overtime

The correlations between body image (FID and FAD) and weight, and adiposity are presented in Table 6.5. FID had positive correlations respectively with body weight (in Kg), adiposity (i.e. BMI, WC and BF%), and also with changes in weight and adiposity.

In general, at high FID weight (r=.44), BF% (r=.11), WC (r=.36), and BMI (.44) significantly increases, indicating that as participants feel more dissatisfied with their overweight status, their weight and adiposity tend to increase. In addition, at high FID there was significant high annual change in weight, WC and BMI, but decreases annual change in BF%. In contrast, FAD negatively correlated with weight (r=-.24) and BMI (r=-.27), WC (r=-.14), and BF% (r=-.12), indicating that at high weight discordances (towards 'size overestimation'), weight as well as adiposity decreases. Similarly, at high

FAD annual changes in weight and BMI increases significantly. However, there was no association between FAD and annual changes in BF% and WC respectively. Significance levels for the correlations undertaken were obtained at p-value <0.001 level (2-tailed). Higher Pearson (r) coefficients and larger measure of variability (R^2) were seen particularly in BMI, WC and weight (in kg), compared to BF%.

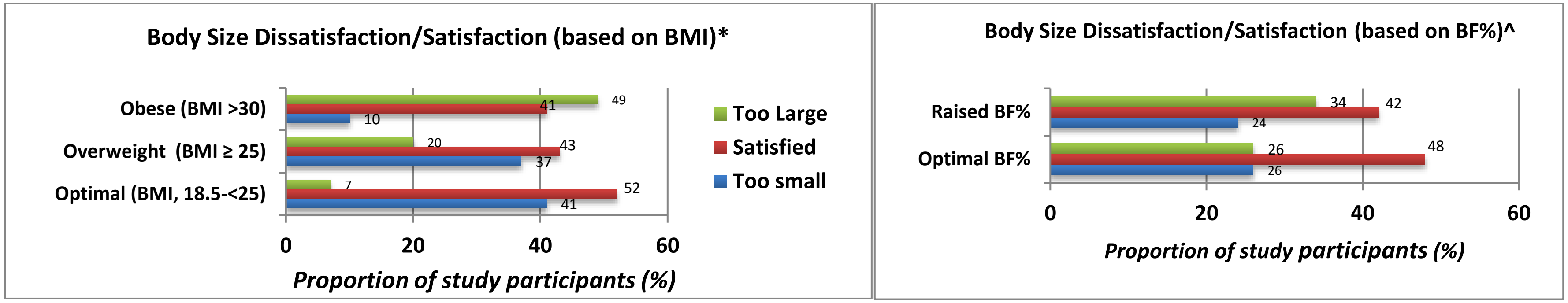

Figure 6.1A: Body size dissatisfaction

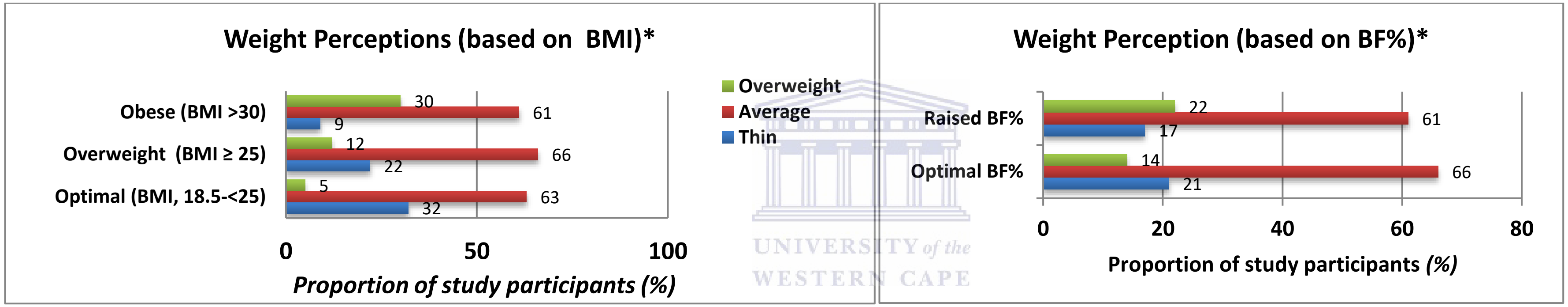

Figure 6.1B: Body weight perception

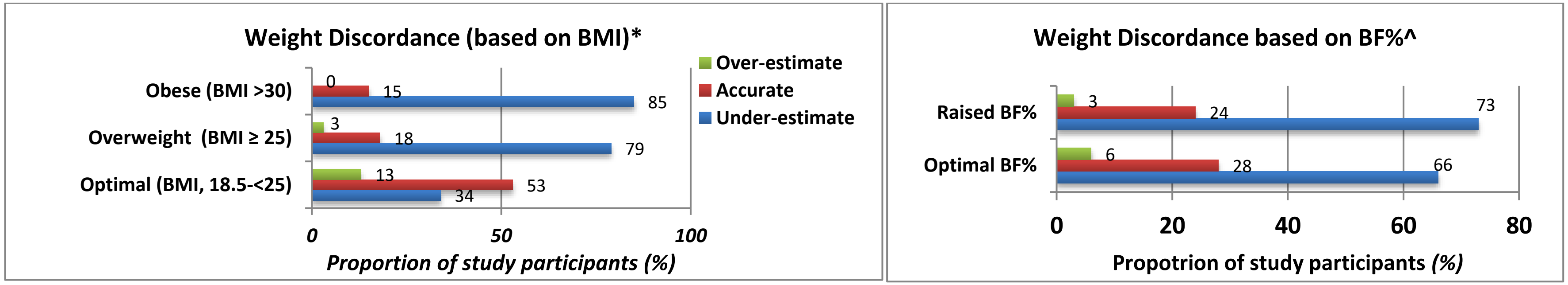

Figure 6.1C: Body weight discordance

Figure 6.1 (A-C): Prevalence of body image dimensions based on BMI and BF% weight categories

**Significant difference (p<0.05), and ^ no significant difference in the comparisons between body image and adiposity categories. Chi-square tests were used for the comparisons.*

Table 6.5: Correlation* between body image (FID and FAD), weight and adiposity (BMI, WC, and BF%)

	Body image				Body image		
	FID	**FAD**	n		**FID**	**FAD**	**n**
Body weight				**Change in body weight**			
Body Weight (Kg)				*Change in weight (Kg)/year*			
r	0.44*	-0.25*	920	r	0.19*	-0.20*	920
Adiposity				**Change in adiposity**			
*BF%^*				*Change in BF%/year*			
r	0.12*	-0.13*	745	r	-0.16*	0.62	693
WC				*Change in WC/year*			
r	0.36*	-0.14*	740	r	0.12*	-0.05	637
BMI				*Change in BMI/year*			
r	0.44*	-0.27*	920	r	0.19*	-0.19*	920

** Bivariate linear correlation*
*r =Pearson's product-moment coefficient; * r significant at the 0.01 level (2-tailed)*

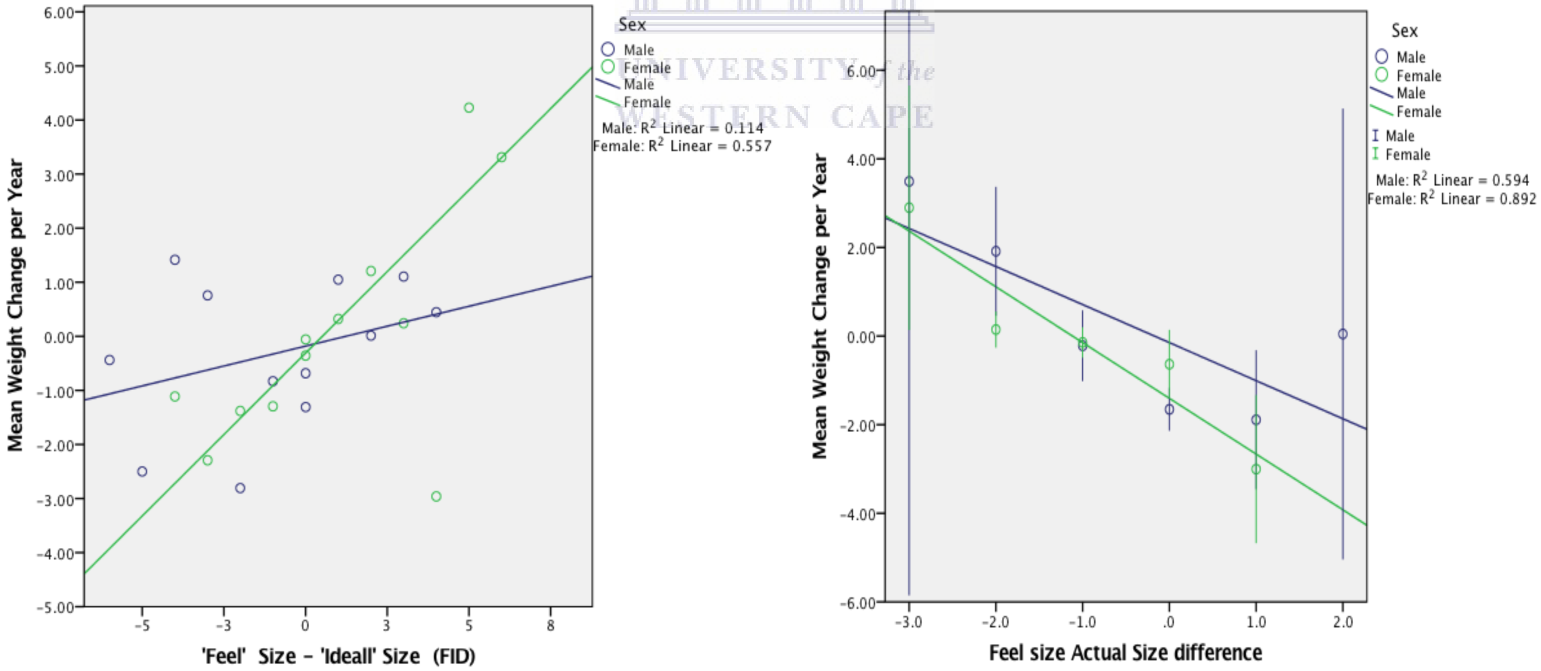

Figure 6.2. Box plot showing linear relationships of body image dimensions (FID and FAD) and annual weight change by sex

The sex-specific differences in body image and weight change are shown in Figure 6.2.

Women who gained weight over the preceding years had higher FID. In contrast, women lose weight over the preceding years had higher FID compared to the mee. . In the women, a weight gain >2.0 kg/year was seen with FID index ≥5, whereas a weight loss of >3.0 kg/year was seen with FAD index ≥2. Change in weight per year was defined

as the difference in weight between follow-up and baseline weights divided by the number of years of follow-up.

6.3.5 Body image and CVD mortality risk score

Based on the partial correlation analysis (Table 6.6), FAD had a significant but weak correlation (r = 0.13) with 10-year CVD score at follow-up, whereas FID had no significant correlation. In this analysis, age, gender and BMI were controlled for, and significant levels of association was estimated at p<0.01.

Table 6.6: Partial correlation of CVD risk and Body image dimensions

Controlled Variables[a]		**10 year CVD risk**	**'Feel' – 'Actual' Weight difference (FAD)**	**'Feel' – 'Ideal' Size difference (FID)**
Age, gender and BMI	Correlation			
	10-year CVD risk score	1.0	0.13**	-0.03
	FAD	0.13**	1.0	0.39**
	FID	-0.03	0.39**	1.0

*[a] Modifiable risk factors (SBP-systolic blood pressure; BMI-body mass index; HPT- reported hypertension; Smoking – tobacco use; and diabetes mellitus status); **. Correlation is significant at 0.01 level*

6.3.6 Factors associated with discordant weight status and body size dissatisfaction

The factors associated with discordant weight and size dissatisfactions are presented in Table 6.7. Demographic and lifestyle factors including age, gender, education, employment, marital status, and smoking were not associated with either weight discordance or size dissatisfactions. In contrast, excessive body weight (obesity or overweight), willingness to lose weight and perceived CVD threat had significant associations with discordant weight and size dissatisfaction respectively. In addition, those with body size dissatisfaction were about four times more likely to show weight discordance (p<0.0001), whereas those with weight discordance were significantly not likely to be dissatisfied with their body size (p<0.0001), but were rather satisfied with their current body size.

Also, those who were willing to lose weight were seven times more likely to be dissatisfied with their current body size but were not likely to have discordant weight compared to those who were not willing. Similarly, those who perceived the threat of CVD due to obesity were two times more likely to have discordant weight (p<0.001) or size dissatisfaction (p<0.01), compared to those who did not perceived the risk.

Table 6.7: Multiple logistics regression models for factors associated with weight discordance and body size dissatisfaction

	Discordant weight †		**Body size dissatisfaction††**	
	AOR	**95% CI**	**AOR**	**95% CI**
Age (years): <45 (ref)				
46-59	0.86	0.53-1.39	0.73	0.44-1.23
60+	1.00	0.58-1.74	0.91	0.51-1.64
Sex: Women vs. men	1.16	0.72-1.87	0.92	0.51-1.67
Education (Tertiary – ref)				
Non-primary	1.63	0.65-4.06	1.10	0.45-2.68
Any high school	1.62	0.66-3.70	2.05	0.43-2.52
Work (Employed – ref)				
Unemployed	1.16	0.60-2.24	0.71	0.36-1.40
Pension/social grant	0.65	0.38-1.12	0.82	0.47-1.42
Married vs. Unmarried	0.91	0.64-1.23	0.98	0.68-1.42
Smoking: Smoking vs. not smoking	1.01	0.72-1.67	1.18	0.74-1.87
BMI (Normal weight – ref)^				
Overweight	0.05***	0.03-0.09	0.06***	0.030-0.13
Obese	0.34***	0.20-0.59	0.34***	0.21-0.55
Dissatisfied with body size (Yes)	3.70***	2.23-6.10	-	-
Weight Discordant (Yes)			0.28***	0.17-0.48
Willingness to lose weight (Yes)	0.35***	0.22-0.56	7.43***	5.08-10.85
Perceived CVD threat	2.18**	1.24-3.82	2.52*	1.23-5.12
Constant	0.894		0.677	
Model fitting percentage	67.5-82.6%		73.5-76.6%	

†Underestimate or overestimate own weight; Feel-Ideal Difference ***(FID) >0***
^ Replacing BMI with BF% did not show any significant association with discordant weight and size dissatisfaction
****** P-value <0.0001; ** P-value <0.001; * P-value <0.01***

The summary of the relationships between body image and some outcome variables, namely, perceived obesity threat, willingness to lose weight, weight change and total CVD risk score, are represented schematically in Box 1. These key findings form the basis for discussions and the recommendations in this thesis.

BOX

Box 1: Relationships between body image and i) perceived obesity threat, ii) willingness to lose weight, iii) weight change, and iv) total 10-year CVD risk score

	Perceived obesity Threat	Willingness to loss weight	Change in Weight	CVD Risk Score
Size Dissatisfaction	↑ 2.5x	↑ 7.0x	↑ (Weight gain)	No Correlation
Weight discordance	↑ 2.2x	↓ 0.4x	↓ (Weight loss)	+ Correlation

Keys: ↑ -- High ↓--- Decrease 2.5x (Adjusted odd; =2.5 times, for an example)

6.4. Discussions

This study explored the relationships of body image dimensions (FID and FAD) with adiposity and weight change as well as absolute CVD risk, contributing to the understanding of how body image perceptions relate to adiposity and CVD mortality risk. The following are the key findings:

1. Participants' CVD risk profiles and excess body weight/adiposity were very high in both men and women in the rural and urban communities studied.
2. Although the majority of women (76%) and 49% of men underestimated their weights, about half (49%) of obese adults (based on BMI), were dissatisfied with their (large) body sizes.

Dissatisfaction with body size was in turn significantly associated with the willingness to lose weight and perceived obesity threat in this study.

3. Change in weight/year significantly increased with increasing size dissatisfaction and decreased with increasing weight discordance in both sexes, and particularly in women indicating the influence of body image on annual change weight.
4. Factors associated with underestimation of weight and size discrepancy included perceived threat and being overweight or obese.
5. Increasing weight discordance had a positive but weak correlation with 10-year CVD risk score, pointing to an association between weight discrepancy and CVD mortality risk score. Details of these findings and their implications are discussed in this order in the paper.

High adiposity and CVD risk profiles

The adiposity and risk profiles were adversely high in both the rural and urban adults. Excess adiposity ranged from 80% to 90% in women and 32% to 44% in men, based on BF%, WC and BMI cut-offs, with even higher proportions in the rural community. A similar trend in women (82%-96%) and men (26%-62%) were reported in this same study cohort based on data collected in 2010 (82), indicating a sustained obesity rate in the population. Expectedly, very high proportion (33%) of the study population recorded total 10-year mortality risk ≥ 20%, considered as 'high-risk' (32). It is alarming that eight in 10 men and four in 10 women aged ≥60 years were at high-risk, and close to half of the women in the study had moderate CVD risk scores (Table 3).

Compared to previous studies in South Africa, this study reported higher prevalence of tobacco smoking (28%), mean systolic BP (140 mmHg), reported diabetes (14%), high mean BMI (30.6 m2/kg) and high body fat (38%) (32,103,162). This CVD profile, which indicates a constellation of cardiometabolic syndromes, is partly expected as high prevalence of tobacco use, obesity and increasing hypertension are reported in the black South African communities (49,103). Also, a study conducted in 2007 in Soweto, a black African community in South Africa had reported a high prevalence of CVD risk factors in 78% of the population, referring to it as a CVD risk '*time bomb*' (162). Recent studies have reported an increasing CVD risk and mortality prevalence in Africa and in the Middle East than previously known (38,153,278).

Previous studies conducted in South Africa, however, reported very low CVD risk in the general population. Based on a large country-wide cross-sectional study conducted with 14,772 adults, and data from the demographic health survey, approximately 18% of the South African adult population is classified as high-risk (i.e. CVD risk ≥ 20%) (32). A recent study conducted in Cape Town black communities by Peers and her colleagues (161) reported a mean CVD risk score of 11.1% in men and 6.8% in women, and only 13% of men and 7% of women had CVD risk ≥ 20%. Our study in contrast shows higher mean CVD risk score of 25.2% in men and 16.7% in women. The proportions of persons with CVD risk ≥ 20% was also comparatively higher; 58.3% of men and 25.5% of women. Matsha and her colleagues in 2012 had reported a high mean 30-year CVD risk of 33.6% among individuals without diabetes, and about 53% among self-reported diabetes (279) in a similar population in Cape Town. Our study recorded comparatively similar proportion of adults (33%) with high CVD risk score even in the general population. From the above set of findings, it can be deduced that there is a very high CVD risk in these communities with predominantly obese adult population, as one third of the study sample is at risk of CVD deaths within a10-year period than previously expected in among black South African adults (103).

The high 10-year CVD risk levels indicate impending high rate of CVD morbidity and subsequent mortality in women and men in these communities in the next 10 years. Unfortunately, there is a low perception of CVD threat (due to obesity) among black overweight adults, particularly women, according to findings from a recent qualitative study in this same cohort (36). This calls for concerted efforts to create awareness regarding obesity and CVD risk in order to check the impending cardiovascular deaths in a decade to come in these communities. Community-based intervention focusing on effective CVD risk assessment and referral for timely care should be implemented to identify at-risk persons and to provide referral services and care to both the obese and non-obese before CVD crisis. This kind of intervention has been shown to improve access to community risk assessment, increased risk awareness and uptake of care in similar communities in South Africa, Bangladesh, Mexico and Guatemala (208,214,266). However, the effect of obesity risk perception on weight control behaviour cannot be overlooked in this setting because of the dominant cultural body image perceptions.

Body image dissatisfaction: a consideration for effective obesity prevention

Significantly high proportions of the participants, especially the obese/overweight, underestimated their weights, describing themselves as *'thin'* or *'average'*. Less than 20% of the obese and overweight participants were likely to estimate their weight accurately (Figure 6.1 A-C). These findings imply that there is still sustained negative body image perceptions in this population, as reported in past decades and in recent times (11,27,34) .

In addition, however substantial proportions (34-49%) of obese and overweight (41-42%) adults, particularly women (based on BF% and BMI), in this study were dissatisfied with their (large) body size compared to earlier studies in the setting (14,27,123). Dissatisfaction with body size status was in turn associated with the perceived obesity threat (adjusted odds ratio = 2.5) and the willingness to lose weight (adjusted odds ratio = 7.4). Based on the assumptions of the study framework, dissatisfaction with body size (particularly among the obese) had led to willingness to lose weight. A recent qualitative study conducted with this same cohort had also shown that obese women who perceived threat of obesity had positive body image than the overweight and normal weight women and men (36). This situation offers a window of opportunity for an effective community-based health education, as the obese women who are no longer satisfied with large bodies due to perceived or felt threat or any personal reasons can be recruited as peer-mentors for obesity prevention advocacy and CVD risk assessment and referrals in their communities. This can be of immense benefit to primary health care if caregivers, community health workers and other health professionals who are dissatisfied with their obese or overweight status are recruited and trained for community health care. Up until now, most health care providers, including the community health workers, working in health facilities in South African communities are predominantly overweight (33,280). The use of health care providers who themselves have optimal body size or overweight with positive body image can influence body image perceptions over time among community members, and can lead to behaviour modification. This strategy can enhance effective community care and lifestyle change under the primary health care re-engineering programme in South Africa.

Body image and changes in weight and adiposity

Another important finding of this study is that body image dimensions (FID and FAD) had significant correlations with body weight, adiposity and change in weight and adiposity over time. Decrease in weight and adiposity over time was associated with high FAD (weight discordance). In contrast, increase in weight, and adiposity (based on BMI, WC and BF) were in significantly associated with high FID (size dissatisfaction) in the study population. Interestingly, increase in weight, as well as BMI and WC per annum was asscociated with size dissatisfaction. The possible explanation is that as people overestimated their weight, they have the tendency to lose weight, BMI and WC over time. On the other hand, weight and adiposity tended to increase even as people were dissatisfied with their body size (i.e. believing their size was ‘too large’). Notably, weight gain was attributed more to high size dissatisfaction in the women than men, whereas weight loss in women as well as in men were linked with a level of weight discordance. These findings, if true for the larger black South African population, can be an important yardstick to consider in targeting body image interventions in this population.

Considering the association of weight discordance with annual weight loss (but not loss in BF%), and size dissatisfaction linked with increase in weight, but reduction in BF%, it therefore means that in line with the adapted study framework in Figure 3.2, body size dissatisfaction and body weight discrepancies have influence on body weight and adiposity, although differently. These findings have added more specific information regarding the relationships of body size with body weight discrepancies, and adiposity in this population (27,34,35).

Factors associated with weight discordance and body size discrepancy

Substantially high proportions of obese/overweight adults underestimated their weights and were at the same time satisfied with their overweight status. This indicates the high propensity to maintain overweight status or gain more weight among adults with excess weight. This would have an impact on the implementation of possible weight control interventions in these communities. Factors associated with weight under-estimation were mainly sociocultural and cognitive (self-efficacy, and lack of overweight health risk awareness) according to a study by Park (276). Women who underestimated their weight had gained 0.31kg per annum whereas those who accurately estimated their weight had lost weight annually (144). A recent study reported that body size distortion (discrepancy) was significantly associated with higher BMI (137). Our study corroborated these findings. From this particularly study, self-efficacy (i.e. readiness to loss weight and perceived threat), and being overweight or obese were significantly associated with weight discordance and size dissatisfaction. In addition, the recent qualitative study involving this study population showed that in addition to self-efficacy, risk perception, NCD morbidity and subjective norms influenced body image distortions. Therefore, factors such as self-efficacy, risk perception and awareness and weight discordance should be considered in community-based obesity interventions.

Previous studies had hypothesized that underestimation of body size by obese women may be linked to increased self-efficacy and positive self-image (9,129). This assertion is an important aspect of body image that needs to be considered in tailoring culturally appropriate interventions among women with excess adiposity. Women with positive self-image and self-efficacy need to be supported to appreciate the need for self-assessment of risk and how to maintain optimal weight over time. Access to affordable, easy-to-use and community-friendly tools and educational resource materials that facilitate risk assessment should be provided.

Another important finding of this study is that body image was not associated with socio-economic status such as age, gender, education, income, employment, and marital status. These findings are in line with those reported by Mogre and colleagues, which indicated that weight discordance was not associated with age and sex but with being overweight (200). However, in contrast to these study findings, Mogre et al. study indicated that those who were unmarried compared to the married had increasing weight discordance.

It is important also to note that those who were willing to lose weight (compared to those who were unwilling) in this study were most likely to be dissatisfied (or perceived their size to be 'two large') with the current overweight/obese status, but less likely to have discordant weight status. Positive attitude towards body weight and the perceived threat were identified in previous studies and in this study as two important factors that influence the willingness to lose weight among black African adults (36,152).

This means that willingness to lose weight is associated with body size dissatisfaction and not on weight discordance (negative body image). This is good news, as perceived dissatisfaction with overweight status can engender certain behaviour change towards weight control among adults with body image challenges. Evidence from a recent study showed that believing that one is obese was positively related with dietary restraint and body image (281). However, those with size dissatisfaction were about four times more likely to show weight discordant, and those with discordant weight status were more likely to perceive the threat of CVD due to overweight. This means that even though some adults had perceived CVD threat, and indicated their intentions to lose weight, the majority still underestimated their weight. This can impact negatively on their actual weight control behaviours, as was the case in this study. A recent study of a sub-sample of this present study population in Cape Town (36) reported that excessive weight adults who perceived the threat of CVD had also indicated their intension to lose weight.

From these findings, it can be inferred that motivation to appropriately perceive that obesity can lead to CVD and an attitude towards optimal weight are two important factors that can positively influence willingness to lose weight in this setting. It is quite interesting to note that, in the study, dissatisfaction in size, though associated with significant willingness to lose weight, was not linked with annual weight loss. This could be the impact of high level underestimation of weight (weight discordance) in the study population.

Weight discordant status, size dissatisfaction and CVD risk scores

The study findings showed that increasing weight discordance had a positive but weak correlation with CVD risk score, while size dissatisfaction had no association with risk scores, after controlling for covariates of CVD risk. This indicates that weight discordance can influence CVD risk mortality at least in this study population. Having strong concerns about weight can lead to behaviours or lifestyle that can impact on CVD risk factors such as weight gain, substance abuse and stress in the long run (9). This study therefore provides evidence on the possible relationship between body image and absolute CVD mortality risk in black Africans.

6.5. Conclusion

This study showed that increasing weight discordance (and not size dissatisfaction) was associated with absolute 10-year cardiovascular risk scores, and overestimation of own weight was associated with decreasing weight and adiposity over time in black South African adults. High CVD risk levels in adults with excess adiposity in the study population can be attributed, to an extent, to attitude towards body weight. Community-based health promotion that incorporates motivation and behaviour change communication strategies for personal weight and CVD risk assessments and the motivation for maintenance of optimal weight should be considered in interventions to reduce obesity and high CVD risk among adults in this setting.

Lastly, it would be important to identify and support high-risk obese and non-obese individuals who have negative body image in order to appropriately target interventions. Developing culturally acceptable body image assessment tools that can identify high-risk individuals with body image discordance for care and support in the community is therefore important. Treatments do exist for improving body image perceptions in obese and non-obese individuals (274,282,283). Further research that incorporates community-based obesity prevention interventions for high-risk patients with negative body image should therefore be commissioned.

Strengths and limitations

Body image studies often use the conventional BMI measure in the classification of adiposity even though BMI has been shown to underestimate overweight. This study used complementary measures such as WC, BF% and WTHR alongside BMI to compare body image patterns based on weight categories. This is important, as it clearly shows that body size perception and weight discordance are associated with change in weight and specific adiposity measure over time. Other important adiposity measures, like BAI and WTHtR were not within the scope of this study.

The study however has some limitations. Parameters for the calculation of absolute CVD risk such as diabetes and tobacco smoking were self-reported and might have been under-reported. Participants from our study were recruited from existing cohort in two selected black communities and may not be a true representation of the entire South African population. These findings may therefore not be generalizable in the entire South African population, nonetheless, larger studies involving the entire South African population can eliminate the uncertainties.

The study participants were predominantly women, majority of them unemployed and physically inactive, and therefore could contribute some possible bias. Similar studies in the larger population and many settings should be undertaken to further validate the relationship between body image index and CVD risk scores, controlling for other exposures and modifiable risk factors. The use of a modern computer-aided body image measurement technique such as BIAS can help assess body image dissatisfaction or discordance more objectively (284). In addition, for further research, structural equation modelling could be applied to explore the relationships of body image perceptons with perceived obesity threat and CVD mortality risk, and their effect on this population (285).

CHAPTER 7

SUMMARY AND RECOMMENDATIONS

This chapter presents the summary of the study, the public health and policy implications of its findings, and the recommendations.

7.1 Study aim and methods used

This study explored body image perception and its associations with obesity, obesity risk perception and total cardiovascular risk to inform obesity prevention in the rural and urban settings of South Africa. The study was embedded in an existing PURE cohort study that investigates the population-level factors that drive the development of known risk factors for chronic non-communicable diseases among black South African adults. The current study was undertaken in three phases utilising a mixed-methods design.

The first phase involved secondary (baseline) data analysis of the 1220 adult participants from PURE study cohort to establish the prevalence and factors associated with excessive body fat (obesity/overweight) in the men and women. Data was analysed using descriptive statistics, and sex-specific multiple logistics regression models. The findings from the first phase informed the investigations for the second and third phase of the study. The second phase explored the influence of body-image perceptions on perceived obesity threat, and the willingness to lose weight among obese and overweight adults. Qualitative methods which included focus groups discussions with separate groups of obese, overweight and optimal weight men and women (N=87) in the PURE study communities were utilised to collect data in this phase. The qualitstive data was analysed using thematic analysis approach. The third phase employed a cross-sectional follow-up survey, and data were collected from 963 existing PURE study participants during the fifth year of the study. Based on the cross-sectional survey data, body image perceptions (i.e. size dissatisfaction and weight discordance) indexes, and CVD-risk scores were calculated and categorised. Bivariate analyses were used to described the patterns and the associations between body image and i) change in weight; and ii) change in adiposity, and iii) CVD-risk scores. In addition, multiple logistics regression models were used to determine the associations of body image perceptions with the relevant explanatory variables.

7.2 Summary findings

In summary, body-image perceptions were significantly associated with changes in weight and adiposity, and total 10-year CVD mortality risk scores among the predominantly obese black adults. The key findings of this study are as follows:

1. There were marked differences in the socio-demographic and lifestyle factors associated with excessive body fat (or adiposity) by sex.
2. Body-image perceptions were associated with adiposity (BF%, BMI and WC), and annual changes in weight and adiposity among black African adults.
3. Body-size dissatisfaction was positively associated with the willingness to lose weight, whereas weight discordance had an inverse association with willingness to lose weight among obese and overweight black African adults.
4. Body-weight discordance was significantly associated with the 10-year total CVD-risk score.

Details of these key findings have been disseminated in the three published articles (see Appendix 1) based on data from the three phases of this study. These findings and their interpretations are summarised as follows:

7.2.1 Sex differences in the determinants of excessive body fat in black South African adults

A high prevalence of general obesity/overweight, particularly in women compared to men (82% vs. 36%), and the high BF% (96% vs. 62%) were reported for this study sample. Similarly, there were sex-differences in the socio-demographic and lifestyle factors associated with excessive body fat (or adiposity) as reported in the first Article based on Phase 1 data for this research (82). Lifestyle factors, such as smoking among women and alcohol use among men, were inversely associated with excess adiposity. In contrast, socio-demographic factors such as marital status and living in an urban location were positively associated with excess adiposity (BMI, BF% and WC) in men and women, and age (<50 years) was inversely associated with only BF% in men and women. These sex differences in the factors associated with obesity should be considered when packaging interventions to reduce obesity in these communities.

7.2.2 Body image perceptions are associated with change in weight and adiposity

A very high proportion of the study population with excess body weight had perceived their weights or sizes differently, indicating a high body image discordance rate. For example, the majority of obese (85%) and overweight (79%) participants underestimated their weight, and 51-66% of these participants with excess body weight were not at all dissatisfied with their obese or overweight body sizes.

Body image indexes (FAD and FID) were associated with body weight and adiposity, and annual changes in weight and adiposity. These findings are captured in the third article based on the findings from Phase 3. Specifically, annual body weight and adiposity (except BF%) decreases with an increase in FAD (i.e. increasing weight overestimation), but increases with an increase in FID (i.e. increasing size dissatisfaction index). On the other hand, annual BF% decreases with an increase in FID, and showed no significant change with FAD. These findings imply that overestimating one's weight status can lead to a loss in weight and adiposity overtime, whereas being dissatisfied with one's body size did not lead to an annual loss in weight or adiposity (at least for BMI and WC), but an annual loss in BF%.

7.2.3 Body size perception influenced perceived risk, and the willingness to lose weight

Body image influenced the perception of obesity threat, and the willingness to lose weight based on Phase 2 (qualitative study) findings (36). Overweight was perceived as less threatening, particularly among overweight women with body image discordance. Interestingly, obese participants (men and women) who had experienced chronic disease conditions perceived obesity as threatening compared to those who were overweight. Consequently, most of the self-reported 'healthy' obese and overweight participants were not personally motivated to undertake physical activity and other appropriate weight-control behaviours that can support weight loss as reported in the second (qualitative) paper of this study (36). These findings imply that healthy overweight and obese women in this study setting may find it difficult to take appropriate actions to lose weight, perhaps, because of the poor perceived threat of overweight. This can be a challenge to weight-loss intervention programmes being advocated in resource-poor settings. The above findings from the qualitative study corroborated with the quantitative survey findings (from Phase 3), and therefore established that body-image perceptions influenced perceived threat and the willingness to lose weight.

7.2.4 Body weight discordance status is significantly associated with CVD mortality risk score

Weight discordance had a significant but weak correlation with absolute 10-year CVD risk score, whereas FID showed no significant relationship. These findings indicate that body image, particularly perception about one's weight, can have an effect on the CVD mortality risk score among black adults. In addition, the patterns of CVD risk scores by age category and body image among obese adults in this study point to increasing CVD risk scores and body image discordance in all age groups. Moreover, a very high proportion of men (61%) and a quarter (26%) of the women with BMI ≥25 kg/m^2 had CVD risk scores ≥20% - which is considered as 'high' CVD risk.

7.3 New information (or contributions) from this study

Based on the summary findings, the following new information emerged from this study:

- Body image discordance is significantly associated with annual changes in adiposity and weight among black South African adults.
- Willingness to lose weight is associated with increasing body image dissatisfaction, and perceived obesity threat based on findings from the quantitative survey and the qualitative interviews.
- Weight discordance index had a significant but weak correlation with total CVD risk score.

7.4 Public health and policy implications of the findings

The findings of this research are of importance to public health programmes and for policy advocacy in some ways. First, the poor perception of obesity risk, the high body image discordance rate, poor motivation for physical activity and poor motivation to lose weight among the predominantly obese population are of importance to public health programme managers saddled with responsibilities for the control of obesity and other NCD. Particularly important for obesity control interventions implementation are the findings which established that perceived obesity threat and increasing body size dissatisfaction are associated with increased willingness to lose weight among the obese/overweight adults in this study.

Second, it is interesting to know that the perceived threat among obese persons was motivated by perceived risk of chronic NCD such as diabetes, heart attack and stroke. This in effect indicates that personal motivation to perceive obesity as a health risk (just like stroke or heart attack), and the desire to maintain optimal weight are key factors that can influence intention to lose weight in this population. Based on these findings, health promotion interventions that enhance adequate obesity risk perception, self-sort screening for health risk, and motivation for the adoption of optimal body size should be considered in weight control interventions targeting adults in this setting.

Third, the cultural norms, the perception of overweight as ‘normal’ and ‘not a disease’ as well as the inaccessibility to facilities and lack of motivation to be physically active will encourage a sedentary lifestyle, This lifestyle tends to negatively influence the readiness to lose weight. This situation would most likely pose a challenge to the implementation of weight-loss interventions among adults in this setting. Efforts should be made to commission culturally appropriate community-specific interventions that can improve behaviour change towards appropriate body-image perception and motivation for regular physical activity.

Fourth, the sustained obesity rates in many countries undergoing epidemiological transitions inspite of many intervention measures calls for an urgent attention to redirect efforts to address this epidemic to mitigate its effects on health and society. The obesity epidemic is a global public health problem, and is a known risk factor for diabetes, hypertension and several cancers. Worldwide, the prevalence of diabetes has increased exponentially, and hypertension, stroke and cancer cases have also gone up. Inspite of messages disseminated, interventions commissioned, and guidelines for management developed, obesity increases unabated. In fact, none of the countries in Africa and those in other regions of the globe have been able to successfully reduce obesity in the past 33 years (2).

The questions then are, how are the guidelines and intervention strategies developed and implemented? Could it be that the cultural component of obesity is neglected as an important aspect needed to be considered in obesity prevention? How about body image discordance and perceptions regarding weight and its effect on eating habits, change in weight and adiposity in obesity-burdened communities, such as black African communities? Assessing body image problems accurately therefore should be an important consideration in the current primary health care re-engineering strategy. Specifically, appropiriate evidence-based methods for screening body image problems along side CVD risk should be included in the Primary Care 101 package (286).

Moving forward, evidence-based obesity interventions that can ensure medium- and long-term sustainable results should be commissioned and evaluated. Of particular importance is to consider strategies that can address cultural perceptions, body image discordance and perceived risk, and culturally-induced demotivations for physical activity which have been shown to influence weight change and willingness to lose weight.

7.5 Recommendations

1. The perception of overweight as less threatening to health and the dominant cultural norms favouring overweight body size, particularly among women in this study population, should be objectively targeted. Also, the perceived obesity threat was linked with the willingness to lose weight, particularly among obese men and women. Therefore, it is important for obesity control programmes to include strategies that can motivate appropriately risk perception to engender the willingness to control weight among adults with excessive body weight.

2. Previous studies have hypothesised that underestimation of body size by obese women may be linked to increased self-efficacy and positive self-image. Obese women, with positive self-image and self-efficacy, need to be supported to appreciate the need for self-assessment of health risk and to make informed decisions to maintain optimal weight over time for a good health outcome. Access to affordable, easy-to-use, and community-friendly tools and educational resource materials that facilitate health-risk assessment, including body-image distortions, should be provided. Tools that can be used to assess problems relating to body image accurately should be developed for use in primary health care.

3. Community-based interventions for CVD-risk assessment and referral involving community health workers, which has been shown to be effective in resource-poor communities (266,287),

should be implemented and scaled up in black South African communities. This will ensure timely identification and referrals of at-risk persons for care before a CVD crisis ensues. This is critically important, as a substantially high proportion of the adult population (between 33% and 53%) are at 'high' CVD mortality risk, based on this study and the previous studies in South Africa. Far higher than the 18% previously reported in the general South African population (32). In addition, it is important to identify and support individuals, with moderate to high CVD-risk scores, who have negative body-image perceptions to appropriately target interventions for their benefit. Culturally acceptable body-image assessment tools that can identify individuals who have body-image discordance for care and support in the community should be developed. Treatments do exist for improving body-image perceptions in obese and non-obese individuals.

4. Furthermore, improving the knowledge of individuals and households about obesity and its health effects, the links relating to obesity and energy intake (food consumption) and energy expenditure (physical activity in particular), and self-efficacy to maintain optimal weight can be considered critical steps for obesity control. Empowering individuals and families through community-based health education to understand obesity from the energy balance viewpoint, will help people to make informed decisions to take steps to expend energy effectively and prevent them from overeating (65). Going forward, community-based obesity control programmes should build self-efficacy, and engender appropriate informed decision to prevent obesity by educating people on its basic dynamics (using energy balance theory).

5. Physical activity avenues and motivation of people to engage in effective activity at the community level should be a good way to increase energy expenditure and foster weight loss in obese/overweight adults. Community-level resources should be harnessed to create a conducive built environment, as well as facilitate motivation and improve access to physical activity through effective community participation and mobilisation. To achieve these, existing community recreation centres, playgrounds, gymnasiums, and other sporting avenues, should first be refurbished. In addition, community-directed physical activity interventions should be initiated

and developed for effective participation, ownership and sustainability. Furthermore, more community-friendly sports and recreation centres should be developed and managed through community-participatory approach.

7.6 Recommendations for future research

1. Appropriate data which can provide concrete evidence are needed to support setting-specific interventions for obesity control, particularly in poor settings. Data on the determinants of obesity exist in many African settings, however, there is the lack of comprehensive information on the predictors of the specific forms of adiposity (obesity) in different populations with diverse cultural and socio-economic differences. Therefore, it is important to investigate a broader scope of predictors for the different forms of obesity (abdominal, regional or general obesity) by sex and in the different settings in South Africa. This will provide more comprehensive information on obesity in different communities to inform cost-effective responses to obesity epidemic (21,163). In this context, a robust research initiative that examines the individual level and ecological multi-level drivers of excessive body weight, lifestyle and metabolic consequences to provide evidence for feasible, acceptable, scalable and cost-effective interventions for obesity prevention are recommended. Such initiative should be collaborative and multi-disciplinary, and should use already established population-based cohorts to describe the matrix and dynamics of obesity across communities (24,153)
2. Based on the results of this thesis, it is suggested that future research and interventions should focus on community-level strategies for screening risk factors, as well as determining the impact of body image on risk perception and weight gain in the population. Studies that involve a true representation of the entire South African population from diverse settings should be undertaken to further validate the relationship between body image index and CVD mortality risk perception and weight loss.
3. Structural equation modelling which has been used to ascertain the relationships between multiple variables or constructs and outcome variables should be applied to further ascertain the effects of

body image on perceived obesity threat, the willingness to loss weight, and actual weight loss in this population (285). This would be one focus for further dissemination of the results of this study.

7.7 Strengths and limitations of the study

The strengths and limitations of the different methodologies used for each of the phases of this study are outlined below. The use of a secondary dataset for the first phase of the study was considered to help build the research on available cohort data. However, the limitations of a secondary dataset, such as the inability to correct possible errors or biases identified, are acknowledged. Also, the purposive selection of two black communities for the study from two out of nine provinces precluded generalizability of the conclusions in the entire South Africa population. However, these results will serve as important information to support the design and implementation of obesity control strategies in poor-resource communities similar to the study settings.

The inclusion of BF% in assessing obesity in these communities is an advantage as it complements WC and BMI measurements in assessing forms of adiposity. However, BF% values used in the secondary analyses were estimated using sex-specific equations, which have a tendency to overestimate BF% in obese individuals (247). Therefore, a more objective method of measuring BF% was implemented in Phase 2, as the study participants' BF% was measured using BIA devices. Also, the use of self-reported rather than objective methods for measuring physical activity, stress and depression might have limited their accuracy. In addition, no information was collected regarding HIV status, as this may have led to either weight gain or weight loss.

The qualitative study used focus groups segregated by sex and stratified by weight categories, and included black South African adults, aged 35-70 years, in whom obesity is highly prevalent (49,82). The segregation of participants by weight group (optimal, overweight or obese) ensured effective discussions on sensitive issues about weight management and risk of disease because of overweight among these adults. However, the participants were purposively sampled from an urban informal setting in the Western Cape Province and, therefore, represent a small proportion of the black population in South Africa. Also, the majority (75%) of participants in this study were unemployed and of low socio-economic status and educational attainment. This could have affected their views and perceptions about obesity-related health risk and their weight-loss intentions.

This cross-sectional survey design was used to complement the qualitative (Phase 2) study and to help ascertain the actual relationships among body image, risk perceptions and adiposity and CVD-risk scores. The mixed-methods approach has revealed not only the quantitative aspect of the relationships, but also helped in the understanding of the context for which these relationships occur. Several body-image studies have used the conventional BMI measures in the classification of adiposity.

Furthermore, this study, used complementary measures such as WC, BF% and WTHR alongside BMI to compare adiposity with body-image patterns, based on weight categories. This is important as BMI has been shown to underestimate overweight. The study findings clearly indicated that body-size perception and weight discordance are associated differently with changes in weight and adiposity over time. Other important adiposity measures like BAI and WTHR were, however, not considered as they were not within the scope of this study.

The study also has some other limitations. For example, the parameters for the calculation of absolute CVD risk, such as diabetes and tobacco smoking were self-reported and might have been under-reported. The study participants were predominantly women from two black communities, mostly unemployed and physically inactive, and therefore, could have contributed possible bias. Similar studies in a larger population and more settings should be undertaken to further validate the relationship between body image index and CVD risk scores, controlling for other exposures and modifiable risk factors.

Of importance would be to further explore the multiple linear relationships (and the effects) among perceived obesity threat, body-size dissatisfaction, willingness to lose weight and the actual weight loss in men and women. This perhaps can be done more appropriately using the structural equation modelling (SEM). SEM is planned for further dissemination efforts for the findings of this research. Although the methods used to assess body-image perceptions in this study have been validated and used over time, it is believed that the use of modern computer-aided body-image measurement techniques such as BIAS would have helped in assessing body image dissatisfaction or discordance more objectively (284).

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APPENDIXES

Appendix 1:

List of publications and contributions by candidate (2014-2016)

Article 1: Okop KJ, Levitt N, Puoane T. Factors Associated with Excessive Body Fat in Men and Women: Cross-Sectional Data from Black South Africans Living in a Rural Community and an Urban Township. PLoS One. 2015;10(10):e0140153.

Article 2: Okop KJ, Mukumbang FC, Mathole T, Levitt N, Puoane T. Perceptions of body size, obesity threat and the willingness to lose weight among black South African adults: a qualitative study. BMC Public Health. BMC Public Health; 2016;16(1):365.

Article 3 (Pending): Kufre Joseph Okop, Naomi Levitt, Thandi Puoane. Weight discordance and not size dissatisfaction is associated with absolute 10-year cardiovascular risk scores among black South African adults. PLOS ONE. July 2016 – In Press.

Article 4: Nwanza Mike, **Okop Kufre**, Puoane Thandi. Evaluation of the Outpatient Therapeutic Programme for Management of Severe Acute Malnutrition in Three Districts of the Eastern Province, Zambia. BMC, Nutrition. Undergoing edictorial review (September, 2016 – Accepted for publication).

Article 5: H. Kunga, **Kufre. J. Okop** & T. Puoane. Perceptions of mothers and caregivers regarding the detection and treatment of severely malnourished children in Kanchele, Kalomo District, Zambia; Africa Journal of Nursing and Midwifery 16 (2) 2014; pp. 98–111.

Appendix 2:

Body image components measurement procedures

Components	Main aspects	Means of measurement	Hypothesis (Lean =1-2; Normal =3-4; Overweight=5-6; Obese=7-8	Body image score[a]		Examples
				High BI index (HBI)	Low BI index (LBI)	
Perceptual body image (PBI)	1) Perceived Ideal body size. Estimating size of ideal body Image –using silhouettes **[a]** (34,72,190)	Difference between: (i) **Feel** and **Ideal** size **(F-I)[b]**	a) High **F-I score** indicates greater body size dissatisfaction . Or Low BI perception	FID ≤ 0	FID ≥ 0	If subject reported perceived **Ideal** body size as picture 7 (obese), and **Feel** as 5 (overweight), then **FID =2**
	2) Perceived ideal body weight [c] Assessing reported 'Feel' body weight and measured weight (Actual) (34,129)	Difference between: 'Feel' and **'Actual'** body weight **(F-A)**	b) High F-A index is associated with greater weight over-estimation or dissatisfaction with own weight.	FAD ≤ 0	FAD ≥ 0	A subject reporting perceived **Feel** (**F**) as 'normal' weight which corresponds to 2, and measured (**Actual**) weight is obese, which corresponds to score 4, then FAD = **-2.**
PBI score categories [d]		**<u>Body Size:</u> FID<0 (Too Small); FID=0 (Satisfied); FID ≥ 1 (Too Large).** **<u>Body Weight:</u> FAD<0 (Underestimation); FID=0 (Accurate estimation); FID ≥ 0 (Overestimation)**				
Attitudinal Body Image[e]	1. Body size satisfaction (196,288)	Difference in **Ideal** and (**Feel**) in perceived body satisfied with.	High **F-I score** associated with greater body size dissatisfaction	F-I ≤1	F-I ≥1	If subject reported perceived **Ideal** body size as picture 8 (obese), and **Feel** as 3 (Normal), then **F-1=-5.**
	2. Weight satisfaction (72,146,200)	Answer to options provided: 'Agree', 'Disagree' or 'Do not Know'.	'Agree' response is associated with greater attitude	**'Agree'** score on 4+ attitude statement	Disagree/ Don't know	Agreeing on '... satisfied with body size/image' indicates positive BI attitude and vice versa.
	3. Feelings of attractiveness (27,123,146)		'**Agree**' indicates greater feeling of attractiveness. '**Disagree**' indicates low attractiveness	'**Agree**' score on 4+ attitude statements	Disagree/ Don't know on key attitude statements	Subject who agreed on feeling of attractiveness desired to be admired with large body image indicates strong attitude and vice versa.

*[a]**BI Score** is an index of increasing positive attitude and perception about body image (from Low to High); [b]Silhouttes are sets of pictures (1-8) showing lean to obese images with 1 indicating lean and 8 obese. [b] Pictures had been validated and used by Mciza et al, 2005; [a]ssessing reported body weight helps validate the accuracy of body size estimation* (27,72); *[d] These categories were used for comparison of body image by age and corresponding CVD risk scores for this study. These categories were used by Lynch et al 2009* (12); *[e] Satisfaction with weight and feeling of attractiveness were not considered for this study.*

Appendix 3:
Focus group discussion guide

Section A	**Perceived susceptibility to further weight gain or overweight**
	1. In your opinion, what are the causes of obesity? a) Is there a possibility that you can put on more weight to what you already have now? [*Only normal weight groups]*
	If yes to (a), how do you know that you are becoming overweight or obese?
	2. a) What in your opinion can make you gain some weight or become overweight?
	b) How would you feel if you gain some more weight now? Would you be happy, unhappy or unconcerned?
Section B	**Perceived obesity severity (threat) and cardiovascular disease risk**
	3. a) ***<u>To All groups:</u>*** Do you think you may be at risk of any disease or health problems at your current weight? *b)* ***<u>To normal weight groups:</u>*** Do you think you may be at risk of any disease or health problems if your gain more weight?
	c) Please, mention the diseases for which you think you can be at risk of. *Probe further or look out for cardiovascular disease*
	[Facilitator gives body image silhouettes on cardboard to each participants} 4. Which of these picture(s) do you think may be associated with the risk of a heart disease?
Section C	**Body Image perceptions and attitude to body weight**
	5. a) Which of these figures do you think shows an ideal normal body size for a woman (or man)? b) Why do you think that is the ideal weight? *Could you please explain more?*
	6. Which one of these figures do you think reflects your body size?
Section D	**Willingness to control weight gain or obesity**
	7. a) Would you be willing to lose weight, gain weight or maintain optimal weight? Tell us more?
	b) What measures have you taken to lose weight or maintain optimal body weight?

Appendix 4:

Body image and CVD risk structured questionnaire

QUESTIONNAIRE MEASURING BODY IMAGE, BODY FAT AND CARDIOVASCULAR RISK AMONG MEN & WOMEN

For Office Use

QUESTIONNAIRE ID NUMBER

0	0	6	8

UNIQUE ID NUMBER

Centre #	Community #	Household #	Subject #	Initials

Date of Interview	D	D		M	M	Y	Y

PART A: SOCIO-DEMOGRAPHICS

Instruction: Please tick (✓) or record in the corresponding box as appropriate

A1. Age of participant ______ years

A2. Gender

Male	1
Female	2

A2.b. Marital Status

Married	1
Never Married/Single	2
Co-habiting	3
Widow	4
Divorced	5
Others (Specify:______	

A3. Position in family

Husband/partner	1
Wife	2
Child	3
Relative	4
Other: _______	5

A4. Are you currently

Employed	1
a) Part-time; b) Fulltime	a or b
Unemployed	2
A Pensioner	3
On disability grant	4
Other:_______________?	5

For Office Use

A5. Is your partner/spouse currently

Employed	1
a) Part-time; b) Fulltime	a or b
Unemployed	2
A Pensioner	3
On disability grant	4
Other:____________	5

A6. What level of formal Education have you completed?

None	1	
Primary	2	
Secondary/High School	3	
Trade School	4	
College/University	5	

A7. Which ethnic group do you belong?

Black	1	
Coloured	2	
Indian	3	
Other:________	4	

A8. What is your monthly income category?

<R2000	1	
R2000-5000	2	
R5001-10000	3	
R10001-1500	4	
R>15000	5	

PART B: ANTHROPOMETRIC MEASUREMENTS & RISK FACTORS

Physical Measurements

	Follow-up Year 3 (2013/4)								Baseline			
B1. Body Weight	0	6	8	.	0	kg	e.g.	Wgt				
B2. Height						m		Ht				
B3. Waist circumference (WC)						cm		WC				
B3.i Hip circumference								Hip				

B4. BIA body composition

Total body weight (kg)		Basal metabolic rate (BMR)		/
Body fat % (BF%)		Metabolic age		/
Body water %		Bone mass		/
Muscle mass		Visceral fat		/
Physical rating				/

B5. Blood pressure (BP)

					Office Use	
					Baseline	Follow-up
1st Systolic BP		2nd Systolic BP		SBP1/2	095.0	095.0
1st Diastolic BP		2nd Diastolic BP		DBP1/2		

Risk Factor Profile

B6. Tobacco smoking status

	Year 3 (2013/4)				Follow-up	Baseline
	Yes	No	NR		Insert code (0, 1 or 2)	
Never smoking	2	1	0	NS		
Currently smoking	2	1	0	CS		
Past smoking	2	1	0	PS		
Exposure to smoking	2	1	0	ES		

NR= No response (or missing)

B6.b What is your history of alcohol drinking?

1) Current drinker		2) Never drinking		3) Past drinker		4) Casual drinker	

B7. Do you have diabetes?

			Follow-up	2	1
Yes=2	No=1	NR=0	Baseline	2	1

B8. Do you take any medication or herbal treatment for diabetes?	Yes=2	No=1	NR=0	

B9. Have you ever been treated for Hypertension?

Yes=2	No=1	NR=0

Follow-up	2	1
Baseline	2	1

B10. Are you currently on hypertensive drug/medication?

Yes=2	No=1	NR=0

Follow-up	2	1
Baseline	2	1

10-year CVD Risk Score

HGT (Glucose/Glucometer test)

B11. Biochemistry

11a. Plasma glucose			mg/dl
11b. HDL (High density lipoprotein)			mg/dl
11c. Cholesterol			mg/dl
11.d. Triglycerides			mg/dl

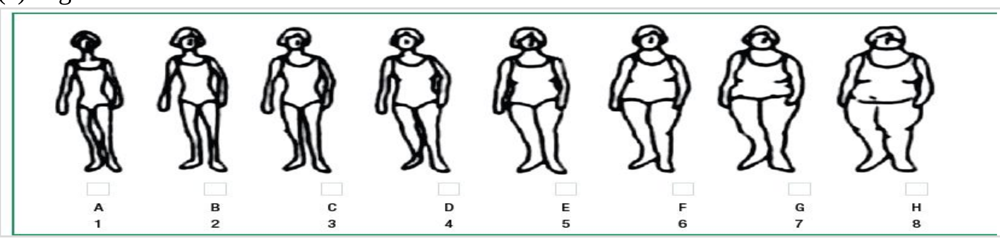
Blood Sample Code: ___________________

PART C: BODY IMAGE PERCEPTION AND ATTITUDE

FEMALES ONLY (questions C1-C3) (If MALE, please go to questions C4-C6).

C1. Please select the box under the pictures that you think **fits best!**

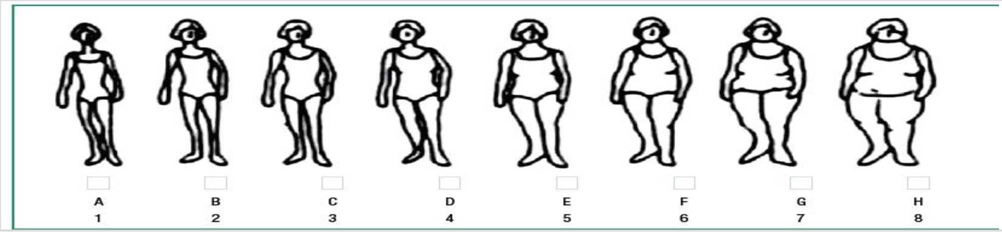
(a) Right now **I feel** like this:



Please tick (✓) one image only!

FI

(b) I **would like** best, if I look like this:



Please tick (✓) one image only!

C2. Choose from the pictures in C1b, the body image that you think

	Insert 1, 2,-8
looks best.	
is the weakest.	
is the strongest.	
will be the happiest.	
will be the most unhappy.	
can lead to optimal health.	
may lead to disease.	

Instruction:
For each line of question, insert only 1 number corresponding to an image above that you've chosen.

C3. How happy or unhappy are you with the following?

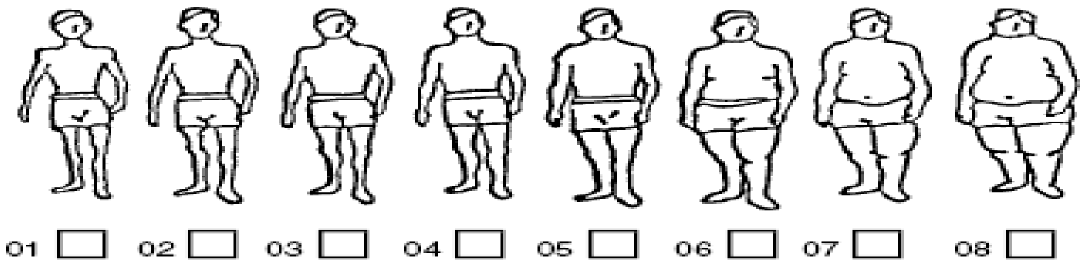
a) Your weight	Happy=3	Unhappy=2	I don't care=1
b) Your height	Happy=3	Unhappy=2	I don't care=1
c) Your legs	Happy=3	Unhappy=2	I don't care=1
d) Your waist	Happy=3	Unhappy=2	I don't care=1
e) Your arms	Happy=3	Unhappy=2	I don't care=1
f) your Thighs	Happy=3	Unhappy=2	I don't care=1
f) Your stomach/Abdomen	Happy=3	Unhappy=2	I don't care=1
h) Your buttocks	Happy=3	Unhappy=2	I don't care=1

Instruction:
Please tick only one for each line

MALES ONLY (questions C4-C6)

C4. Please select the box under the pictures that you think **fits best!**

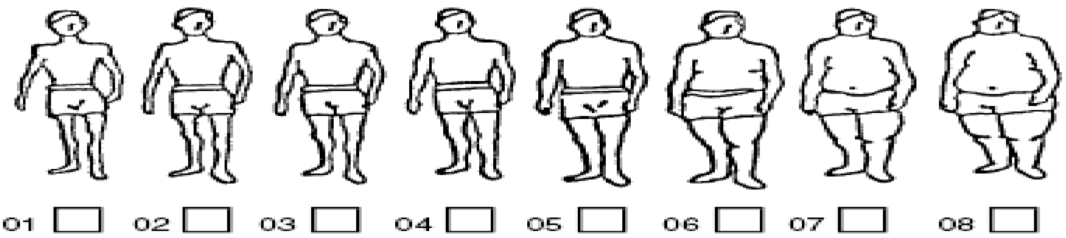
(a) Right now **I feel** like this:



Please tick (✓) one image only!

FI

(b) I would **like best**, if I look like this:



Please tick (✓) one image only!

C5. Choose from the pictures in question C4b, the body image that you think

	Insert 1, 2,-8
looks best.	
is the weakest.	
is the strongest.	
will be the happiest.	
will be the most unhappy.	
can lead to optimal health.	
may lead to disease.	

For each line of question, insert only 1 number corresponding to an image above that you've chosen.

C6. How happy or unhappy with the following?

a) Your weight	Happy=3	Unhappy=2	I don't care=1
b) Your height	Happy=3	Unhappy=2	I don't care=1
c) Your legs	Happy=3	Unhappy=2	I don't care=1
d) Your waist	Happy=3	Unhappy=2	I don't care=1
e) Your arms	Happy=3	Unhappy=2	I don't care=1
f) your Thighs	Happy=3	Unhappy=2	I don't care=1
f) Your stomach/Abdomen	Happy=3	Unhappy=2	I don't care=1
h) Your buttocks	Happy=3	Unhappy=2	I don't care=1

<u>FOR FEMALES AND MALES</u> (questions C7-D4)

C7. Do you think your weight is:

Too high	1
A bit high	2
Good	3
Too low	4

C8. Would you like your weight to be:

Much lower	1
A bit lower	2
No different	3
Higher	4

C9. At your current weight/body size, do you feel that you are

Very thin	1
Somewhat thin	2
Average weight	3
Somewhat overweight	4
Overweight	5
Obese	6

C10. Have you ever tried to lose weight?

Yes=2	No=1

C11. Have you ever tried to gain weight?

Yes=2	No=1

C12. What does leanness (or thinness) mean to you personally? Tick/write as mentioned. Probe!

1. Looking slim is a sign of good health.	**1**
2. It is quite good to be thin/It shows you are physically fit.	**2**
3. If I am thin, it shows that I have a problem – either health, emotional, etc.	**3**
4. If you are thin, people may think you have a disease/sickness.	4

5. Those who are thin are smart, and can work without getting tired easily. | 5
6. If you are thin, you would be admired. | 6
7. Those who are thin are happier. | 7
8 Other reasons:____ | 8
____ | 9
____

C13. What does being very huge or round or overweight mean to you personally? Tick/write as mentioned. Probe!

1. Looking huge or overweight is a sign of good health.	**1**	
2. It is quite good to be huge/It shows you are physically fit.	**2**	
3. If I am huge/overweight, it shows that I have a problem –health, emotional, etc..	**3**	
4. If you are overweight, people may think you have a disease/sickness.	4	
5. Those who are huge are smart, and can work without getting tired easily.	5	
6. If you are huge, or round you would be admired.	6	
7. Those who are huge or round are happier.	7	
8 Other reasons:____	8	

C14. If you gain more weight now, would you be

Happy	1	
Unhappy	2	
Does not matter	3	

C15. If you lose weight now, would you be

Happy	1	
Unhappy	2	
Does not matter	3	

C16. Do you think the following people will be happy or unhappy about your weight if they were asked?

a) Your husband/wife/partner	Happy=3	Unhappy=2	Do not care=1	
b) Your child	Happy=3	Unhappy=2	Do not care=1	
c) Your father/mother	Happy=3	Unhappy=2	Do not care=1	
d) Your friends	Happy=3	Unhappy=2	Do not care=1	
e) Your neighbour(s)	Happy=3	Unhappy=2	Do not care=1	

C17. Do you agree that being overweight would make someone your age and sex				**For Office Use**
a) well liked	Yes=2	No=1	Do not care=1	
b) feel better about themselves	Yes=2	No=1	Do not care=1	
c) more attractive	Yes=2	No=1	Do not care=1	
d) look pretty	Yes=2	No=1	Do not care=1	
e) be less confident	Yes=2	No=1	Do not care=1	
f) be respected	Yes=2	No=1	Do not care=1	

C18. Please tick "Yes" or "No" as applicable to the following statement.

a) I am scared of becoming thin	Yes=2	No=1	Not sure=1	
b) I am scared of becoming overweight	Yes=2	No=1	Not sure=1	
c) I feel satisfied with the shape of my body	Yes=2	No=1	Not sure=1	
d) I always try to gain some weight	Yes=2	No=1	Not sure=1	
e) I always try to lose some weight	Yes=2	No=1	Not sure=1	
f) I do think that if I lose weight people would think I am happy or fine!	Yes=2	No=1	Not sure=1	

C19. What do you think influences people to like (or want to adopt) huge or large body size?

a) Culture pressures/demand	Yes=2	No=1	Not sure=0	
b) Personal desires, preferences and attitudes	Yes=2	No=1	Not sure=0	
c) Desire to look round and beautiful	Yes=2	No=1	Not sure=0	
d) We are expected to be round or 'robust'.	Yes=2	No=1	Not sure=0	
e) It is important to please my friends/peers	Yes=2	No=1	Not sure=0	
f) Others: specify:______________________	Yes=2	No=1	Not sure=0	

______________________________				

C20. What do you think can influence you to gain weight?

a) Culture pressures/demand	Yes=2	No=1	Not sure=0	
b) Personal desires, preferences and attitudes	Yes=2	No=1	Not sure=0	
c) Desire to look round and beautiful	Yes=2	No=1	Not sure=0	
d) We are expected to be round or 'robust'.	Yes=2	No=1	Not sure=0	
e) It is important to please my friends/peers	Yes=2	No=1	Not sure=0	
f) Others: specify:____________________	Yes=2	No=1	Not sure=0	
______________________________				

PART D: PERCEIVED CONSEQUENCES OF OVERWEIGHT

D1 (a). Are overweight persons more likely to suffer from some forms of health conditions compared with those who are normal weight?

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Yes=2	No=1	

D1 (b). If 'Yes' to question D1(a), please mention these health conditions? *Tick option(s) only when mentioned (or not mentioned). Do not probe?*

1) Heart disease	Mentioned=1	Not mentioned=0	
2) High blood pressure (hi-hi)	Mentioned=1	Not mentioned=0	
3) Diabetes mellitus	Mentioned=1	Not mentioned=0	
4) Arthritis	Mentioned=1	Not mentioned=0	
5) Cancer	Mentioned=1	Not mentioned=0	
6) Liver disease	Mentioned=1	Not mentioned=0	
7) Others: Specify:____________	Mentioned=1	Not mentioned=0	

D2. What do you think are the disadvantages of being overweight? *Please probe?*

1) Makes one very sluggish	Mentioned=1	Not mentioned=0	
2) Makes one tired every morning/day	Mentioned=1	Not mentioned=0	
3) Unable to walk long distance	Mentioned=1	Not mentioned=0	
4) There is no disadvantage	Mentioned=1	Not mentioned=0	
5) Others (specify):_____________	Mentioned=1	Not mentioned=0	
6) ____________________________	Mentioned=1	Not mentioned=0	

D3. Do you think it is possible to prevent overweight/obesity, or to control it?

Yes=2	No=1	

D4. Mention ways that you think people can prevent themselves from getting overweight *Tick option(s) only when mentioned (or not mentioned). Do not probe?*

1) By exercising regularly	Mentioned=1	Not mentioned=0	
2) By eating less fat food	Mentioned=1	Not mentioned=0	
3) By avoiding junk food, chips and fried food	Mentioned=1	Not mentioned=0	
4) by watching our weight	Mentioned=1	Not mentioned=0	
5) By measuring/assessing weight to inform self about any weight gain.	Mentioned=1	Not mentioned=0	
6) Involved in dance clubs/social clubs	Mentioned=1	Not mentioned=0	
7) By thinking about effect of large body size on health and taking appropriate action(s)	Mentioned=1	Not mentioned=0	

Appendix 5:

Study information sheet

UNIVERSITY OF THE WESTERN CAPE
Private Bag X 17, Bellville 7535, South Africa
Tel: +27 21-959, Fax: 27 21-959
E-mail:

INFORMATION SHEET

Project title: Exploration of the association between body image, body fat, and total cardiovascular risk among adults in rural and urban communities of South Africa

What is this study about?

This is a research project being conducted by a PhD student and two Professors from the University of Western Cape, University of Cape Town. We are inviting you to participate in this research project because you have been randomly selected for this study. This research is aimed at assessing a the linkage between body image, body fat and cardiovascular disease (CVD) risk among adults in the rural and urban communities of South Africa, using body fat percent and body image score. Excessive body fat and body image perceptions have been linked with CVDs which affects many people in our communities here in South Africa. Perceptions of large body images among the adults have been shown to be associated with increasing body weight and overweight. In order to prevent many from dying of these diseases (CVD and obesity) which are preventable, we need to measure body fat percent obesity levels and determine body image score among men and women, in order to better understanding the extent to which body fat and body image affect CVD in men and women in the community.

Questions would be asked on body image perception and attitude, as well as the health consequences of overweight. Information collected in this research will assist health professions to plan strategies that would improve the prevention obesity and related diseases, especially cardiovascular diseases in the communities.

What will I be asked to do if I agree to participate?

You will be asked to sign a consent form to allow us interview you using the study guides, and questionnaires. We will also measure your weight, height, blood pressure, waist circumference and body fatness using bio-electric impedance analysis (BIA) device. Questions related to your body size or image will be asked, in addition to inquiry on perceived health consequences about overweight.

Would my participation in this study be kept confidential?

We will do our best to keep your personal information, including the focus group discussions confidential. To help protect your confidentiality, only the researchers will have access to the information collected about you.

Your name will not be used; only numbers will be used as a form of identification. Once the research is completed, the data will be locked up at the University of the Western Cape. If we write a report or article about this research project, your identity will be protected to the maximum extent possible. In accordance with legal requirements and/or professional standards, we will disclose to the appropriate individuals and/or authorities information that comes to our attention concerning potential harm to you or others.

What are the risks of this research?

There are no known risks associated with you participating in this research project.

What are the benefits of this research?

This research is not designed to help you personally, but the results may help the investigator learn more about on issues related prevention of cardiovascular disease, and improvement of healthy lifestyle, such as healthy eating and activity living. We hope that, in the future, other people will benefit from this study through improved understanding of these issues, as the information from this research would be published in peer review journal. Once the project is completed however, you will be invited for the presentation of the results at a meeting in your local health facility or town hall.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. You may stop participating at any time without having to give a reason. If you decide not to participate in this, you will not be penalized or lose any benefits to which you otherwise qualify.

What if I have questions?

This research is being conducted by ***Kufre Joseph Okop*** from the School of Public Health, University of the Western Cape. If you have any questions about the research study itself, please contact the following person:

Study Coordinator's Name: Thandi Puoane
University of the Western Cape
Private Bag X17, Belville 7535
Telephone: (021)959- 2809
Cell: 0827075881
Email: tpuoane@uwc.ac.za

This research has been approved by the University of the Western Cape's Senate Research Committee and Ethics Committee.

Appendix 6:

Consent form - Survey

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27 21-959, Fax: 27 21-959

CONSENT FORM

Exploration of the association between body image, body fat, and total cardiovascular risk among adults in rural and urban communities of South Africa

The study has been described to me in a language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way. I agree to maintain the confidentiality of the information discussed by all participants and researchers during the focus group sessions.

Participant's name: ____

Participant's signature: _______________________________

Witness: ____

Date: _________________

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact the study coordinator:

Study Coordinator's Name: Thandi Puoane

University of the Western Cape

Private Bag X17, Belville 7535

Telephone: (021)959- 2809

Cell: 0827075881

Email: tpuoane@uwc.ac.za

Appendix 7:

Consent form - FGD

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27 21-959, Fax: 27 21-959

CONSENT FORM

FOCUS GROUP DISCUSSION/KEY INFORMANT PARTICIPANTS

You are invited to participate in a research study focusing on determining obesity levels and estimating the risk of cardiovascular diseases using body image and body fat measurements among men and women in the rural and urban communities of South Africa. This study is being conducted by **Kufre Joseph Okop** and Professors from the School of Public Health at the University of the Western Cape, and the University of Cape Town. You are invited to participate in this focus group discussion because you are selected as one of the key stakeholder in this community.

Participation in this study is voluntary. Not participating will not affect any benefits or services now or in the future. All information and insights gain during the focus group discussion will be anonymized. Participating in a group discussion entails your active involvement in a group discussion on issues regarding perception and attitude about body image and the health consequences of overweight. The discussion will be led by Kululwa, and Didi, and supported by Kufre Okop. It will be conducted in both English and Xhosa. An FGD guide will be used to guide the discussion. The discussion will focuses on three aspects viz. 1) Perceptions and belief, and 2) Attitudes about body image and overweight; and 3) Perceived health consequences of overweight. The focus group discussion will last approximately 1hour 30 minutes.

The discussion will be audio-recorded in order to accurately capture what is discussed. If you participate in the study, you may be requested that the recording be paused at any time. You may also choose to leave the focus group at any time. Participating in this study will help us learn about the effects of large body image on cardiovascular diseases among men and women and would inform the development of setting specific and better interventions to improve healthy lifestyle in our communities. However, you may not benefit directly. The information you will share with us if participate in this study will be complexly confidential to the full extent of the law. Participants will be asked not to use any names during the focus group discussion. Reports of the study findings will not include any identifying information. Audio-recordings of the focus groups will be kept on a password-protected computer in Mr. Okop's locked office. After the focus group recording is typed, it will be destroyed. The typed transcriptions will be kept on the password-protected computer.

If you have any questions about the research study itself, please contact the following person:

Study Coordinator's Name: Thandi Puoane
University of the Western Cape
Private Bag X17, Belville 7535
Telephone: (021)959- 2809
Cell: 0827075881
Email: tpuoane@uwc.ac.za

If you have questions about your rights as a research participant, you may contact the University of Cape Town Human Research Ethics Committee Office through **Prof Thandi Puoane.**

Your signature on this consent form indicates your agreement to participate in this study. You will be given a copy of this form to keep, whether you agree to participate or not. The second signed consent form will be kept by the researcher.

I have read the consent form and all of my questions about the study have been answered. I understand that the focus group will be recorded. I agree to participate in this study.

Print Name: ____

Signature ____

Date: _________________________