RELATIONSHIP BETWEEN SEDENTARY LIFESTYLE PATTERNS AND OBESITY AMONG ADULTS IN HA-TSHIKUNDAMALEMA AREA OF LIMPOPO PROVINCE, SOUTH AFRICA

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DECLARATION

I Ntsieni Vhonani Margareth, hereby declare that this mini-dissertation titled **"Relationship between sedentary lifestyle and obesity among adults in Ha-Tshikundamalema area of Limpopo Province, South Africa"** is my own original work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgement/ references), and this work has not been submitted for the award of any other degree or diploma at this university or any other institution of higher learning.

…… ……

Ntsieni VM **Date**

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DEDICATION

This work is dedicated to all who want to live a healthy lifestyle. A distinguished dedication is advanced to:

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ABSTRACT

Sedentary lifestyle may contribute to obesity and non-communicable diseases, which are the major public health problem in South Africa. This study investigated the relationship between sedentary lifestyle and obesity among adults in Ha-Tshikundamalema area. A quantitative descriptive cross-sectional study among 298 participants (116 males and 182 females) aged 20-60 years, sampled systematically was conducted. Socio-demographic and, sedentary lifestyle and physical activity information was collected using a questionnaire, while anthropometric indices were measured according to ISAK protocol. Data were analysed using SPSS, version 24.0; where Pearson correlation and linear regression analyses to determine significant predictors of obesity were performed. The prevalence of TV viewing and low participation in moderate-vigorous activity were 75.8%, 69.1% and 82.6%, respectively. Twenty-nine point nine percent and 27.2% were overweight and obese, while 26.8% had very high WC (central obesity). According to Pearson correlation, TV viewing time, food, household activity, walking days and time, vigorous activity work vigorous activity, female gender, age (30-39), being married, unemployment, smoking and alcohol consumption were significantly related to BMI and WC. No significant association was found between most of the sedentary behaviours, level of education and socio-economic status. However, obesity was more prevalent among those with less education and low socio-economic status. In regression analyses, only TV viewing time, work vigorous activity, gender, being married and smoking were the independent and significant predictors of high BMI and WC (obesity) ($P < 0.05$). There was an association of sedentary lifestyle and socio-demographic characteristics, and obesity. Intervention to prevent sedentary lifestyle and obesity should target females, particularly married, unemployed and those with less level of education.

Key words: Adult, Obesity, Sedentary Lifestyle

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LIST OF ACRONYMS

AHA	:	American Heart Association
BMI	:	Body Mass Index
BP	:	Blood Pressure
CCHS	:	Canadian Community Health Surveys
CDC	:	Centre for Disease Control
CHD	:	Coronary Heart Diseases
Cm	:	Centimetre
COPD	:	Chronic Obstructive Pulmonary Diseases
CPM	:	Counts per Minute
CVDs	:	Cardiovascular Diseases
DALYS	:	Disability-Adjusted Life Years
DHHS	:	Department of Health and Human Services
EE	:	Energy Expenditure
EI	:	Energy Intake
EMPHN	:	Eastern Mediterranean Public Health Network
HBP	:	High Blood Pressure
HCD	:	Higher Degrees Committee
HR	:	Heart Rate
HR	:	Human Resource
IARC	:	International Agency for Research on Cancer
IDF	:	International Diabetes Federation
Kg/m2	:	Kilograms per Meter Square

MET	:	Metabolic Rate
MmHg	:	Millimetres of Mercury
MRC	:	Medical Research Council
NCDs	:	Non-Communicable Diseases
NIDDM	:	Non-insulin Dependent Diabetes mellitus
NR-NCD	:	Nutritional Related Non -Communicable Diseases
OGTT	:	Oral Glucose Tolerance Test
PA	:	Physical Activity
PAR	:	Physical Activity Recall
P-value	:	Probability Value
RBP	:	Resting Blood Pressure
RHR	:	Resting Heart Rate
RR	:	Relative Risk
SA	:	South Africa
SAHNANES	:	South African National Health and Nutrition Examination
SASSO	:	South African Society for the Study of Obesity
SES	:	Socio-economic status
SL	:	Sedentary Lifestyle
SPSS	:	Statistical Package for Social Sciences
TBP	:	Teaching Blood Pressure
THR	:	Teaching Heart Rate
UDM	:	Undiagnosed Diabetes

UK	:	United Kingdom
US	:	United State
USA	:	United States of America
WC	:	Waist Circumference
WHO	:	World Health Organisation
WHR	:	Waist-Hip Ratio
WHtR	:	Weight to Height Ratio

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 Introduction

Sedentary lifestyle (SL) is one of the several behavioural risk factors of non-communicable diseases (NCDs) such as cancer, cardiovascular diseases, chronic respiratory diseases and diabetes (Retamal, 2013). It is defined as behaviour characterized by low physical movements and energy expenditure of less than 1.5 metabolic equivalent rates (METs). This section will provide the justification of why this study had to be conducted and provide background information regarding sedentary lifestyle and global epidemic of obesity. The objectives and expected benefits of the study are also outlined in this section.

1.2 Background of the study

Sedentary lifestyle accounts for more than 2 million deaths and 19 million disability adjusted life years (DALYs) worldwide every year (World Health Organization [WHO], 2002). Physical inactivity is the fourth leading risk factor for global death and it ranks before obesity (5%) and after hypertension (13%), tobacco use (9%), and high blood glucose (6%) (WHO, 2010). Sedentary lifestyle involves activities such as sitting, lying down, watching television, using the computer and other screen-based entertainment. Various studies have revealed that individuals can spend most of their waking hours in sedentary activities (Retamal, 2013; Matthews, Chen, Freedson, Buchowski & Beech, 2008).

Sedentary lifestyle along with increasing smoking, poor diet and nutrition are increasingly becoming part of today's lifestyle, which leads to rapid rise in NCDs. Sedentary lifestyles increase all causes of mortality, double the risk of cardiovascular diseases, diabetes, and obesity, and increase the risk of colon cancer, high blood pressure, osteoporosis, lipid disorders, depression and anxiety (Retamal, 2013; Mfrekemfon & Okey-Orji, 2015). According to the World Health Organisation, 60 to 85% of people in both developed and developing countries lead sedentary lifestyles, making it one of the more serious yet insufficiently addressed public health problems of our time. It is estimated that nearly two-thirds of children are also insufficiently active, with serious implications for their future health (WHO, 2015).

Occupation in itself is another risk factor for NCDs in addition to being a modifier of the lifestyle, physical activity practices and diet practices (Mathur, 2006; Rameswarapu, Lakshman & Valsangkar, 2014). Occupation increases the development of these diseases through the burden of stress and psychosocial distress (Retamal, 2013; Glozier, Tofler, Colquhoun, Bunker, Clarke & Hare, 2013). There is a strong, positive association between sedentary occupations and cardiovascular morbidity and death, and this association remains high even after controlling factors such as age, waist circumference, frequency of alcohol intake, cigarette smoking and non-occupational physical activity (Stamatakis, Chau, Pedisic, Bauman, Macniven & Coombs, 2013; Retamal, 2013). A study, which was conducted with the aim of assessing physical activity and sedentary behaviour at the workplace revealed low physical activity levels at work and high sedentary behaviour (Castillo-Retamal & Hinckson, 2011).

Globally, obesity has increased since the 1980s. It is estimated that there are over 600 million obese adults in the World (WHO, 2015). Recently, it has been shown that obesity is responsible for about 3.4 million deaths annually and 3.8% of the global burden of diseases (Ezzati, Obermeyer, Tzoulaki, Mayosi, Elliot, & Leon, 2015). Obesity has previously been a problem of developed countries such as America, but now is seen as an increased epidemic in middle income countries such as South Africa (WHO, 2010). In recent decades, obesity and overweight have been strongly linked to more deaths worldwide than underweight (Lim, Vos & Flaxman, 2012). Since 1980, United State has been experiencing the largest increase in the number of obese people, followed by China, Brazil, and Mexico (Stevens, Sigh & Lu, 2012).

South Africa has the highest rate of obesity and overweight in Sub-Saharan Africa. The South Africa Demographic and Health Survey (SADHS) reported that 29% of men and 56% of women were either overweight or obese in 2002 (Puoane, Steyn, Bradshaw, Laubscher, Fourie, Lambert & Mbananga, 2002). Similar estimates were also reported in cross-sectional studies conducted in various areas in the country (Malhotra, Hoyo, Østbye, Hughes, Schwartz, Tsolekile, Zulu & Puoane, 2008; Malaza, Mossong, Barnighausen & Newell, 2012). Recently, in South Africa, obesity epidemic has been to be increasing more than in previous years. The Heart and Stroke Foundation South Africa reported that up to 70% of women and a third of men are classified as either overweight or obese. And about 40% of women in South Africa are obese, having the BMI of greater than 30 kg/m^2 (HSFSA, 2016). This foundation has also revealed that 1 in 4 girls and 1 in 5 boys (age 2-14 years) are overweight and obese.

Obesity prevalence is a major public health problem in South Africa, as it has negative health effects that may impact negatively on the country's resources (Mayosi, Flisher, Lalloo, Sitas, Tollman & Bradshaw, 2009). The number of people in South Africa who are overweight and obese has been increasing every year over the past few decades and this situation simply cannot be allowed to continue (National Department of Health, NDOH, 2015). Obesity is associated with a number of chronic diseases including, type 2 diabetes, CVDs, chronic obstructive pulmonary diseases, arthritis and certain cancers (WHO, 2014; Nguyen, Nguyen, Lane & Wang, 2011). Obesity is also seen as the major risk factor contributing to the increase of non-communicable disease burden in SA and other developing countries (Aikins, Unwin, Agyemang, Allotey, Campbell & Arhinful, 2010; Parkin, Sitas, Chirenje, Stein, Abratt & Wabinga, 2008). The inactivity of South Africans is a major contributor to the obesity epidemic. The problem starts in childhood and continues into adulthood, with less than two-thirds of children participating in weekly physical activity. In adults half of males and almost two thirds of females are physically inactive (HDOH, 2015). Managing obesity is the key to reducing the burden of NCDs and improving the health of populations.

The Department of Health strategic plan (2013-2017) aims to reduce NCDs incidence and to improve care, treatment and support to people who are suffering from NCDs. The strategic plan places emphasis on the need to reduce obesity and other related risk factors in order to control non-communicable diseases. However, in order to successfully reduce the obesity rate requires knowledge on not only the prevalence, but also its determinants and distribution in the population. There is also a need to identify the populations that are prone to obesity in order to establish factors influencing the epidemic. However, information on the epidemiology of obesity in South Africa is scanty (Goedecke, Jennings & Lambert, 2005). While some studies highlight the age and gender-specific prevalence and distribution of obesity in South Africa (Puoane et al., 2002; Malhotra et al., 2012; Dalais, 2012), there are no studies that assess sedentary lifestyle as one the determinants of obesity.

1.3 Problem statement

The researcher resides at Tshikundamalema area and has observed with concern that many adults at Tshikundamalema area look obese. According to the Tshikundamalema Clinic (2016), about 30% of adults are on medication for BP and Diabetes. Sixty percent of those on medication are also obese. Studies reveal that regular exercises and physical activities can prevent the

development of obesity and other NCDs (Hassapidou, Papadopoulou, Vlahavas, Kapantais, Kaklamanou, Pagkalos, Kaklamanou & Tzotzas, 2013; Dalais, 2012; Retamal, 2013). However, it is not known whether the obesity is related to the sedentary lifestyle patterns of adults at Ha-Tshikundamalema. Therefore, this study seeks to investigate the relationship between obesity and the sedentary lifestyle patterns of adults in Ha-Tshikundamalema area.

1.4 Rationale of the study

Various studies (Dalais, 2012; Mkhonto, Labadarios & Mabaso, 2012) within South Africa have addressed numerous aspects of sedentary lifestyle and obesity, and thus confirmed the increasing prevalence of sedentary lifestyle and obesity epidemic among adults. However, little is known about the sedentary lifestyle patterns and obesity epidemic among adults in Limpopo and Tshikundamalema in particular. In view of the obesity knowledge gap outlined above, the researcher was motivated to investigate the association between sedentary lifestyle patterns and obesity.

1.5 Significance of the study

Adults in Ha-Tshikundamalema area may have a greater understanding and knowledge of their health status, health risks and health practices. The study might benefit Limpopo Province as the findings on the relationship between obesity and sedentary lifestyle patterns among adults as well as the recommendations made will be useful for decision-making and may serve as input into the general health policy of the Department of Health in Limpopo and other provinces in South Africa. Furthermore, it is possible that the results and recommendations may contribute to formulating an appropriate context-related intervention to assist in the management or prevention of chronic diseases of adults in the Ha-Tshikundamalema area in Limpopo province, South Africa. The findings will also contribute to the existing body of knowledge about the status of sedentary lifestyle and obesity among adults in South Africa as there is a knowledge gap in this area of research.

1.6 Purpose of the study

The purpose of this study was to investigate the relationship between sedentary lifestyle patterns and obesity among adults in the Ha-Tshikundamalema area of Limpopo Province, South Africa.

1.7 Objectives of the study

The followings objectives were formulated to guide the study:

- To assess sedentary lifestyle patterns among the participants.
- To determine the obesity status of the participants using body mass index (BMI) and waist circumference.
- To establish the relationship between sedentary lifestyle patterns and obesity among adults in Ha-Tshikundamalema area.

1.8 Definition of key terms

Adult: An adult is a person older than 19 years of age unless national law defines a person as being an adult at an earlier age. It is operationally defined as individuals from the age of 20-60 years residing in Ha-Tshikundamalema area.

Obesity is defined as the accumulation of excess body fat, particularly the fat stored around the abdomen and waist (WHO, 2012); but in this study obesity is defined as the Body Mass Index (BMI) of greater than or equal to 30 kg/m² and waist circumference of greater than 88 cm for females and 102 for males.

Sedentary lifestyle is defined as waking behaviour characterized by energy expenditure of ≤1.5 metabolic equivalent rates (Sedentary Behaviour Research Network, 2012). In this study, a sedentary lifestyle is defined as any waking behaviour that is characterised by sitting (in a car, on computer screen, watching TV and etc.) for more than two hours per day.

1.9 Conclusion

Obesity is seen a major public health problem in both developed and developing countries. Overweight and obesity are increasing at an alarming rate in South Africa, leading to the rapid rise in NCDs. South Africa has the highest rate of overweight and obesity in Sub-Saharan Africa. The inactivity of the South Africans is seen as the major cause of obesity. Obesity is major cause on NCDs in South Africa.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Reduced physical activity has exposed people to high risk of developing obesity and other chronic diseases such as CVDs and cancers (Mfrekemfon et al., 2015). Chronic diseases are viewed as serious public health issue and have been recognised as a global epidemic by WHO (2011). In view of this, the present researcher looked at sedentary lifestyle patterns, factors that enhance sedentary lifestyle and chronic diseases associated with sedentary lifestyle as well as the obesity epidemic.

2.2 Sedentary lifestyle

2.2.1 Prevalence of sedentary lifestyle

Sedentary lifestyles have become prevalent in contemporary society, primarily due to environmental changes occurring at societal level, and the drastic evolvement of technology. For instance, the proportion of households with access to the Internet and computers has increased (from 15% to 79%) over the past 2 decades (that is, between 1989 and 2012) (WHO, 2012). Moreover, there have been dramatic increases in the proportions of people working in jobs requiring low levels of energy expenditure (EE) all over the world and corresponding decreases in those working in physically challenging jobs (Brownson, Boehmer & Luke, 2005). In 2010, American adults spent more than 4 hours per day watching TV, and the proportion of American adults with smartphone ownership was nearly 25% (Nielsen Company, 2010). Furthermore, over half of US households were found to have high-definition TVs in their homes (Nielsen Company, 2010).

Prevalence rates of sedentary lifestyle (SL) at the population level have been reported in previous empirical studies. Matthews, Chen and Freedson (2008) estimated the amount of time spent sedentary in the US population (Matthews, Chen & Freedson, 2008). In the study data were obtained from 6,329 participants (that is, children and adults) that wore an Actigraph accelerometer for at least 10hours per day as part of the National Health and Nutrition Examination Survey (NHANES). To estimate overall sedentary time from an objective monitoring device (for example, Actigraph), a cut-point value of 100 counts-per-minute (CPM) (Evenson,Catellier, Ondrak & McMurray, 2008; Treuth , Schmitz & Catellier, 2003) was used. The

study reported that the overall SL time of the US population was 7.7 hours/day, which is equivalent to approximately 55% of waking hours per day (Matthews et al., 2008). Tudor-Locke, Leonardi, Johnson and Katzmarzyk (2011) also estimated the population-level sedentary time from 30,758 working American adults whose SL and PA were assessed with a 24-hours physical activity recall (24PAR) in the American Time Use Survey (ATUS). They documented that on average, working adults in the US spent 4.2 hours being sedentary (outside of sleep/work): 7.8 hours sleeping and 7.5 hours at work. Moreover, they found that as the intensity category of work increased from 'sedentary' to 'vigorous', time spent, being sedentary outside of sleep/work also increased (Tudor-Locke et al., 2011).

A cross-sectional study was conducted in Turkey with the objective of estimating the physical activity level of the school teachers. The total MET values of the participants suggest that 11% of them were inactive, 43% have low physical activity level and 46% have adequate physical activity level. This findings are consistent with the results of the study conducted among primary school teachers in New Zealand by Retamal (2013). There was a low level of physical activity among New Zealand teachers. These results suggest that teacher's physical activity levels are not adequate for a healthy daily life (Yoncalik, Tanir & Yoncalik, 2011).

Brito, Santos, Marcolongo, Campos, Bocalini, Antonio, Silva, Tucci, and Serra (2012) conducted a study whose aim was to assess the physical activity level in public school teachers in Brazil. Brito et al. (2012) assessed the physical activity level in 1681 teachers and found that the prevalence of low, moderate and high level of physical activity levels were 46.3 %, 42.7 % and 11 % respectively. The study also revealed that the low PA prevalence was high among those aged 31 to 42 years old (19.5%) and less prevalent among those aged 55 to 66 (5.2%). Teachers who had low physical activity, also had elevated blood pressure and body mass index. The risk of NCDs was very high in teachers who had low physical activity level and elevated blood pressure. The researchers also observed that the moderate and vigorous PA level significantly differed due to the place teachers occupy. Moderate and vigorous levels of PA were less prevalent among older teachers. From the results of the study, the researchers concluded that variables such as age, gender and city area should be taken into account when planning and targeting campaigns aimed at promoting increased physical activity in this population (Brito et al., 2012).

In the developing world, and especially in sub-Saharan Africa, adults are not regularly physically active, which puts them at a higher risk of suffering from chronic diseases (Nizeyimana &

Phillips, 2005). The South African population, particularly black people, has moved towards a disease profile very similar to that of high-income countries, where NCDs (mainly chronic and lifestyle-related conditions) are major public health problems (Walter, Du Randt & Venter, 2011). Evidence is very strong that a large number of South Africans follow a sedentary lifestyle (Steyn, 2007).

Physical inactivity has negative health consequences. According to Joubert, Norman , Lambert , Groeneward, Bradshaw, Schneider, Bull and the South African Comparative Risk Assessment Collaborating Group (2000) 20 Men and 26 Women aged 30 years and above die daily in South Africa due to lack of regular physical activity. In 2014, South Africa had an estimated 43% – 49% prevalence of physical inactivity amongst adolescents and adults (Micklesfield, Pedro, Kahn, Kinsman, Pettifor & Tollman, 2014). The prevalence of physical inactivity has increased to 59.7% as revealed by the study conducted by Wu and his team in 2015 (Wu et al., 2015). This study was conducted in various countries, physical inactivity prevalence was highest is South Africa. A significant age-gradient was observed in all countries, where prevalence consistently increased with increasing age. Older urban residents were more likely to engage in low level physical activity in all countries.

Lambart and Kolbe-Alexande (2005) conducted a study among adults in the North-West Province of South Africa, where they found that people of younger to older age groups were insufficiently active (Lambert & Kolbe-Alexande, 2005); only a few were classified as highly active, with most being either inactive or moderately active. The researchers also found that the youth spent more than 3 hours/day watching television and did not participate in physical activities (Lambert et al., 2005). Dalais et al (2014) also found a high prevalence of physical inactivity among South Africans. This inactive lifestyle increases the risks of developing chronic non-communicable diseases.

2.2.2 Factors that enhance sedentary lifestyle.

Numerous factors enhance sedentary lifestyle, such as technology advancement, demographic factors and long working hours (Mfrekemfon et al., 2015). Sedentary lifestyle is associated with low levels of physical activity, sitting for a long period of time in schools, communities, cars and public places, have been restricted in ways that reduce/limit human movement and muscular activity. Technological knowledge, mechanization and computerization have reduced routine manual jobs. The use of computers and all kinds of machines that limits physical activity thus

enhances sedentary lifestyle have been used for work organization and household chores (Mfrekemfon et al., 2015; Elsevier, 2013).

The environment plays a major role in influencing sedentary lifestyle through significant changes in the form of rapid urbanization, automobile dominance for personal travel, labour saving device in the home and the workplace, extra availability of energy dense food, satellite TV, increased reliance on computers and telecommunication technology, as well as decreased occupational-work demands (Kaur & Kaur, 2014; Jones, Bentham, Foster, Hillsdon & Panter, 2007). These changes have a remarkable lifestyle transformation by reducing the daily life physical requirements and encouraging sedentary lifestyle which consequently leads to an epidemic of non-communicable diseases and contribute substantially to the global burden of comorbidities, disability and death (Department of Health and Human Services, 2010).

A sedentary lifestyle increases during childhood and from childhood into adolescence. Adolescents spend most of their time on computers and television, thus increase their chances of developing chronic conditions (Elsevier, 2013). There is no difference in TV viewing and computer use between boys and girls younger than 10 years. Some evidence suggests that boys spend most of their time watching TV or playing computer games (Elsevier, 2013; Salmon,Tremblay, Marshall & Hume, 2015; Elsevier, 2014). A sedentary lifestyle is inversely associated with socio-economic status. Sedentary behaviour tends to be higher in low socio-economic status (Salmon et al., 2015). Long working hours is another factor that enhances sedentary lifestyle. An average worker spends 8-10 hours at work without a little time for recreation. According to Mfrekemfon and his colleague, workers spend most of their time sitting at work and driving to and from the office/ work places. These long sitting hours enhance sedentary lifestyle (Mfrekemfon et al., 2015).

2.2.3 Health risks associated sedentary lifestyle

Sedentary lifestyle increases the risk of overweight and obesity, abdominal obesity, cardiovascular diseases and cancer. Metabolic dysfunction is one of the deleterious effects of sedentary behaviour. Metabolic dysfunction is characterized by increased plasma triglyceride, decreased levels of High density lipoprotein (HDL) and decreased insulin sensitivity (Tremblay, Colley & Saunders, 2010). According to Hassapidou group (2013), frequent TV viewing and long office hours are associated with the development of hypertension, hyper cholesterol and type two diabetes (Hassapidou et al., 2013).

In 2007 Hamburg and his team conducted a study on the effect of five days' bed rest on metabolic health (Hamburg, McMackin, Shenouda & Widlansky, 2007). Participants remained in bed for more than 23.5 h per day and they experienced increases in glucose, insulin resistance, plasma triglycerides and total cholesterol. The findings of Hamburg et al. (2007) suggest that increased time of sedentary behaviour increases the risk of metabolic dysfunction. Similarly, Yanagibori and his team (2010) found that more than 20 days of bed rest resulted in significant increase in plasma triglycerides and significant decrease in HDL cholesterol, which is good cholesterol that is needed by the body (Yanagibori, Kondo, Suzuki, Kawakubo, Iwamoto, Itakura & Gunji, 2010). Chronic conditions (diseases) discussed below may be caused by a sedentary lifestyle.

2.2.3.1 Hypertension

Sedentary lifestyle along with poor diet and smoking are associated with high blood pressure, bearing in mind that obesity is a major determinant of hypertension. Frequent exercise practices reduces the risk of hypertension, while frequent TV watching and office work increases the risk of hypertension (Hassapidou et al., 2013; Retamal, 2013). It was found that watching TV for more than 16 hours per week and office work longer than 14 hours per week increased the risk of hypertension by 36 %(Hassapidou et al., 2013). Undiagnosed and uncontrolled blood pressure leads to heart attack, stroke as well as kidney and eye damage. Early death, disability, loss of income, and medical care expenditures due to high blood pressure, all take their toll on families, communities and national budgets. The loss of family income from death or disability can be devastating. Spending on health care, which is often long-term or lifelong in the case of complications of high blood pressure, also pushes millions of people into poverty.

Hypertension is prevalent all over the world, killing a large number of people. Wu et al (2015) conducted a study in six countries with the aim of assessing the prevalence of non-communicable disease risk factors (Wu et al, 2015). The prevalence of hypertension in six countries ranged from 33% (India) to 78% (South Africa). For both men and women in China, India and Russia, the prevalence of hypertension increased with age. The prevalence of hypertension was higher in urban than in rural areas in Ghana, India and Mexico. In China, prevalence decreased with increasing household income. However, in Ghana and India, respondents with higher household income were more likely to have a higher prevalence of self-report hypertension (Wu et al., 2015).

A large number of people in South Africa are suffering from hypertension. According to the results of Dalais's et al (2014) study, large number of teachers have elevated blood pressure while others were on medication for high blood pressure. Most of the people who were hypertensive were also obese, eating poor diets and had low levels of physical activity. These results show that there is a strong relationship between diet, physical activity, obesity and hypertension. Mkhonto et al. (2012) conducted a study in Limpopo Province of South Africa with the aim of determining the relationship between obesity, physical activity and hypertension. The results of this study reveal that there was a strong relationship between BMI, WC, WHR and hypertension, meaning that people with elevated BMI also had elevated WHR, WC and blood pressure. Hypertension was more prevalent among women (Mkhonto et al., 2012)

2.2.3.2 Hypercholesterolemia

High blood cholesterol is also known as hyperlipidaemia, which refers to the high amount of fat in the blood (Puoane, Tsolekile & Parker, 2009). Too much cholesterol can form a plaque, which hardens and narrows the arteries after a long time. The narrowing also limits the flow of oxygenated blood to the brain and other organs of the body (University of Michigan, 2014). In addition, various conditions may develop, such as heart attack, depending on which artery is affected. Sedentary lifestyle along with poor diet (food rich in saturated fats, trans-fatty acids and food high in cholesterol), obesity, smoking and diabetes are risk factors for elevated blood cholesterol (Puoane et al., 2009; University of Michigan, 2014; Department of Health and Human Services, 2005). Watching TV for long periods of time and long office work are associated with the increased risk of hypercholesterolemia(HCE), which can lead to the development of coronary artery diseases (Hassapidou et al., 2013).

Hypercholesterolemia is inversely associated with frequent exercise practices, meaning that the more you exercise, the lesser the risk of hypercholesterolemia. According to Hassapidou et al. (2013), exercising for more than 7 hours per week reduces the risk of HCE by 55%. Various studies have revealed an improvement in blood lipids (low density lipoprotein, high density lipoprotein, triglycerides) after the introduction of exercise to the participants (Hassapidou et al., 2013; Retamal, 2013; Katzmarzyk & Lear, 2012). Hassapidou and his team conducted a study among Greek adults with the aim of investigating the relationship between physical activity, sedentary behaviour with obesity and cardiometabolic comorbidities. The results of their study

revealed that TV watching for more than 16 hours per week and office work longer than 14 hours per week increased the risk of HCE by 20% and 55% respectively (Hassapidou et al., 2013).

2.2.3.3 Diabetes Mellitus

Physical inactivity has a strong relationship with Type 2 diabetes mellitus (T2DM) which results from the inability of the body to effectively use insulin. Prolonged sitting time, screen time, reading and driving time, among other factors, are strongly related to excessive eating and weight gain, which can lead to the development of diabetes(Brannon & Feist, 2007; Hassapidou et al., 2013). Harmful habits such as snacking, drinking soft drinks and eating of energy dense food can be caused by watching TV for a long period of time (Dullo, Antic, Yang & Montani, 2006). Spending more than 4 hours on screen (TV, Video & computer) increases the chances of developing type two diabetes. This is caused by reduced physical activity and unhealthy eating practices associated with screen times, especially watching TV.

In the survey conducted by the International Journal of Behavioural nutrition and physical activity (IJBNP) among 63048 middle-aged Australian men about their average sitting time per day and diagnosis of any related chronic diseases. There were various responses from 4-8 hours of sitting time per day (Illiade, 2013). It was also found that increased sitting time exposed respondents to type two diabetes mellitus (Briddle, O'Connel & Braithwaite, 2011). These findings are similar to the results of the studies conducted by other researchers, who found that excessive TV viewing increases the risk of Type 2 diabetes (Hu, Colditz, Willett & Manson, 2003; Hassapidou et al., 2013). A two-hour per day increase in TV viewing is related with a 20% increase in the risk of Type 2 diabetes (Hu, Leitzmann, Stampfer, Colditz, Willett & Rimm, 2001). The findings of this study contradict with the findings of a study conducted by Hassapidou et al. They have found that TV watching and office work are not associated with the risk of T2DM (Hassapidou et al., 2013).

Ninety percent of Type 2 diabetes in women is associated with overweight, unhealthy eating and physical inactivity, which are resultant effects of sedentary lifestyle (Mfrekemfon et al., 2015). Type 2 diabetes mellitus is more common in adults older than 30 years. However, it can also affect children (Mfrekemfon et al., 2015). Cardiovascular, neurological and renal complication are more common if the disease in not properly controlled (Salmon et al., 2015; Mfrekemfon et al., 2015). Numerous studies have reported that increased physical activity levels are associated with

a reduction of T2DM and insulin resistance (Ford, Li & Zhao, 2010; Retamal, 2013; Hassapidou et al., 2013). According to Williams (2008), exercise intensity is inversely associated with T2DM (Williams, 2008). He also found that fitter men had a lower risk of becoming diabetic.

2.2.3.4 Cardiovascular diseases

A sedentary lifestyle, along with unhealthy eating and smoking, are associated with the development of cardiovascular diseases (Hassapidou et al., 2013; Briddle, Pearson, Ross & Braithwaite, 2008). Olds, Ridley and Dollman (2007) conducted a study on time spend on two sedentary behaviours, namely, riding in car and TV viewing per week. Eighty-two percent of participants reported more than 10 hours of riding in car and 23 hours per week of TV viewing; and 64% of them showed a greater risk of cardiovascular diseases. In that study, physical inactivity was revealed as a major public health problem and the second cause of death due to cardiovascular diseases. Adults spend 8.6% (170 minutes) of daily total energy expenditure watching TV, 10.9% of their daily energy on driving and 55.57% on other sedentary activities such as computer operation, video games, reading books or sleeping (Mfrekemfon et al., 2015).

Sedentary activities do not enhance muscular activities and so favour the development of cardiovascular diseases such as Ischemic heart diseases, coronary heart disease and stroke. In addition to that, there is a strong relationship between physical inactivity and cardiovascular diseases (Brannon et al., 2007; Dong, Block & Mendel, 2014). Chronic diseases which result from sedentary lifestyle further expose people to cardiovascular impairment. Physical inactivity, poor diet and obesity are associated with sedentary lifestyle and are health risks of cardiovascular diseases which are on the increase in developing countries, creating a double burden to these countries already suffering from the effects of communicable diseases (Briddle et al., 2008).

2.2.3.5 Cancer

Sedentary lifestyle increases the risk of colon and breast cancer (Salmon et al., 2015), because inactive body tissue muscles and cells can trigger the development of cancerous cells which have high morbidity and mortality rates (Mfrekemfon et al., 2015). Sitting for a long period of time is associated with the increased risk of colon cancer in women and men and endometrial cancer in women (Block, Zaslavsky, Ding & Ayanian, 2009). In addition, inactive men and women have increased risk of developing prostate and breast cancer respectively (Shetty, 2003; Mfrekemfon et al., 2015).

2.3 Obesity

2.3.1 Definition of obesity

Obesity is defined as the accumulation of excess body fat, particularly the fat stored around the abdomen and waist (WHO, 2012). Abdominal obesity (central obesity) is associated with mortality (Cameron, Magliano, Shaw, Zimmet & Carstensen, 2012; Whitlock, Lewington ,Sherliker, Clarke & Emberson, 2009), morbidity such as cardiovascular diseases and diabetes (Grimble, 2010), increased disability (Averett, 2011), poor quality of life (Bentley, Palta, Paulsen, Cherepanov & Dunham, 2011; Perez & Warren, 2012) and increased health care costs (Finkelstein & Yang, 2011; Moriarty, Branda , Olsen , Shah & Borah, 2012; Cawley & Meyerhoefer, 2012)) . Obesity has been identified by WHO as a major public health problem worldwide.

BMI is one of the most common method for measuring overweight and obesity, and it is (BMI) defined as weight relative to the height (WHO, 2015). Waist circumference and WHR are the best estimates of visceral fat, the internal fat which covers the organs. They are more accurate predictor of CVDs risk, type 2 diabetes and metabolic syndrome in individuals. A BMI of 25-29.9 kg/m² and 30kg/m² or greater indicates that individuals are overweight and obese respectively. A waist circumference greater than 88cm in females and 102cm in males, and a WHR of 0.86 in females and 0.96 of males indicates that an individual has central obesity and is at a higher risk of suffering from chronic diseases (ACSM, 2014).

There is abundant evidence that obesity increases the risk of elevated blood sugar, hypertension, and hypercholesterolemia. Obesity is also believed to be an independent risk factor for CVD in men and women. Even in the absence of other comorbid conditions, individuals who are obese have higher rates of cardiovascular events over their lifetimes (Barnes, 2011). One study suggests that the mechanism for this increased risk may be related to the presence, in obese individuals, of elevated inflammatory markers that are associated with CVD.

2.3.2 Obesity epidemic

Obesity is a major public health concern in countries across the world. The current obesity prevalence of South African adults is nearly 61% (NDOH, 2015). Evidence indicates that, in general, the 1980s are the beginning of the obesity pandemic globally (Finucane,Stevens & Cowan, 2011) as well as in South Africa (WHO, 2015).This global obesity pandemic has been primarily attributable to societal/environmental changes (rather than biology) (Hill, Wyatt , Reed & Peters, 2003; Swinburn, Sacks & Hall, 2011). Another reason may be substantial declines in

time spent being physically active and increases in time spent sedentary, mainly due to the advancement of multimedia (that is, Internet, Mobile Phones) and the increased use of motor vehicles over the past 3 decades (Pratt , Sarmiento & Montes, 2012).

Globally, remarkable annual increases in BMI (i.e. 0.4 kg/m² for each year) have been identified since 1980. However, in the US, obesity prevalence has been static for the past decade (that is, between 2000 and 2010) (Flegal, Carroll, Kit & Ogden, 2012; Flegal, Carroll, Ogden & Curtin, 2010; Rokholm, Baker & Sorensen, 2010), while it dramatically increased by nearly 55% over the two prior decades: between 1976 (that is, 14.5%) and 1994 (that is, 22.5%). While these trends suggest a plateau in prevalence, it may be too early to confirm this pattern.

A recent study indicates that “record-high” obesity prevalence rates may be observed as cohorts of young adults born in the 1980s (that is, particularly exposed to the drastic obesogenic societal changes) reach their peak obesity prevalence (Robinson, Keyes, Utz, Martin & Yang, 2013). It is estimated that prevalence rate of overweight and obesity will continue to increase from 2010 onwards until 2020 (after the plateau between 2000 and 2010) in South Africa as well as in other countries. According to the projections, by 2020, nearly 75% of South African adults will likely be considered overweight. It is also noteworthy that the accelerating rate of the overweight prevalence for the next decade is almost identical to that between 1980 and 2000.

Various studies have been conducted in different countries and have revealed that there is a high prevalence of obesity and especially abdominal obesity worldwide (Retamal, 2013; Ezzati et al., 2015; Dalais, 2012). The BMI and other anthropometric variable were measured among office workers and school teachers, using standard protocol in Sri Lanka by Marrimal, Jaisheeba, and Sornarji (2012). The results have shown elevated BMI levels between both groups. Similarly, Oyeyemi and Adeyemi (2013) found that 33.3% and 30.7% are overweight and obese respectively. They have also found a high prevalence of central obesity. Forty percent of the men had a waist circumference greater than 102cm and 46.5% of the women had waist circumference greater than 46.5%.

In the study conducted in SAGE countries, a high prevalence of central obesity was found in 84.5% of older Mexicans, the highest of all SAGE countries. In China and Ghana, prevalence tended to increase with age, and was higher in urban than in rural areas. The most eye-catching difference is the much higher implied risk among women, compared to men in China, Ghana, India and South Africa. In addition, Obesity was more common in South Africa, the Russia

Federation and Mexico (45.2%, 36%, and 28.6%, respectively), compared with China, Ghana and India (15.3%, 9.7%, and 6.4%, respectively). Obesity tended to rise with household income in all six countries, but a slight drop can be seen for the highest income quintile in China, Mexico, Russia Federation and South Africa (Wu, Guo, chatterji, Zheng & Naidoo et al., 2015). Dalais and his team (2014) also found high prevalence of obesity among primary school teachers residing in Western Cape (Dalais, Abrahams, Steyn, de Villiers, Fourie, Hill, Lambert & Draper, 2014).

Skaal and Pengpid (2011) conducted a study with the aim of identifying and quantifying the prevalence of obesity and health problems among South African Health Care Workers (HCW). The findings of this study revealed that obesity and overweight were more prevalent among these group of people (75% of them were overweight and obese). The results of the study conducted in Limpopo at Ga-Mothapo area showed that 30.6% and 23.6% of participants were overweight and obese respectively (Sengwayo, Moraba & Motaung, 2013). The findings of the study conducted at Ga-Mothabo are consistent with the results of the study conducted among nurses in Vhembe District of Limpopo Province by Goon, Maputle, Olukoga, Lebese, Khoza and Mothiba (2014). The aim was to assess the prevalence of abdominal obesity. The findings of the study indicated a high prevalence of abdominal obesity (68.2%, 81.8% and 56.9 for waist circumference (WC), waist to hip ratio (WHR) and weight to height ratio (WHtR) respectively (Goon et al., 2014). In the study conducted in Limpopo Province among villagers in Dikgale Village, the study revealed a high prevalence of obesity among both women and men in Dikgale area, but it was more prevalent among women (Mkhonto et al., 2012).The results of these two studies indicate that obesity is more prevalent in Limpopo area and is a very serious problem that needs early intervention.

2.4 Sedentary lifestyle in relation to obesity

Multiple factors have played roles in creating the contemporary obesity epidemic. However, a lifestyle change (from physically active to sedentary) is one of the key factors. Sedentary lifestyle leads to accumulation of excess calories and fatty acids, because weight maintenance depends on the number of calories absorbed via food intake and the number expended through physical activity and metabolism (Mfrekemfon et al., 2015). Sedentary people absorb and store more calories due to the reduced level of physical activity (Salmon et al., 2015).There have been dramatic increases in multimedia use (that is, computers, TV, the internet), motor vehicle use for transportation, and substantial decreases in the number of physically intense professions (Hill et al., 2003; Pratt, 2012). These types of sedentary lifestyles have led to reductions in EE, while excessive consumption of unhealthy foods have led to increases in energy intake (EI). Even small

individual changes in EE and EI can lead to systematic energy imbalance (that is,EI exceeds EE) and population changes in obesity.

The contemporary obesogenic society is attributable to this energy imbalance from changing from physically active lifestyles to sedentary lifestyles (in conjunction with increases in intake of unhealthy foods). Several research has been conducted to investigate the deleterious effects (and specific patterns) of SL in relation to obesity. Matthews, George and Moore (2012) indicated that for obese adults, ≥5 hours/day of TV viewing were significantly associated with all-cause mortality, whereas significant associations were observed with ≥3 hours/day of TV viewing for normal weight or overweight adults. Proper, Cerin, Brown and Owen (2007) found that adults with 1170–1859 min/week and ≥1860 min/week of leisure-time sitting were 52% and 105% greater odds of being overweight or obese, respectively, compared with those with <1170 min/week, after adjustment of all covariates included. Proper et al (2007) also indicated that males, older individuals (that is, 34-49yrs, 50-65yrs), and adults with lower neighbourhood socio-economic status were more likely to be overweight or obese.

In a study by Sugiyama, Healy, Dunstan, Salmon and Owen (2008) using NHANES data, overweight or obese individuals were found to show more time spent sedentary, to have a smaller number of breaks in sedentary time, and to be less likely to adhere to the PA guidelines (Tudor-Locke, Leonardi, Johnson & Katzmarzyk, 2008), compared with normal weight individuals. In a prospective cohort study by Meyer and his team (Meyer, Evenson, Couper, Stevens, Pereria & Heiss, 2008), greater TV viewing time was significantly associated with 43% greater odds (1.43, 95% CI 1.29, and 1.58) of being overweight or obese at baseline in a sample of 12,678 adults, but no significant association at the 6-years follow-up. Bowman (2006) demonstrated that obese people spent 3 hours/day, which was greater than time spent watching TV for normal weight (2.3 hours/day) and overweight (2.6 hours/day) individuals: data from the US Department of Agriculture survey with 9,157 adults. Another finding was that >2 hours/day of TV viewing were associated with greater levels of BMI, and greater proportions of being overweight or obese in comparison with <1 hour/day of TV viewing (Bowman, 2006).

McDowell, Hughes and Borrud (2006) reported that overweight or obese individuals had worse indicators of self-reported health, health care civilization, and limitation in daily activities, joint pain, shortness of breath, and low back pain, compared with normal weight individuals. Another relevant study by De Cocker, van Uffelen and Brown (2010) demonstrated that women who gained weight over time showed higher increases in sitting time (>5%) compared with those who

lost weight during the same time period, and women whose sitting time increased had higher increases in BMI values (>20%) than those whose siting time decreased.

Mushtaq group (2011) found that sedentary behaviours such as watching TV, working on computer and playing video games have strong relationship with higher BMI (Mushtaq,Gull, Shahid, Shad & Akram, 2011). According to the National Task Force on the Prevention and Treatment of Obesity (NTFPT), watching TV increases the risk of obesity due not to decreased energy expenditure but also to the increased intake of food rich in fat and sugar during this inactivity (NTFPT, 2000).Therefore, it is important to identify and treat early, individuals with central obesity, in order to plan appropriate remedial strategies for their health.

Clinically, fat patterning is supported by numerous epidemiological studies confirming its deleterious effect on cardiovascular risk and morbidity and mortality (Whitlock et al., 2009; Despres, 2007), and believed to be a better precursor of weight-related and many other types of chronic diseases than total body fat (Klein, Allison, Heymsfield, Kelley, Leibel & Nonas, 2007). People must move to prevent the development of obesity. Hassapidou et al. (2013) reported that regular walking for more than 2 hours per week reduces the risk of being overweight and obese.

Banks, Lim, Seubsman, Bain and Sleigh (2012) conducted a study in Asia with the aim of determining association of obesity to physical activity, domestic activities, and sedentary behaviours and Asians. In their study increased leisure screen time was found to be associated with increasing risk of being obese in both male and females, with 85% and 16% increases in risk respectively (Banks et al., 2012). The positive relationship between screen-time and being obese was still present following additional adjustment for housework/gardening and exercise-related physical activity.

2.5 Sedentary lifestyle, Physical activity and obesity

Sedentary lifestyle contribute to all cause of mortality (DHHS, 2010); low quality of life (Jiang, Tang, Futatsuka & Zhang, 2004; Kaur et al., 2014); higher risk of obesity, hypertension, diabetes, CVDs, osteoporosis, fractures, cancer (colon, breast and prostate), psychiatric disorders (DHHS, 2010; Jiang et al., 2004; Retamal, 2013) and overall higher risk of hospitalization (Sari, 2010). The increase in physical activity through brisk walking, climbing stairs, doing house and yard work, and engaging in active recreational activities have been recommended by public health to reduce sedentary lifestyle (DHHS, 2010).

Physical activity is a therapeutic option due to its negative association with CVDs risks and thus often prescribed to patients as means of improving cardiometabolic profile (Hu, Willet, Li, Stampfer, Colditz & Manson, 2004; Barnes, 2011). However, changes in individual risk factors with physical activity tend to be modest, on the order of 5% for blood lipids (Kraus, Houmard, Duscha, Knetzger, Wharton, McCartney, Bales, Henes, Samsa, Otvos, Kulkarni & Slentz, 2002, Retamal, 2013), 3-5 mmHg for blood pressure (Whelton, Chin, Xin & He, 2002), and 1% for haemoglobin Alc (Thompson, Crouse, Goodpaster, Kelley, Moyna & Pescatello, 2001) in contrast to the large 30-50% reductions in CVD risk and increased longevity seen with physical activity, independent of weight or body fat loss (Li, Rana, Manson, Willet, Stampfer, Colditz, Rexrode & Hu, 2006). Physical activity modify other CVD risk factors particularly related to inflammation and homeostasis (Mora, Lee, Buring & Ridker, 2006). Avoiding sedentary lifestyle increases total life expectancy without cardiovascular diseases in adults of both sexes (Franco, de Laet, Peeters, Jonker, Mackenbach & Nusselder, 2005).

According to the report of the Public Health Agency of Canada (2014), of all the factors considered and measured through the Canadian Community Health Survey (CCHS), being inactive emerged as having the strongest association with NCDs at the population level for both men and women. The report further established that an estimated 405,000 cases of male obesity and 646,000 cases of female NCDs could potentially be altered or averted if inactive populations became active. It is usually encouraged that those who are overweight /obese should increase their level of physical activity, as this will increase the level of their energy expenditure and in the long run reduce their excess body fats and reduce the risk of developing NCDs. However, Cheng and Mao (2006) found that there is a higher prevalence of physical inactivity among obese Canadian men and women.

2.6. Theoretical Framework: Ecological Theory of Obesity

The ecological theory of obesity, a model used to explain the predictors of adult obesity was developed by United States of America (USA). According to the USA, there are complex factors from multiple context that come into play to place adults at the risks of obesity and having a BMI of over thirty. One of those factors include sedentary lifestyle. This model predicts that individual who lead sedentary lifestyle are at the higher risks of obesity. The theory predicts that there is a positive relationship between obesity and sedentary behaviours. The theory further predicts that all types of sedentary behaviours are linked to future obesity and overweight. According to this theory, TV viewing is associated with increased body mass index (BMI) due to unhealthy food

people eat when watching TV. Work demands, time spent sleeping, relaxing, sitting in car/chair are also associated with obesity.

This theory also emphasized that, sedentary behaviour such as watching TV, driving and computer use can be influenced by family and friends and increase the fat stored in the body. If a person is raised/ married in a family that leads a sedentary lifestyle, he or she might be at the higher risk of becoming obese than someone who is raised/married in a family that leads active lifestyle.

Work-places, schools and colleges are seen as factors that can place an individual at risk of becoming obese, because of the time spent in working and reading books. The Department of Epidemiology in US conducted a study on college students and an intervention programme for weight loss. It was shown that the weight loss programme do work for college students, as long as the participants remain active in the programme (Minet & Moris, 2010).

The present researcher finds the Ecological Theory of Obesity relevant for this study because the theory explains how various sedentary behaviours contribute to weight status of adults which could lead into the development of obesity.

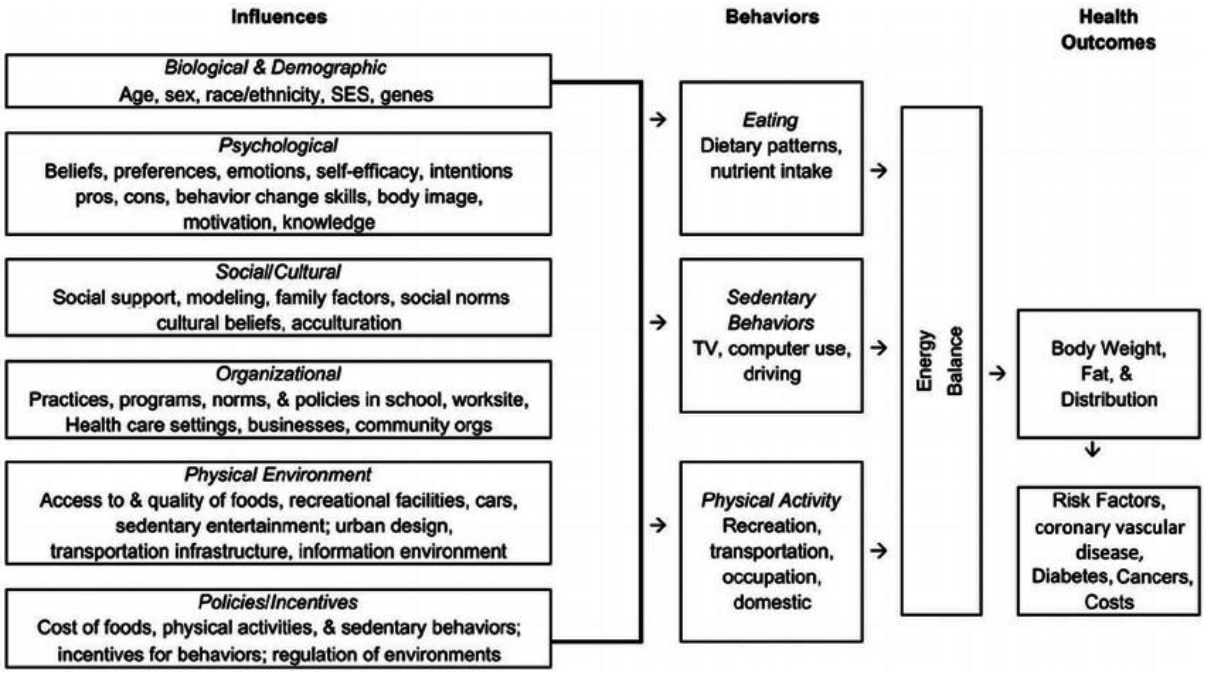

Figure 2.1 Framework for factors associated with adult obesity (USA, 2004)

2.7 Conclusion

This chapter review literature from South Africa and other countries. The reviewed literature revealed that there is association between sedentary lifestyle and physical activity. The ecological theory used in this study revealed that sedentary lifestyle can be influenced by various factors such as work demand, education (study time) and others. Sedentary lifestyle is associated with the development of obesity which could lead to the development of various NCDs. Since this chapter presented the reviewed literature and theory, the next chapter discussed the study design and methods.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

Methodology refers to ways of obtaining, organising and analysing data (Polit & Hungler, 2004). According to Burns and Grove (2003), methodology includes the design, setting, sample, methodological limitations, and the data collection and analysis techniques in a study. The following areas are addressed in this chapter: study design, study setting, the study population and sample size, data collection instrument, validity and reliability of instrument, method used for data collection and analysis and ethical consideration.

3.2. Study Design

This study adopted a quantitative, cross-sectional survey method. According to Rubin and Babbie (2010), quantitative research is a method that emphasises precise, objective and generalizable findings. This cross-sectional design was chosen because the researcher planned to collect data from the participants at a point in time and it could be carried quickly (Friis & Sellers, 2014). Quantitative design was chosen because it is believed to be more scientific.

3.3. Study setting

This study was conducted at Ha-Tshikundamalema area in Vhembe District of the Far North region of the Limpopo Province of South Africa. Ha-Tshikundamalema is situated in Thulamela Municipality (Ward 4). Thulamela Municipality is a Category B Local Authority established in terms of the Local Government Municipal Structures (Act no 117 of 1998) and is one of the four local municipalities comprising the Vhembe District Municipality in the Limpopo Province. It is situated in the far north of Limpopo Province. Thulamela Municipality is the most populated Local Municipality in the District; with a total population of 618 462 (Thulamela Municipality, 2016). Ha-Tshikundamalema is accessed through P277/1 road linking Thohoyandou and Mutale area. It is located 75 km from Thohoyandou. The area has seven sub-villages. Each sub-village is led by one headman. The population of Ha-Tshikundamalema is 2676. The majority of residents are unemployed and illiterate. Most of those who are unemployed receive a social grant. Only 100 people have professional jobs and 40% of them have helpers in their homes (they do not do household chores). Eighty percent of the working population use transport to and from their work

places and they do sedentary jobs such as office work. There is one clinic, which caters for the Ha-Tshikundamalema population and other nearby villages. Thirty percent of Ha-Tshikundamalema adult population is on medication for chronic non-communicable diseases (Tshikundamalema clinic, 2016). There are two schools (primary and secondary school) and four sports grounds which are utilized by males for soccer. Residents of Ha-Tshikundamalema do not perform indigenous activities like they used to do before, which were good for their health.

3.4. Target population

Polit and Beck (2008) define a population as "the totality of all subjects that conform to a set of specifications, comprising the entire group of persons that is of interest to the researcher and to whom the research results can be generalized". Participants of the study was all adults aged 20-60 years, residing in Ha-Tshikundamalema area of Vhembe District, Limpopo Province. The total number of adults (aged 20-60) in Ha-Tshikundamalema area was 1176 of which 450 (38%) males and 726(62%) were females. All eligible adults were given an information sheet which contains the facts of the study, and then written inform consent was obtained.

Table 3.1: The Population Frame of each Sub-village (N= 1176)

Villages	Male	Female	Total	Percentage (%)
Gwengoni	70	92	162	13.8%
Thogani	78	94	172	14.6%
Lurangwe	100	240	340	29%
Thondoni	85	100	185	15.7%
Tshitambe	55	90	145	12.3%
Mvala	44	70	114	9.7%
Mutshuludi	18	40	58	5%
Total	450(38%)	726(62%)	1176(100%)	100%

(Tshikundamalema Tribal Authority, 2016)

3.5 Participants sample size

According to Unrau, Gabor and Grinnel (2007), a sample can be viewed as a subset of measurements drawn from a population in which we are interested. Barker (2003) defined it as a small portion of the total sets of objects or persons from which a representative selection is made. For the purpose of this study, a total of 298 adults (182 females and 116 males) was selected to constitute the sample size. These are adults who resides in Ha-Tshikundamalema area.

The sample size was calculated using Slovin's formula, where n is the participants sample size, N is the total number of population (adults) and e is accepted level of error (Almeda, Capistrano & Sarte, 2010). In this study e is 0.05.

$n = N/ (1+ (Ne^2))$

$n = 1176/ (1 + (1176 \times 0.05^2))$

$n = 1176/ (1 + (1176 \times 0.0025))$

$n=1176/ (1 +2.94)$

$n = 1176/3.94$

$n = 298$

Therefore, sample size (n) = 298 participants

The number of participants in each village was drawn based on the proportion in the population in order to achieve a degree of representativeness, as shown in the table below.

Table 3.2: Participants' Sample Frame (n= 298)

Villages	Male	Female	Total	Percentage
Gwengoni	16	18	34	13.8%
Thogani	17	20	37	14.6%
Lurangwe	33	74	107	29%
Thondoni	20	21	41	15.7%
Tshitambe	13	27	40	12.3%
Mvala	10	13	23	9.7%
Mutshuludi	7	9	16	5%
Total	116(38.9%)	18(61.1%)	298(100%)	100%

3.6 Sampling

Sampling refers to the researcher`s process of selecting the sample from a population in order to obtain information regarding a phenomenon in a way that represents the population of interest (Burns & Grove, 2011). All seven villages in Ha-Tshikundamalema area formed part of the study and a total of 298 participants were selected within these villages; an extra 12 participants were selected in order to make up for those who would refuse to form part of the study or withdraw from the study. Using the information from Tshikundamalema Tribal Authority, as shown in Table 3.2, the number of participants in each village was drawn based on the proportion in the population according to gender in order to achieve a degree of representativeness. A sample of adults within these villages was selected using systematic sampling technique. Firstly, the researcher calculated the sampling interval by dividing the size of population by the desired sample. It was calculated as follows: 1176 ÷ 298 = 3.9 = 4. The sampling interval was 4. Every fourth household was selected to form part of the study. In Gwengoni village, the first household was randomly selected and then every 4th house was selected until the desired sample size was collected. If the selected house had no one who meets the criteria, the researcher randomly used the following house to replace the house which had no person meeting the criteria. This was done in all villages to select both males and females.

Inclusion criteria

The inclusion criteria of this study was as follows:

- Male and female adults aged 20-60 years who reside in Ha-Tshikundamalema area
- Provision of informed consent for joining with the study.

Exclusion criteria

- People who were not willing to participate in the study were excluded.
- People who were not from Ha-Tshikundamalema and women who were pregnant during data collection process were excluded from the study.
- People with physical disability (who cannot stand on their legs).

3.7 Data collection tools

Data-collection instruments refer to the devices used to collect data such as questionnaires, tests, interview schedules and checklists (Polit & Beck, 2008). For the purpose of this study, a structured self-administered questionnaire, stadiometer, digital scale (Seca Robusta 813) and a non-elastic retractable measuring tape were used for data collection. The questionnaire was designed in such

a way that it allows for relevant data collection and also was provided in English with Tshivenda translations because some of the participants do not have good commands of the English language. The questionnaire had two sections; namely Section A: socio-demographic information of participants and Section B: sedentary lifestyle practices/ patterns. A stadiometer was used to measure body height and a digital scale was used to measure body mass (for calculation of BMI). A non-elastic retractable measuring tape was used to measure waist circumference (WC).

3.8 Data collection procedure

A structured self-administered questionnaire, stadiometer, digital scale and a non-elastic retractable measuring tape were used to gather information from participants in this study. The researcher obtained ethical clearance from the Research Ethics Committee of the University of Venda. An ethical clearance certificate, together with the permission letter, were submitted to the Tshikundamalema Tribal Authority in Vhembe District to seek permission to conduct a study within villages. A letter from Tshikundamalema Tribal Authority was then submitted to the participating villages together with another letter seeking permission from the Headman to conduct the study in their villages. Once the permission was granted the researcher commenced data collection on the 15 of June 2017 until 15 July 2017. Data collection took place in the household of each participant (Gazebos were provided to ensure privacy). Arrangements were made with the headman and civic of each village. The researcher introduced herself and then explained the purpose of her study. Once they agreed to participate, the researcher provided them with the informed consent form (Appendix 7) to sign.

Questionnaire:

A questionnaire was given to those who signed the consent form or verbally agreed to form part of the study. For those who couldn't read Tshivenda, the research helped them complete the questionnaire by reading it for them. Questionnaires were administered to participants on the day of data collection

Measurements:

Participants' height, body mass and waist circumference were measured according to the protocol of the International Society for the Advancement of Kinanthropometry (ISAK, 2010).

Height was measured without shoes using a Stadiometer.

Procedure:

- The participants were advised to keep their heels together; feet flat on the ground and inhale deeply, hold the breath, and maintain an erect position.
- The head was positioned in such a way that the angle of the eye and the operating external auditory meatus were in horizontal line.
- The height measurement was read to the nearest 0.1 cm.

Body mass was measured with participants in light clothing using a digital scale (Seca Robusta 813) and was measured to the nearest of 0.5 kg. The weighing scale was regularly checked and calibrated with known standard weights at the commencement of each session of the measurement.

Procedure:

- Participants were asked to stand immobile without support on the weighing machine, with head facing the wall.
- Body mass was recorded in kilograms up to one decimal place.

Height and body mass were used to calculate body mass index using the formula BMI= body mass (kg)/height (m^2).

Waist measurement was taken using cross hand technique with researcher standing on the right side of the participants. Non-elastic retractable measuring tape was used and measurement was read to the nearest 0.1 cm.

Procedure:

- Waist measurement was taken at the narrowest part of the torso.
- The researcher stood in front of the participant and correctly located the narrowing of the waist.
- The measurement was taken at the end of normal expiration with arm relaxed at the sides of the body.

3.9 Data analysis

In this study, data were analysed using Statistical Package for Social Science (SPSS), version 24.0. The questionnaire and derived measurements were numbered (coded) and entered into SPSS. Descriptive analyses were performed to show frequencies and percentages for categorical

variable, and mean and standard deviation for continuous variables. The participants' body mass index (BMI) and waist circumference were compared with their Norms shown in table 3.3-4. For BMI, underweight were numbered 0, normal weight numbered 1, overweight 2, obesity numbered 3 on the SPSS. Same numbering method was used when coding waist circumference. The associations of sedentary lifestyle and physical activity patterns with BMI, WC were studied by calculating Pearson correlation. Similar analyses were performed for socio-demographic characteristics. All types of sedentary lifestyle and physical activity patterns, and socio-demographic characteristics with an association with BMI and WC in bivariate Pearson correlation analyses were selected for linear regression analysis to see if they were independently associated with the dependent variables (BMI and WC). A p-value of ≤ 0.05 was considered statistically significant. The results was summarised in the form of tables, charts and figures.

Table 3.3: BMI classifications

BMI categories	
Definition	BMI range (kg/m²)
Underweight	< 18.5
Normal Range	18.5 – 24.9
Overweight	≥ 25 .0-29.9
Obese	≥ 30.0

Source: WHO, http://www.who.int/features/factfiles/obesity/facts/en/

Table 3.4: Waist circumference (WC) in men and women (SASSO, 2003)

	Ideal	**High**	**Very high (central obesity)**
Men	<94 cm	94.0-101.9 cm	≥102 cm
Women	<80 cm	80.0-87.9 cm	≥88 cm

3.10 Validity and reliability of the research tool

3.10.1 Validity

Validity is the ability of an instrument to measure what it purports to measure (Creswell, 2009). According to Babbie (2010), it refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration. In order to ensure validity, the researcher adapted existing instruments (questionnaires) after extensive literature search on the

topic and in due consultation with supervisors and other experts in the field of public health in the Department of Public Health at the University of Venda. All the equipment were calibrated prior to data collection in order to ensure validity.

3.10.2 Reliability

Johns Hopkins University and Weiner (2007) describe reliability as the consistency with which a tool measures the attribute it is supposed to measure. If a study and its results are reliable, other researchers using the same method will obtain the same results. In other words, it refers to a measuring instrument's ability to yield consistent numerical results each time it is applied (Babbie, 2007; de Vos, Strydom, Fouche & Delport, 2013) and it does not fluctuate unless there are variations in the variable being measured (Gravetter & Forzana, 2003) . The reliability of the questionnaire and measuring equipment was ensured using the pre-test method of reliability testing.

3.10.3 Pre-Test

Thirty (10% of the sample population) adults were randomly selected on day one of data collection process, and these set of adults were excluded from the main study. The objective of the pre-test study was to see if the instruments can reliably collect the required data. Cronbach Alpha correlation was calculated to establish if the result falls within the acceptable limit of 0.75.

3.11 Ethical considerations

3.11.1 Ethical clearance

The basic principles of ethics were properly observed. The proposal was presented to the Higher Degrees Committee (HDC) of the School of Health Sciences. The approval to conduct the study was granted by the University Higher Degree Committee (UHDC). The University Research Ethics Committee issued an ethical clearance. The ethical clearance certificate was then used to obtain permission from Tshikundamalema Tribal Authority and Headman of each village to access the participants.

3.11.2 Informed consents

Consent forms were given to each participant to sign. The consent form was discussed with those who were illiterate for their verbal consent if they were willing to form part of the study. Information sheet containing all the essential information, such as purpose of the study, significance of the study, assurance of anonymity and confidentiality as well as voluntary participation was provided,

together with the consent form, to enable the participants to make an informed decision before signing the form (Appendix 6 & 7). Only consenting individuals were chosen to form part of the study.

3.11.3 Confidentiality and Anonymity

Confidentiality and anonymity was ensured by requesting the participants not to write their names or provide any form of identification on the questionnaire and consent form. Only pseudo names were provided. Completed questionnaires and record sheet were kept under lock and key and the information obtained from the participants would not be revealed to any other person except the supervisors of the study.

3.12 Plans for Dissemination of Results

The findings of this study and recommendations in the form of hard bound copies would be kept at the University of Venda Library. A copy was also submitted to Tshikundamalema Tribal Authority. The findings of the study would be published in peer-reviewed and accredited national and international journals and presented at seminars and conferences in South Africa and abroad.

3.13 Conclusion

This chapter discussed the research design and methods used to conduct the study. It has also explained the ethical considerations. The next chapter describes data analysis, presentation and interpretation of the findings.

CHAPTER FOUR

RESULTS PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter analyses and interprets socio-demographic factors, sedentary lifestyle patterns and obesity status (using BMI and waist circumference) and determines the association between sedentary lifestyle patterns and obesity status of the participants involved in this study. Socio-demographic characteristics were also correlated with obesity (BMI and WC). Participants were interviewed and assessed as per study protocol and data were analyzed in line with the objectives of the study. Results are presented in figures/graphs and tables.

4.2 Socio-demographic characteristics of the participants

This section was included in the study in order to draw the socio-demographic profile of the participants. The study included a sample of 298 adults aged 20 to 60 years. Table 4.1 represents the socio-dempgraphic characteristics of the study participants. Out of 298 participants,116 (38.9%) were males and 182 (61.1%) were females, with the mean age (SD) of 36.23 (11.34). When data were analysed seperately for the four age groups categories; the results show that 86 (28.9%) were in age group 20-29 , 118 (39.6%) were in age group 30-39 , 43 (11.2%) were in age group 40-49 , and 51 (17.1%) were in age group 50-60. All of the study participants were black. The majority of the participants in this study were South Africans (98.3%), and only 1.7% were non-South Africans. One hundred and fifty seven (52.7%) of the study participants were single, 41.6% were married while 2.0%, 1.7% and 2.0% were divorced, cohabiting and widowed respectively. Six participants (2.0%) had no education, while 75 (25.2%) of the study participants had primary education, 134 (45.0%) participants had secondary education. Matriculants represented 7.7% and those at tertiary level represented 13.8%. only few participants were graduates with certificate (0.7%), diploma (1.0%) and degree (4.7%). Of the study participants, 199 (66.8%) were unemployed, 56 (18.8%) were employed, 11 (3.7%) were self- employed while 32 (10.7%) were students/ learners. Almost ninety percent (89.6%) of the participants in this study had low socio-economic status, while 3.9% and 6.5% had middle and high socio-ecomonic status respectively. Out of 298 participants, only 32 (10.7%) were smokers while 266 (89.3%) were non-smoker

Table 4.1: Socio- demographic characteristics of participants (n = 298)

Characteristics	Total(N=298) n (%)	Males (N=116) n (%)	Females(N=182) n (%)
Age:			
20-29 years	86 (28.9)	41 (35.3)	45 (24.7)
30-39 years	118 (39.6)	39 (33.6)	79 (43.4)
40-49 years	43 (14.4)	13 (11.2)	30 (16.5)
50-60 years	51 (17.1)	23 (19.8)	28 (15.4)
Ethnicity:			
Black	298 (100)	116(100)	182 (100)
Nationatity:			
South African	293 (98.3)	112 (96.6)	181 (99.5)
Non-South African	5 (1.7)	4 (3.4)	1 (0.5)
Marital status:			
Single	157 (52.7)	66 (56.9)	91 (50.0)
Married	124 (41.6)	48 (41.1)	76 (41.8)
Divorced	6 (2.0)	1 (0.9)	5 (2.7)
Cohabitation	5 (1.7)	1 (0.9)	4 (2.2)
Widowed	6 (2.0)	0 (0)	6 (3.3)
Education:			
No education	6 (2.0)	2 (1.7)	4 (2.2)
Primary	75 (25.2)	31 (26.7)	44 (24.2)
Secondary	134 (45.0)	44 (37.9)	90 (49.5)
Passed matric	23 (7.7)	14 (12.1)	9 (4.9)
Tertiary	41 (13.8)	17 (14.7)	24 (13.2)
Certificate	2 (0.7)	0 (0)	2 (1.1)
Diploma	3 (1.0)	0 (0)	3 (1.6)
Degree	14 (4.7)	8 (6.9)	6 (3.3)

Employment:			
Unemployed	199 (66.8)	56 (48.3)	143 (78.6)
Employed	56 (18.8)	33 (28.4)	23 (12.6)
Self- employed	11 (3.7)	6 (5.2)	5 (2.7)
Student/ Learner	32 (10.7)	21 (18.1)	11 (6.0)
Socio-economic status:			
Low	207 (89.6)	60 (78.9)	147 (94.8)
Middle	9 (3.9)	6 (7.9)	3 (1.9)
High	15 (6.5)	10 (13.2)	5 (3.2)
Smoking:			
Yes	32 (10.7)	28 (24.1)	4 (2.2)
No	266 (89.3)	88 (75.9)	178 (97.8)
Alcohol consumption:			
Yes	65 (21.8)	50 (43.1)	15 (8.2)
No	233 (78.2)	66 (56.9)	167 (91.8)
Food eaten daily:			
Pap	297 (99.7)	115 (99.1)	182 (100.0)
Bread	1 (0.3)	1 (0.9)	0 (0)
How often do you eat Fast-food:			
Do not eat	47 (15.8)	16 (13.8)	31 (17.0)
Once a week	18 (6.0)	5 (4.3)	13 (7.1)
2/3 times a week	25 (8.4)	10 (8.6)	15 (8.2)
1/ 2 times a month	184 (61.7)	71 (61.2)	113 (62.1)
Daily	24 (8.1)	14 (12.1)	10 (5.5)
Health conditions:			
None	262 (87.9)	99 (85.3)	163 (89.6)
Diabetes	7 (2.3)	4 (3.4)	3 (1.6)
Heart disease	1 (0.3)	0 (0)	1 (0.5)

Asthma	2 (0.7)	0 (0)	2 (1.1)
High blood pressure	26 (8.7)	13 (11.2)	13 (7.1)

Sixty-five (21.8%) participants in this study drink alcohol while 233 (78.2%) do not drink alcohol. Males showed a higher percentage of smokers (10.7%) and drinkers (43.1%) when compare to 2.2% and 8.2% of females respectively. The majority of the study participants (99.7%) eat pap daily while only 0.3% eat bread. Almost sixteen percent (15.8%) of the participants do not eat fast-foods while 6.0% eat fast-foods once a week. Twenty-five (8.4%) participants eat fast-food once/ twice a week, 184 (61.7%) eat once/twice a month and 24 (8.1%) eat fast-foods daily. The majority of the participants (87.9%) in this study had no health problems/ conditions, 2.3% had diabetes, 0.3% had heart diseases, while 0.7% and 8.7% had asthma and high blood pressure respectively.

4.3 Sedenary lifestyle and physical activity patterns of the participants

Table 4.2 represents TV viewing by the study participants. Of the 298 participants, 226 (75.8%) reported that they watch TV while only 72 (24.2%) do not watch TV. Among the 266 participants who watch TV, 59 (26.1%) watch TV for </= 1 hour while 167 (73.9%) watch TV for more than 1 hour per day. Most of the participant who view TV for more than 1 hour per day were females (83.2%). Among the participants in this study, 144 (63.7%) do not eat when watching TV while remaining participants eat snacks (13.3%), soft drinks/ beer (9.3%), pap (5.3), Tea (8.4%).

Table 4.2 TV viewing by the participants (n= 298)

TV viewing characteristics	Total N n (%)	Males N n (%)	Females N n (%)
TV Viewing:	N= 298	N= 116	N= 182
Yes	226 (75.8)	83 (71.7)	143 (78.6)
No	72 (24.2)	33 (28.4)	39 (21.4)
TV Viewing time per day:	N= 226	N= 83	N= 143
< /=1hour	59 (26.1)	35 (42.2)	24 (16.8)
>1hour	167 (73.9)	48 (57.8)	119 (83.2)
Food eaten while watching TV:	N= 226	N= 83	N= 143
Do not eat	144 (63.7)	54 (65.1)	90 (62.9)
Snacks	30 (13.3)	7 (8.4)	23 (16.1)
Softdrinks/ beer	21 (9.3)	12 14.5)	9 (6.3)
Pap	12 (5.3)	2 (3.6)	9 (6.3)
Tea	19 (8.4)	7 (8.4)	12 (8.5)

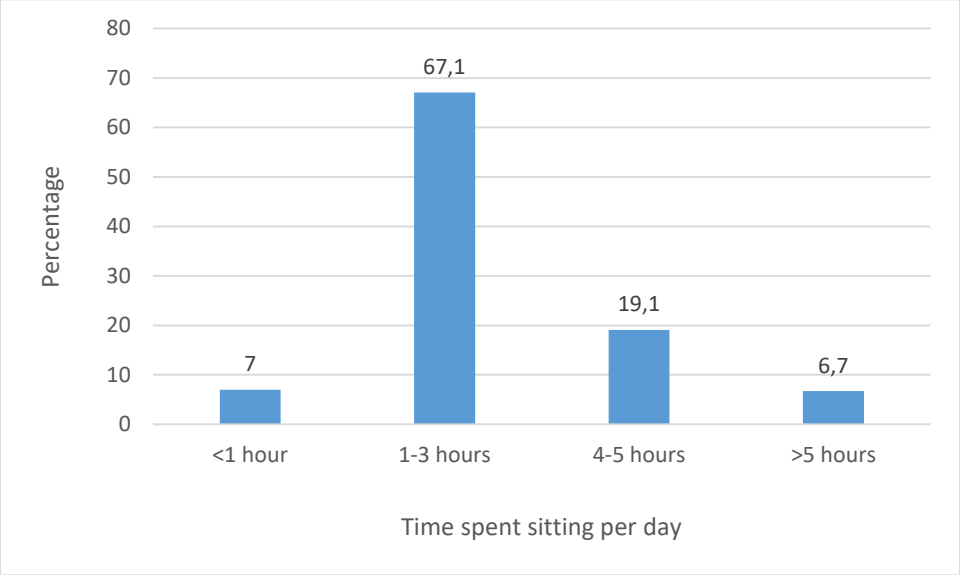

Figure 4.1 Time spent sitting per day for the total group (n= 298)

Figure 4.1 presents the time spent sitting per day for the total group. Of the 298 participants, only 7% sit for less than one hour while 67.1% sit for 1-3 hours per day. Nineteen point one percent (19.1%) of the total population sit for 4-5 hours per day and 6.7% sit for more than 5 hours per day.

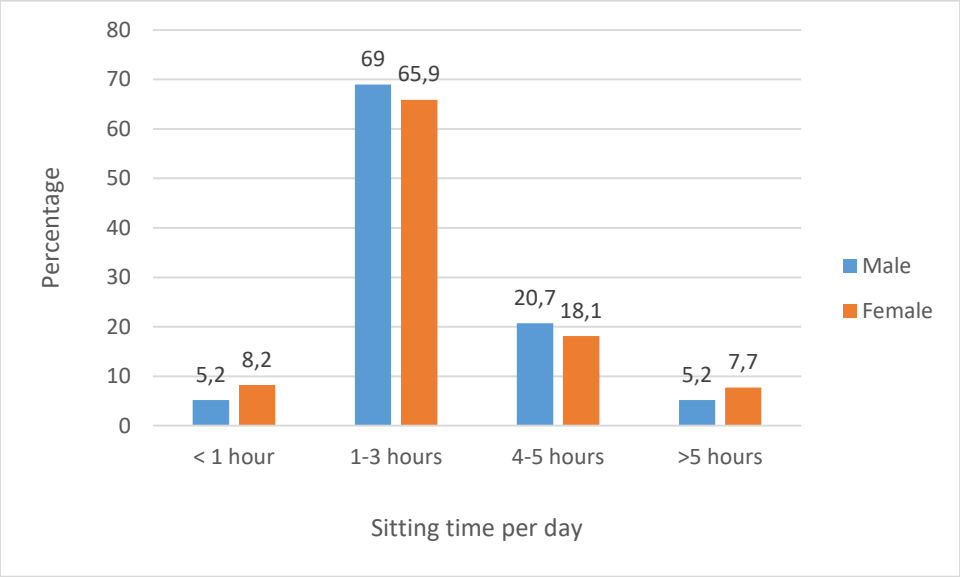

Figure 4.2: Time spent sitting per day by gender (n=298)

Figure 4.2 represents percentage of Males and females sitting time per day (time spent on computer screen, reading, listeting to music, etc, in various places except at work places). The results shows that 5.2% and 8.2% of males and females sit for less than 1 hour. Sixty-nine percent (69%) and 65.9% of male and female participants sit for 1-3 hours per day, while 20.7% and 18.1% sit for 4-5 hours per day. Lastly, 5.2% of males and 7.7% of females sit for more than 5 hours per day.

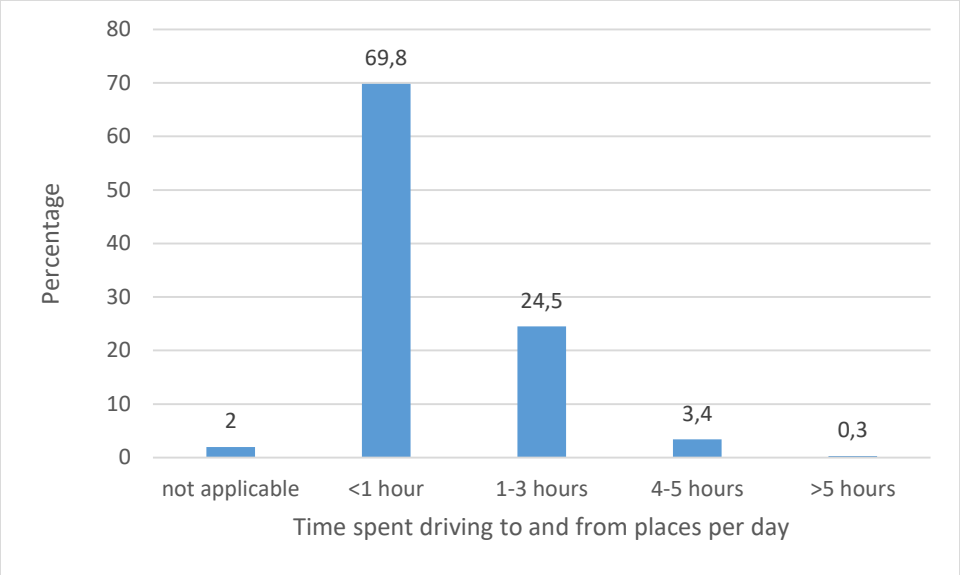

Figure 4.3 Time spent driving to and from places per day for the total group (n= 298)

Figure 4.3 represents the percentage of participants who travel from one place to another using transport. Out of 298 participant, six (2%) do not travel to and from places using car/ public transport, while 69.8% drive for less than one hour per day. Almost twenty five percent (24.5%) drive for 1-3 hours per week. Three point four percent (3.4%) and 0.3% of the study participant drive to and from places for 4-5 hours and more than 5 hours per day.

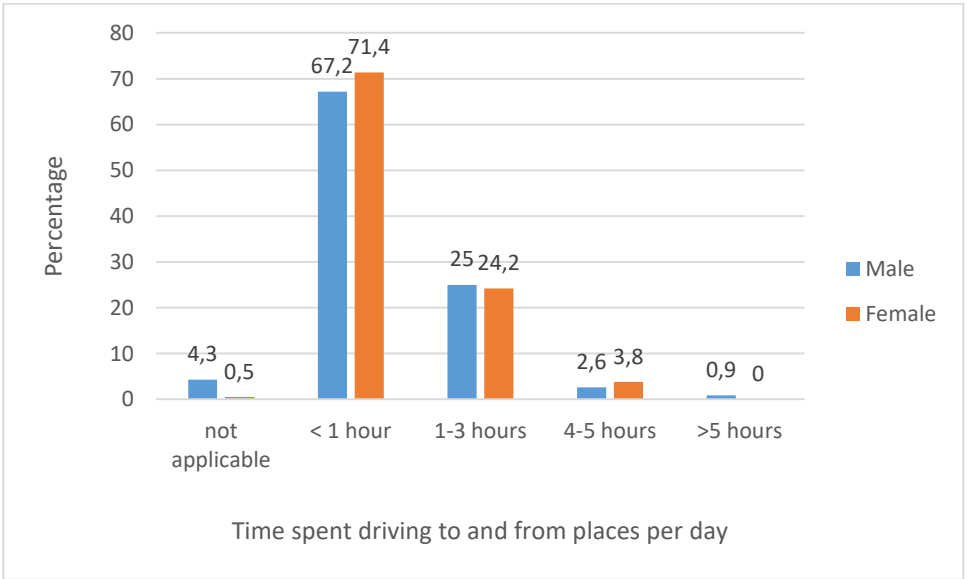

Figure 4.4: Time spent driving to and from places per day by gender (n= 298)

Figure 4.4 reprensent the percentage of people who drives to and from places by gender. Four point three percent (4.3%) and 0.5% of male and female participants don't drive or use transport,

respectively. Seventy-eight (67.2%) males and 130 (71.4%) females drive to and from places for less than one hour per day, while 29 (25.0%) males and 44 (24.4%) females spent 1-3 hours driving. Only three males (2.6%) and 7 (3.8%) females drive for 4-5 hours per day while 1(0.9%) male participant spent more than five hours driving.

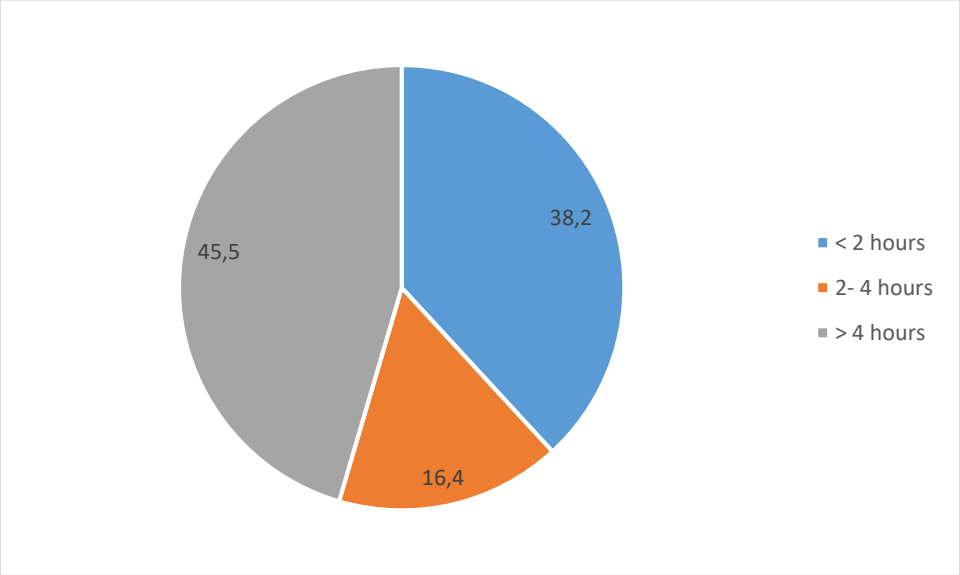

Figure 4.5 Time spent sitting at work places for total group per day (n=298)

Figure 4.5 represents participants time spent sitting at work places performing their duties. The results show that of the 55 employed participants, 21 (38.2%), 9 (16.4%) and 45.5% spent < 2 hours, 2-4 hours and > 4 hours sitting at their work places respectively.

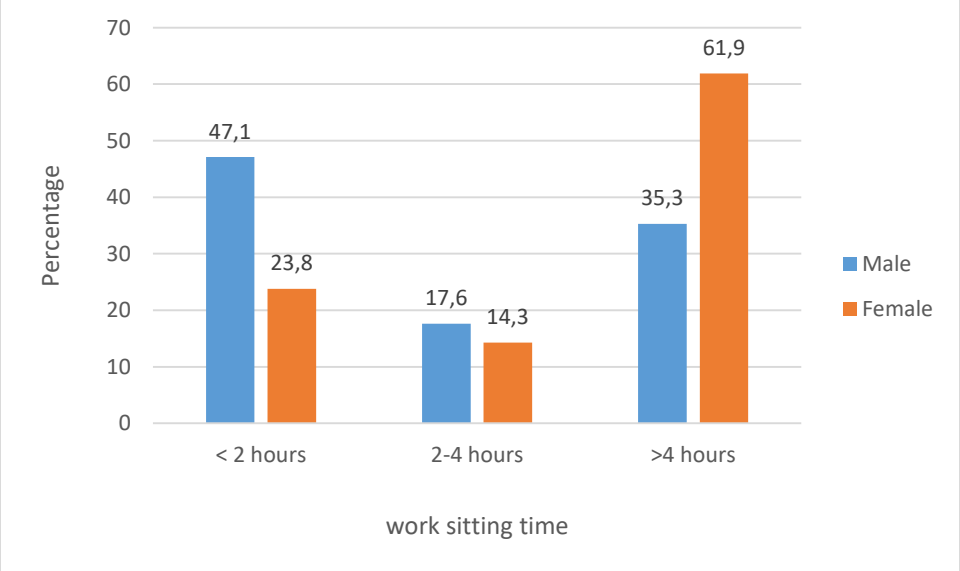

Figure 4.6: Time spent sitting at work places per day by gender (n= 298)

Figure 4.6 represent the time spent by participants sitting at their workplaces by gender. Of the 55 employed participants, 47.1% and 23.8% of male and female participants spent < 2 hours sitting at their work places respectively, while 17.6% and 14.3% of them spend 2-4 hours sitting. Thirty five point three percent (35.3%) of male and almost 62% (61.9%) of female participants sit for more than four hours at their work places.

Table 4.3 present the activities done by the study participants. Thirty five (11.7%) participants indicated that they didn't do household chores, gardening or shopping in the past month, while only 6 (2.0%) did those activites for less one hour per day. Almost ten percent (9.7%) of the study participants did household chores, gardening or shopping for 1-3 hours per day in the past month. Eighteen point one percent (18.1%) performed household chores/ gardening/ shopping for 3-6 hours per day while remaining 58.4% of the participants did those activities for 6-10 hours (29.2%) and > 10 hours (29.2%). when data were analysed separately for both male and female study participants, nearly twenty-seven percent (26.7%) of male participants and 2.2% of female participants didn't do those activities in the past month. Six males (5.2%) had done those activites for less than one hour. Nineteen point eight percent (19.8%) and 6.3% of males and females performed household chores/ gardening/ shopping for 1-3 hours in the past month respectively. Out of 298 study participants, only 19 (16.4%) males and 35 (19.2%) females performed household chores/gardening/ shopping for 3-6 hours, while 21 (18.1%) males and 66 (36.3%) females performed those activities for 6-10 hours in the past month. Of the study participants, 16 (13.8%) males and 71 (39.0%) females have done household chores/ gardening/ shopping for more than 10 hours a day in the past month as shown in table.

The majority (96.0%) of the participants reported that they walk or use bicycle continuously for atleast 10 minutes per day while 12 (4.0%) partcipants don't. Of the 116 male participants, 115 (99.1%) walk/ biycle continuously for atlest 10 minutes per day while only 0.9% don't. Most of the female participants (94.0%) reported that they could walk continuously for 10 minutes and only a few of them (6.0%) walk for less than 10 minutes. Out of 286 participants who walk continuously for atleast 10 minutes, 30 (10.5%) of them walk for less than 3 days a week; followed by those who walk for 3-5 days a week (30.4%) and then those who walk for more than 5 days a week (59.1%). Of the total group of participants, 50 (17.5%) walk for less than 30 minutes, 146 (51.0%) walk for 30-60 minutes perday while 90 (31.5%) walk for more than 60 minutes perday. Seven point zero percent (7.0%) of male participants walk for less than 3 days, followed by 22.6% who walk for 3-5 days a week and 70.4% walk for more than 5 days a week. Nineteen (16.5%), 50 (43.5%) and 46 (40.0%) male participants walk for less than 30 minutes, 30-60 minutes, and more

than 60 minutes per day respectively. Twenty two females (12.9%), 61 (35.7%) and 88 (51.5%) walk for < 3 days, 3-5 days and more than five days respectively.

Table 4.3: Activities done by participants (n= 298

Characteristics	Total (N) n (%)	Male (N) n (%)	Female (N) n (%)
Household chores, gardening etc time	N= 298	N= 116	N= 182
None	35 (11.7)	31 (26.7)	4 (2.2)
< 1 hour/day	6 (2.0)	6 (5.2)	0 (0)
1-2 Hours/day	29 (9.7)	23 (19.8)	6 (3.3)
3-6 hours/day	54 (18.1)	19 (16.4)	35 (19.2)
6-10 hours/day	87 (29.2)	21 (18.1)	66 (36.3)
>10 hours/day	87 (29.2)	16 (13.8)	71 (39.0)
Walking:	N=298	N=116	N= 182
Yes	286 (96.0)	115 (99.1)	171 (94.0)
No	12 (4.0)	1 (0.9)	11 (6.0)
Days spent walking/week:	N= 286	N= 115	N= 171
< 3 days	30 (10.5)	8 (7.0)	22 (12.9)
3-5 days	87 (30.4)	26 (22.6)	61 (35.7)
>5 days	169 (59.1)	81 (70.4)	88 (51.5)
Time spent walking/ day:			
< 30 minutes	50 (17.5)	19 (16.5)	31 (18.1)
30-60 minutes	146 (51.0)	50 (43.5)	96 (56.1)
>60 minutes	90 (31.5)	46 (40.0)	44 (25.7)
Vigorous activity for leisure	N= 298	N= 116	N= 182
Yes	92 (30.9)	59 (50.9)	33 (18.1)
No	206 (69.1)	57(49.1)	149 (81.9)
Days of vigorous activity/ week:	N=92	N= 59	N= 33
< 3 days	29 (31.5)	19 (32.2)	10 (30.3)

3-5 days	48 (52.2)	30 (57.6)	14 (42.4)
>5 days	15 (16.3)	6 (10.2)	9 (27.3)
Time spent on vigorous activity/ day:			
< 30 minutes	9 (9.8)	3 (5.1)	6 (18.2)
30-60 minutes	44 (47.8)	30 (50.8)	14 (42.4)
>60 minutes	39 (42.4)	26 (44.1)	13 (39.4)
Moderate activity:	N= 298	N= 115	N= 182
Yes	52 (17.4)	22 (19.0)	30 (16.5)
No	246 (82.6)	94 (81.0)	152 (83.5)
Days of moderate activity/week:	N= 52	N= 22	N= 30
< 3 days	19 (36.5)	10 (45.5)	9 (30.0)
3-5 days	20 (38.5)	6 (27.3)	14 (46.7)
>5 days	13 (25.0)	6 (27.3)	7 (23.3)
Time spent on moderate activity/day:			
<30 minutes	15 (28.8)	5 (22.7)	10 (33.3)
30-60 minutes	23 (44.2)	10 (45.5)	13 (43.3)
>60 minutes	14 (26.9)	7 (31.8)	7 (23.3)
Vigorous activity as part of work:	N= 62	N= 37	N= 25
Yes	22 (35.5)	15 (40.5)	7 (28.0)
No	40 (64.5)	22 (59.5)	18 (72.0)
		N= 15	N= 7
Days of vigorous activity/week at work:	N= 22		
< 3 days	2 (9.1)	0 (0)	2 (28.6)
3-5 days	16 (72.7)	12 (80.0)	4 (57.1)
>5 days	4 (18.2)	3 (20.0)	1 (14.3)
Vigorous activity time/day at work:			
< 2 hours	5 (22.7)	1 (6.7)	4 (57.1)
2-4 hours	10 (45.5)	7 (46.7)	3 (42.9)

>4 hours	7 (31.8)	7 (46.7)	0 (0)
Moderate activity at work:	N= 62	N= 37	N= 25
Yes	17 (27.4)	10 (27.0)	7 (28.0)
No	45 (72.6)	27 (73.0)	18 (72.0)
Days of moderate activity/week:	N= 17	N= 10	N= 7
< 3 days	0 (0)	0 (0)	0 (0)
3-5 days	11 (64.7)	7 (70.0)	4 (57.1)
>5 days	6 (35.3)	3 (30.0)	3 (42.9)
Moderate activity time/day at work:			
< 2 hours	8 (47.1)	4 (40.0)	4 (57.1)
2-4 hours	5 (29.4)	4 (40.0)	1 (14.3)
>4 hours	4 (23.5)	2 (20.0)	2 (28.6)

Eighteen point one percent (18.1%) of female participants walk for less than 30 minutes while 56.1% and 25.7% walk for 30-60 minutes and more than 60 minutes respectively.

Ninety-two partcipants (30.9%) do vigorous sports/fitness/ leisure activity while 206 (69.1%) don't. Of the 92 participants, 59 were males and 33 were females. Twenty-nine (31.5%) do vigorous activity for less than 3 days per week while 48 (52.2%) and 15 (16.3%) do it for 3-5 and more per week respectively. Nine (9.8%), 44 (47.8%) and 39 (42.4%) study participants to vigorous activity for the duration of less than 30 minutes, 30-60 minutes and more than 60 minutes respectively. Nineteen (32.2%) males and 10 (30.3%) females do vigorous activity for less than 3 days per week while 30 (57.6%) and 14 (42.4%) do it for 3-5 days per week. Ten point two percent (10.2%) of males and 27.3% of females do vigorous activity for more than 5 days a week. Participants vigorous activity duration was also analysed. Only three (5.1%) and 6 (18.2%) male and female participants respectively, engaged in vigorous activity for less than 30 minutes a day. Almost fifty-one percent (50.8%) and 42.4% of both males and females participants engaged in vigorous activity for 30-60 minutes per day, while 44.1% and 39.4% of male and female study participants engaged in vigorous activity for more than 60 minutes per day. The results show that more of male (59) participants engaged in vigorous activity than females (33) participants.

Moderate physical activity for sports/ fitness/ leisure was done by only 52 (17.4%) study participants while the rest (82.6%) don't engage in moderate activity. Of the 52 participants who engage in moderate activity (22 males and 30 females), thirty-six point five percent (36.5%) of the participants do moderate activity for less than 3 days. Almost thirthy-nine percent (38.5%) of the participants in the study engaged in moderate activity for 3-5 days per week while 25.0% do moderate physical activity for more than 5 days a week. Fifteen (28.8%) of the participants engaged in moderate activity for less than 30 minutes per day while 44.2% do it for 30-60 minutes per day. And almost twenty-seven percent (26.9%) of the study participants engage in moderate activity for more than 60 minutes per day. Data were also analysed separately for male and female participants. The results reveal that 22 (19.0%) male and 30 (16.5%) female participants engage in moderate activity. Ten (45.5%) and 9 (30.0%) of both male and female engage in moderate activity for less than 3 days a week, while 27.3% males and 46.7% females do moderate activity for 3-5 days a week. Twenty-five percent (25%) and 23.3% of the study participants peformed moderate activity for more than 5 days a week. In this study, 22.7% of male and 33.3% of female engage in moderate activity for less than 30 minutes per day while 45.5% and 43.3% do moderate activity for 30-60 minutes per day. Moderate activity was done for more than 60 minutes by 31.8% and 23.3% of male and female participants respectively.

When data were analysed for employed participants, 22 and 17 of the participants indicated that they do vigorous and moderate activity as part of their work respectively. Of the 22 participants who do vigorous activity, 9.1%, 72.7% and 18.2% do moderate work activity for less than 3 days, 3-5 days and more than five days a week respectively. Almost twenty-three percent (22.7%) of the employed participants do work vigorous activity for less than 2 hours per day while 45.5% do it for 2-4 hours per day. The remaining 31.8% of the study participants do vigorous work activity for more than 4 hours per week. Almost twenty-nine percent (28.6%) of females do vigorous work activity for less than 3 days per week. The results reveal that 80.0% and 57.1% of male and female participants do vigorous activity as part of their work for 3-5 days a week while 20.0% and 14.3% engage in those activites for more than five days a week. Only one (6.7%) male participant do vigorous activity for less than 2 hours a day, while the remaining percentage (93.4%) do it for 2-4 hours (46.7%) and > 4 hours (46.7%) per day. In this study, 57.1% and 42.9% of female participants do vigorous activity for < 2 hours and 2-4 hours per day respectively. Seventeen participants reported that their work involve moderate activity and some do it for 3-5 days (64.7%) a week while others do it for more than 5 days a week (35.3%). Eight participants (47.1%) engaged in moderate activity for less than 2 hours, while the remaining 29.4% and 23.5% do it for 2-4 hours and more than 4 hours respectively. In this study 70.0% of male and 57.1% of female

participants get involved in moderate work activity for 3-5 days a week while 30.0% (males) and 42.9% (females) get involved on moderate activity for more than 5 days a week. Eighty percent (80%) of male participants peformed moderate work activity for < 2 hours (40%) and 2-4 hours (40%), respectively, while only 20% of the get involved for more than four hours per day. Of the seven females participants, 4 (57.1%), 1 (14.3%) and 2 (28.6%) do moderate activity task for < 2 hours, 2-4 hours and more than four hours respectively (see table 4.3).

4.4 Obesity status using BMI and waist circumference (WC)

Figure 4.7 presents the percentage of BMI categories for the participants BMI. Of the total 298 study partcipants, 16 (5.4%) were underweight while 112 (37.6%) had normal weight. Almost thirty percent (29.9%) of the participants in the study were oveweight and the remaininng 27.2% were obese.

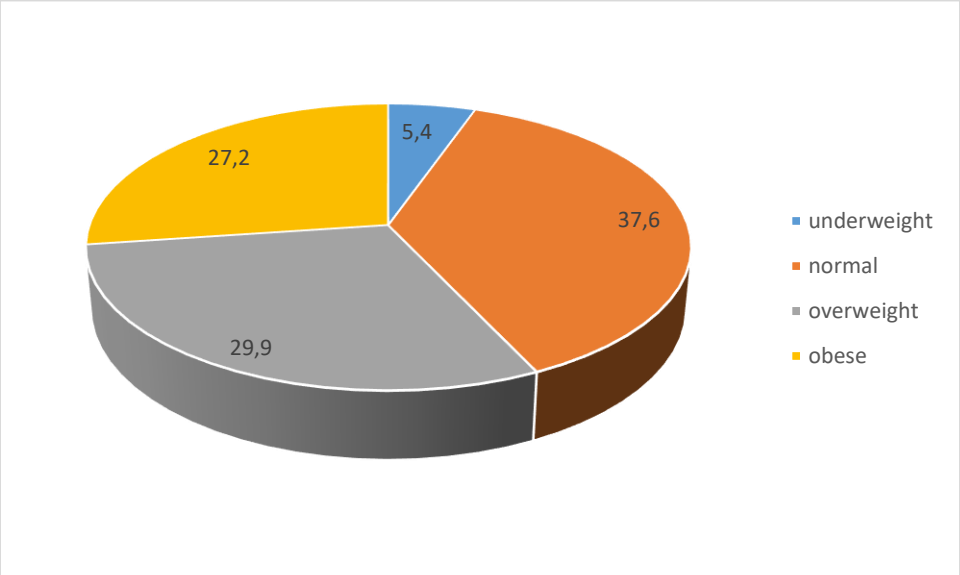

Figure 4.7: Percentage (%) of BMI categories for the total group (n= 298)

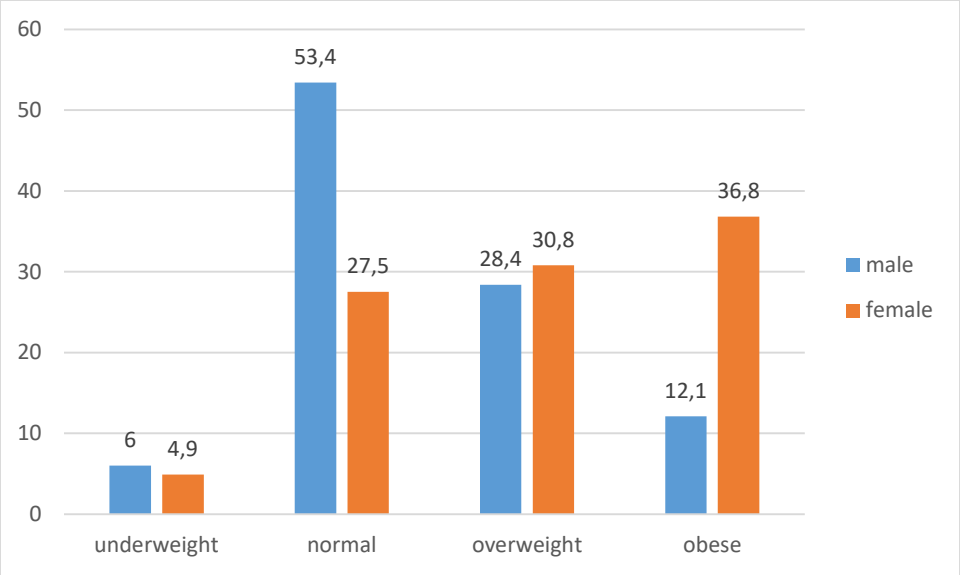

Figure 4.8: Percentage (%) of BMI categories for males and females (n=298)

Figure 4.8 presents the percentage of BMI categories by gender. The results show that 6.0% and 4.9% of males and females were classified as underweight. Fifty three percent (53.0%) of male and 27.5% of female participants were in the normal weight category. Twenty eight point four percent (28.4%) and 30.8% of male and females were in the overweight category respectively. Females (36.8%) showed higher percentage of obesity compared to males (12.1%).

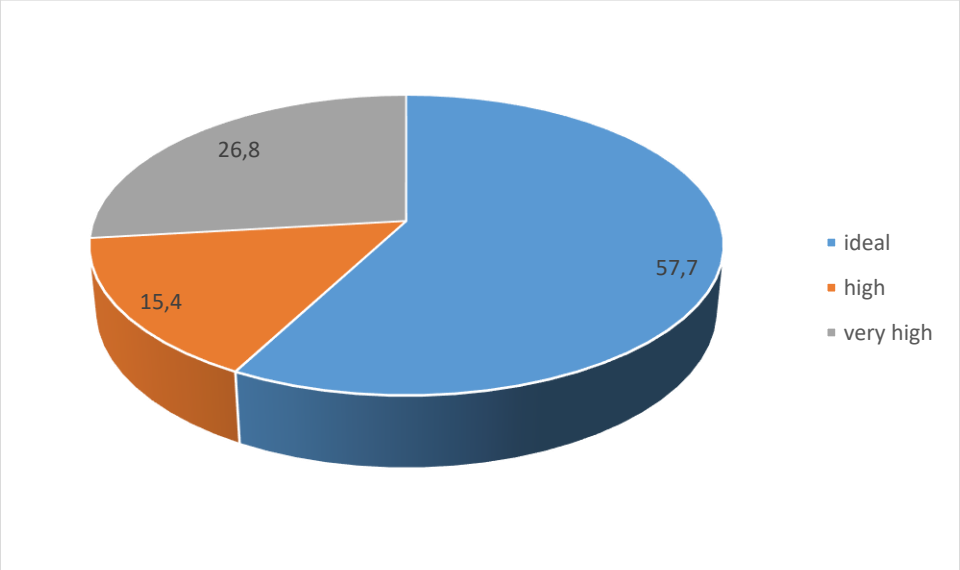

Figure 4.9: Percentage (%) of WC categories for the total group (n=298)

Figure 4.9 presents WC categories for the total group. One hundred and seventy-two (57.7%) of the study participant had ideal WC, while 46 (15.4%) and 80 (26.8%) had high and very high WC respectively.

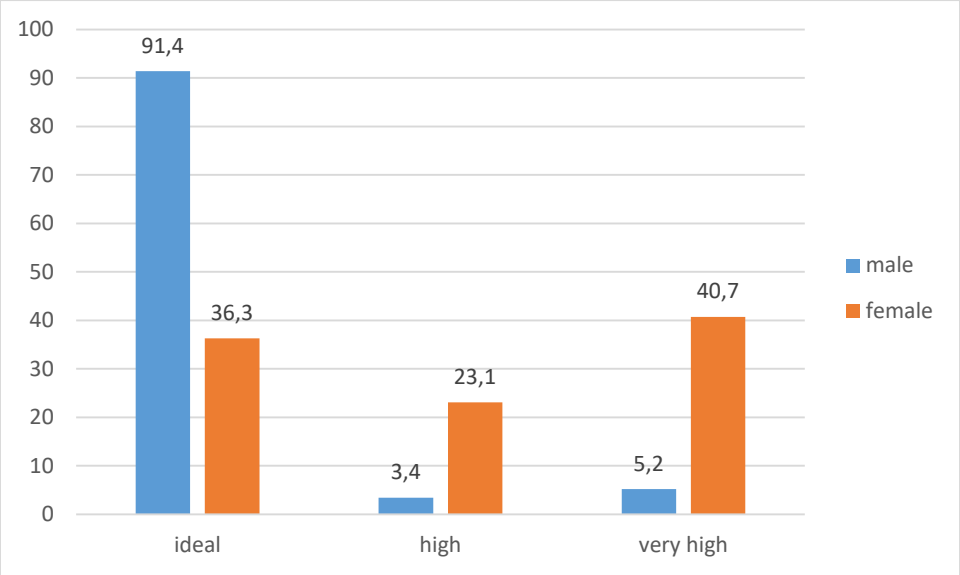

Figure 4.10: Percentages (%) of WC categories for males and females (n= 298)

Figure 4.10 presents the percentage of WC categories by gender. Ninety-one percent (91%) and 36.3% of male and female participants had ideal WC. Three point four percent (3.4%) and 23.1% of male and female participants had high WC respectively. Females (40.7%) show high percentage of very high waist circumference when compared to males (5.2%).

4.5 Relationship between sedentary lifestyle and obesity

4.5.1 Association of sedentary lifestyle and physical activity patterns with Body Mass Index (BMI)

Table 4.4 represents the association of sedentary lifestyle and physical activity patterns with obesity. From underweight category, 13 (81.3%) participants watched TV while only 3 (18.3%) didn't watch. Of the 112 normal weight participants, 74.1% reported TV viewing while 25.9% do not watch TV. Almost 79% (78.7%) of those who watched TV were overweight, while 21.3% never watched TV. Sixty percent (60%) and 25.9% of obese participants watched and didn't watch TV respectively. No association was found between TV viewing and BMI (P= 0.775). Most of the participants who watched TV for more than 1 hour per day were overweight (80.0% vs 20.0%) and obese (85.0% vs 15%).TV viewing time was significantly associated with overweight and

obesity (P=0.029). Food eaten while watching TV was significantly associated with overweight and obesity (P= 0.022). Other sedentary behaviors such as sitting on Computer/ chatting to friends/ reading/ listening radio, driving to and fro places, work and total sitting time per day were computed and no association of these variables with overweight and obesity were found (P= 0.571; P= 0.607;P= 0.820; P=0.356).

Activities around the house including gardening, were grouped in to six categories: none; < I hour; 1-3 hours; 3-6 hours; 6-10 hours and > 10 hours. One hundred and twelve participants under these six categories had normal body mass index and only 89 and 81 participants were overweight and obese respectively, and significant inverse association of household activities with BMI was observed (P=0.014). Of the underweight participants, 14 (87.5%) walked for more than 10 minutes per day while 2 (12.5%) didn't. One hundred and eleven participants (99.1%) who walked for more than ten minutes per day had normal weight (99.1% vs 0.9%). Overweight and obesity were found among 84 and 77 participants who walk for more than 10 minutes per day, and no association was found between walking and BMI (P= 0.762). In walking days per week, 76 of those walking for more than 5 days a week had normal BMI while 43 and 39 were overweight and obese. There was a negative significant association of walking days with BMI (P= 0.006). Walking for more than 1 hour per day was significantly associated with low/ normal BMI (P= 0.029).

From the underweight BMI category, 6 (37.5%) engaged in vigorous activity while 10 (62.5%) didn't. Of the 112 normal BMI category, 47 (42.0%) were physical active while 65 (58.0%) were not active. Seventy-five point three percent (75.3%) and 79.0% of the participants who do not engage in vigorous activity were overweight and obese respectively. There was a significant association of vigorous physical activity with BMI (P= 0.01). Participants who don't engage in vigorous activity were more likely to be overweight and obese than those who do. No association of vigorous activity days and time; moderate activity participation, days and time with BMI was observed (P=0.687, P= 0.060; P=0.086, P=0.469, P=0.940). Eleven participants (52.4%) who do vigorous activity as part of their work had normal BMI while 47.6% don't do vigorous activity as part of their work. Most of the participants who didn't do vigorous activity as part of their work were overweight (17, 73.9%) and obese (13, 76.5%). Work vigorous activity was statistically associated with BMI (P= 0.013), the more they engage in vigorous work activity, the lesser the BMI. There was no association of work vigorous activity days per week, work vigorous activity time, work moderate activity, work moderate activity days and time, with BMI were found (P=0.259, P=0.060, P=0.296, P=0.454, P= 0.735).

Table 4.4: Sedentary/ physical activity patterns and BMI categories of the participants (n=298)

Variables		BMI n (%)				P-values
		Underweight	Normal	Overweight	Obese	
TV Viewing	Yes	13 (81.3)	83 (74.1)	70 (78.7)	60 (74.1)	0.775
	No	3 (18.8)	29 (25.9)	19 (21.3)	21 (25.9)	
TV hours/ day	</= 1 hour	6 (37.5)	30 (36.1)	14 (20.0)	9 (15.0)	0.029**
	>1 hour	7 (43.8)	53 (63.9)	56 (80.0)	51 (85.0)	
TV Food	Do not eat	7 (53.8)	47 (56.6)	47 (67.1)	43 (71.7)	0.022*
	Snacks	1 (7.7)	10 (12.0)	12 (17.1)	7 (11.7)	
	Soft drinks	1 (7.7)	13 (15.7)	3 (4.3)	4 (6.7)	
	Pap	2(15.4)	6 (7.2)	2 (2.9)	2 (3.3)	
	tea	2 (15.4)	7 (8.4)	6 (8.6)	4 (6.7)	
Computer time, chatting etc	<1hr	1 (6.3)	7 (6.3)	8 (9.0)	5 (6.2)	0.571
	1-3 hrs	11 (68.8)	77 (68.8)	63 (70.8)	49 (60.5)	
	3-5 hrs	3 (18.8)	18 (16.1)	16 (18.0)	20 (24.7)	
	>5 hrs	1 (6.3)	10 (8.9)	2 (2.2)	7 (8.6)	
Driving time	None	1 (6.3)	3 (2.7)	2 (2.2)	0 (0)	0.607
	<1hr	11(68.8)	74 (66.1)	61 (68.5)	62 (76.5)	
	1-3 hrs	4 (25.0)	30 (26.8)	22 (24.7)	17 (21.0)	
	3-5 hrs	0 (0)	4 (3.6)	4 (4.5)	2 (2.5)	
	>5 hrs	0 (0)	1 (0.9)	0 (0)	0 (0)	
Sitting at work	< 2 hrs	0 (0)	9 (50.0)	6 (27.3)	6 (40.0)	0.820
	2-4 hrs	0 (0)	2 (11.1)	4 (18.2)	3 (20.0)	
	>4 hrs	0 (0)	7 (38.9)	12 (54.5)	6 (40.0)	

Total sedentary time/day	< 3hr	0 (0)	5 (4.5)	2 (2.2)	0 (0)	0.356
	3-5 hrs	14 (87.5)	81 (72.3)	67 (75.3)	63 (77.8)	
	>5 hrs	2 (12.5)	26 (23.2)	20 (22.5)	18 (22.2)	
Household chores, gardening etc/ day	None	1 (6.3)	12 (10.7)	18 (20.2)	4 (4.9)	0.014*
	< 1 hr	0 (0)	3 (2.7)	2 (2.2)	1(1.2)	
	1-3hr	2 (12.5)	16 (14.3)	7 (7.9)	4 (4.9)	
	3-6 hr	2 (12.5)	23 (20.5)	17 (19.1)	12 (14.8)	
	6-10 hr	6 (37.5)	24 (21.4)	22 (24.7)	35 (43.2)	
	>10 hr	5 (31.3)	34 (30.4)	23 (25.8)	25 (30.9)	
Walking	Yes	14 (87.5)	111(99.1)	84 (94.4)	77 (95.1)	0.762
	No	2 (12.5)	1 (0.9)	5 (5.6)	4 (4.9)	
Walking day per week	< 3 days	1 (7.1)	9 (8.1)	11 (13.1)	9 (11.7)	0.006**
	3-5 days	2 (14.3)	26 (23.4)	30 (35.7)	29 (37.7)	
	>5 days	11 (78.6)	76 (68.5)	43 (51.2)	39 (50.6)	
Walking time per day	< 0.30 hr	0 (0)	19 (17.1)	15 (71.9)	16 (20.8)	0.029*
	0.30- 1 hr	10 (71.4)	51 (45.9)	41 (48.8)	44 (57.1)	
	>1 hr	4 (28.6)	41 (36.9)	28 (33.3)	17 (22.1)	
Vigorous activity	Yes	6 (37.5)	47 (42.0)	22 (24.7)	17 (21.0)	0.01*
	No	10 (62.5)	65 (58.0)	67 (75.3)	64 (79.0)	
Days of vigorous activity/week	< 3 days	2 (33.3)	15 (31.9)	5 (22.7)	7 (41.2)	0.687
	3-5 days	3 (50.0)	24 (51.1)	13 (59.1)	8 (47.1)	
	>5 days	1 (16.7)	8 (17.0)	4 (18.2)	2 (11.8)	
Vigorous activity time/day	< 0.30 hr	0 (0)	3 (6.4)	2 (9.1)	4 (23.5)	0.060
	0.30- 1 hr	1 (16.7)	25 (53.2)	11 (50.0)	7 (47.1)	
	>1 hr	5 (83.3)	19 (40.4)	9 (40.9)	6 (35.3)	
Moderate activity	Yes	3(18.8)	23 (20.5)	17 (19.1)	9 (11.1)	0.086
	No	13 (81.3)	89 (79.5)	72 (80.9)	72 (88.9)	

Days of moderate activity/week	< 3 days	2 (66.7)	8 (34.8)	6 (35.3)	3 (33.3)	0.469
	3-5 days	1 (33.3)	6 (26.1)	8 (47.1)	5 (55.6)	
	>5 days	0 (0)	9 (39.1)	3 (17.6)	1 (11.1)	
Moderate activity time/day	<0.30 hr	2 (66.7)	8 (34.8)	4 (23.5)	1 (11.1)	0.940
	0.30-1 hr	0 (0)	7 (30.4)	9 (52.9)	7 (77.8)	
	>1 hr	1 (33.3)	8 (34.8)	4 (23.5)	1 (11.1)	
Work vigorous activity	Yes	1(100)	11(52.4)	7 (26.1)	4 (23.5)	0.013*
	No	0 (0)	10 (47.6)	17 (73.9)	13 (76.5)	
Work vigorous activity days/week	< 3 days	0 (0)	0 (0)	1 (16.7)	1 (25.0)	0.259
	3-5 days	1 (100)	8 (72.7)	4 (66.7)	3 (75.0)	
	>5 days	0 (0)	3 (27.3)	1 (16.7)	0 (0)	
Work vigorous activity time/day	< 2 hrs	0 (0)	3 (27.3)	1 16.7)	1 (25.0)	0.060
	2-4 hrs	1 (100)	4 (36.4)	2 (33.3)	3 (75.0)	
	>4 hrs	0 (0)	4 (36.4)	3 (50.0)	0 (0)	
Work moderate activity	Yes	0 (0)	5 (23.8)	6 (26.1)	6 (35.3)	0.296
	No	1 (100)	16 (76.2)	17 (73.9)	11 (64.7)	
Work moderate activity days/week	< 3 days	0 (0)	0 (0)	0 (0)	0 (0)	0.454
	3-5 days	0 (0)	2 (40.0)	5 (83.3)	4 (66.7)	
	>5 days	0 (0)	3 (60.0)	1 (16.7)	3 (33.3)	
Work moderate activity time/day	< 2 hrs	0 (0)	1 (20.0)	4 (66.7)	3 (50.0)	0.735
	2-4 hrs	0 (0)	1 (20.0)	2 (33.3)	2 (33.3)	
	>4 hrs	0 (0)	3 (60.0)	0 (0)	1 (16.7)	

***correlation significant at 0.05 level (2 tailed test); ** Correlation significant at 0.01 (2 tailed test)**

Table 4.5: Linear regression analysis of sedentary lifestyle/ physical activity patterns with BMI among adults in Ha-Tshikundamalema area ([abc]) (n= 298)

Characteristics	Correlation coefficient (95% CI)	p- value	Standard error
TV Viewing time	0.81 (− 0.06 to 1.68)	0.08	0.44
TV food	−0.23 (−1.74 to 1.28)	0.76	0.74
Household chores, gardening, etc	0.172(−0.30 to 0.65)	0.45	0.23
Walking days/week	−0.61(−1.97 to 0.74)	0.36	0.66
Walking time	−0.42(−2.61 to 1.76)	0.70	1.07
Vigorous activity	2.17 (−2.10 to 6.44)	0.31	2.09
Work vigorous activity	5.52 (0.93 to10.12)	0.02*	2.25

a. dependent variable: Body Mass Index (BMI); b.R= 0.558; c.R^2=0.311; *P<0.05

Table 4.5 shows the sedentary lifestyle and physical activity patterns that were significantly associated with BMI. Linear regression procedure was used to examine variables that were significantly associated with BMI. The variables include: TV viewing time, TV food, Household chores, gardening, walking days/ week, walking time per days, vigorous activity and work vigorous activity. TV viewing (P= 0.08), TV food (P=0.76), household chore, gardening (P=0.45), walking days (P=0.36), walking time (0.70) and vigorous activity (P=0.31) showed no significant statistically association with the BMI, meaning that these variables cannot influence BMI independently. They are dependent on other factors. Work vigorous activity (P= 0.02) showed a strong inverse independent association with BMI. People who do vigorous work activity are 5 times less likely to be obese than those who do light work.

4.5.2 Association of sedentary lifestyle and physical activity patterns with WC

Table 4.6 presents the association of sedentary lifestyle and physical activity patterns with WC. One hundred and twenty-nine (75.0%) of the participants who viewed TV had ideal WC, while 36 (78.3%) and 61 (76.3%) had high and very high WC. Twenty-five point zero percent (25.0%), 21.7% and 23.80% of those who didn't watch TV had ideal, high and very high WC respectively. There was no association of TV viewing and WC was observed (P= 0.589). Almost 78% (77.8%) and 86.9% of those who watched TV for more than one hour per day were more likely to have abdominal/ central obesity than those who watched TV for less than 1 hour (22.2% and 13.1%).

Table 4.6: Sedentary/ physical activity patterns with WC categories (n= 298)

Variables		WC n (%)			P-values
		Ideal	High	Very high	
TV Viewing	Yes	129 (75.0)	36 (78.3)	61 (76.3)	0.589
	No	43 (25.0)	10 (21.7)	19 (23.8)	
TV hours/ day	</= 1 hour	43 (33.3)	8 (22.2)	8 (13.1)	0.001**
	>1 hour	86 (66.7)	28 (77.8)	53 (86.9)	
TV Food	Do not eat	75 (58.1)	23 (63.9)	46 (75.4)	0.037*
	Snacks	19 (14.7)	5 (13.9)	6 (9.8)	
	Soft drinks	14 (10.9)	4 (11.1)	3 (4.9)	
	Pap	9 (7.0)	1 (2.8)	2 (3.3)	
	Tea	12 (9.3)	3 (8.3)	4 (6.6)	
Computer time, chatting etc	< 1hr	9 (5.2)	6 (13.0)	6 (7.5)	0.616
	1-3 hr	118 (68.6)	30 (65.2)	52 (65.0)	
	3-5 hr	33 (19.2)	7 (15.2)	71 (21.3)	
	>5 hrs	12 (7.0)	3 (6.5)	5 (6.3)	
Driving time	None	6 (3.5)	0 (0)	0 (0)	0.186
	< 1hr	118 (68.6)	29 (3.5)	61 (76.3)	
	1-3 hr	44 (25.6)	12 (26.1)	17 (21.3)	
	3-5 hr	3 (1.7)	5 (10.9)	2 (2.5)	
	>5 hr	1 (0.6)	0 (0)	0 (0)	
Sitting at work	< 2hr	14 (41.2)	4 (57.1)	3 (21.4)	0.641
	2-4 hrs	6 (17.6)	0 (0)	3 (21.4)	
	>4 hrs	14 (41.2)	3 (42.9)	8 (57.1)	
Total sitting time	< 3 hrs	5 (2.9)	2 (4.3)	0 (0)	0.920
	3-5 hrs	127 (73.8)	33 (71.7)	65 (81.3)	

	>5 hrs	40 (23.3)	11 (23.9)	15 (18.8)	
Household chores, gaderinng etc/ day	None	29 (16.9)	2 (4.3)	4 (5.0)	0.053*
	< 1 hr	6 (3.5)	0 (0)	0 (0)	
	1-hr	25 (14.5)	2 (4.3)	2 (2.5)	
	3-6 hr	30 (17.4)	13 (28.3)	11 (13.8)	
	6-10 hr	37 (21.5)	12 (26.1)	38 (47.5)	
	>10 hr	45 (26.2)	17 (37.0)	25 (31.3)	
Walking	Yes	166 (96.5)	44 (95.7)	76 (95.0)	0.844
	No	6 (3.5)	2 (4.3)	4 (5.0)	
Walking day per week	< 3 days	12 (7.2)	8 (17.4)	10 (13.2)	0.006**
	3-5 days	46 (27.7)	12 (27.3)	29 (38.2)	
	>5 days	108 (65.1)	24 (54.5)	37 (48.7)	
Walking time per day	< 0.30 hr	28 (16.9)	6 (13.0)	16 (21.1)	0.583
	0.30- 1 hr	80 (48.2)	23 (52.3)	43 (56.6)	
	>1 hr	58 (34.9)	15 (34.1)	71 (22.4)	
Vigorous activity	Yes	69 (40.1)	8 (17.4)	15 (18.8)	0.084
	No	103 (59.9)	38 (82.6)	65 (81.3)	
Days of vigorous activity/week	< 3 days	21 (30.4)	1 (12.5)	7 (46.7)	0.721
	3-5 days	38 (55.1)	4 (50.0)	6 (40.0)	
	>5 days	10 (14.5)	3 (37.5)	2 (13.3)	
Vigorous activity time/day	< 0.30 hr	4 (5.8)	1 (12.5)	4 (26.7)	0.087
	0.30- 1 hr	34 (49.3)	3 (37.5)	7 (46.7)	
	>1 hr	31 (44.9)	4 (50.0)	4 (26.7)	
Moderate activity	Yes	34 (19.8)	7 (15.2)	11 (13.8)	0.791
	No	138 (80.2)	39 (84.8)	69 (86.3)	

Days of moderate activity/week	< 3 days	14 (41.2)	1 (14.3)	4 (36.4)	0.504
	3-5 days	11 (32.4)	3 (42.9)	6 (54.5)	
	>5 days	9 (26.5)	3 (42.9)	1 (9.1)	
Moderate activity time/day	<0.30 hr	12 (35.3)	2 (28.6)	1 (9.1)	0.573
	0.30-1 hr	13 (38.2)	1 (14.3)	9 (81.8)	
	>1 hr	9 (26.5)	4 (57.1)	1 (9.1)	
Work vigorous activity	Yes	17 (44.7)	2(25.0)	3 (18.8)	0.006**
	No	21 (55.3)	6 (75.0)	13 (81.3)	
Work vigorous activity days/week	< 3 days	0 (0)	0(0)	2 (66.7)	0.059
	3-5 days	14 (82.4)	1 (50.0)	1 (33.3)	
	>5 days	3 (17.6)	1 (50.0)	0 (0)	
Work vigorous activity time/day	< 2 hrs	2 (11.8)	1 (50.0)	2 (66.7)	-
	2-4 hrs	8 (47.1)	1 (50.0)	1 (33.3)	
	>4 hrs	7 (41.2)	0 (0)	0 (0)	
Work moderate activity	Yes	11 (28.9)	1 (12.5)	5 (31.3)	0.577
	No	27 (71.1)	7 (87.5)	11 (68.8)	
Work moderate activity days/week	< 3 days	0 (0)	0 (0)	0 (0)	0.640
	3-5 days	6 (54.5)	1 (100)	4 (80.0)	
	>5 days	5 (45.5)	0 (0)	1 (20.0)	
Work moderate activity time/day	< 2 hrs	5 (45.5)	1 (100)	2 (40.0)	0.573
	2-4 hrs	3 (27.3)	0 (0)	2 (40.0)	
	>4 hrs	3 (27.3)	0 (0)	1 (20.0)	

***correlation significant at 0.05 level (2 tailed test); ** Correlation significant at 0.01 (2 tailed test)**

There was a positive association of TV viewing time and abdominal obesity or high WC (P= 0.001). Food eaten while watching TV was also associated with abdominal obesity (P=0.037). No association was found between other sedentary behaviors (sitting on Computer/ chatting to

friends/ reading/ listening radio, driving to and fro, work, total sitting time per day) and WC (P= 0.616; P= 0.186; P= 0.641, P=0.920).

Household chores, gardening etc, were grouped in to six categories and a significant association of household chores, gardening etc., with WC (P=0.053) was found. In ideal WC, 166 (96.5%) walked for more than 10 minutes per day while only 3.5% didn't, no association was found between walking and WC (P=0.844). From ideal WC category, 7.2%, 27.7% and 65.1% walked for less than 3 days, 3-5 days and more than 5 days per week respectively. A few number of people fall under high and very high WC (44; 76). There was a significant inverse association of days spent walking per week with WC (abdominal obesity) with P value < 0.01. Walking time per day, vigorous activity, days of vigorous activity and time of vigorous activity, moderate activity, days and time of moderate activity per week and day respectively, were also computed to check if they correlate with WC but no association was observed in this variables (P= 0.583, P=0.084, P=0.721, P= 0.087, P= 0.791, P= 0.504, P= 0.573). Of the 62 employed participants, seventeen of those who do vigorous activity as part of their work had ideal WC, while 2 (25.0%) and 3 (18.8%) had high and very high WC and the association of variables were observed (P=0.006). There was no association of other remaining activity variables (work vigorous activity days, work moderate activity, work moderate activity days and time) with WC (see Table 4.6).

Table 4.7: Linear regression analysis of sedentary lifestyle/ physical activity patterns with WC among adults in Ha-Tshikundamalema area ([abc]) (n=298)

Characteristics	Correlation coefficient (95% CI)	p- value	Standard error
TV Viewing time	2.40 (1.02 to 3.79)	0.001*	0.679
TV food	−7.75 (−4.13 to 0.63)	0.144	1.169
Household chore, gardening etc.	0.59 (−0.15 to 1.33)	0.113	0.363
Walking days/week	−1.81(−3.97 to 0.36)	0.99	1.06
Work vigorous activity	13.72 (6.26 to 21.18)	0.001*	3.66

a.dependant variable: WC; bR= 0.684; cR²= 0.468; *P< 0.001

Table 4.7 presents the linear regression analysis performed on variables that were significantly associated with WC. In linear regression, TV viewing time showed a significant positive independent association with WC (P=0.001), while work vigorous activity showed a significant inverse independent association with WC (p= 0.001). It was also found that variables such as TV food, household chores, gardening and walking days per week were dependent on other variables to influence WC, no association of this variables with WC was found**.**

4.6 Association of socio-demographic characteristics with BMI and WC.

Since there was no statistical significant association of many variables with BMI and WC, the researcher became more interested in finding out if there was any association between Socio-demographic characteristic and obesity (BMI and WC).

4.6.1 Association of socio-demographic characteristic with BMI

Table 4.8 presents the association of socio-demographic characteristics with BMI. Almost 44% (43.8%) males and 56% females were underweight, while 55.4% and 44.6% male and female participants had normal weight. Of the study participants, 37.1% males and 62.9% females were overweight. Most of the female participants (82.7%) were obese when compared to 17.3% males. There was a statistical significant association between gender and obesity (P= 0.000). Females were more likely to be overweight (62.9%) and obese (82.7%) when compared to males, 37.1% and 17.3% respectively. Of the study participants under the 20-29 age category, 56.3%, 35.7%, 21.3% and 22.2% were underweight, normal weight, overweight and obese respectively. At the 30-39 age category, 12.5% and 39.3% were underweight and ideal (normal) weight while 42.7% and 42.0% were overweight and obese respectively. None of the participants were underweight at the age category 40-49 while 12.5% had normal weight. Fifteen (16.9%) and 14 (17.3%) at this age category were overweight and obese respectively. Thirty one point three percent, 12.5%, 19.1% and 18.5% of the participants at the age category 50-60 were underweight, normal weight, overweight and obese. There was a significant correlation of age with BMI (P= 0.020), BMI was seem to increase with increasing age.

Fifty-six point three percent (56.3%) and 43.8% of single and married study participants were underweight while 60.7% and 35.7% had normal weight. Overweight was observed among 53.9% and 41.6% of the single and married participants respectively, while 39.5% and 49.4% of those participants were obese. There was a significant association between marital status and BMI (P= 0.001). Married (49.4%) participants in this study were obese than single (39.5%), divorced (2.5%), cohabitation (4.9%) and widowed (3.7%). Six participants had no education. Most of the participants (134) had secondary education, followed by those with primary education (75). No relationship was found between level of education and BMI (P= 0.651). From the unemployed category, 75.0% were underweight, 67.0% had normal weight while 62.9% and 69.1% were overweight and obese. Of the study participants, 17.0% of the self-employed participants had normal weight while 23.6% and 18.5% were overweight and obese respectively. A few number of

student were underweight (18.8%), normal weight (12.5), overweight (9.0%) and obese (8.6%). No association between level of education and BMI was found (P= 0.374).

Table 4.8: Socio-demographic Characteristics and BMI categories (n= 298)

Variables		Underweight n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	P-values
Gender	Male	7 (43.8)	62 (55.4)	33 (37.1)	14 (17.3)	0.000**
	Female	9(56.2)	50 (44.6)	56 (62.9)	67 (82.7)	
Age (yrs)	20-29	9 (56.3)	40 (35.7)	19 (21.3)	18 (22.2)	0.020*
	30-39	2 (12.5)	44 (39.3)	38 (42.7)	34 (42.0)	
	40-49	0 (0)	14 (12.5)	15 (16.9)	14 (17.3)	
	50-60	5 (31.3)	14 (12.5)	17 (19.1)	15 (18.5)	
Marital status	Single	9 (56.3)	68 (60.7)	48 (53.9)	32 (39.5)	0.001**
	Married	7 (43.8)	40 (35.7)	37 (41.6)	40 (49.4)	
	Divorced	0 (0)	3 (2.7)	1 (1.1)	2 (2.5)	
	Cohabitating	0 (0)	1 (0.9)	0 (0)	4 (4.9)	
	Widowed	0 (0)	0 (0)	3 (3.4)	3 (3.7)	
Education level	None	1 (6.3)	0 (0)	3 (3.4)	2 (2.5)	0.651
	Primary	4 (25.0)	27 (24.1)	22 (24.7)	22 (27.2)	
	Secondary	8 (50.0)	54 (48.2)	34 (38.2)	38 (46.9)	
	P/matric	1 (6.3)	12 (10.7)	8 (9.0)	2 (2.5)	
	Tertiary	2 (12.5)	15 (13.4)	12 (13.5)	12 (14.8)	
	Certificate	0 (0)	1 (0.9)	0 (0)	1 (1.2)	
	Diploma	0 (0)	1 (0.9)	1 (1.1)	1 (1.2)	
	Degree	0 (0)	2 (1.8)	9 (10.1)	3 (3.7)	
Employment status	Unemployed	12 (75.0)	75 (67.0)	56 (62.9)	56 (69.1)	0.374
	Employed	0 (0)	19 (17.0)	21 (23.6)	15 (18.5)	
	Self-employed	1 (6.3)	4 (3.6)	4 (4.5)	3 (3.7)	
	Student	3 (18.8)	14 (12.5)	8 (9.0)	7 (8.6)	

SES	Low	10 (100)	73 (91.3)	57 (81.4)	67 (94.4)	0.821
	Middle	0 (0)	2 (2.5)	6 (8.6)	1 (1.4)	
	High	0 (0)	5 (6.3)	7 (10.0)	3 (4.2)	
Smoking	Yes	3 (18.8)	21 (18.8)	5 (5.6)	3 (3.7)	0.001**
	No	13 (81.3)	91 (81.3)	84 (94.4)	78 (96.3)	
Alcohol	Yes	4 (25.0)	32 (28.6)	19 (21.3)	10 (12.3)	0.05**
	No	12 (75.0)	80 (71.4)	70 (78.7)	71 (87.7)	
Daily food	Pap	16 (100)	111(99.1)	89 (100)	81 (100)	0.335
	Bread	0 (0)	1 (0.9)	0 (0)		
Fast-food	Do not eat	4 (25.0)	20 (17.9)	13 (14.6)	10(12.3)	0.371
	Once a week	1 (6.3	5 (4.5)	4 (4.5)	8 (9.9)	
	2/3 times a week	4 (25.0)	10 (8.9)	3 (3.4)	8 (9.9)	
	1/ 2 times a month	6 (37.5)	66 (58.9)	61 (68.5)	51 (63.0)	
	Daily	1 (6.3)	11 (9.8)	8 (9.0)	4 (4.9)	
Health conditions						0.095
	None	14 (87.5)	106 (94.6)	73 (82.0)	69 (85.2)	
	Diabetes	1 (6.3)	1 (0.9)	3 (3.4)	2 (2.5)	
	Heart disease	0 (0)		1 (1.1)	0 (0)	
	Asthma	0 (0)		2 (2.2)	0 (0)	
	High blood pressure	1 (6.3)	5 (4.5)	10 (11.2)	10 (12.3)	

Of the underweight category, 10 (100%) had low socio-economic status (SES). None of the underweight participants had middle and/ or high socio-economic status. Ninety-one point three percent (91.3%), 2.5% and 6.3% of the normal weight study participants had low, middle and high

socio-economic status respectively, while 81.4%, 8.6% and 4.2% under these three socio-economic status categories were overweight. Of the obese participants in this study, 94.4% had low socio-economic status while the remaining 1.4% and 4.2% had middle and high socio-economic status respectively. No relationship was found between socio-economic status and BMI (P= 0.821). From the underweight category, 3 (18.8%) were smokers whereas13 (81.3%) were non-smokers. Eighteen point eight percent (18.8%) and 81.3% of smokers and non-smokers respectively, had a normal weight. Majority of the participants (94.4% and 96.3%) who are non-smokers were overweight and obese respectively. Negative association was found between smoking and obesity (BMI) (P= 0.001). Alcohol consumption was also inversely correlated to obesity (P=0.05). Participants who uses alcohol were less likely to be obese than those who don't. Two hundreds and ninety-seven (99.9%) study participants eat pap daily while only one person eat bread. Eighty-nine and 81 study participants who eat pap were overweight and obese respectively. The association of fast-food and health condition with obesity (BMI) was also assessed. No relationship was found between those variables and obesity (P= 0.371; P=0.095%).

Table 4.9: Linear regression analysis of socio-demographic characteristics with BMI among adults in Ha-Tshikundamalema area ([abc]) (n= 298)

Characteristics	Correlation coefficient (95% CI)	p- value	Standard error
Gender	2.74 (1.15 to 4.33)	0.001*	0.81
Age	0.67 (-0.00 to 0.14)	0.057	0.35
Marital status	1.02(0.07 to 1.97)	0.035*	0.48
Smoking	−0.61(0.24 to 6.14)	0.034*	1.50
Alcohol consumption	−0.19(−2.44 to 2.06)	0.869	1.14

a.dependent variable: BMI; b.R=0.352; c.R^2= 0.124; *P< 0.05

Table 4.9 presents the linear regression analysis performed on socio-demographic variables that were significantly associated with BMI. In linear regression analysis of the variables that showed significant relationship with obesity (BMI), a statistical significant association of gender and BMI was observed (P= 0.001). Most of the female participants were overweight and obese. No association of age with BMI was found when the regression analysis was done. A positive association of marital status with obesity was observed (P= 0.035), married people were more likely to be obese that divorced, widowed and cohabiting participants. There was a negative association between smoking and BMI, there more you smoke, and the lesser the BMI. No association of alcohol consumption with BMI was observed (P=0.869).

4.6.2 Association of socio-demographic characteristics with WC

Table 4.10: Socio-demographic characteristics and WC categories (n= 298)

		WC			
Variables		Ideal n (%)	High n (%)	Very high n (%)	P-values
Gender	Male	106 (61.6)	4 (8.7)	6 (7.5)	0.000**
	Female	66 (38.4)	42 (91.3)	74 (92.5)	
Age (yrs)	20-29	63 (36.6)	9 (19.6)	14 (17.5)	0.014*
	30-39	61 (35.5)	19 (41.3)	38 (47.5)	
	40-49	17 (9.9)	10 (41.3)	16 (20.0)	
	50-60	31 (18.0)	8 (17.4)	12 (15.0)	
Marital status	Single	104 (60.5)	22 (47.8)	31 (38.8)	0.001**
	Married	63 (36.6)	20 (43.5)	41 (51.3)	
	Divorced	2 (1.2)	2 (4.3)	2 (2.5)	
	Cohabitation	1 (0.6)	0 (0)	4 (5.0)	
	Widowed	2 (1.2)	2 (4.3)	2 (2.5)	
Level of education	None	3 (1.7)	0 (0)	3 (3.8)	0.320
	Primary	37 (21.5)	14 (30.4)	24 (30.0)	
	Secondary	76 (44.2)	20 (43.5)	38 (47.5)	
	Passed matric	16 (9.3)	6 (13.0)	1 (1.3)	
	Tertiary	31 (18.0)	2 (4.3)	8 (10.0)	
	Certificate	1 (0.6)	0 (0)	1 (1.3)	
	Diploma	1 (0.6)	0 (0)	2 (2.5)	
	Degree	7 (4.1)	4 (8.7)	6 (3.8) 7	
Employment status	Unemployed	104 (60.5)	35 (76.1)	60 (75.0)	0.015*
	Employed	35 (20.3)	6 (13.0)	15 (18.8)	
	Self-employed	5 (2.9)	3 (6.5)	3 (3.8)	
	Student	28 (16.3)	2 (4.3)	2 (2.5)	

Socioeconomic-status	Low	101 (87.1)	39 (90.7)	67 (93.1)	0.335
	Middle	5 (4.3)	3 (7.0)	1 (1.4)	
	High	10 (8.6)	1 (2.3)	4 (5.6)	
Smoking	Yes	26 (15.1)	3 (6.5)	3 (3.8)	0.016*
	No	146 (84.9)	43 (93.5)	77 (96.3)	
Alcohol	Yes	50 (29.1)	5 (10.9)	10 (12.5)	0.128
	No	122 (70.9)	41 (89.1)	70 (87.5)	
Food eaten daily	Pap	171 (99.4)	46 (100)	80 (100)	0.835
	Bread	1 (0.6)	0 (0)	0 (0)	
Fast-food	Do not eat	25 (14.5)	12 (26.1)	10 (12.5)	0.574
	Once a week	9 (5.2)	1 (2.2)	8 (10.0)	
	2/3 times a week	17 (9.9)	2 (4.3)	6 (7.5)	
	1/ 2 times a month	105 (61.0)	27 (58.7)	52 (65.0)	
	Daily	16 (9.3)	4 (8.7)	4 (5.0)	
Health conditions	None	153 (89.0)	40 (87.0)	69 (86.3)	0.263
	Diabetes	3 (1.7)	1(2.2)	3 (3.8)	
	Heart disease	1 (0.6)	0 (0)	0 (0)	
	Asthma	1 (0.6)	1 (2.2)	0 (0)	
	High blood pressure	14 (8.1)	4(8.1)	8 (10.0)	

Table 4.10 presents the association of socio-demographic characteristics of the study participants with WC. In this study, 106 (61.6%) males and 66 (38.4%) females had ideal WC while 8.7% and 91.3% of both male and female participants had high WC. Very high WC was observed among 7.5% males and 92.5% females. Females had higher WC than males. There was a relationship between gender and WC (abdominal obesity) (P=0.000) among the study participants. Of the

ideal WC category, 36.6%, 35.5%, 9.9% and 18.0% were of age category 20-29, 30-39, 40-49 and 50-60 respectively. High WC was observed in 19.6% 20-29 years, 41.3% 30-39 years, 41.3% 40-49 and 17.4 50-60 years. Fourteen participants (17.5%) of age category 20-29 had very high WC while 47.5%, 20.0% and 15.0% of age category 30-39, 40-49 and 50-60 had very high WC respectively. The positive association of age with WC was observed in this study (P= 0.014). One hundred and four (60.5%) and 63 (36.6%) of single and married participants had ideal WC while only 1.2%, 0.6% and 1.2% of the divorced, cohabiting and widowed study participants also had ideal WC. Of the high WC category, 47.8%, 43.5%, 4.3% and 4.3% were single, married, divorced and widowed respectively. Thirty one (38.8%) and 41 (51.3%) of single and married participants had very high WC respectively, while a few percentage of divorced (2.5%), cohabiting (5.0%) and widowed (2.5%) also had a very high WC. Association of marital status with WC was observed (P= 0.001).

Of the six participants who never went to school, 3 (1.7%) had ideal WC while 3 (3.8%) had very high WC. None of them had a high WC. Of those who received primary education, 37 (21.5%), 14 (30.4%) and 24 (30.0%) had ideal, high and very high WC respectively. Out of 134 study participants who had secondary education, 76 (44.2%) had ideal WC while 20 (43.5%) and 38 (47.5%) had high and very high WC respectively. Nine point three percent (9.3%), 13.0% and 1.3 % of those who passed matric, and 18.0%, 4.3% and 10.0% of the participants at tertiary level had ideal, high and very high WC respectively. Certificate, diploma and a degree were held by 2, 2 and 14 participants respectively. Of those who had certificate 1 (0.6%) had ideal WC while the other one had a very high WC. Zero point six percent (0.6%) and 2.5% of those with diploma had ideal and very high WC respectively. Seven study participants with a degree had ideal WC while 4 (8.7%) and 3 (3.8%) had high and very high WC respectively. One hundred and four (60.5%), 35 (20.3%), 5 (2.9%) and 28 (16.3%) of the unemployed, employed, self-employed and students had ideal WC respectively. Seventy-six point one percent (76.1%) and 75.0% of the unemployed participants had high and very high WC respectively. From employments status category, 6 (13.0%) and 15 (18.8%) of the employed participants had high and very high WC, while only 6.5% and 3.8% of the self-employed participants fall under the same categories. Four of the students had high 2 (4.3%) and very high 2 (2.5%) WC. Association of employment status with WC was found among the study participants (P=0.015).

One hundred and one (87.1%) of low socio-economic status category had ideal WC while 39 (90.7%) and 67 (93.1%) had high and very high WC. From the middle socio-economic status category, 5 (4.3%), 3 (7.0%) and 1 (1.4%) had ideal, high and very high WC respectively. Of the

high socio-economic status group 10 (8.6%) had ideal WC while 1 (2.3%) and 4 (5.6%) had high and very high WC respectively. No correlation of socio-economic status with WC was observed (P=0.335). From the ideal WC category, 26 (15.1%) were smokers while 146 (84.9%) were non-smokers. A large number of non-smokers had high (93.5%) and very high (96.3%) WC when compared to 6.5% and 3.8% of the smokers respectively. Smoking was negatively associated with WC (P=0.016). There more you smoke, the lesser the WC. Amongst the study participants who consumed alcohol, 50 (29.1%) had ideal WC while 5 (10.9%) and 10 (12.5%) had high and very high WC.

Table 4.11: Linear regression analysis of socio-demographic characteristics with WC among adults in Ha-Tshikundamalema area ([abc]) (n= 298)

Characteristics	Correlation coefficient (95% CI)	p- value	Standard error
Gender	5.46 (1.96 to 8.96)	0.002*	0.44
Age	0.13 (−0.23 to 0.29)	0.99	0.74
Marital status	2.26(0.18 to 4.35)	0.034*	0.23
Smoking	4.23(−1.15 to 9.60)	0.123	0.66
Employment status	−0.41(−2.11 to 1.29)	0.635	1.07

a.dependent variable: WC; b.R=0.323; c.R^2=0.104; P< 0.05

One hundred and twenty-two (70.9%), 41 (89.1%) and 70 (87.5%) of those who don't consumed alcohol had ideal, high and very high WC. There was no relationship between alcohol consumption and WC in this study (P=0.128). Majority of the study participants eat pap and only one person eat bread. Of those who eat pap daily, 171 (99.4%), 46 (100%) and 80 (100%) had ideal, high and very high WC. A significant association of food eaten daily with WC was not found (P=0.574). Twenty-five (14.5%), 12 (26.1%) and 10 (12.5%) of the study participants who don't eat fast-food had ideal, high and very high WC. Participants who eat fast-food once a week were 18, 9 (5.25%) had ideal WC, 1 (2.2%) had high WC and 8 (10.0%) had very high WC. Of the 2-3 time a week fast-food consumption category, 17 (9.9%) had ideal WC, 2 (4.3%) had high WC while 6 (7.5%) had very high WC. One hundred and five of the study participant who eat fast-food once/twice a month had ideal weight while 27 (58.7%) and 52 (65.0%) had high and very high WC respectively. Fast-food were consumed daily by 24 participants, 16 (9.3%) of them had ideal weight while the remaining 8 had high 4 (8.7%) and very high 4 (8.7%) WC. Fast-food consumption was not correlated to WC (P=0.574). Out of the 262 participants who don't have any health problems, 153 (89.0%) had ideal WC, 40 (87.0%) had high WC and 69 (86.3%) had very high WC. From the ideal WC category, 3 (1.7%) had diabetes, 1 (0.6%) had Heart disease, 1

(0.6%) had Asthma and 14 (8.1%) had high blood pressure. Only one participant (2.2%) with diabetes had high WC while three (3.8%) had very high WC. One participant (2.2%) with asthma had high WC, while 4 (8.1%) and 8 (10.0%) of participants with high blood pressure had high and very high WC respectively. Health conditions were not significantly associated with WC (P=0.263).

Table 4.11 presents the regression analysis performed on socio-demographic variables that were significantly associated with WC. In regression analysis, gender was significantly associated with WC (P=0.002). Females were 5 times more likely to be obese than males. No association was found (P= 0.99) between age and WC (central obesity), meaning that age could not independently influence the high WC (abdominal obesity) of the study participants. Marital status was significantly associated with the WC (P= 0.034) of the participants, with married people being 2 times more likely to have high WC. Regression analysis results revealed no significant association of smoking (P= 0.123) and employment status (P= 0.635) with WC.

4.7 Summary of the findings

Objective 1: Assess sedentary lifestyle and physical activity patterns among the participants

- Almost seventy-six percent (75.8%) of the participants watched TV. Of those who watched TV, 73.9% watched it for more than 1 hour per day and 63.7% don't eat when watching TV.
- Sixty-seven point one percent (67.1%) of the study participants spent 1-3 hours sitting per day.
- Almost seventy percent (69.8%) of the participants in this study spent less than one hour driving to and from places per day.
- Of the employed participants, 38.2%, 16.4% and 45.5% spent < 2 hour, 2-4 hours and more than 4 hours sitting at their work places respectively.
- Fifty-eight point four percent (58.4%) perform household chores/gardening for more than 6 hours per day.
- The majority (96.0%) of the study participants walk/ bicycle continuously for more than ten minutes daily.
- Thirty point nine percent (30.9%) and 17.4% of the study participants engaged in vigorous and moderate sports/ fitness or leisure activities.

- Almost thirty-six percent (35.5%) and 27.4% of the working participants do vigorous and moderate activity as part of their work.

Objective 2: Determine obesity status of the participants using body mass index (BMI) and waist circumference (WC).

- Generally, five point four percent (5.4%) were underweight, 37.6% had normal weight, and 29.9% and 27.7% were overweight and obese respectively.
- One hundred and seventy two (57.7%) of the participants in this study had ideal WC and, 15.4% and 26.8% had high and very high WC.

Objective 3: Establish the relationship between obesity and sedentary lifestyle patterns among adults in Ha-Tshikundamalema area.

- Generally, almost seventy nine percent (78.7%) of those who watched TV were overweight. No association was found between TV viewing and BMI (obesity) (P= 0.775).
- The majority (85%) of the participants who watched TV for more than one hour per day were obese while 80% of them were overweight. There was a positive association of TV viewing time with BMI (obesity) (P= 0.029), Food eaten while watching TV was also associated with BMI (P=0.022). No significant association was found between sedentary behaviours such as computer time, chatting etc (P= 0.571), driving time (P=0.607%), work sitting time (P= 0.820), eating time (P= 0.773) and total sitting time (P= 0.356).
- Inverse association of household chores/gardening with BMI was observed (P=0.014).
- In general, no association was found between walking and BMI (obesity).
- Seventy five point three percent (75.3%) and 79.0% of those who didn't engage in vigorous sports/fitness or leisure activities were overweight and obese, a significant association of vigorous activity with BMI was observed (P= 0.01), no association of moderate sports/fitness or leisure activities with BMI was observed (P= 0.086).
- Generally, most of the participants who didn't do vigorous activity as part of their work were overweight (73.9%) and obese (76.5%), work vigorous activity was significantly associated with BMI (P= 0.013), no association of work moderate activity with BMI was observed among the study participants (P= 0.296).

- Seventy eight point three percent (78.3%) and 76.3% of the participants who viewed TV had high and very high WC, a significant correlation of TV viewing time with WC was found (P= 0.001).
- Generally no association of various sedentary activities with WC was observed.
- Household chores/gardening was significantly associated with WC (P= 0.053).
- The majority of the participants (96.5%) who walked for more than 10 minutes per day had ideal WC and no association was found (P= 0.844).
- Generally, no association of vigorous and moderate sports/ fitness or leisure activities with WC was observed (P=0.084, P= 0.791).
- Vigorous work activity was significantly associated with WC (P= 0.006), whereas moderate work activity was not associated with WC.

Association of socio- demographic characteristics with obesity (BMI and WC)

Since most of the variable were not associated with obesity, the researcher move further and assess the relationship of socio-demographic characteristics with obesity.

- Generally, 62.9% and 82.7% of females were overweight and obese when compared to 37.1% and 17.3% of males, gender was associated with BMI (P=0.000). Females were more likely to have high BMI than males.
- Significant positive association of age with BMI was observed (P= 0.020).
- Forty-nine point four percent (49.4%) of married participants were obese, marital status was significantly associated with BMI (P=0.001).
- No association was found between level of education, employment status and socio-economic status, and BMI (obesity) (P=0.651; P=0.374; P= 0.821).
- Majority of the participants who are non-smokers were overweight (94.4%) and obese (96.3%) and 81.3% of smokers had normal BMI. Smoking was negatively associated with high BMI (obesity) (P= 0.001).
- Most of the participants who don't drink alcohol were overweight (78.7%) and obese (87.7%). Alcohol consumption was negatively associated with BMI (P= 0.05).
- No association of food eaten daily, fast-food and health conditions with BMI (P= 0.335. P= 0.371, P= 0.096).

- The majority of female participants had high (91.3%) and very high (92.5%) WC when compared to males (8.7% and 7.5%). Association of gender with WC was observed (P= 0.000).
- Age was also associated with WC (P=0.014).
- Marital status was also associated with WC (P= 0.001), most of the married participants (51.3%) had high WC (abdominal obesity).
- Most of the participants with secondary education had high (43.5%) and very high (47.5%) WC; no association was found (P= 0.320).
- Association of employment status with WC was observed (0.015).
- The majority of the participants with low socio-economic status had ideal (87.1%), high (90.7%) and very high (93.1%). Socio-economic status was not significantly associated with WC (P= 0.335).
- The majority of the non-smokers had high (93.5%) and very high (96.3%) WC when compared to 6.5% and 3.8% of the participants who smokes, and a significant association was observed (P=0.016).
- No association of alcohol consumption, food eaten, fast-food and health conditions with WC was found (P= 0.128, P=0.835, P= 0.574, P= 0.263).

4.8 Conclusion

This chapter presented the analyzed and interpreted results section by section. A summary of the findings was also presented. The next chapter discussed the findings, and gives conclusions, implications and recommendations based on the findings.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS OF THE STUDY

5.1 Introduction

The previous chapter presented analyzed and interpreted results of this study. This chapter discusses findings and draws conclusions on the study based on the objectives of the study. Recommendations are also given based on study findings. The chapter is structured as follows: discussions of the findings in which the researcher elaborate on the findings and link them with the existing literature; conclusions: the researcher states the conclusions made from the discussions of the results; implications of the study: a discussion on what the research conclusion to the health and public community in general; and recommendations, a section in which major ideas could be utilized in the quest to improve obesity and sedentary lifestyle awareness and adults attitudes towards prevention of obesity.

5.2 Discussion of the findings

5.2.1 Assess sedentary lifestyle and physical activity patterns among the participants

This study revealed that almost seventy-six percent (75.8%) of Ha-Tshikundamalema adult population watch TV. Of those who watch TV, 73.9% watched it for more than 1 hour per day and 63.7% don't eat when watching TV. The findings were consistent with those made by Heinonen et al. (2013) and Little, Humphries, Patel and Dewey (2016). In Cleland, Schmidt, Dwyer and Venn (2008) study, all participants reported to be watching TV, and most of them watched it for more than 1 hour per day. TV viewing for more than 1 hour by this study participants could be because of unemployment as 66.8% of the study participants were unemployed. Most of the study participants (67.1%) spent between 1-3 hours (69%) males and 65.9% (females) sitting (on computer screen, reading books, listening music or chatting with friends) per day. In this study, 69.8% of the participants spent less than one hour driving to and from places whereas 45.5% of the working population spent less than two hours sitting at their work places performing their duties. Participants in this study spent most of their time in sedentary activities which are TV viewing, computer screen, driving and sitting at work places. Consistently, a study by Patil, Dhoble and Kaware (2017) revealed that 59% of the study participants were having a sedentary lifestyle (includes sitting on TV or computer screen, chatting with friends and sitting at work places).

Sedentary lifestyle is independently associated with obesity and mortality from CVDs, hypertension, diabetes and other health conditions (Mfrekemfon, 2015).

Household chores, gardening/shopping in the past month was done for 3-6 hours by 58.4% of the participants. These activities were done mostly by females as shown in table 4.3. The majority (96%) of the participants in this study reported that they walk continuously for at least 10 minutes per day; 59.1% of them walk for more than 5 days per week; and 51.0% walk more 30-60 minutes per day. The high percentage of participants walking daily could be because of being in a deep rural areas where people are to walk long distance to reach their nearest shops, clinics and schools. The findings of this study is contrary to the findings of the study done by Al-Nakeeb, Lyons, Collins, Al-Nuain, Al-Hazza, Duncan and Nevill (2012). The study also revealed that 69.1% of the study participants do not engage in vigorous sports/ fitness or leisure activity; 52.2% of those who do vigorous activity do it for less than 3 days per week; lastly, 47.8% do vigorous activity for 30-60 minutes per day. Vigorous activity was done more by males (50.9%). For moderate sports/fitness/ leisure, 82.6% reported that they don't engage in moderate activity and it was done by 17.4% of the participants. Less participation in vigorous and moderate activity among adults from Ha-Tshikundamalema might be due to lack of sports grounds, leisure parks and facilities that are suitable to engage in physical activities and sport. There are only four sports grounds in the whole area of Ha-Tshikundamalema which are utilized only by males. These results are related to other studies. Al-Nakeeb et al. (2012) found the high prevalence of low level of physical activity among youth. Similar results was also found by Patil et al. (2017) in India. Twenty seven percent (27%) and 14% were having moderate and vigorous active lifestyle. Researchers revealed that insufficient physical activity is associated with the development of obesity, which is one of the major risk factors of non-communicable diseases; non-communicable diseases is a major burden in South Africa today.

5.2.2 Determine obesity status of the participants using BMI and WC

A high prevalence of overweight (29.9%) and obesity (27.2%) was found in this study, underweight was rare (5.4%) and 37.6% had normal weight. A high percentage of obesity was seen among females (36.8%) than males (12.1%). Obesity is seen as a major cause of mortality and morbidity worldwide and it has become a major public health problem. Previously, it was seen as a problem of the developed countries; but now the trends increase in both underdeveloped and developing countries such as South Africa; every region is affected by obesity (Centre for

Disease Control and Prevention, 2014; Doku & Neupane, 2015). This study findings concur with the previous studies conducted in South Africa, showing a high prevalence of obesity (Adeniyi, Longo-mbeza & Goon, 2015; Goon, Libalela, Amusa & Muluvhu, 2013; Van den Berg, Okeyo, Danhausser & Mariette, 2012). A study by Owolabi, Goon, Adeniyi, Adedokun & Seekoe (2017) found a high prevalence of obesity of 46.0% among South African adults in Eastern Cape. In comparison with the findings of other studies done in developed countries (Al-Nakeeb et al., 2012; Poobalon & Auccot, 2016; Rengma, Sen & Mondal, 2015), South Africa suffers a greater burden of obesity. This study also found high percentage of participants with ideal waist circumference. Twenty-six point eight percent (26.8%) of the study population had abdominal obesity which is defined by a very high WC. Similar to BMI results, abdominal obesity was more prevalent among females (40.7%) than males (5.2%). What has been found in this study is consistent with what had been found by other researchers from South Africa (Puoane et al., 2002; Goon et al., 2014) and Australia (Cleland et al., 2008).

5.2.3 Establish the relationship between obesity and sedentary lifestyle among adults in ha- Tshikundamalema area

i) Body Mass Index (BMI) correlates

In this study, 78.7% and 74.1% of the participants who watch TV were overweight and obese respectively. Based on the findings, participants who watch TV were more likely to be obese than those who don't. The majority of participants who watch TV for more than 1 hour per day were overweight (80.0%) and obese (85.0%). TV viewing time and energy intake were significantly associated with obesity. This study findings concurred with other studies conducted in developed countries (Little, Humphries, Patel & Dewey, 2016; Heinonen et al., 2013). TV viewing time and food were not seen as independent risk factors of obesity (larger BMI) in this study as it was revealed by regression analysis results, which showed no relationship. Surprisingly, sedentary behaviors (computer time, driving, sitting at work and total sedentary time per day) were not significantly associated with obesity, consistent to the findings of the study done by Little et al. (2016) in India. This study's findings are contrary to the findings in various countries (Heinonem et al., 2013; Brown, Williams, Ford, Ball & Dobson, 2004). Additionally, Al-Nakeeb et al. (2012) found a positive association of computer time with obesity. This indicates that the more time spent on computer screen, the higher the chance of gaining weight.

There was negative association of household chores, walking days and time, with obesity. Participants who do household chores or walk continuously for more than 10 minutes per day were more likely to have lesser BMI. Vigorous physical activity was done by only 92 participants. Most of the participants who didn't engage in vigorous activity were overweight (75.3%) and obese (79.0%). Involvement in vigorous physical activity was inversely associated with BMI. These findings support the ideas raised by the NDOH that insufficient physical activity is one of the major causes of overweight and NCDs burden in South Africa (NHOH, 2013). No association of moderate physical activity with obesity was found, but overweight and obesity were more prevalent among participants who were not involved in moderate activity. This indicates that the more active you are, the lesser the BMI. Moreover, doing vigorous activity as part of work in the work place was strongly and independently associated with low or normal BMI. Physical activity has been described by WHO as one of the most important measure to improve general health and prevent or decrease the increasing burden of NCDs worldwide (WHO, 2017). When people engage in physical activity, they are less likely to be overweight and obese. Less engagement in physical activity increases the risks of development of various disease. Obese people are more likely to be physical inactive due to their high weight status, which in turn could lead to the development of metabolic syndrome. Similarly, Al-Nakeeb et al. (2012), found low levels of physical activity and high percentage of overweight and obesity among their study participants. Studies by Patil et al. (2017), Little et al. (2016), and Vaidya and Krettek (2014), found a significant association between levels of physical activity and obesity status. Their findings were concordance with this study findings.

ii) Waist circumference (WC)

There was a high prevalence of high (78.3%) and very high (76.3%) WC among participants who reported that they view TV. Time spent watching TV was directly associate with very high WC (abdominal obesity). A high prevalence of abdominal obesity (WC > 102 cm and > 88 cm) was found among study participants who watch TV for more than 1 hour per day. This study findings were consistent with the findings from Heinonem et al. (2013) study. Lakerveld, Dustan, Bot, Dekker, Nijpels & Owen (2011) also find similar results. Cleland et al. (2008) study find the positive association of food and beverages consumed when watching TV with abdominal obesity, consistent with this study findings. No association was found between other sedentary activities (computer time, driving time, sitting at work and total sitting time) and WC. Contrary to the present study findings, Myers, Gibbons, Finlayson and Blundell (2016) found a positive association

between sedentary behaviors and WC. Furthermore, sitting for more than 42 hours per week was associated with metabolic syndrome in Myers et al. (2016) study.

Of all the physical activity variables, household chores/gardening, walking days and work vigorous activity were significantly associated with abdominal obesity. Though, there was no significant association between moderate-vigorous physical activity and abdominal obesity, individuals who don't engage in moderate-vigorous physical activity had very high waist circumference (86.3%; 81.3%). Consistent to this study findings, Myers et al. (2016) found a negative significant association of moderate-vigorous physical activity with abdominal (central) obesity, meaning that there more you engage in physical activity, the lesser the waist circumference (cm). Rathnayake, Roopasingam and Dibley (2014), found a significant negative association between energy expenditure from physical activity and WC. A study by Xiao, shen, chu, Gao, Xu, Huang et al, (2016) showed that less sitting and more vigorous activity is associated with low risks of central obesity and metabolic syndrome. Moreover, physical inactivity is associated with poor health and excessive waist circumference (Asztalos, huybrechts, Temme, van Oyen & Vandervijvere, 2013).

5.2.4 Correlation of socio-demographic characteristics with obesity (BMI and WC)

i) Correlation Socio-demographic characteristics with BMI

Demographic characteristics such as gender, age and marital status were the significantly associated with increased BMI (overweight and obesity) among the participants of this study. This study findings were similar to previous studies conducted in South Africa and other countries (Owolabi et al., 2017; Addo, Nyarko, Sackey, Akweongo & Sarfo, 2015; Rengma et al., 2015) which showed that female gender, age and being married are the significant risk factors of overweight and obesity. In this study, the higher percentage of Overweight and obesity was found among females, middle aged (30-39 years) and married participants. However, various studies in developed countries found male gender to be strongly associated with higher/ increased BMI (Murray & Ng, 2016; Cai, Han, Qi, Li, Zhang & Liu, 2014). According to Chukwuonye, Chuku and John (2013), higher percentage of overweight and obesity among females is due to lesser involvement in vigorous or hard activities. This could also explain why overweight and obesity are more prevalent among married than in single, divorced, cohabiting and widowed study participants. In addition, physiological changes occurring after giving birth also contribute to excessive weight gain (Gunderson, 2009).

Consistent with Rengma et al. (2015), overweight and obesity were significantly higher among middle-age participants (30-39 years) than lower ages; contrary to studies conducted in china and Uganda (Kirunda, Fadness, Wamani, Broeck & Tylleskar,, 2015; Cai et al., 2014). As people grow, they tend to lose muscle-mass and gain fat mass (Rosmond, 2004). Level of education, employment and socioeconomic statuses were not significantly associated with overweight and obesity ($P > 0.05$). However, higher percentage of overweight and obesity was found among those who received primary (24.7%, 48.2%) and secondary education (27.2 %, 46.9%); unemployed (62.9%, 69.1%); and low socioeconomic status (81.4%, 94.4%). Contrary to the findings of this study, Sen, Mondal and Dutta (2013), found a significant association between level of education and BMI. Though, there was no significant association found in this study, education has an inverse risk of overweight and obesity, the lesser the education level, the higher the BMI. No significant association was found between socioeconomic makers (education, income and house/property-owned) and obesity. However, the majority of the participants under the low socioeconomic status category were overweight (81.4%) and obese (94.4%). Inconsistent to this study's findings, Little et al. (2016) found a significant association of low socioeconomic status with underweight. This has also been found by studies conducted in other countries rural areas (Zaman, Patel, Hillis, Krishnam, Raju, Neal & Chow, 2012; Kinra, Bowen, Lyngdoh, Prabhakaran, Reddy & Ramakrishnan, 2010). The higher percentage of overweight (81.4%) and obesity (94.4%) among participants under low socioeconomic status in this study might be due to the kind of food eaten daily by poor participants. Majority of participants (99.1%) eat pap daily, which is high in energy.

The findings from this study indicated that there was a significant association of smoking and alcohol use with overweight and obesity. This study's findings corroborate previous reports (Owolabi et al., 2017; Little et al., 2016; Kindura et al., 2015). In this study, current smokers were less likely to be overweight and obese (5.6%, 3.7%) which corroborate with previous reports showing unintended weight loss among smokers (Traversy & Chaput, 2015). Also, study participants who drink alcohol were less likely to be overweight (21.3) and obese (12.3%). There seems to be a negative association between alcohol use and obesity. The strong association of alcohol consumption with obesity has been advocated in many studies (Sen et al., 2013; Traversy & Chaput, 2015; Shelton & Knott, 2014). In Cready and Kyle (2016) study, no clear association was found between alcohol use and obesity; they concluded that weight gain among alcohol users was due to gender influence and insufficient physical activity. The findings of this study showed no significant association of food eaten daily, fast food and health conditions with BMI or obesity.

Overweight and obesity were prevalent among people who have had pap daily, who don't consume fast-food and those who are in good health.

ii) Correlation of socio-demographics characteristics with WC

In the present study, gender, age, marital status was significantly associated with WC. Very high WC (abdominal obesity) was more prevalent in females (92.5%), middle age group (47.5%) and married people (51.3%). Vasilic-Brasnjevic, Marinkovuc, Vlajinac, Jakovljevic, Nikic and Maksimovic (2016) found similar results in their study. This association also supported the findings of Castro, Nunes and Silva (2016) study. Contrary to my study findings, researchers from Europe found that being a male was associated with abdominal obesity (higher WC circumference) (Stewart-Knox, Duffy, Bunting, Parr, Vas de Almeida & Gibney, 2012). Most of the participants with low level of education had higher WC, but no significant association was found between level of education and WC. Studies done in other countries found a significant association between education and WC, less education were independent predictors of having larger WC (cm) (Stewart-Knoz et al., 2012; Vasilic-Brasnjevic et al., 2016). The findings of this study showed a significant association of employment status with abdominal obesity. Participants who were unemployed were more likely to be obese than employed participants. Higher percentage of abdominal obesity among unemployed participants might be because of sedentary lifestyle and kind of food they eat daily. This study findings corroborate with other studies done in developing countries (Correa, Ingram, Canossa-Terris, Comerford & Kurlansky, 2005; Vasilic-Brasnjevic et al., 2016; Stewart-Knox et al., 2012). Employment was the only socioeconomic makers significantly associated with abdominal obesity. More surprisingly, individuals with low socioeconomic status had abdominal obesity (93.1%) than those at middle (1.4%) and high (5.6%) socioeconomic status, and no significant association was found.

Of the remaining sociodemographic characteristics, smoking was the only characteristic that was significantly associated with very high WC (abdominal obesity). Participants who reported smoking were less likely to be obese than non-smokers. The findings of this study concur with the reports from other countries (Vasilic-Brasnjevic et al., 2016). This negative association could be because of the reduced food intake by smokers. Studies found that people who quit smoking usually gain adiposity due to the increase urge of eating than smoking (Harris, Zopey & Friedman, 2016; Audrain-McGovern & Benowitz, 2011).

The majority (80%) of the participants who eat pap/starch daily as their main source of energy had abdominal obesity, but no significant association was found. Song, Lee, Paik and Yong (2013) found a significant association of food high in carbohydrates with abdominal obesity. Song et al. (2013) study corroborate with the findings of the study conducted by Rathnayake et al. (2014); their study found a higher prevalence of central obesity and a significant positive correlation between high carbohydrate diet and waist circumference. Fast-food was consumed by few people, and no association of fast-food with abdominal obesity was observed. Contrary to this study's findings, Payaba, Kelishadi, Qorbani, Motlaghe, Ranjbar, Ardalane, Zahedi, Chinian, Asayeshi, Larijani and Heshmat (2015), found that fast-food/ junk food correlate with excessive WC (central obesity). Several studies reveal that food high in energy including pap (starchy) and fatty food (junk food/processed foods) have a high impact on adiposity and total body weight gain (Rathnayale et al., 2014; Payaba, 2015). Physiologically, abdominal obesity (fat stored around the abdomen) is seen as a high risk factor of diabetes, heart disease and high blood pressure (metabolic syndrome) (Westphal, 2008). The majority (86.3%) of the participants who were not suffering from any health problems had abdominal obesity; the researcher was more surprised by this results since abdominal obesity is always associated with metabolic syndrome. Consistent with this study findings, Vasheghani-Farahani, Ashraf, Abolhasani, Hosseini, Jazayeri and Karbalayi (2015), found no significant association between waist circumference and hypertension, diabetes and dyslipidemia. However, central obesity was associated with a higher incidence of development of the risk factors related to cardiovascular diseases (Barroso, Marins, Alves, Gonçalves, Barroso, & de Souza Rocha, 2017). A study by Westphal (2008) found a significant positive association between diabetes, Heart diseases and high blood pressure, and WC (cm). This findings has also between supported by the WHO (2017).

5.3 Limitations of the study

This study has a number of limitations:

- This study was of cross-sectional design, it does not enable the researcher to ascertain the causal relationship between variables.
- Sedentary lifestyle and physical activity patterns were not measured by accelerometers, but with the modified international physical activity questionnaire. There could be conscious or unconscious over or under reporting of sedentary lifestyle and physical activity by the participants.

- BMI and waist circumference were used to measure obesity instead of waist-to-hip ratio or skinfold thickness, which may be the most valid methods of determining obesity. However, BMI and WC are more accurate when comparing people within the same ethnic group (Gallengher, Mariolein, Sepu, Pierson, harris & Heymsfield, 1996).

5.4 Conclusions of the study

Conclusions were drawn based on the findings of this study:

Prevalence of obesity within a population is considered a risk factor of morbidity and mortality. Moreover, sedentary lifestyle and insufficient physical activity, economic development, nutritional transition and improved socioeconomic status have contributed to the increasing prevalence of overweight and obesity. Sedentary lifestyle and insufficient physical activity were more prevalent among this study participants; light activity (walking) was done by the majority of participants (96.0%); in this study, sedentary lifestyle and insufficient physical activity seem to contribute to a higher prevalence of overweight and obesity. According to Mfrekemfon et al. (2015), sedentary lifestyle is independently associated with NCDs such as obesity, cancer, diabetes, and cardiovascular diseases, etc; and physical activity on the other hand is associated with improved overall health including improved body weight and cardiovascular fitness (WHO, 2017). The results of this study suggested that gender, age, being married and unemployment have significantly greater effects on overweight and obesity prevalence. Even though, there was no statistical significant association, high prevalence of overweight and obesity was also seen among participants with less education and low socioeconomic status. These made the researcher conclude that lack of knowledge and poverty have high impact in the increasing prevalence of overweight and obesity among rural dwellers. There is a need to address the challenges of establishing measures that would reduce the ill-effects of sedentary lifestyle and overweight-obesity related morbidity.

5.5 Recommendations of the study

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

- Since obesity was more prevalent, and numerous determinants of obesity were not included in this study, further studies are needed to investigate associations of all determinants of obesity with obesity among rural dwellers.

- A longitudinal study should be done to check causal effects of the independent variables on outcome (dependent) variable.
- Adults in Ha-Tshikundamalema area need to engage more in vigorous activity since less involvement in vigorous-moderate activity was reported; physical inactivity is associated with the development of obesity, which is the major cause of NCDs.
- Government and private sectors must work together to improve rural areas in terms of leisure parks and other training facilities. It could help rural dwellers to be more physically active and females in particular.
- Policy makers must develop and implement any public health programme and appropriate intervention strategies to reduce the prevalence and associated risk factors of overweight and obesity. The programme may include: educating people from rural areas about the health risks associated with sedentary lifestyle, poor diet and obesity; and encourage them to be involved more on sports, fitness or leisure.

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Appendix 1: Ethical Clearance

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Ms VM Ntsieni

Student No:
11541983

PROJECT TITLE: **Sedentary lifestyle among adults in Ha-Tshikundamalema area of Limpopo Province, South Africa.**

PROJECT NO: SHS/17/PH/09/0307

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr TG Tshifangano	University of Venda	Supervisor
Ms M Mohlala	University of Venda	Co- Supervisor
Ms VM Ntsieni	University of Venda	Investigator – Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: July 2017
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Prof. G.E. Ekosse

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2017 -07- 07
Private Bag X5050
Thohoyandou 0950

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950A LIMPOPO PROVINCE SOUTH AFRICA
TELEPHONE (015) 962 8504/8313 FAX (015) 962 9060
"A quality driven financially sustainable, rural-based Comprehensive University"

Appendix 2: Request for a permission to conduct a study in Ha-Tshikundamalema area

University of Venda

Private Bag X 5050

Thohoyandou

0950

10 June 2017

Tshikundamalema Tribal Authority

Ha-Tshikundamalema

PO BOX 1152

Mutale

0956

Dear sir/ madam

Application to conduct a study

I, Ntsieni Vhonani Margareth, hereby request the Tshikundamalema Tribal Authority to allow me to conduct a study in villages around Ha-Tshikundamalema.

The title of the research is “Relationship between sedentary lifestyle patterns and obesity among adults in Ha-Tshikundamalema area of Limpopo Province, South Africa”.

I hope this study will help Tshikundamalema adult population to have a better understanding and knowledge about their health status, health risks and health practices.

Thanking you in advance for considering my application.

Yours faithfully

Ntsieni Vhonani Margareth

Cell: 083 862 2224

Email: ntsienivm@gmail.com

Appendix 3: Permission to conduct a study by Tshikundamalema Tribal Authority

Tshikundamalema Tribal Authority

Enquires: Manakise B Cell: 0726336744

Ntsieni VM

University of Venda

Private Bag X5050

Thohoyandou

0950

Greetings,

Re: Relationship between sedentary lifestyle patterns and obesity among adults in Ha-Tshikundamalema area of Limpopo province, South Africa

The above matter has refers:

1. Permission to conduct a study is granted
2. Kindly be informed that after completion of the study, a copy should be submitted to Ha-Tshikundamalema Tribal Authority to serve as a resource; the findings of this study are be discussed to the community in general.

Your cooperation will be highly appreciated.

Ha-Tshikundamalema tribal Authority **Date: 30 June 2017**

Appendix 4: Questionnaire

Relationship between sedentary lifestyle patterns and obesity among adults in Ha-Tshikundamalema area of Limpopo province, South Africa

Village name……. Questionnaire number…….

House number……. Individual number……

Participant nick name…….. Date……

Instructions:

- Please answer all questions
- For some questions, please tick using a cross[X] in the appropriate box, and for some, please write the appropriate answer in the space provided

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION OF PARTICIPANTS

1. Gender: Male ☐ Female ☐

2. Age: (20-29) ☐ (30-39) ☐ (40-49) ☐ (50-50) ☐

3. Ethnic Background: Black ☐ White ☐ Coloured ☐ Indian ☐

4. Nationality: South African ☐ Non-South African ☐

5. Marital status: Single ☐ Married ☐ Divorced ☐ Cohabitation ☐ Widowed ☐

6. Level of education: No education ☐ Primary ☐ High school ☐ Matric ☐ Tertiar ☐
Certificate ☐ Diploma ☐ Degree ☐

7. Employment situation: Please circle the one that applies to you.

Unemployed……1

Employed……..2

Self-employed……3

Student/ learner…….4

8. If you are unemployed, what is the source of household income/

9. If employed, what is your profession or job?

10. How long have you been working? < 1 year ☐ 1-2 years ☐ 3-4 years ☐ over 4 y ☐ rs

11. What is your gross monthly income before deductions, including all sources of income?

Amount	**Answer**
R1- R 400	
R 401- R 800	
R 801- R 1600	
R 1601 R 3200	
R 3201- R 6400	
R6401 R 12800	
R12801 – R 25600	
R 25601 or more	

12. In terms of socio-economic status (income levels), how do you classify yourself? Low ☐ Middle ☐ High ☐

13. Are you a smokers? Yes ☐ No ☐

14. Do you drink alcohol? Yes ☐ No ☐

If yes, how many per week? 1-2 ☐ 3-4 ☐ 5-6 ☐ >7 ☐

15. What kind of food do you eat daily?.....

16. How many regular meals do you eat per day?.....

17. How often do you eat fast food or processed food? Do not eat ☐ Once/week ☐ 2/3 times/week ☐ 1or2 times/month ☐ Daily ☐

18. Are you suffering from any of the following? Diabetes ☐ Cancer ☐ Heart Diseases ☐ Asthma ☐ High blood pressure ☐ High Cholesterol ☐ other…….

SECTIONB: SEDENTARY LIFESTYLE AND PHYSICAL ACTIVITY PATTERNS

19. **Sedentary lifestyle:** Do you watch Television (TV)? Yes ☐ No ☐

20. If yes, how many times do you watch TV per day? Once ☐ Twice ☐ Three times ☐ More than 3 times ☐

21. How long (time) do you watch TV per day while sitting or standing? 30 min-1hr ☐ 1h30-2hr ☐ 2h30 and more ☐ Not applicable ☐

22. On average, how many minutes do you spend per week watching TV?.....

23. What kind of food your normally eat while watching TV? Snacks ☐ Soft drinks ☐ pap ☐ Tea ☐ Do not eat ☐ Other (specify)……

24. How many minutes do you spend sitting at home on computer screen, social network, reading books, listening music per day? a <1hour ☐ 2.-3 hours ☐ 4-5 hour ☐ >5 hours ☐

25. On average, how many minutes do you spend per week?.....

26. How many minutes do you spend sitting at work performing your duties?.....

27. On average, how many minutes do you spend per week?.....

28. How many minutes do you spend sitting at home/ work chatting to friends or colleagues per day? Less than 1hour ☐ 2.-3 hours ☐ 4-5 hour ☐ more than 5 hours ☐

29. How many minutes to you spend sitting in car, bus/ taxi (driving) to and from places per day? Less than 1hour ☐ 2.-3 hours ☐ 4-5 hour ☐ more than 5 hours ☐

30. For how long do you sit for breakfast, lunch and evening meal per day/ daily? < 10 min ☐ 10-15 min ☐ >30 min ☐

31. Physical activity patterns: Activities in and around the house

Approximate number of hours each week	**Average over the last 12 months**					
	None	**Less than 1 hr a day**	**1to3 hrs a day**	**3 to 6 hrs a day**	**6 to 10 hrs a day**	**More than 10 hrs a day**
Preparing food, cooking and washing						
Shopping for food and groceries						
Cleaning the house and yard						

Doing the laundry and ironing						

32. Does your work involve much: sitting ☐ Standing ☐ walking ☐ 50% sitting/50% walking? ☐

33. Does your work involve vigorous-intensity activity that causes large increase in breathing or heart rate (carrying or lifting heavy load, construction and etc.) for at least 10 minutes continuously? Yes ☐ No ☐ **. If no go to question 36.**

34. In a typical week, on how many days do you do vigorous-intensity activities as part of your work?.....

35. How much time do you spend doing vigorous intensity activities at work on a typical day?.....

36. Does your work involve moderate-intensity activity that causes a small increase in breathing or heart rate (such as brisk walking or carrying light loads and etc.) for at least 10 minutes continuously? Yes ☐ No ☐ **. If no go to question 39.**

37. In a typical week, on how many days do you do moderate-intensity activities as part of your work?.....

38. How much time do you spend doing moderate intensity activities at work on a typical day?.....

39. Do you walk or use bicycle for at least 10 minutes continuously to get to and from places? Yes ☐ No ☐ . **If no go to question 42.**

40. In a typical week, on how many days do you walk or bicycle for at-least 10 minutes continuously to get to and places?.....In a typical week, on how many days do you do moderate-intensity activities as part of your work?.....

41. How much time do you spend walking or bicycling for travel on a typical day?.....

42. Do you do vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like (running, jumping or football etc.) for at least 10 minutes continuously? Yes☐ No☐ . **If no go to question 45.**

43. How many days do you do vigorous-intensity sports, fitness or leisure activities per week?.....

44. How much time do you spend doing vigorous-intensity sports, fitness or leisure activities per day?.....

42. Do you do moderate-intensity sports, fitness or recreational (leisure) activities that cause small increases in breathing or heart rate like (brisk walking, swimming or dancing etc.) for at least 10 minutes continuously? Yes☐ No ☐

43. How many days do you do moderate-intensity sports, fitness or leisure activities per week?.....

44. How much time do you spend doing moderate -intensity sports, fitness or leisure activities per day?.....

THANK YOU FOR PARTICIPATING IN THIS STUDY

Appendix 5: Physical Examination sheet **Questionnaire number……..**

Village name……. Individual number…….. Date…….

Participant nick name…….. Gender…… Age……

Measurements	**Value**	
Height(m)		
Weight(kg)		
BMI(kg/m²)		
Waist (cm)		

Appendix 6: **Information sheet**

My name is Vhonani Margareth Ntsieni, a master's student in the Department of Public Health, School of Health Sciences; University of Venda. I am conducting this research to fulfill the requirements of my Master of Public Health degree. The topic of the study is **relationship between sedentary lifestyle patterns and obesity among adults in Ha-Tshikundamalema area of Limpopo Province, South Africa.**

I am inviting you to participate in this research project because you are an adult in the area within which I wish to conduct my research and may have some insights into the topic being researched. The purpose of the research is to describe sedentary lifestyle patterns of Tshikundamalema adult population and to determine if an association exists between sedentary lifestyle patterns and obesity.

You will be asked to complete a questionnaire. The following sections or areas will be covered in the questionnaire: i) socio-demographic information; ii) assessment of sedentary lifestyle and physical activity patterns. Height, weight and circumference will be measured.

I will do my best to keep your personal information confidential. To help protect your confidentiality, any documents used relevant to the study will be stored under lock and key. All computer files or documents will be password-protected, and only accessible to the researcher. Information obtained will not be revealed to anybody, in order to respect each participant's right to privacy. In addition, you will not be identified by name or by village on the questionnaire or other documents and all information obtained will be treated as privilege confidential as described in the health Insurance and Accountability act of 1996. For reporting purposes, that is, the writing of a report or article about this research project, your identity will be protected as far as possible.

There are no known risks associated with participating in this research project. Also, there are no costs involved in participating in the study, except for the time you will be spending in completing the questionnaire and during measurements. This research is not designed to help you personally, but the results may help the investigator learn more about adults' profiles of sedentary lifestyle patterns; the relationship between sedentary lifestyle patterns and obesity. The results may also help the Department of Health to come up with strategies to prevent or control chronic

diseases associated with sedentary lifestyle and their risk factors, in order to improve the overall health of people.

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

Questions about the procedures that will be used during data collection or about the results of the study are encouraged. If you have any concern or question, please ask for further explanation.

I trust my request will be successful. Thanking you in advance for your cooperation

Sincerely

Ntsieni Vhonani Margareth
Student No: 11541983
E-mail: ntsienivm@gmail.com
Cell: 083 862 2224

Signature:----------

Date:----------

Appendix 7: Consent Form

Informed consent form for participants

I have read and understood the information about this research project in the information sheet. I have had an opportunity to ask questions and to have them answered to my full satisfaction. I understand that I may withdraw myself at any time prior to completion of data collection without being disadvantaged in any way. If I withdraw, I understand that all the information provided or/ and related with my participation will be destroyed. I voluntary agree to take part in this research project

Participant's signature……..

Participant's name……

Date……

Appendix 8: Confirmation by Language Editor

SCHOOL OF HUMAN AND SOCIAL SCIENCES

10 April 2017

School of Health Sciences
University of Venda
Private Bag X5050
Thohoyandou
0950

Dear sir/madam

This letter serves to certify that I have proof-read Ms.V.M. Ntsieni's proposal, titled, "Sedentary Lifestyle Among Adults in Ha-Tshikundamalema Area of Limpopo Province".

The proof-reading entailed editing some parts of it, where I felt it would make the document more understandable; for example, to avoid wordiness, redundancy, sub-divide long sentences into shorter ones, for clarity, etc. However, I have not tempered with the content of the proposal, except where I found that this constituted repetition or made the content confusing.

The proposal is now ready for examination/presentation.

Thank you for your time.

Sincerely

V.T. Bvuma

Mobile: 083 423 9227

University of Venda

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