INVESTIGATING THE HEALTH PROFILE OF EMPLOYEES AT A PHARMACEUTICAL COMPANY IN JOHANNESBURG

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Master of Science (Med) Sport and Exercise Science

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DECLARATION

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

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(Signature of candidate)

_____day of_____20_____in_____

DEDICATION

I wish to dedicate this dissertation to my mother Maria Goncalves da Silva, my fiancé Damir Turkovic and my siblings Manuel Duarte da Silva, Luis Filipe Da Silva, Gorette Da Silva and Zelia Da Silva for their continued love, understanding, encouragement and support during my period of study at the University of the Witwatersrand, Johannesburg.

CONTRIBUTION TO THE WORK PRESENTED IN THIS THESIS

Together with my supervisor, I collected data on the socio-demographics, physical activity, lifestyle behavioural patterns via questionnaire instruments and objective measures.

In addition, I contributed to quality control and data management for the questionnaires, objective physical activity and point-of-care blood analysis.

ACCEPTED ABSTRACT FOR CONFERENCE PROCEEDINGS

Researchers: Gradidge PJ, Da Silva MP

Title: Accelerometer-derived Physical Activity Intensities and its correlation with Cardiovascular Disease Risk in Factory Workers

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Type of presentation: Poster

Date: May 26-30, 2020

Place: Moscone Center West and San Francisco Marriott Marquis in San Francisco, California

Student contributions: Maggie P Da Silva collected the data. Phillipe J Gradidge interpreted the data and wrote the paper.

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1. Researchers: Gradidge PJ, Da Silva MP

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Type of presentation: Poster

Date: June 04 – 07, 2019

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Student contributions: Maggie P Da Silva collected the data. Phillippe J Gradidge interpreted the data and wrote the paper.

2. Researchers: Gradidge PJ, Da Silva MP

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ABSTRACT

BACKGROUND: Obesity is a pandemic that has grown dramatically over the recent thirty years. It is a disease that is associated with non-communicable diseases and is considered a public health concern. Populations in the sub-Saharan African region are particularly vulnerable to obesity and co-morbid diseases. Existing and emerging research demonstrates that employed African populations are also at risk for obesity and related cardiometabolic diseases, which can negatively impact workplace health and productivity. Further research is required to address these concerns.

AIM: The master's research project aimed to determine the health profile and risk factors associated with obesity and related cardiometabolic diseases amongst employees in a pharmaceutical company in Johannesburg, South Africa.

METHODS: The study used a cross-sectional, observational study design. This study recruited 145 study participants, who were employees at Ascendis Health Supply Chain and of which 86 were female. Anthropometric data (height, weight, waist, hip, and calf circumference), automated blood pressure, total cholesterol, and random glucose were measured using standard protocols. The following self-reported questionnaires were also conducted: The Global Physical Activity Questionnaire (GPAQ) was used to determine physical activity and sitting time; estimated beverage consumption was collected with the Beverage Intake Questionnaire (BEV-Q 15), while self-reported sleep duration was determined using the Pittsburgh Sleep Questionnaire Index (PSQI); the Centre for Epidemiologic Studies Depression Scale (CESD-R) was used to determine self-reported depression; smoking, alcohol consumption, and basic dietary behaviour were collected using the Discovery Health Index Questionnaire; and absolute absenteeism was determined using the Health and Work Performance Questionnaire. Objective free-living data, physical activity, inactivity, and sleep were collected using Axivity wrist-worn monitors. Descriptive data were presented as mean ± standard deviation or median (interquartile range) in tables. Univariate analysis and multiple linear regression analysis were performed to determine the association of behavioural factors with anthropometry, obesity, cardiometabolic diseases, and sickness absence.

RESULTS: The mean ± standard deviation (SD) age of the study population was 39.4 ± 10.1 years, with mean years at work for all participants being 5.9 ±7 years. The total number of sick leave days was 14.4 ± 14.2 days, with females taking more days off than males 16.4 ± 14.4 vs 11.3 ± 13.6, p = 0.032. Axivity monitors demonstrated lower MVPA and higher inactivity levels than self-reported measures, with the greatest discrepancy noted in vigorous activity (median of 2.92 (0.99 – 5.89) mins/day (objective measure) versus median of 60 (0-360) mins/day (subjective measure). Objective inactivity measures of 498.1 (450.7 – 563.8) mins/day were higher than self-reported inactivity with mean of 180 (120 – 300) mins/day. Of the total study population, 34.5% had an inadequate fruit and vegetables intake per day. The overall prevalence of hypertension was 42.8%. Females presented with a mean BMI of 31.5 ± 6.96, indicative of obesity, with males showing to be overweight with a mean BMI of 26.8 ± 4.99. Altogether, 42.1% of the total population showed to be obese with a BMI >30 kg˙m² and 32.4% were at risk of obesity with a BMI between 25 and 29.9 kg˙m². The total population glucose levels were 6.47 ± 1.53, with a low prevalence of self-reported diabetes type 2 at 3.4% of the total sample size. The total prevalence of self-reported cholesterol was 6.9%, with a total population cholesterol level mean of 4.65 ± 0.68. Alcohol consumption was considerably higher in males than females (88.5 ± 185 vs 39.3 ± 109 (p = 0.047), respectively). A higher mean depression score was seen in females (8.97 ± 6.15) than 5.71 ± 4.66 in males, (p = 0.001). Females showed a higher PSQI score (6.2 ± 3.62) demonstrating lower quality of sleep when compared to males (5.08 ± 2.82, p = 0.049). However, both males and females obtained similar hours of sleep per night at a self-reported mean of 7.30 ± 1.19 hours of the total population, 42.8% struggled to cope with stress, with 31.7% indicative of depression. According to the Framingham 10-year CVD risk algorithm, a total of 21.4% of study population showed to be at a moderate – high risk of developing cardiovascular disease. Moderate to vigorous physical activity (mins/day) showed to decrease obesity risk by being inversely associated with waist circumference (β: - 0.07, p = 0.02), CVD risk (β: - 0.04, p = 0.02) and sick leave (β: - 0.26, p = 0.04). Current smoking status was positively associated with total cholesterol (β: 0.71, p = 0.005) whereas subjective light physical activity was negatively associated with total cholesterol (β: - 0.00, p = 0.01). Total years at work (β: 0.27, p = 0.02), semi-skilled work (β: 0.27, p = 0.02), depression total score (β: 0.22, p = 0.03) and subjective LPA (β: 0.25, p = 0.04), were positively associated with total sick leave.

CONCLUSION: The findings of this study show a high prevalence of obesity and hypertension within this study population, demonstrating the need for these diseases to be addressed in the workplace. Females showed to be at a greater risk for obesity and cardiometabolic disease in comparison to males. Discrepancies were noted between subjective and objective measures of physical activity, indicative of possible overestimation for self-reported physical activity levels. Light physical activity and high depression scores were associated with sick leave, confirming the urgent need to address mental health in employees within the workplace. Interventions to reduce sugar intake, increase activity, particularly vigorous activity and address mental health in the workplace could show beneficial in reducing risk factors and possibly improve absenteeism rates.

KEYWORDS

Cardiometabolic Disease, Obesity, Employee Health, Workplace, Axivity, Accelerometer, Behavioural risk factors, Risk factors, Sickness leave.

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ABBREVIATONS

ATPIII	Adult Treatment Panel III
BMI	Body mass index
BP	Blood pressure
CMD	Cardiometabolic diseases
cm	Centimetre (s)
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
GPAQ	Global physical activity questionnaire
GGIR	R-package to raw accelerometer data for physical activity and sleep research
HC	Hip circumference
hrs/day	Hour (s) per day
hrs/wk	Hour (s) per week
IDF	International Diabetes Federation
kg	Kilogram (s)
$kg \cdot m^2$	Kilogram (s) per metre squared
m	Metre (s)
mins/day	Minute (s) per day
mins/wk	Minute (s) per week
mmol. L-1	Millimole (s) per litre
m/s^2	Unit for gravitational acceleration
MVPA	Moderate - to - vigorous physical activity

NCD	Non-communicable diseases
PA	Physical activity
RG	Random glucose
SAHS	South African Hypertension Society
SBP	Systolic blood pressure
SCORE	Systemic Coronary Risk Estimation
SDS	Socio-demographic status
SSB	Sugar-sweetened beverages
TC	Total cholesterol
VA	Vascular age
VIF	Variance inflation factor
WC	Waist circumference
W-H Ratio	Waist to hip ratio
WHtR	Waist to height ratio
WHO	World Health Organisation

DEFINITION OF TERMS

- **Absenteeism**

Days taken off work due to physical/mental illness and/or behavioural/environmental risk factors associated with obesity and cardiometabolic disease in the workplace (1).

- **Axivity-related inactivity**

Time spent below 30 mg (2, 3).

- **Axivity-related light activity**

Time spent between 30 and 100 mg (2, 3).

- **Axivity-related moderate activity**

Time spent between 100 and 400 mg (2, 3).

- **Axivity-related vigorous activity**

Time spent above 400 mg (2, 3).

- **Body Mass Index**

Body weight in kilograms (kg) divided by his or her height in meters squared (4).

- **Bouted**

Periods of at least 10 minutes of either inactivity or light/moderate/vigorous activity (2, 3).

- **Cardiometabolic diseases**

A combination of metabolic dysfunctions mainly characterized by excess body fat, insulin resistance, impaired glucose tolerance, hypercholesterolemia and hypertension (5). For the purposes of this master's research and due to limited funding, only selected cardiometabolic diseases were considered. These include diabetes (type 2), hypertension and hypercholesterolaemia.

- **Cardiovascular disease risk**

Risk category estimates which is used to show probability of an individual for developing cardiovascular disease (CVD) (6).

- **Health profile**

For the purpose of this master's study, 'health profile' includes anthropometry, cardiometabolic factors (random glucose and total cholesterol), behavioural (dietary habits, sleeping pattern, physical activity, and sitting time), mental health status and absenteeism profile relating to obesity and cardiometabolic disease (7).

- **Inactivity**

Insufficient amounts of moderate and vigorous-intensity activity (MVPA), i.e. not meeting specified physical activity guidelines (8).

- **Sugar-sweetened beverages (SSB)**

Water-based beverages with added sugar. This includes flavoured juice drinks, sweetened tea, non-diet soft drinks/sodas, coffee, sports drinks, energy drinks, and electrolyte replacement drinks (9).

- **Unbouted**

Activity outside of the 10-minute periods contributing to either inactivity or light/moderate/vigorous activity (2, 3).

- **Vascular age**

A measure of the apparent age of your arteries in comparison to a healthy population, used to determine cardiovascular disease risk (10).

CHAPTER ONE:

LITERATURE REVIEW

1.1. INTRODUCTION

It is well known that a healthy workforce contributes to greater productivity, reduced absenteeism, increased profit margins and ultimately an improved economy (11). However, between 2006 and 2015, South Africa accumulated $1.88 billion in losses from non-communicable diseases (NCD's), in particular diabetes, stroke, and coronary heart disease (12).

The World Health Organization has predicted that by the year 2030, sub-Saharan Africa will show the greatest rise in NCD deaths globally (13). This holds especially true if modifiable behavioural risk factors (i.e. tobacco use, physical inactivity, unhealthy diet, and the harmful use of alcohol) are not addressed (14). In addition, metabolic risk factors such as raised blood pressure, overweight/obesity, hyperglycaemia, and hyperlipidaemia further increases the risk for cardiometabolic disease (14, 15).

Obesity, being an important risk factor for a number of cardiometabolic diseases, is listed as one of the leading risk factors for high mortality in both developed and developing countries (14). Overweight and obesity have been documented as the fifth leading risk for at least 2.8 million global deaths (16). The high mortality rate due to obesity can be explained by its prevalence, leading to cardiometabolic complications such as type 2 diabetes, hypercholesterolemia, and hypertension (17).

Developing countries undergoing economic transition such as South Africa are being particularly affected by obesity across all economic levels and age groups (18). The effects of this transition from rural to urban living have further shown to increase cardiometabolic risk (19-21). Of all sub-Saharan countries, the Non-communicable Disease Risk Factor Collaboration (NCD-RisC) estimated South Africa to have the highest adult obesity rate in sub-Saharan Africa (22), which is listed in Table 1.1.

Table 1.1: Prevalence of adult obesity (BMI ≥ 30) in sub-Saharan Africa (22)

Country	Obesity (%)
South Africa	41.1
Botswana	30.5
Lesotho	27.7
Namibia	26.5
Zimbabwe	26.3
Seychelles	21.4
Gabon	21.2
Djibouti	19.1
Mauritania	19.3
Ghana	17.3

Source: Non-Communicable Disease Risk Factor Collaboration, 2017

Obesity prevalence is showing to be of particular concern within the workforce, with growing literature investigating its associated economic burden (17, 23-27). Such studies show how indirect costs arising from high rates of absenteeism, poor productivity, and longer sick leave are strongly linked to obesity and metabolic complications.

There is however limited research on obesity and associated disease risk within the South African workplace. The purpose of this study is therefore to investigate relevant behavioural and metabolic components associated with obesity and related cardiometabolic diseases among a sample of employees at a supply chain in Johannesburg, South Africa.

1.2. CONCEPTUAL FRAMEWORK

The conceptual framework displayed in Figure 1.1 has been adapted and modified from Brunzell et at (28). The model proposes risk factors for cardiovascular disease as specific components, represented collectively by the term metabolic syndrome, which may lead to the onset of cardiometabolic diseases**.**

The framework shows the possible influence of socio-demographics, socio-economic status, lifestyle habits, mental health and worksite-related environmental factors on obesity and related cardiometabolic disease. Identifying risk factors is crucial to understanding the prevalence of obesity and cardiometabolic diseases in the South African workforce, which may be associated with poor job performance and/or high absenteeism rates.

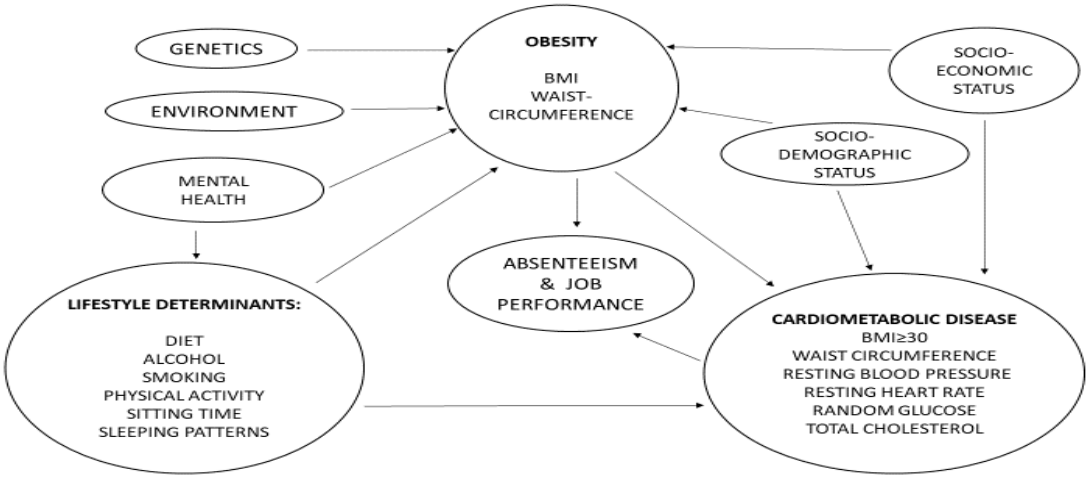

Figure 1.1: Potential factors associated with obesity and related cardiometabolic disease; adapted from: Brunzell et al. (2008)

The following sections provide an overview of potential risk factors for obesity and cardiometabolic disease within a sub-Saharan African context, followed by a review of studies investigating the contribution of body composition, sociodemographic status, lifestyle determinants, and mental health on the development of obesity and cardiometabolic disease in the workplace. Although important, ethnicity, marital status, and genetics falls outside the scope of this thesis.

1.3. OBESITY

1.3.1 Definition

Although previously defined as a nutritional-related disorder (29), Obesity has since reached a deeper understanding of other factors such as ones' genetics, environment, metabolism and behavioural patterns that may contribute to the condition (30). This has led researchers to describe Obesity as rather a complex chronic disease not resulting from diet alone (30). In 2000, the World Health Organisation formally defined Obesity as a disease in which excessive fat accumulation may adversely affect health, with its practical definition based on the level of body mass index (31).

An increase in body mass index (BMI) has been shown to increase the risk of other chronic diseases such as cardiovascular disease, diabetes and some cancers (16, 32). The measurement of BMI, calculated as weight (kg) divided by height (m) squared, does not come without drawbacks, however, as it does not reflect changes in body fat and muscle mass, particularly with age (32). It has therefore shown useful and in many cases more accurate to bring in additional anthropometric measures of obesity and related health risks such as waist and hip circumference, as stated by Haregu et al (32), specifically within a sub-Saharan African population where differences in ethnicity and/or genetic make-up may play a role.

1.3.2. Epidemiology and background

Obesity continues to increase worldwide, with the global age-standardised mean BMI having increased from 21.7 kg˙m² in 1975 to 24.2 kg˙m² in 2014, and from 22.1 kg˙m² in 1975 to 24.4 kg˙m² in 2014 for men and women, respectively (33). Although a high prevalence of obesity has been documented in high-income countries, studies have shown a rapid increase in developing countries (34, 35).

Within Africa, the mean BMI has shown to be higher than the global average in northern and southern Africa, and lower in central, eastern and western Africa (36). Of particular concern is the substantial growth of an overweight population in Southern Africa, showing a 330% increase in 25 years compared to other countries (37).

Over the past two decades, modernization, economic and social development have adversely influenced South Africans by exposing them to a variety of risk factors for obesity and related-cardiometabolic disease (38, 39). Such risk factors include poor diet, smoking, alcohol consumption, physical inactivity, and high-stress levels (40). In many cases the increase in high-density energy foods, as well as decreased physical activity due to changes in transportation and work modes, has proved the imbalance of energy consumption versus energy expenditure to be the fundamental cause of overweight and obesity (16).

The risk factors are becoming more evident, particularly within the work environment (26). Adding to such factors is an individuals' work environment, whereby job settings that require long-working hours, various shift schedules and low energy expenditure are showing a greater obesity risk (26). This is problematic due to the negative impact on employee health and job performance, subsequently affecting company productivity, and ultimately resulting in job loss (27).

1.4. CARDIOMETABOLIC DISEASE

1.4.1 Definition

Non-communicable diseases such as obesity, diabetes and hypertension increase the likelihood of cardiometabolic complications, defined as multifactorial diseases holding numerous factors such as environment, lifestyle, diet, genetics, and epigenetics (41). Such Cardiometabolic complications include hypercholesterolemia, hypertriglyceridemia, insulin resistance, nephropathy, non-alcoholic liver disease, and cardiovascular disease (15, 41). There have been various accepted definitions concerning cardiometabolic syndrome, with the World Health Organization emphasizing the presence of diabetes mellitus and insulin resistance as the two essential

requirements in addition to two other risk factors (obesity, hypertension, high triglycerides, reduced high-density level cholesterol level, or micro-albuminuria) (42).

The Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATPIII) notes central obesity rather than total body obesity and overweight as an important specification in better understanding cardiometabolic disease (42). Measures used to identify cardiometabolic risk, together with elevated body mass index, are hypertension, increased waist circumference, increased glucose levels, elevated total cholesterol levels, and elevated triglyceride levels. African population studies are currently still using the available definitions based on western thresholds of body mass index and central obesity, showing a need for specific assessment into anthropometric measures for cardiometabolic disease risk within Africa (35, 43).

In the workplace, obesity is a major contributing factor to cardiometabolic complications with Kempf et al (15) showing body mass index to be strongly associated with cardiometabolic risk factors, and with cardiometabolic disease prevalence being higher in overweight and obese participants.

1.4.2. Epidemiology and background

Socio-economic conditions are changing the world over, which is believed to contribute to the increase in obesity and diabetes and in turn cardiometabolic diseases. This is evident in developed, as well as developing nations. In Africa alone, the global burden of disease related to non-communicable diseases is predicted to increase by 27% over the next 10 years (44). It has also been projected, that by 2030, 366 million individuals will be diagnosed with diabetes, with 298 million being in developing countries (45). South Africa in specific is known to have one of the highest prevalence of hypertension in the world (46). Reasons for such statistics could be due to mounting evidence in increased urbanization, increased dependence on both public and private

transportation, and decreased mandatory physical activity both outside, and within the workspace (38, 45, 47-49).

Increased age has also shown to increase cardiometabolic risk, with middle-aged individuals (40 – 60 years) being predominantly affected (35). This can have massive implications in our workforce with a study showing hypertension, blood sugar, inadequate exercise, and alcohol being associated with older workers (50). This suggests, given the global ageing workforce (51) that keeping workers healthy throughout their working career is paramount to a thriving economy.

1.5. BEHAVIOURAL RISK FACTORS ASSOCIATED WITH OBESITY AND CARDIOMETABOLIC DISEASE

1.5.1. Dietary behaviour

Suboptimal diet has been reported as the leading risk factor for cardiometabolic disease (CMD) in 11 countries, making up for up to 72% of CMD deaths (52). Westernization has led to a large intake of animal fat, added sugar, as well as a decrease in cereal and fibre (45). Ashfin *et al* (52) found that of all the harmful dietary factors, high salt consumption was responsible for the highest number of CMD deaths.

Within the workplace, Fitzgerald et al (53) highlight how work-related stress can negatively affect dietary intake. An unhealthy and imbalanced diet can lead to weight gain and health complications, subsequently resulting in increased absenteeism. On the other hand, introducing a healthier diet high in fruit and vegetables and low in saturated fat, salt and sugar have shown to be beneficial in improving employee health (53). With improvements in employee health, an increase in employee productivity and a reduction in absenteeism becomes evident (53).

Also, due to its high energy content, high consumption of sugar-sweetened beverages has been shown to contribute to poor health markers such as long-term weight gain, insulin resistance, and

increased cardiovascular risk (54). According to WHO, no more than 6 teaspoons (± 120 kilocalories) of sugar a day should be consumed by children and adults alike (55).

1.5.2. Sleep pattern

Poor sleeping patterns and chronic sleep disorders are widely recognized as contributing risk factors for obesity and cardiometabolic disease in both adults and children (56). Van Someren et al (57) explains how disruptions to sleep duration, timing and continuity can affect hormonal and metabolic homeostasis. Sleep duration of fewer than 7 hours per night has been linked to cardiometabolic risk, with very short sleep durations (< 5 hours/night) showing the most risk (58).

In the workplace, night-shift workers present with greater disrupted sleep patterns, greater fatigue, higher food intake, and less energy expenditure, thus being more prone to cardiometabolic health problems when compared to day workers (59).

However, sleep duration of longer than 9 hours also show negative health outcomes by being associated with low physical activity levels and alcohol consumption (60).

1.5.3. Smoking and alcohol consumption

It is currently estimated that tobacco use causes about six million deaths worldwide, of which 600 000 are reported to be from the effects of second-hand smoke (61). In South Africa, 17.6% of people are reported to smoke tobacco, with the prevalence in males (29.2%) being four times greater than in females (62). Smoking has shown to be associated with many diseases including type 2 diabetes risk and cardiovascular disease have increased mortality risk (40, 63).

Several studies have found smokers to have a lower BMI than non-smokers, with smoking cessation causing weight increase (40). Conversely, smokers have also been found to have a greater waist circumference compared to non-smokers, particularly heavy smokers (40).

Alcohol consumption is another risk factor associated with cardiometabolic risk when taken in large volumes (64).

Nationally, risky alcohol intake has been reported to be highest in the province of Gauteng, with urban areas showing greater consumption compared to rural areas, and particularly among men aged 22-34 (65). Although light to moderate alcohol consumption has not been linked to disease risk, heavy drinking and binge drinking have been associated with increased weight (66).

1.5.4. Physical activity constructs

Despite the many health benefits of physical activity, 31.1% of the worlds' population is said to be inactive (67), with 43-49% prevalence of inactivity estimated in South Africa (68). To achieve the minimum health benefits associated with exercise, the American College of Sports Medicine (ACSM) suggests 150 minutes of moderate-intensity or 60 minutes vigorous activity a day for adults aged 18-65 years. While a lack of physical activity has been shown to increase cardiometabolic disease and mortality risk (69), high levels of moderate-intensity exercise of about 60-75 min per day has been shown to eliminate mortality risk associated with prolonged sitting time (70).

In developing countries, South Africa has one of the highest levels of inactivity (71). Already in 2005, Kruger et al (72) noted how poor environmental conditions, high crime rates and negative cultural attitudes towards thin people were contributing to the low levels of physical activity in South Africa. Assah et al (73) found how the rural-urban transition had affected habitual physical activity, with the prevalence of metabolic syndrome being associated with low physical activity

energy expenditure. More recently, Kolbe-Alexander et al (74) found physical activity levels to be significantly lower in workers compared to the general population.

When assessing physical activity levels of individuals in the workplace, Steene- Johannessen et al (75) and Doherty et al (76) highlights the importance of an objective measure such as an accelerometer for more effective results.

Various accelerometers have been specifically designed for research purposes and clinical uses. These include the ActiGraph, GENEActiv, activPAL and Axivity monitors. The advantages of utilising objective measures for physical activity are numerous but include avoiding bias due to subjective recall of events or the desire to appear more active to the assessor, as well as capturing sedentary and physical activity across different domains such as leisure, transportation, domestic and occupational (77).

For this study, Axivity monitors, using the GGIR open-source software (78) were used to assess sleep duration, different intensities of physical activity and inactivity of the employees over 7 days.

1.5.5. Mental health

Evidence is inconsistent in studies aiming to associate mental health status with obesity and cardiometabolic diseases. One study found no association between obesity (8% females, 9% males) and depression/anxiety in adolescents (59% females, 63% males), speculating the result to be due to a positive attitude towards fatness amongst the populations' families and peers (79). Another study showed depression to increase ones' risk of developing obesity(80).

In addition, several studies have reported that functional disability, low quality of life and chronic diseases such as angina is associated with depression (81). This could have detrimental effects in the workplace where high-stress levels have shown to lead to depression and other psychological

disorders, which increases the risk for metabolic complications such as hypertension and diabetes (82).

1.5.6. Absenteeism

Most studies addressing obesity in the workplace agree that absenteeism is substantially increased in obese workers (83), with Howarth et al (11) showing BMI to be one of the biggest predictors of absenteeism. Colombi and Wood (84) showed worksites with a higher rate of obesity to have significantly higher episodes of care of any kind per 1000 employees compared to worksites with lower rates of obesity. This is also of concern in developing countries as affected staff present with a shorter work-lifespan due to increased mortality risk (85). Furthermore, company productivity and profits are negatively impacted (12, 85)

1.6. PROBLEM STATEMENT

Evidence of rapid urbanization has brought about shifts in diet and physical activity levels, contributing to the development of obesity and subsequent compromised health (36). More specifically, Africa is showing an increase in obesity and related cardiometabolic disease prevalence within the workplace (26, 86-88). Employees at high risk of obesity and cardiometabolic disease have been shown to negatively affect productivity in the workforce (26), with central obesity increasing the expected frequency of absenteeism (53).

1.7. SIGNIFICANCE OF STUDY

The prevalence of obesity and cardiometabolic diseases has become a public health concern in South Africa. Amongst workers, reduced levels of physical activity, long working hours/disrupted sleeping patterns, stress, poor eating habits, alcohol, and smoking consumption have been shown to cause harm to one's health (40). There is however limited research on the health status of workers in South Africa.

1.8. AIM

This master's research project aimed to determine the health profile and risk factors associated with obesity and related cardiometabolic diseases amongst employees in a pharmaceutical company in Johannesburg.

1.8.1. Objectives

- To investigate the behavioural factors (dietary habits, smoking, alcohol intake, sleeping pattern, physical activity, and inactivity), mental health, and absenteeism profile of workers at a pharmaceutical company.
- To indicate the association between behavioural risk factors and obesity and cardiometabolic disease risk of the participants.

1.9.Hypothesis

- There is an association between behavioural risk factors and obesity and related cardiometabolic disease in a sample of workers.

CHAPTER TWO:

METHODOLOGY

2.1. Introduction

This chapter outlines the methodology used for the collection of subjective and objective data. It includes the study design, the population of study, criteria for study selection, data collection, and data analysis.

2.2. Study design

A cross-sectional study design was conducted to understand the health risk of the population.

2.3. Background of the study setting

Guy Wertheim Aymes, founder of Pharma Natura started the company in 1959 after having opened the first natural health store in the centre of Johannesburg, South Africa. Manufacturing of Weleda products commenced in 1965. Many new products and innovations followed so that today, the company can boast over 600 products. It is the only pharmaceutical company in South Africa that manufactures: anthroposophic, herbal, homeopathic medicine, nutritional supplements and tissue salts. In 2014 Ascendis health purchased Pharma Natura, and in 2016 Pharma Natura (Pty) Ltd changed their name to Ascendis Supply Chain (Pty) Ltd, which to date employs over 200 staff.

2.4. Participants

All employees (total of 219) at Ascendis Health Supply Chain were invited to participate in the study. Male and female employees who were older than 18 years of age were included in the study. Those who had not given consent to participate were not included in the study sample. For the purpose of the study, employees who were pregnant were excluded from the study. Participants were invited to wear a wrist-worn axivity monitor for 7 days as an objective measure of sleep and physical activity. Questionnaires and anthropometry measurements were administered by 4th year exercise science students who were all trained in the study protocol prior to data collection.

2.5. Self-reported questionnaires

Various questionnaires were administered to all participants to gather subjective data. The questionnaires were printed and included the following components:

2.5.1. Physical Activity

The Global Physical Activity Questionnaire (GPAQ) was used to obtain self-reported physical activity. The questionnaire has shown to be reliable and validated for use in Africa (89). It comprises of 16 questions and considers activity at work, travel to and from places, recreation activities, and sitting time. Total moderate-vigorous physical activity (MVPA) in minutes per week (mins/wk) were calculated from combining leisure-time, occupation-related, and travel-related physical activity. Self-reported average sitting time (mins/day) was also determined using the GPAQ.

2.5.2. Sleep

The Pittsburgh Sleep Questionnaire Index (PSQI) is an effective instrument for measuring quality and patterns of sleep in adults (90). It differentiates "poor" from "good" sleep quality by measuring seven different components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month. A total score, ranging from 0-21 points is obtained by summing up individual item scores. Higher scores indicate worse sleep quality. Participants with a score >5 are shown to experience poor sleep quality whereas a score ≤ 5 is indicative of good quality sleep.

2.5.3. Mental health

The Centre for Epidemiologic Studies Depression Scale Revised (CESD-R) questionnaire was administered to determine mental health of participants, specifically eliciting self-reported symptoms of depression. CESD-R shows to be a reliable and valid screening tool for depression in South Africa (91). It comprises of 10 Likert scale questions which measures a continuum from well-being to depression in the past week. Three items are on depressed affect, five on somatic symptoms and two on positive affect. A value of 0, 1, 2 or 3 was assigned to a response depending upon whether the item was worded positively or negatively. Each item ranges from a "rarely or none of the time" response with a score of 0, to a response of "all of the time" with a score of 3. The scoring for items 5 and 8 is reversed since they are positive affect statements. The score range is 0-30, with the cut point being a score of 10. A response ≥ 10 indicates depression.

2.5.4. Diet and lifestyle habits

The Discovery Health Index questionnaire was developed by South Africa's largest private health insurer to assess the most common health risks amongst South African employees. An adapted version of the questionnaire was used for the purpose of this study which included questions on smoking, alcohol consumption, and dietary behaviours (7).

2.5.5. Beverage intake

The Beverage Intake Questionnaire (BEV-Q 15) comprises of 15 items, fluid intake recall of the past 7 days to determine both the amount and quantity of adult beverage consumption (92). The questionnaire estimates total intake of the following 15 beverages in kilocalories (kcal); water, regular soft drinks, 100% fruit juice, other juice drinks (not fruit juice), full cream milk, low-fat milk, skim (fat-free) milk, sweetened tea, coffee or tea with milk and sugar, black coffee or tea without sugar, light beer, regular beer, mixed alcoholic drinks, wine (red or white), meal

replacement drinks, and energy drinks. The total of sugar sweetened beverages (SSB) calorie consumption is calculated from the estimated energy consumption of each item after considering the amount and frequency of each item.

2.5.6. Sickness absence

The Health and Work Performance Questionnaire (HPQ) is an assessment of work functioning based on the International Classification of Functioning, Disability and health (93). The HPQ measures health-related decreased job performance, sickness absence and injuries within the workplace. Validity and reliability have been established among populations of people with and without chronic conditions (94).

Absenteeism is scored in terms of hours lost per month, with a high score indicating a higher amount of absenteeism. Absolute absenteeism is expressed in raw hours with a negative lower bound (should the participant work more than expected) and an upper bound equal to the expected number of working hours. Relative absenteeism is a percentage of expected hours, ranging between a negative number (having worked more than expected) and 1.0 (always absent) (94, 95).

The Human Resources Department consented to access the company's sick leave data files. This enabled us to calculate the number of sick days off work for each participant.

2.6. Anthropometry and cardiometabolic markers

2.6.1. Body mass index

A calibrated portable stadiometer scale (Seca 213, Seca, USA) was used to measure height. Participants were required to be barefoot and stand upright with heels, calves, buttocks and back

against the stadiometer rod with head in Frankfort plane (Sellen,1998), facing forward. Measurement was taken to the nearest 0.1cm at the end of a deep inspiration. Body weight was measured to the nearest 0.1 kg using an electronic, calibrated weighing scale (Omron HN288, Omron, Japan) placed on hard-surface floor. All participants were measured barefoot, wearing light clothing. Participants were requested to stand upright with feet hip-width apart, and weight distributed evenly to both feet. Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared ($kg \cdot m^2$). A body mass index $\geq$ 30 $kg \cdot m^2$ was indicative of obesity and persons with a BMI greater than 25 $kg \cdot m^2$ were considered at risk of obesity and cardiometabolic disease.

2.6.2. Waist to hip and waist to height ratio

An inelastic, yet flexible measuring tape (purchased from Kendon Medical) was used to measure waist circumference (WC) at the greatest anterior extension of abdomen whilst subject was standing upright at the end of normal expiration. Raised WC as a risk factor for obesity and related cardiometabolic disease risk was defined as $\geq$ 94cm for men and $\geq$ 80cm for women as defined by the International Diabetic Foundation (IDF). Hip measurement was horizontally taken at the maximal circumference of buttocks, whilst subject was standing upright with feet slightly apart. Measurement was taken to nearest 0.1cm. Waist to hip ratio (W-H ratio) was calculated as waist in centimetres divided by hip in centimetres and categorised as in Table 2.1. In addition, a waist to height ratio (WHtR) was calculated as waist in centimetres divided by height in centimetres. A WHtR $\geq$ 0.5 is predictive of cardiometabolic disease risk (96). Participants who showed to have an elevated BMI, waist circumference, W-H ratio or WHtR were educated on their obesity and cardiometabolic disease risk, advised on making positive lifestyle changes and/or referred to an appropriate healthcare professional for further assistance.

Table 2.1: W-H ratio category classification according to the World Health Organization (97)

HEALTH RISK	WOMEN	MEN
Low	0.80 or lower	0.95 or lower

Moderate	0.81–0.85	0.96–1.0
High	0.86 or higher	1.0 or higher

Source: World Health Organization, 2011

2.6.3. Blood pressure

Blood pressure (BP) was measured using an automated blood pressure monitor (Omron M7 (Intelli IT (HEM-7322T-E), Omron, Kyoto, Japan) according to the following standard protocol (Seedat et al, 2014). Participants were seated on a chair with a back rest, with legs uncrossed, and feet flat on the floor. Arm was extended and supported on a tabletop, level with heart. The pressure cuff was secured around left arm, 2 cm above elbow with tubing aligned with brachial artery, for standardization. Participant were asked to sit for 5 minutes prior to the measurement before pressing the start button in order to obtain a reading. Three readings were taken 2 minutes apart. For greater accuracy the first reading was discarded and the average of the second and third reading was recorded. Participants who showed to have elevated readings were educated on the risk thereof, advised on making positive lifestyle changes and/or referred to an appropriate healthcare professional. Blood pressure cut points can be seen in Table 2.2. where hypertension was diagnosed as BP ≥ 140/≥ 90 mm Hg or using antihypertensive agents. Participants presenting with altered BP were educated on the risk thereof and referred to an appropriate healthcare professional for further assistance.

Table 2.2: Blood pressure category classification according to South African Hypertension Society guidelines (98)

Classification	**SBP (mmHg)**		**DBP (mmHg)**
Normal	<120	and	<80
Optimal	120 - 129	and	<80
High normal	130 - 139	or	80 - 90
Grade 1 Hypertension	140 - 159	or	90–99

Classification	SBP (mmHg)		DBP (mmHg)
Grade 2 Hypertension	160 - 179	or	100 - 109
Grade 3 Hypertension	≥ 180	or	≥ 110

Source: South African Hypertension Society guidelines, 2019

2.6.4. Random blood glucose and total cholesterol

A HemoCue glucose 201 RT system (Hemocue, Sweden) and Accutrend Plus cholesterol meter (Roche, USA) was used to measure non-fasting blood glucose and total cholesterol, respectively. Researchers who conducted the test wore gloves. Participants middle or ring finger were used. The finger was wiped with an alcohol swab before being pricked with a sterile lancet. on the side of the finger, while having applied light pressure towards the tip, researcher punctured the skin with the lancet to obtain a small drop of blood. The first 2-3 drops were wiped away with an alcohol swab. The drop of blood thereafter was gently pressed onto test strips and inserted into their respective meters. A new lancet was used for each participant. Participants glucose results was recorded after the 12 -seconds waiting period. Total cholesterol was recorded after 3-minute waiting period. All alcohol swabs used needles and gloves were disposed of in a medical waste bin. An elevated random glucose reading was defined as ≥ 11.1 mmol/l and an elevated total cholesterol reading as ≥ 5.18 mmol/l according to American College of Sports Medicine guidelines. Participants with elevated readings were educated on the risk thereof, counselled and/or referred to an appropriate healthcare professional for further assistance.

2.7. Cardiometabolic Disease Risk

Cardiometabolic disease risk factors were defined as systolic BP ≥ 130 mmHg, diastolic BP ≥ 90 mmHg, total cholesterol ≥ 5.18 mmol/l, random glucose ≥ 11.1 mmol/l, BMI ≥ 25 kg˙m², waist

circumference ≥ 94 cm for men and ≥ 80 cm for women, waist to hip ratio > 1 for men and > 0.86 for women, and waist to height ratio ≥ 0.5 for men and women.

The cardiovascular disease (CVD) risk over the next 10 years from the date of assessment was calculated for each employee by means of a validated, chart-based non-laboratory algorithm for SA, based on the Framingham study (99). The risk factors required for the cardiovascular disease risk calculation were gender, age, systolic blood pressure, body mass index category, reported current smoking and diabetes status. The calculated risk number was then categorised as either low risk (<10%), moderate risk (10-20%) or high risk (>20%).

2.8. Vascular age

Vascular age is another emerging method of estimating cardiovascular disease risk (10) which was included in the analysis and predicted. Vascular age is a concept derived from the Framingham risk tables but can also be calculated Systemic Coronary Risk Estimation (SCORE) scale using the combination of age, gender, smoking, total cholesterol and systolic blood pressure levels (100, 101).

2.9. Objective measures

The objective measurement for physical activity, sleeping patterns and inactivity was done via a wrist-worn accelerometer. The axivity AX3 wrist-worn monitor (Axivity, UK) was issued to the participants. Such triaxial accelerometers are proving to be a reliable tool in providing objective data on lifestyle behaviours such as inactivity, physical activity and sleep in various population groups (102-105) Due to a limited number of available monitors, the monitors were rotated amongst a group of 30 participants, until all participants had worn the monitor. The monitor was worn on the non-dominant arm, and triaxial acceleration data was captured over a 7-day period at 100Hz with a dynamic range of 8*g*. After collection, data was downloaded, monitors recharged,

cleaned and given to the next group of 30 participants. Captured data was processed into summary data for interpretation.

Participants with at least three days of 16 hours wear time per day were included in the analysis. This criterion was required since researched findings showed 72 hours of wear were needed to be within 10% of a complete seven-day measure (76). The recorded days were a combination of weekdays and weekends. The data from the monitors were downloaded from UK Biobank in *.cwa format, auto-calibrated, resampled (100 Hz) and converted to .wav format by open-source software (Omgui Version 1.0.0.37; Open Movement, Newcastle, UK).

All axivity monitor files in wav. format was processed and analysed with the R-package GGIR version (1.10 - 4) (https://cran.r-project.org). GGIR processing included the detection of abnormally high values, detection of non-wear, as well as calculation of the average magnitude of dynamic acceleration corrected for gravity by means of Euclidean Norm minus 1g (ENMO). These were averaged over 5 epochs and expressed in milli-gravitational units (m*g*). Wear time, sleep time, acceleration and MVPA were averaged across all valid days and cut-points defined various intensities for combined bouted and unbouted physical activity as follows: Inactivity (< 30mg), light PA (30-100mg), moderate PA (100 – 400mg) and vigorous PA (≥ 400mg). The decision to include both bouted and unbouted physical activity in the analysis was in line with emerging literature suggesting that both short bouts and bouts of 10 min or longer were associated with cardiometabolic health (77).

2.10. Ethical consideration

An application for ethical clearance was submitted to the Human Research Ethics Committee and HREC (Medical) committee, University of the Witwatersrand (ethics certificate number: M180347) (see Appendix 6). Permission to conduct the study at the Ascendis Health Supply Chain was granted by Acendis Health (see Appendix 5). Potential participants were informed about the study with study objectives and testing procedures explained once ethical clearance had been obtained and permission of company granted. Consent forms and information sheets were given

to each interested employee to read and sign before participating in the study (see Appendix 1 and 2). Participants were free to withdraw at any time, without any negative implications. Only the researcher and supervisor of study had access to the raw data which was stored in a secure designated area.

2.11. Statistical analysis

All data was captured on an excel spreadsheet and checked for errors before being analysed. Data cleaning involved double-checking the data entry for internal consistency, allocating missing values, correct grouping and coding. Statistica version 13.5.0.17 was used for data handling and statistical analysis.

Descriptive analysis was used to depict the health profile of the workers which included behavioural lifestyle factors, mental health status, absenteeism and productivity.
Continuous data shown to be normally distributed were reported as means (+- standard deviation) otherwise as median and interquartile range. Independent t test was used to compare all continuous data between males and females. Categorical data were reported as frequency and percentages. Pearson's Chi-Square test was used to compare categorical data between males and females.

Inferential analysis: Pearson's Correlations was used to determine the correlation of behavioural risk factors and covariates with obesity and cardiometabolic disease risk. The outcome variables are BMI, waist circumference, systolic and diastolic blood pressure, random glucose (RG), total cholesterol (TC), cardiovascular disease risk (CVD) and vascular age (VA).

Pearson's correlation was also used to test the strength of the association between variables derived from raw accelerometery and sleep time versus self-reported physical activity and sleep.

Multiple linear regression models were used to compare socio-demographic characteristics and behavioural risk factors with anthropometry and cardiometabolic outcomes. The association between the outcomes and the independent variables were measured using a backward stepwise multilinear regression model. All independent variables were included in the model and then removed based on the significance level of their effect on the model, until all remaining had a value < 0.2 in the analysis of independence. Statistical significance was set at level of $p < 0.05$, where a p-value less than 5% indicates statistical significance. The variance inflation factor (VIF) was used to check for multicollinearity, although no multicollinearity was noted with all VIFs < 2.0. Regression model results were tabulated as standardised β values which takes into account the direct comparisons of the strengths of the associations.

CHAPTER THREE:

RESULTS

3.1. Introduction

Of the 219 employees invited, 145 consented to take part, of which 86 were female and 59 were male. All 145 participants completed a questionnaire and anthropometric measurements. The study sample consisted of different skills and education levels ranging from cleaners and security staff to factory workers, admin staff, and managers. While some participants had had less than 6 months of work experience in the company, others had been with the company for several years. Figure 3.1 illustrates the sample size of participants who agreed to wear an axivity monitor to record inactivity, LPA, MVPA, and sleep. Data that did not meet the requirements were excluded from analyses.

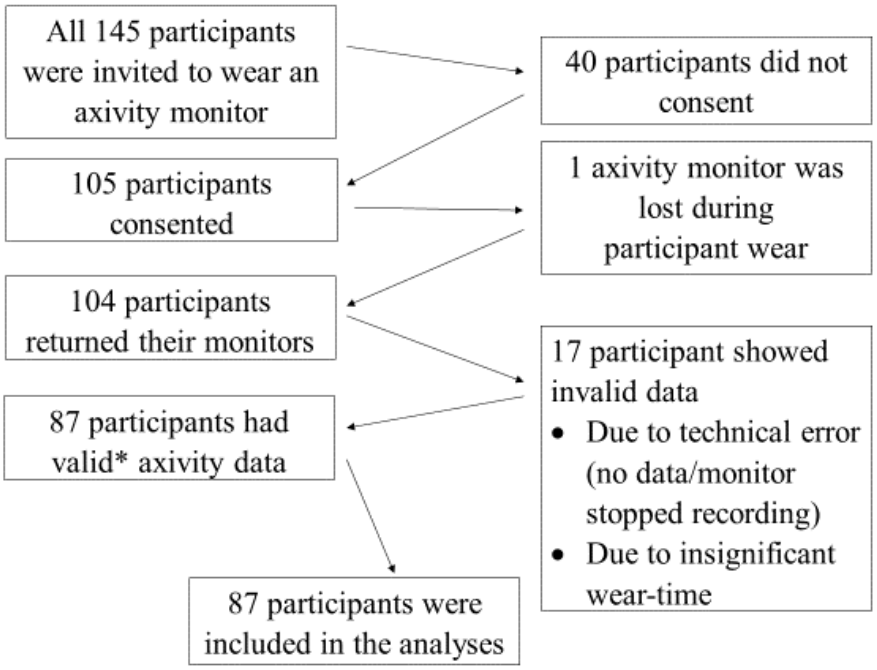

Figure 3.1: Flow Chart of the study axivity sample size. * valid data defined as wear time ≥ 3 days and nights.

Table 3.1: Characteristics of employees by gender.

Variables	Total	Female	Male	P-value
Demographics	**(N=145)**	**(N=86)**	**(N=59)**	
Age (years)	39.4 ± 10.1	37.7 ± 9.57	41.8 ± 10.3	**0.016**
Years at work (years)	5.9 ± 7.0	5.2 ± 6.7	6.9 ± 7.4	0.154
Education				
Incomplete high school, n (%)	42 (29)	26 (30.2)	16 (27.1)	
Matric, n (%)	19 (13.1)	6 (7)	13 (22)	**0.030**
Higher education, n (%)	84 (57.9)	54 (62.8)	30 (50.9)	
Job grade				
A (unskilled), n (%)	28 (19.3)	13 (15.1)	15 (25.4)	
B (semi-skilled), n (%)	86 (59.3)	57 (66.3)	29 (49.2)	0.076
C (skilled), n (%)	26 (17.9)	15 (17.4)	11 (18.6)	
D & E (middle/senior management), n (%)	5 (3.4)	1 (1.2)	4 (6.8)	
Salary grade				
(< R5000), N (%)	75 (51.7)	48 (55.8)	27 (45.8)	
(R5000 - R15000), N (%)	56 (38.6)	32 (37.2)	24 (40.7)	0.474
(> R15000 - R30 000), N (%)	11 (7.6)	5 (5.8)	6 (10.2)	
(> R30 000), N (%)	3 (2.1)	1 (1.2)	2 (3.4)	
Work-related measures				
Total sick leave (days)	14.4 ± 14.2	16.4 ± 14.4	11.3 ± 13.6	**0.032**
Absenteeism				
Absolute	1.67 ± 22.6	2.38 ± 20.6	0.62 ± 25.4	0.645
Relative	0.01 ± 0.12	0.02 ± 0.13	- 0.00 ± 0.11	0.342

Presenteeism				
Absolute	87.2 ± 15.1	88.3 ± 14.4	85.8 ± 16	0.329
Relative	1.27 ± 0.8	1.29 ± 0.55	1.23 ± 1.05	0.626
Anthropometry				
Height (cm)	1.65 ± 0.09	1.59 ± 0.06	1.72 ± 0.06	**0.000**
Weight (kg)	79.8 ± 16.6	80.1 ± 18	79.3 ± 14.3	0.300
BMI ($kg \cdot m^2$)	29.6 ± 6.64	31.5 ± 6.96	26.8 ± 4.99	**0.000**
Waist (cm)	91.7 ± 12.5	92.1 ± 12.6	91.1 ± 12.5	0.660
Hip (cm)	109 ± 13.1	113 ± 13.8	102 ± 8.4	**0.000**
WHR (cm)	0.84 ± 0.08	0.81 ± 0.07	0.89 ± 0.07	**0.000**
WHtR (cm)	0.55 ± 0.09	0.57 ± 0.1	0.53 ± 0.07	**0.006**
Cardiometabolic				
Resting systolic blood pressure (mmHg)	126.2 ± 18.9	124 ±20.9	130 ±15	0.081
Resting diastolic blood pressure (mmHg)	79.5 ±10.7	79.2 ±11.5	79.9 ±9.4	0.715
Resting heart rate (bpm)	76.2 ±11	78.4 ±10.4	72.9 ±11.4	**0.003**
Random glucose levels (mmol/l)	6.47 ± 1.53	6.31 ±1.48	6.71 ±1.59	0.120
Total cholesterol levels (mmol/l)	**(N = 64)** 4.65 ±0.68	**(N = 42)** 4.60 ±0.55	**(N = 22)** 4.74 ±0.87	0.438
Vascular age (years)	45.9 ± 17.2	43.5 ±17.4	49.4 ±16.5	0.656
CVD risk (%)	6.6 ± 8.5	3.99 ±5.02	10.4 ±10.8	**0.000**
Lifestyle factors				
Total sugar sweetened consumption (kcal)	234.3 ± 244.4	211 ± 245	268 ± 242	0.166

Total alcohol consumption (kcal)	59.3 ± 146.4	39.3 ± 109	88.5 ± 185	**0.047**
Self-reported physical activity (mins/wk)				
Total work	150 (10 – 1800)	150 (0 – 1850)	210 (30 – 1800)	0.955
Total travel	140 (50 – 250)	140 (75 – 250)	140 (30 – 280)	0.598
Total leisure	180 (0 – 420)	180 (0 – 480)	165 (30 – 360)	0.713
Total moderate	500 (240 – 1350)	465 (210 – 1500)	555(300 – 1350)	0.822
Total vigorous	60 (0 – 360)	55 (0 – 360)	60(0 – 540)	0.961
Total MVPA	870 (380 – 2250)	895 (350 – 2490)	840 (465 – 2160)	0.926
Self-reported total rest/inactivity (mins/day)	180 (120 – 300)	240 (120-375)	180 (120 – 240)	**0.031**
Mental health CESD-R score	7.64 ± 5.80	8.97 ± 6.15	5.71 ± 4.66	**0.001**
Sleep - PSQI score	5.74 ± 3.35	6.2 ± 3.62	5.08 ± 2.82	**0.049**
Napping (mins/day)	30.0 ± 48.0	37.4 ± 52.9	19.3 ± 37.7	**0.025**
Sleep duration (hrs/day)	**(N = 142)** 7.30 ± 1.19	**(N=83)** 7.42 ± 1.27	**(N=59)** 7.14 ± 1.06	0.175
Axivity measures	**(N = 87)**	**(N = 48)**	**(N=39)**	
Wear time (hrs/day)	23.0 ± 1.16	23.0 ± 1.21	23.0 ± 1.11	0.924
Acceleration (mg)	43.1 ± 12.2	40.3 ± 11.2	46.6 ± 12.6	**0.016**
Sleep (hrs/day)	5.62 ± 1.28	5.83 ± 1.25	5.35 ± 1.29	0.081
Unbouted and bouted physical activity (mins/day)				
Light (30 – 100 mg)	281.3 (244.7 - 350.2)	283.8 (253.9 – 356.9)	281.3 (229 – 349.1)	0.363

Moderate (100-400 mg)	103.9 (75.2 - 139.3)	92.7 (69.9 – 128.5)	114.2 (86 – 161.9)	0.482
Vigorous (≥ 400 mg)	2.92 (0.99 - 5.89)	1.69 (0.73 – 5.01)	3.83 (1.58 – 7.67)	**0.011**
MVPA (100 - ≥ 400 mg)	108.8 (75.7 - 143.5)	98.3 (70.4 – 132.2)	124.3 (88.3 – 175.3)	**0.031**
Total inactivity (< 30 mg)	498.1 (450.7 - 563.8)	491.6 (451.8 – 560.1)	502.9 (444.8 – 572.4)	0.762

Data presented as mean ±SD, median (interquartile range) (IQR) or as percentages (%). BMI, body mass index; WHR, waist-to-hip ratio; WHtR, waist-to-height ratio; CVD risk, cardiovascular disease risk; MVPA, moderate to vigorous physical activity; CESD-R, Centre for Epidemiologic Studies Depression Scale Revised; PSQI, Pittsburgh Sleep Questionnaire Index. Highlighted *p* values show statistical significance.

Table 3.1 shows the general characteristics of the study population. A total of 145 employees participated in the study, of which 86 (59.3%) were females and 59 (41%) were male. The mean age of the study population was 39.4 ± 10.1 years, with mean years at work for all participants being 5.9 ± 7 years. The majority (57.9%) of the study participants attained higher education, with 59.3% in semi-skilled jobs. Of the total population, 29% reported not having completed their matric, with a large number (51.7%) earning less than R5000 per month. The total mean number of sick leave days was 14.4 ± 14.2 days, with females taking more days off than males 16.4 ± 14.4 vs 11.3 ± 13.6, $p = 0.032$).

Of the study population, females showed to have a higher BMI than males (31.5 ± 6.96 vs 26.8 ± 4.99, $p = 0.00$), as well as a higher WHtR (0.57 ± 0.1 vs 0.53 ± 0.07, $p = 0.006$). Mean W-H Ratio, however, demonstrated males to be slightly more elevated than females (0.89 ± 0.07 vs 0.81 ± 0.07, $p = 0.00$) The mean systolic BP was 126.2 ± 18.9 mmHg. Total sugar-sweetened beverage consumption of the total population amounted to 234.3 ± 244.4 kcal per day, which is almost double the World Health Organisation recommendations of 120 kcal per day. Alcohol kcal consumption was considerably higher in males (88.5 ± 185 vs 39.3 ± 109, $p = 0.047$).

No statistical significance was noted in self-reported physical activity between males and females. Total self-reported inactivity however was greater in females (240 (120-375)) compared to males (180 (120 - 240, $p = 0.031$). Data from the axivity monitors had no statistical significance in terms of physical inactivity but did demonstrate the male cohort to have obtained a higher MVPA than the females (124.3 (88.3 – 175.3)) vs 98.3 (70.4 – 132.2, $p = 0.031$).

The population of monitor-wearing participants (n = 87) achieved the recommended amount of 150 minutes per week of moderate physical activity but obtained very low vigorous physical activity levels (2.92 (0.99 – 5.89)) in comparison to self-reported vigorous activity (60 (0 – 360)).

A higher mean score in the CESD-R mental health questionnaire was seen in females (8.97 ± 6.15) vs 5.71 ± 4.66 in males ($p = 0.001$), who also scored higher in the PSQI sleep questionnaire (6.2 ± 3.62 vs 5.08 ± 2.82 in males ($p = 0.049$). The total mean napping time in the population was 30 ± 48 minutes with females reporting longer naps than males (37.4 ± 52.9) vs 19.3 ± 37.7, $p = 0.025$). No statistical significance was seen in self-reported sleep duration with the study population showing an acceptable 7.3 ± 1.19 hours of sleep per night.

Table 3.2: Prevalence of risky lifestyle behaviours, personal medical history and mental health amongst employees.

Risk factors	**Total (n = 145)** **N (%)**	**Females (n = 86)** **N (%)**	**Males (n = 59)** **N (%)**	**P-value**
Sugar sweetened beverage consumption (> 120 kcal/day)	89 (61.4)	48 (55.8)	41 (69.5)	0.097
Alcohol consumption (light intake)	114 (78.6)	69 (80.2)	45 (76.3)	0.482
Alcohol consumption (moderate intake)	12 (8.3)	8 (9.3)	4 (6.8)	0.482
Alcohol consumption (heavy intake)	19 (13.1)	9 (10.5)	10 (16.9)	0.482

Nutrition (inadequate fruit &veg intake)	50 (34.5)	33 (38.4)	17 (28.9)	0.234
Cigarette smoking (current smokers)	28 (19.3)	15 (17.4)	13 (22)	0.491
Sleep duration (< 6hrs/> 9hrs)	22 (15.2)	14 (16.3)	8 (13.6)	0.654
Physical activity -self -reported physical inactivity (< 150 min/wk.)	15 (10.3)	10 (11.6)	5 (8.5)	0.540
Stress (not coping)	62 (42.8)	41 (47.7)	21 (35.6)	0.149
Mental health (CESD-R score ≥ 10)	46 (31.7)	34 (39.5)	12 (20.3)	**0.015**
Heart disease (self-reported)	2 (1.4)	1 (1.2)	1 (1.7)	0.787
Type II diabetes (self-reported)	5 (3.4)	2 (2.3)	3 (5.1)	0.371
Peripheral vascular disease (self-reported)	1 (0.7)	1 (1.2)	0 (0.0)	0.406
Asthma (self-reported)	5 (3.4)	3 (3.5)	2 (3.4)	0.975
High cholesterol (self-reported)	10 (6.9)	6 (7)	4 (6.8)	0.963
High blood pressure (self-reported)	20 (13.8)	10 (11.6)	10 (17)	0.361
Stroke (self-reported)	1 (0.7)	1(1.2)	0 (0.0)	0.406
Cancer (self-reported)	1 (0.7)	1 (1.2)	0 (0.0)	0.406

Data presented as number (%). CESD-R, Centre for Epidemiologic Studies Depression Scale Revised. Highlighted *p* values show statistical significance.

Table 3.2 shows key findings for lifestyle behaviours, mental health, and personal medical history.

Overall, 61.4% of the study population consumed more than the recommended amount of sugar per day (>120 kcal per day) and 34.5% had inadequate fruit and vegetable intake (< five portions per day). 42.8% of the participants struggled to cope with stress, with 31.7% scoring greater than 10 on the CESD-R questionnaire suggesting possible depression in those individuals.

Females showed to have higher scores on the CESD-R depression scale (p = 0.015). There were no statistically significant differences between males and females for other risky behaviour. However, sugar-sweetened beverage consumption showed 55.8% in females and 69.5% in males, suggesting a tendency for the males to be consuming more sweetened beverages than females.

Table 3.3: Prevalence of obesity in Ascendis employees.

Indicators	**Total (n = 145)** **N (%)**	**Females (n = 86)** **N (%)**	**Males (n = 59)** **N (%)**
BMI			
Underweight (<18.5 kg˙m²)	3 (2.1)	-	3 (5.1)
Normal weight (18.5 – 24.9 kg˙m²)	34 (23.4)	15 (17.4)	19 (32.2)
Overweight (25 – 29.9 kg˙m²)	47 (32.4)	25 (29.1)	22 (37.3)
Obese (>30 kg˙m²)	61 (42.1)	46 (53.5)	15 (25.4)
WC			
Not at risk (< 94cm for men, < 80cm for woman)	44 (30.3)	16 (18.6)	28 (47.5)
At risk (≥ 94cm for men, ≥ 80cm for women)	101 (69.7)	70 (81.4)	31 (52.5)

Table 3.3 represents obesity prevalence in the study population. More than half of all females and a quarter of all males were classified as obese. Almost 70% of the total population had abdominal obesity. With only 23.4% of the study population being of normal weight, 29% females and 37% males showed to be at risk for obesity.

Table 3.4: Prevalence of cardiometabolic disease risk factors amongst Ascendis employees.

Clinical measurement	**Total** **N = 145**	**Females** **N = 86**	**Males** **N = 59**	**P-value**
	N (%)	**N (%)**	**N (%)**	
Raised systolic blood pressure (≥ 140 mmHg)	24 (16.6)	16 (18.6)	8 (13.6)	0.422
Raised diastolic blood pressure (≥ 90 mmHg)	21 (14.5)	12 (14)	9 (15.3)	0.827
Hypercholesterolaemia (total cholesterol ≥ 5.18 mmol/l)	15 (10.3)	8 (9.3)	7 (11.9)	0.619
Suggested diabetes **(**random glucose ≥ 11.1 mmol/l)	2 (1.4)	1 (1.2)	1 (1.7)	0.787
BMI: Overweight/Obese (BMI ≥ 25 kg˙m²)	108 (74.5)	71 (65.7)	37 (34.3)	**0.007**
WC (cm) (≥ 94 for men, ≥ 80 for women)	101 (69.7)	70 (81.4)	31 (52.5)	**0.0002**
WHR (cm) **(**> 1 for men, > 0.86 for women)	15 (10.3)	13 (15.1)	2 (3.4)	**0.02**
WHtR (cm) (≥ 0.5 for men and women)	108 (74.5)	71 (82.6)	37 (62.7)	**0.007**

Data presented as number (%). BMI, body mass index; WC, waist circumference; WHR, waist-to-height ratio; WHtR, waist-to-height ratio. Highlighted *p* values show statistical significance.

Table 3.4 represents objective cardiometabolic disease risk factors. Less than 20% of the study population screened for hypertension showed or exceeded the risk thresholds of 140 mmHg and 90

mmHg for systolic and diastolic blood pressure, respectively. However, when combining participants on medication for hypertension, the total percentage of hypertension jumps to 42.8% of the total population. There was no significant difference by gender for blood pressure, suggested diabetes, and raised cholesterol. Hypercholesterolemia (≥ 5.18 mmol/l) was present in only 10% of the population. However, 74.5% of participants showed a BMI greater than 25 and a WHtR greater than 0.5, with a significantly higher proportion being noted in females (p = 0.007). Similarly, more females than males had abdominal obesity by waist circumference (p = 0.002) and waist-to-hip ratio (p = 0.02).

Table 3.5: Prevalence of estimated 10-year risk for developing cardiovascular disease.

Category	**Low risk**	**Moderate risk**	**High risk**	**P- value**
	N (%)	**N (%)**	**N (%)**	
All (n = 145)	114 (78.6)	20 (13.8)	11 (7.6)	
Females (n = 86)	77 (89.5)	7 (8.1)	2 (2.3)	**0.0004**
Males (n = 59)	37 (62.7)	13 (22)	9 (15.3)	
18- 39 (n = 82)	81 (98.8)	1 (1.2)	0 (0.0)	
40 – 59 (n =59)	33 (55.9)	18 (30.5)	8 (13.6)	**P < 0.0001**
≥ 60 (n = 4)	0 (0.0)	1 (25)	3 (75)	

Data represented as number (%). Chi-square test used for male versus female and age categories. Highlighted p values show statistical significance.

Table 3.5 represents the estimated 10-year risk of developing cardiovascular disease in the study population. Altogether, 21.4% were at moderate-high risk. A significant difference was noted between males and females (p < 0.0001), as well as a significant increase in risk with increasing age (p < 0.0001).

3.2. Correlations between lifestyle behaviours, obesity, and cardiometabolic disease risk outcomes

To indicate the extent to which lifestyle risk factors and anthropometry and cardiometabolic risk factors correspond. A positive correlation indicates the extent to which these variables increase or decrease in parallel, whereas a negative correlation indicates the extent to which one variable increases as the other decreases.

Table 3.6: Correlation coefficients between lifestyle behaviours, obesity ad cardiometabolic disease risk outcomes, CVD risk and vascular age.

Lifestyle Behaviours	**BMI (kg˙m²)**	**WC (cm)**	**SBP (mmHg)**	**DBP (mmHg)**	**GLU (mmol/L)**	**TC (mmol/L)**	**VA**	**CVD risk**
Inactivity (mins/day)	-0.056	0.01	-0.04	0.01	-0.09	0.19	-0.03	-0.02
LPA (mins/day)	0.19	**0.26**	**0.23**	0.18	0.15	-0.20	**0.32**	**0.24**
MVPA (mins/day)	-0.12	**-0.21**	-0.07	-0.17	0.18	-0.24	**-0.26**	-0.17
Smoking	0.04	0.13	-0.03	-0.06	0.05	-0.01	0.02	0.01
Total alcohol consumption	-0.07	0.12	0.08	0.05	**0.27**	0.24	0.12	**0.31**
Total sweetened beverage consumption	- 0.07	-0.01	0.02	0.08	-0.09	0.07	0.08	0.04
Sleep (hrs/day)	- 0.05	-0.09	**-0.12**	**-0.25**	-0.13	0.03	-0.10	-0.02
Sick leave	0.15	0.07	-0.04	0.02	0.03	-0.05	0.01	-0.04

Data presented as Pearson moment of correlation (r). min/day, minutes per day; hrs/day, hours per day; LPA, light physical activity; MVPA, moderate-vigorous physical activity; BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; GLU, random glucose; TC, total cholesterol; VA, vascular age; CVD, cardiovascular disease. Highlighted values show significant correlation.

Table 3.6 presents the association between lifestyle behaviours and cardiometabolic outcomes. An increase in light activity was positively associated with waist circumference, systolic blood pressure, vascular age, and cardiovascular disease risk, whereas moderate-vigorous physical activity (min/day) was inversely associated with waist circumference and vascular age. Inactivity, along with smoking, sweetened beverage consumption, and sick leave had no association with any cardiometabolic outcomes. However, an increase in alcohol consumption was positively associated with random blood glucose levels and cardiovascular disease risk, with an increase in sleep demonstrating a decrease in systolic and diastolic blood pressure measures.

Table 3.7: Correlation coefficients between questionnaire-derived variables and objective measures of PA and sleep.

Objective Variables	**Self-reported variables**					
	Sleep (hrs/day)	Inactivity (min/day)	Tot work (min/day)	Tot travel (min/day)	Tot leisure (min/day)	MVPA (min/day)
Sleep (hrs/day)	**0.46**	0.00	0.14	0.11	0.04	0.16
Inactivity (mins/day)	**- 0.30**	0.04	-0.09	-0.03	0.03	- 0.07
LPA (mins/day)	- 0.09	- 0.18	**-0.26**	0.06	0.13	-0.16
MVPA (mins/day)	0.12	0.02	-0.01	-0.02	-0.01	-0.02

Data presented as Pearson moment of correlation (r). avg min/day, average minutes per day; avg hrs/day, average hours per day; Tot, total; LPA, light physical activity; MVPA, moderate-vigorous physical activity. Highlighted values show significant correlation.

Table 3.7 presents a correlation between objective and subjective measures of sleep, inactivity, and physical activity. The objective sleep variable was positively associated with the subjective sleep variable, demonstrating a strong correlation between the two methods of measurement. Axivity-

monitored inactivity was inversely associated with self-reported sleep and axivity-monitored light activity was inversely associated with self-reported total work (min/day).

Objective measures of moderate-vigorous physical activity were not associated with any self-reported variable, therefore displaying a poor correlation between the two methods of measurement for physical activity.

3.3. Multiple linear regressions between socio-demographic status, risk factors, and obesity and cardiometabolic disease risk outcomes

To determine the association between socio-demographic characteristics and lifestyle risk behaviours with anthropometry and cardiometabolic outcomes. Backward stepwise multilinear regression models were performed with each cardiometabolic variable.

Table 3.8. Multiple linear regressions between socio-demographic characteristics, lifestyle risk factors, obesity, and cardiometabolic risk outcomes.

Ind. Variable	**BMI** β (*p*-value)	**WC** β (*p*-value)	**SBP** β (*p*-value)	**DBP** β (*p*-value)	**GLU** β (*p*-value)	**TC** β (*p*-value)	**CVD risk** β (*p*-value)	**Sick leave** β (*p*-value)
Age			**0.49 (0.004)**	**0.28 (0.006)**	**0.05 (0.004)**	- 0.02 (0.11)		- 0.19 (0.17)
Gender	**5.83 (< 0.0001)**		**- 10.30 (0.000)**					- 0.04 (0.77)
Body mass index			**0.90 (0.001)**	**0.37 (0.009)**				0.15 (0.17)
Total years at work					**- 0.04 (0.02)**	0.03 (0.08)		**0.27 (0.02)**
Education (Matric)					**1.34 (0.001)**	- 0.56 (0.12)		0.05 (0.63)

Job Grade (B – semi-skilled)	- 2.57 (0.09)	- 4.89 (0.09)						**0.27 (0.02)**
Sleep duration (hrs)				- 1.37 (0.09)				- 0.16 (0.12)
Napping			4.46 (0.16)					
Shift work			- 5.68 (0.11)		**-0.58 (0.04)**		- 2.64 (0.12)	0.16 (0.13)
Current smoking	2.69 (0.13)	6.50 (0.05)		-3.12 (0.20)		**0.71 (0.005)**		- 0.03 (0.74)
Total alcohol consumption					0.00 (0.06)			
Total sugar (unsweetened beverages)				**0.01 (0.02)**				
Total fruit & veg intake							2.54 (0.12)	
Depression (CESD-R total score)								**0.22 (0.03)**
Absolute absenteeism								**0.37 (< 0.0001)**
Inactivity	- 0.01 (0.19)	- 0.03 (0.10)					- 0.01 (0.13)	
Light physical activity		0.03 (0.06)				**- 0.00 (0.01)**	0.02 (0.11)	**0.25 (0.04)**
Moderate-vigorous physical activity		**- 0.07 (0.02)**			**0.01 (0.02)**	**-**	**- 0.04 (0.02)**	**- 0.26 (0.04)**
VIF	1.08	1.24	1.13	1.05	1.26	1.65	1.21	< 2.1

R^2 (*p*-value)	0.17 (0.0008)	0.15 (0.0026)	0.27 (0.0000)	0.21 (0.0002)	0.28 (0.0000)	0.29 (0.0097)	0.10 (0.0198)	0.26

Data presented as standardised β coefficients (p-value). CESD-R, Centre for Epidemiologic Studies Depression Scale Revised. Highlighted *p* values show statistical significance

In table 3.8 Age was directly associated with systolic blood pressure (β: 0.49, $p = 0.004$), diastolic blood pressure (β: 0.28, $p = 0.006$) and glucose levels (β: 0.05, $p = 0.004$). Gender was directly associated with BMI (β: 5.83, $p < 0.0001$) but negatively associated with systolic blood pressure (β: - 10.3, $p = 0.004$). Body mass index was positively associated with both systolic blood pressure (β: 0.90, $p = 0.001$) and diastolic blood pressure (β: 0.37, $p = 0.009$).

A negative association between total number of working years (β: - 0.04, $p = 0.02$), shift work (β: - 0.58, $p = 0.04$) and glucose levels were noted whilst education (β: 1.34, $p = 0.001$) and moderate-vigorous physical activity (β: 0.01, $p = 0.02$) demonstrated a positive association with glucose levels.

Current smoking status was positively associated with total cholesterol (β: 0.71, $p = 0.005$) whereas self-reported light physical activity was inversely associated with total cholesterol (β: 0.00, $p = 0.01$).

Moderate-vigorous physical activity had a positive association with glucose levels (β: 0.01, $p = 0.02$) but a significant negative association with waist circumference (β: -0.07, $p = 0.02$), CVD risk (β: - 0.04, $p = 0.019$) and total sick leave (β: - 0.26, $p = 0.04$).

The regression model for sick leave, adjusted for absolute absenteeism, demonstrated total years at work, Job-grade B (semi-skilled), depression total score, and axivity-related light physical activity to be positively associated with total sick leave.

CHAPTER 4

DISCUSSION

4.1. Introduction

This thesis investigated the factors associated with obesity and related cardiometabolic disease in South Africa factory workers. This chapter illustrates the summary of objectives and related findings in table 4.1 followed by discussion of some emerging themes from the results of the study. The strengths and limitations will be discussed, as will recommendations on how best to address the relevant outcome issues. The chapter will end with an overall conclusive summary of the study.

Table 4.1: Summary of objectives and findings

No.	Objectives	Key findings
1.	To describe the subjective and objective measurements of sleep, physical activity, and sitting time of the participants	Subjective: Participants slept a mean of 7.30 ± 1.19 hours per night, demonstrated a median of 180 (0-420) self-reported minutes of inactivity per week and a median of 870 (380 – 2250) self-reported minutes of moderate-vigorous physical activity per week. Objective: Participants slept a mean of 5.62 ± 1.28 hours per night, demonstrated a median of 498.1(450.7 – 563.8) minutes of inactivity per week, and a median of 108.8 (75.7 – 143.5) minutes of moderate-vigorous physical activity per week.
2.	To measure the anthropometry, blood pressure, glucose and total cholesterol levels of the participants	BMI showed mean of 29.6 ± 6.64, WHR of 0.84 ± 0.08 and WHtR of 0.55 ± 0.09. Resting SBP showed a mean of 126.2 ± 18.9 and resting DBP a mean of 79.5 ± 10.7 mmHg. Random glucose demonstrated a mean of 6.47± 1.53 mmol/L and total cholesterol a mean of 4.65 ± 0.68 mmol/L.

4.	To evaluate the behavioural risk factors, personal medical history and mental health of the participants associated with obesity and related cardiometabolic outcomes	Results demonstrated that 61.4% of total population consumed > 120 kilocalories of sugar, with 34.5% not taking in adequate fruit and vegetable, and 13.1% reporting heavy alcohol consumption. 10.3% of the population showed to have less than 150 minutes of physical activity per week. 31.7% of evaluated workforce had a CES-D score ≥ 10, indicative of depression, with 42.8% struggling to cope with stress. 13.8% of the population reported to taking medication for high blood pressure.
5.	To compare results between males and females	Females showed a higher body mass index, waist circumference and waist to hip ratio, with a higher percentage of sick leave. Females demonstrated higher perceived inactivity, a higher CES-D score and a higher PSQI score. Males demonstrated a higher intake of sugar and alcohol, with a greater CVD risk with age. Objectively, males performed more MVPA than their female counterpart.
6.	To compare objective data with subjective data on inactivity, physical activity and sleep	Only subjective and objective sleep showed to have a strong correlation. Objective and subjective measures of physical activity showed no correlation. Objective measures showed lower MVPA and higher inactivity than self-reported measures. All axivity monitor wearers achieved the recommended MVPA (n=87), however not indicative of the total cohort due to low number of wearers.

7.	To determine prevalence of obesity and cardiometabolic risk factors	16.6% had SBP ≥ 140mmHg and 14.5% with a DBP ≥ 90 mmHg. 10.3% had total cholesterol ≥ 90mmHg and only 1.4% had random glucose measure ≥ 11.1mmol/l. 74.5% of total population had a body mass index ≥ 25 and 69.7% had a waist circumference ≥ 94cm for males or ≥ 80cm for females.
8.	To determine prevalence of estimated 10-year risk for developing cardiovascular disease	13.8% of total population showed to be at moderate risk, with 7.6% at a high CVD risk. 75% of population ≥ 60 years old were at highest risk of developing CVD, followed by 30.5% of age category 40-59 at a moderate CVD risk.
9.	To determine correlation of lifestyle patterns with anthropometric and cardiometabolic variables	Correlations demonstrated LPA as positively associated with WC, SBP, VA and CVD risk. MVPA was inversely correlated to WC and VA. Total alcohol consumption was positively correlated to glucose levels, with sleep having an inverse relationship with both SBP and DBP.
10.	To determine correlation between subjective and objective measures of inactivity, physical activity and sleep	Objective variable for sleep duration was positively correlated with self-reported sleep variable (r = .046). No correlations were noted with inactivity and different physical activity intensities.
11.	To examine which socio-demographic characteristics, lifestyle factors and anthropometry variables were independent predictors for obesity, cardiometabolic variables and sick leave.	In multivariable linear regression models showed age was positively associated with SBP (β: 0.49, $p = 0.004$), DBP (β: 0.28, $p = 0.006$) and glucose levels (β: 0.05, $p = 0.004$). Gender was independently associated with BMI (β: 5.83, $p < 0.0001$) but negatively associated with SBP (β: - 10.3, $p = 0.004$).

		BMI was independently associated with SBP (β: 0.9, *p* = 0.001) and DBP (β: 0.37, *p* = 0.009). Current smoking was independently associated with TC (β: 0.71, *p* = 0.005). LPA was negatively associated with TC (β: - 0.0, *p* = 0.01) but positively associated with sick leave (β: 0.3, *p* = 0.04). MVPA showed a positive association with glucose levels (β: 0.01, p = 0.02) but an inverse relationship with WC (β: - 0.07, *p* = - 0.02), CVD risk (β: - 0.04, *p* = 0.02) and total sick leave (β: - 0.26, *p* = 0.04). Total years at work, semi-skilled, total CES-D score, and objective LPA were positively associated with total sick leave.

4.2. Emerging themes

The emerging themes of this thesis were that (i) obesity and hypertension prevalence were high, (ii) differences in objective and subjective physical activity measures, and that (iii) depression was high in the study population. A more detailed discussion of these study findings follows.

4.2.1 The prevalence of obesity and cardiometabolic disease risk factors in South-African factory workers

This total study cohort demonstrated a high percentage of overweight and obesity, however, with a higher percentage noted in the female participants. At 65.7%, the female population is almost double the overweight and obesity prevalence of the male population combined. These findings are on par with other national studies, showing higher obesity incidence in females (48, 106).

Furthermore, a high prevalence of hypertension of 42.8% was seen, again with females obtaining a higher percentage (Table 3.3). These findings are in line with several studies within Africa showing similar results in their female cohort (87, 88, 107-109). Hendriks et al (110) noted hypertension prevalence as being greater than all other CVD risk factors in their sub-Saharan cohort, with age and BMI being independent predictors for an increase in blood pressure. This is important since an analysis of pooled-population based studies across Africa (36) showed females in northern and Southern Africa as having the highest BMI, with the mean BMI being higher than the global average.

It is known that South Africa is experiencing a transition of urbanisation and socio-political change, which seem to have an influence in the workplace with the adoption of westernised behaviour such as high sugar intake, inadequate fruit and vegetable consumption, and high objective inactivity levels which were seen in this study population.

This study demonstrated 61.4% of the total population to consume greater than the recommended 6 teaspoons of sugar per day. Much research has shown how a high intake of sugar-sweetened beverage consumption can lead to weight gain, diabetes and metabolic syndrome (9), with a 2014 study in South Africa showing a prediction of 3.8% obesity reduction in males, and 2.4% obesity reduction in females as a result of the imposed 20% sugar tax (111). Although seemingly small in terms of percentage size, this number can be translated to a decrease in obesity for over 220 000 adults.

A total of 34.5% of the study population consumed less than the recommended 5 servings of fruit and vegetables per day, much lower than a previous local study showing the majority of their employees (86%) to have poor nutritional habits (7). Poor diet has a clear link to weight gain and due to the many hours spent at work, worksite initiatives have the potential to improve employee health and wellbeing, both within the work setting, and outside of the worksite (112).

Self-reported alcohol intake showed only 13.1% of total participants to be heavy drinkers, similar to the national prevalence of self-reported binge drinking sitting at 14.1% of the total population (113). Despite government attempts to implement alcohol control measures, consumption is still high, with the global total alcohol per capita consumption projected to increase to 7.0 litres in 2025 (114). With 19% of all deaths attributable to alcohol abuse being due to cardiovascular disease, it is a viable risk factor requiring continued interventions to lower its overall prevalence.

It is well known that when people are asked to report on products such as alcohol, perceived as somewhat socially undesirable, they will under-estimate as much as up to 50%, in an attempt to appear more socially acceptable (115). In South Africa, researchers also found a considerable under-reporting of actual alcohol consumption by respondents in surveys (116).

The prevalence of cigarette smoking was only slightly lower in females (17.4%) than males (22%), higher than anticipated due to both the low global and national incidence of smoking in females (117). Smoking showed to increase total cholesterol in this population, which is comparable to studies suggesting tobacco smoke to be reduced for its beneficial effect on various cardiometabolic risk factors including blood cholesterol (118).

Interestingly, an increase in sleep duration showed to have a lowering effect on both systolic and diastolic blood pressure. Although this supports previous studies with corresponding findings (58, 119, 120), other studies have suggested sleep duration of particularly longer than 9 hours to increase blood pressure, suggesting it a plausible risk factor for cardiometabolic disease (60).

4.2.2. Physical activity: self-reported versus objective measures in South African factory workers

Light activity levels in this cohort showed to improve cholesterol measures, showing how even small amounts of activity can be beneficial to such biomarkers as Grace et al (121) and Winkler et al (122) have proved. Conversely, this study revealed how an increase in light physical activity

saw an increase in waist circumference, systolic blood pressure, vascular age, cardiovascular disease risk and sick leave. This is in contrast to other studies, where individuals who accumulated greater LPA demonstrated a lower risk for metabolic syndrome, irrespective of the amount of MVPA they had performed (123, 124). Our study findings perhaps lend more to that of Cassidy et al (102), whose study showed the average daily acceleration to be lower in males and females with a cardiometabolic disease, and who performed half of the MVPA on a daily basis compared to healthy individuals.

Although males showed to perform more MVPA in this study cohort, this is in contrast to Doherty et al (76) whose large scale study showed males to spend more time in low/sedentary levels of activity when compared to females.

In comparison to self-reported MVPA, the amount of MVPA minutes recorded per day were lower for the objective variables, and considerably more so for vigorous activity (Table 3.1). A recent Canadian study, although having used a different PA questionnaire, showed a similar finding whereby the total accelerometer-measured MVPA showed 39% compared to 60% for self-reported physical activity total (125). A systematic review (126) looked at 57 studies where correlations between questionnaires and accelerometery were weak to moderate. Most of the studies, however, made use of the International Physical Activity Questionnaire (IPAQ) and ActiGraph monitors. This is in disfavour to Rowlands et al (127) who noted greater similarities in MVPA with the Axivity and GENEActiv accelerometers rather than with the ActiGraph when comparing physical activity outcomes in terms of acceleration and physical activity cut points between all three monitors.

When considering associations with obesity and cardiometabolic markers, increased MVPA showed to be negatively associated with waist circumference, glucose levels, VA, and CVD Risk. This is not surprising, with other studies showing similar positive effects of MVPA on several health markers (125, 128). Although our study included both bouted and unbouted MVPA in the analysis, there is evidence that both bouted and nonbouted are independently associated with health markers, with the strength of the association being greater in MVPA (102, 129).

Similar to MVPA, Inactivity demonstrated a large discrepancy between self-reported data and axivity data. The total average of self-reported inactivity was only 180 min/day, as opposed to 498.1 min/day via accelerometery. This shows a considerable overestimation of physical activity and underestimation of inactivity using the GPAQ. Celis-Morales et al (130) found similar results in their cohort comparison, concluding how self-reported measures of activity can underestimate the strength of relationships with cardiometabolic risk factors.

A novel finding in this study sample was how vigorous activity showed to decrease sick leave. This supports the idea of Losina et al (131) who shows the opposite to be associated with more sick, recommending employee-based interventions to increase physical activity as a favourable tool to try reduce unplanned days off work.

There is limited current research focussing on the dose-response of physical activity in the workplace, although one study did publish promising results of how vigorous physical activity sessions, when implemented for at least three times a week, showed positive effects on sick leave (132). This could be extremely beneficial to our study population who objectively demonstrated very low vigorous physical activity levels.

4.2.3. Mental Health of South African factory workers

Almost 40% of the female cohort scored greater than 10 on the CESD-R questionnaire, which is suggestive of depression. Although a small cross-sectional study, this finding does support previous studies showing major depressive disorder in 9.7% of the South African adult population (133) with 18.3% reported to be receiving treatment at any given time (134). Furthermore, being female has been previously reported as a prevalent contributor to depression frequency (135, 136). This seems to be a global finding where studies have found depression to be higher in females, irrespective of age, however showing evidence of obesity prevalence increasing with higher depressive symptom levels in some cases and depression prevalence increasing with an increased BMI in other cases (137, 138).

Although depression was not associated with any of the cardiometabolic outcomes in this study, a recent South African study showed low quality of life and chronic conditions such as stroke and angina to be associated with 12-month depression status (81). Our study sample did, however, show depression to be positively associated with sick leave (p = 0.03). This agrees with the findings of Mall et al (139) in which anxiety and depression were associated with the highest days out of role per annum. A possible reason of the high depression and absenteeism rate in the workplace could be due to the lack of workplace autonomy and imposed shift schedules on employees (140) which would be worth exploring in a South African context.

More research is needed to understand depression in the workplace. Whilst limited local data have demonstrated a link between depression and absenteeism, a few others have shown depression to be more closely linked to presenteeism (134, 136) with depressed employees not particularly taking days off work, but instead having higher incidences of social withdrawn and low job functionality in the workplace (136).

4.3. Strengths of the research

Comprehensive questionnaires allowed for a very thorough investigation, which was carried out with the help of well-trained study-protocol assistants. Participants were allowed as much time as required to understand the question and to ask for clarity when necessary. This study also included more than one anthropometric measure for determining obesity risk (i.e. BMI as well as waist circumference, W-H Ratio, and WHtR) which allowed for richer analysis.

Most studies within Sub-Saharan Africa which investigated the effects of various exercise domains on health markers have done so only with subjective measures. Objective measures for physical activity and sleep were included in this study, giving us the opportunity of analysing raw data over several days and mitigating potential social bias and recall errors.

4.4. Limitations of the study

This study has several important limitations worth noting. Due to the nature of the study being cross-sectional, and having a relatively small population size, one cannot assume the findings to be representative of the South African working population.

Due to the permitted times for assessment and different shift schedules of workers, our study looked at random glucose levels, rather than the recommended fasting glucose measurements, which may have underestimated the true incidence of this health marker in population. Our available equipment did not allow for triglyceride measurements, therefore only reporting total cholesterol which may have masked the number of participants at risk.

The poor correlation between subjective and objective measures in physical activity could be due to the different methods being measured during different weeks. Also, not all participants wore their monitor for a full 7 day period, which could have lowered correlation, as studies have shown stronger correlations with increased wear-time (126).

Furthermore, due to the sensors not being waterproof, it could not consider water-based activities which could lead to miscalculations of the physical activity intensities. Stationary activity such as strength training and cycling has also proved difficult for accelerometers to sense (125, 126) It was also noted how several participants admitted to increasing their activity whilst wearing the device, which would have a negative effect on correlation.

Although the GPAQ is cost-effective and its reliability has been tested in South Africa with acceptable results (89), a draw-back in the tool is that it lacks sensitivity found in objective measures, only assesses self-reported physical activity which can lead participants to overestimate their weekly activity levels (141). Despite this challenge, the GPAQ remains a valid tool for

assessing physical activity domains in sub-Saharan Africa, with various countries showing up to 75% of their moderate-vigorous physical activity to be from within the workspace (142).

4.5. Recommendations for further investigation

Both subjective and objective measures of physical activity can lead to understanding the impact of physical activity on health. The findings of this study can be used as additional evidence to support the notion that objective measures of physical activity should not be used in place of subjective measures and vice versa. Questionnaires should rather continue to be utilized as the measure of an individuals' perceived time spent in different activity intensities whereas the accelerometers measure time spent in continued movement within defined threshold categories, both showing equal importance and validity in the field of research (130, 143).

Worksite interventions appear a reasonable strategy to integrate into the workspace to increase employee productivity, more so than reducing sick leave (144). Furthermore, programs that assess and monitor risk factors can be used to inform companies on how to best prevent and manage obesity in the workplace.

The workplace shows to be an ideal setting for health promotion as it allows access to large populations (Howarth et al). Unfortunately, there is no formal guideline in South Africa for addressing non-communicable diseases in the workplace setting, highlighting a need for more evidence in intervention design, implementation, and success rate in the long-term (145).

4.6. Conclusion

In conclusion, this master's research project has highlighted a high percentage of obesity and hypertension amongst factory workers in the pharmaceutical manufacturing industry. This finding confirms data from earlier studies of blue-collar and lower-earning workers in South Africa. This

shows an urgent need to manage obesity and hypertension in the country (22, 46). It was also noted that light physical activity and high depression scores are associated with sick leave. These data findings highlight the urgent need to address the mental health and physical activity of employees through target worksite schemes to improve health and wellness. Further investigation is needed to determine the best approach to adopt amongst this study population.

Based on the study findings, interventions directed at addressing physical activity, diet, and mental health of employees could assist in lowering obesity and cardiometabolic risk in the study population. Improving health markers associated with obesity and cardiometabolic disease risk could improve overall employee health thus lessening amount of sick leave days per employee and increasing company productivity.

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APPENDICES

APPENDIX ONE: INFORMATION SHEET

Title of Study: Investigating the health profile of employees at a pharmaceutical company in Johannesburg.

Good day, my name is Margarida Pereira da Silva, a MSc (Med) Sports & Exercise student at the University of the Witwatersrand. I would like to invite you to participate in my research study. The title is "Investigating the health profile of employees at a pharmaceutical company in Johannesburg". Please consider reading and understanding more about the study before you make a decision about participating in the study. Please feel free ask any questions about information you are not sure about and you can ask for details about the study. I appreciate you taking the time to read this information document.

Invitation to participate:

Obesity and cardiometabolic diseases are increasing in the South African population, which can be attributed to several behavioural risk factors. These risk factors may cause obesity and/or cardiometabolic diseases, leading to sick days taken from work. Our team of researchers wants to find out if there is a problem of obesity and related cardiometabolic disease in your workplace in order to work with you to improve your health and well-being. This study is important as the findings will help the management and other similar companies with ensuring the health of their workers.

Where will the study take place?

The study will be held at your place of employment, i.e. Ascendis Pharma, Isando, Johannesburg.

Participation is in this study is voluntary. You will be invited to participate, however, even after consenting, you may decide to leave the study at any time without any negative consequences.

Once you have read and understood the purpose of the study, and are willing to volunteer to take part, you will be asked to sign a consent form. A research assistant will check your glucose and cholesterol levels. You will then be guided through a questionnaire related to your health, followed by blood pressure and body composition measurements (height, weight, calf, waist and hip circumference). You will also be asked to wear a lightweight activity monitor (AX3) on your wrist for 7 days so that we can determine physical activity and sleeping pattern.

Taking part in this study will not result in any risks or complications.

Those taking part in this study will not benefit directly.

The information collected by the research team will be kept strictly confidential and password protected by the supervisor. Any identifiable information collected during the course of the study will not be shared with the employer; only collective anonymized information may be presented to the employer. This information will help the research team with identifying and understanding the association between behavioural risk factors and obesity and cardiometabolic diseases in workers at Ascendis Pharma. The information of the whole group will also be presented at conferences and written in peer reviewed journals.

Ethical considerations:

The proposal for this intervention study has been submitted and approved by the University of the Witwatersrand, Human Research Ethics Committee (HREC), Medical. For further information regarding this, contact the HREC chairman Prof Clement Penny on 0114883820 or email: Clement.Penny@wits.ac.za

Contact details:

For further information, you may contact me:

Maggie Da Silva

Telephone: 082 722 2924

Email: mpbiokinetics@gmail.com

APPENDIX 2: INFORMED CONSENT

Title of Study: Investigating the health profile of employees at a pharmaceutical company in Johannesburg.

I agree to participate in the study.

The goals and methods of the study are clear to me.

All the details and purposes of this study have been explained to me.

I agree to participation in the study understanding that:

1. I can withdraw from the study at any time voluntarily and that no adverse consequences will follow on withdrawal from the study.
2. I have the right not to answer any or all questions posed in the interviews and not to participate in any or all of the procedures / assessments.
3. The University of the Witwatersrand Human Ethics committee has approved the study protocol and procedures.
4. All results will be treated with the strictest confidentiality.
5. Only group results, and not my individual results will be reported. These may be published in scientific journals and in the media.
6. The scientific team are committed to treating participants with respect and privacy through interviews conducted in private and follow-up counselling available on request.
7. I will receive a referral note to a health service if any result is out of the normal range or a problem is detected in the course of the study.

PARTICIPANT

Printed Name	**Signature**	**Date and Time**

RESEARCH ASSISTANT:

Printed Name	**Signature**	**Date and Time**

APPENDIX 3: QUESTIONNAIRE

Section 1: Demographics and socioeconomic status

1) What is your Age? _____

2) What is your gender? Please tick the appropriate box

☐Male ☐Female

3) What is your highest level of school education? Please tick the appropriate box

☐No school ☐Primary school ☐Incomplete high school ☐Completed matric

4) If you have **completed high school**, what is your highest completed level? Please tick the appropriate box

☐College/technical school diploma ☐University degree ☐Postgraduate qualification

5) What is your occupation type? Please tick the appropriate box

☐Administrative/clerical	☐Middle management	☐Professional	☐Sales	☐Senior management	☐Manual laboure r	☐Cleaner	☐Driver

6) What is your current net salary after deductions? Please tick the appropriate box

☐ Prefer not to answer	☐ <R5000	☐ R5000 to R10000	☐ R10000 to R15000	☐ R15000-R20000	☐ R20000-R30000	☐>30000

Section 2: Absenteeism

1) About how many hours altogether did you work in the past 7 days? (If more than 97, enter 97.)

Number of hours (00-97)

2) How many hours does your employer expect you to work in a typical 7-day week? (If it varies, estimate the average. If more than 97, enter 97.)

Number of hours (00-97)

3) Now please think of your work experiences over the past 4 weeks (28 days). In the spaces provided below, write the number of days you spent in each of the following work situations. In the past 4 weeks (28 days), how many days did you...

Number of days (00-28)

3a) Miss an **entire** work day because of problems with your physical or mental health? (Please include only days missed for your **own** health, not someone else's health.)

3b) Miss an **entire** work day for any other reason (including vacation)?

3c) Miss **part** of a work day because of problems with your physical or mental health? (Please include only days missed for your **own** health, not someone else's health.)

3d) Miss **part** of a work day for any other reason (including vacation)?

3e) Come in early, go home late, or work on your day off?

4) About how many hours altogether did you work in the past 4 weeks (28 days)? (See examples below.)

Number of hours in the past 4 weeks (28 days)

Examples for Calculating Hours Worked in the Past 4 Weeks

- 40 hours per week for 4 weeks = 160 hours
- 35 hours per week for 4 weeks = 140 hours
- 40 hours per week for 4 weeks with 2 8-hour days missed = 144 hours
- 40 hours per week for 4 weeks with 3 4-hour partial days missed = 148 hours
- 35 hours per week for 4 weeks with 2 8-hour days missed and 3 4-hour partial days missed = 112 hours

5) On a scale from 0 to 10 where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate the usual performance of most workers in a job similar to yours?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

Worst performance Top performance

6) Using the same 0-to-10 scale, how would you rate your usual job performance over the past year or two?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

Worst performance Top performance

7) Using the same 0-to-10 scale, how would you rate your overall job performance on the days you worked during the past 4 weeks (28 days)?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

Worst performance Top performance

Section 3: Medical History

Family history

Do you have a family history (parents or siblings) of any of the following medical conditions?

Heart disease	☐ Yes	☐ Before or at the age of 50	High cholesterol	☐ Yes	☐ Before or at the age of 50
Insulin dependent diabetes	☐ Yes	☐ Before or at the age of 50	High blood pressure	☐ Yes	☐ Before or at the age of 50
Non-insulin dependent diabetes	☐ Yes	☐ Before or at the age of 50	Stroke	☐ Yes	☐ Before or at the age of 50
Peripheral vascular disease	☐ Yes	☐ Before or at the age of 50	Cancer	☐ Yes	☐ Before or at the age of 50

Asthma	☐ Yes	☐ Before or at the age of 50	Stroke	☐ Yes	☐ Before or at the age of 50

Personal medical history

Have you suffered, or do you suffer from any of these medical conditions?

Heart disease	☐ Yes	☐ Before or at the age of 50	High cholesterol	☐ Yes	☐ Before or at the age of 50
Insulin dependent diabetes	☐ Yes	☐ Before or at the age of 50	High blood pressure	☐ Yes	☐ Before or at the age of 50
Non-insulin dependent diabetes	☐ Yes	☐ Before or at the age of 50	Stroke	☐ Yes	☐ Before or at the age of 50
Peripheral vascular disease	☐ Yes	☐ Before or at the age of 50	Cancer	☐ Yes	☐ Before or at the age of 50
Asthma	☐ Yes	☐ Before or at the age of 50	Stroke	☐ Yes	☐ Before or at the age of 50

Diagnosed by?	☐ Cardiologist	☐ Specialist physician	☐ Medical practitioner	☐ Blood test
Diagnosed when?	☐ in the past year	☐ 1-5 years ago	☐ >5 years ago,	
Specific intervention?	☐ healthy dietary habits	☐ medication	☐ regular activity	

Medication

Are you currently on medication for heart disease, peripheral vascular disease, diabetes, cholesterol and/or blood pressure?

☐ Yes ☐ No

If yes, please write your medical condition, name of medication and dosages, below:

Condition: e.g. Cholesterol	**Medication: e.g. Lipitor**	**Dosage: e.g. 10mg 1/day**

Section 4: Behaviours

Smoking status: Please tick the appropriate box relating to your smoking

Never smoked ☐

How long have you been an ex-smoker?

☐ less than 3 months ☐ 1-5 years ☐ 11-15 years ☐ less than 1 year ☐ 6-10 years ☐ more than 15 years

Current smoker ☐

☐ <10 per day ☐ 10-20 per day ☐ 21-30 per day ☐ > 30 per day

☐ Cigar ☐ Pipe ☐ Cigarettes ☐ Chewing Tobacco/Snuff

For Smokers only: Please tick only one of the options that best describe your current smoking situation

☐ I have no intention of becoming tobacco free in the next 6 months.

☐ I intend to become tobacco free in the next 6 months.

☐ I am trying to become tobacco free, but I am not always successful.

☐ Although I am currently using tobacco again, in the past I have been tobacco free for more than 3 months.

Alcohol use

Please make the appropriate selection relating to your weekly alcohol consumption.

☐ I don't have any alcoholic drinks.

☐ Never more than 1-2 drinks per occasion or per day.

☐ 3-4 drinks in a day, only 2-3 per month.

☐ 3-4 drinks in a day, 4 times per month.

☐ 3 or more drinks in a day, more than once a week and / or more than 4 drinks at a time.

Sleep: Pittsburgh Sleep Quality Index

INSTRUCTION

The following questions relate to your usual sleep habits during the past month only. Your answer should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?
   USUAL BED TIME…….
2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?
   NUMBER OF MINUTES……
3. During the past month, when have you usually gotten up in the morning?
   USUAL GETTING UP TIME……

4. During past month, how many hours of actual sleep did you get at night?
   (This may be different than the number of hours you spend in bed)
   HOURS OF SLEEP PER NIGHT…….

For each of the remaining question, check the one best response. Please answer all questions

5. During the past month, how often have you had trouble sleeping because you
   a) Cannot get to sleep within 30 minutes

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

   b) Wake up in the middle of the night or early morning

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

   c) Have to get up to use the bathroom

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

   d) Cannot breathe comfortable

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

   e) Cough or snore loud

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

   f) Feel too cold

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

g) Feel too hot

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

h) Had bad dreams

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

i) Have pain

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

j) Other reason(s), please describe…….

How often during the past month have you had trouble sleep because of this?

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

6. During the past month, how would you rate your sleep quality overall?

Very good…….
Fairly good…….
Fairly bad…….
Very bad…….

7. During the past month, how often have you taken medicine (prescribed or over the counter) to help you sleep?

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month	Less than once a week	Once or twice a week	Three or more times per week

9. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

No problem at all…….
Only a very slight problem……
Somewhat of problem…….
A very big problem……

10. Do you have a bed partner or roommate?

No bed partner or roommate…….
Partner/roommate in other room……
Partner in same room, but not same bed……
Partner in same bed …….

Stress management:

Are you coping with your daily stress?

☐ No, and I have no intention to implement coping strategies in the next 6 months.

☐ No, but I intend to learn how to cope with my daily stress in the next 6 months.

☐ I am trying to cope but I do not always cope successfully

☐ Yes, I have been coping with my daily stress, but for LESS than 6 months.

☐ Yes, I have been coping with my daily stress for MORE than 6 months.

☐ Although I am not coping with my daily stress, in the past I have coped well for more than 3 months.

Mental health (CES-D-R 10)

Below is a list of some of the ways you may have felt or behaved.

Please indicate how often you have felt this way during the past week by checking the appropriate box for each question.

	Rarely or none of the time (less than 1 day)	**Some or a little of the time** (1-2 days)	**Occasionally or a moderate amount of time** (3-4 days)	**All of the time** (5-7 days)

1. I was bothered by things that usually don't bother me.	☐	☐	☐	☐
2. I had trouble keeping my mind on what I was doing.	☐	☐	☐	☐
3. I felt depressed.	☐	☐	☐	☐
4. I felt that everything I did was an effort.	☐	☐	☐	☐
5. I felt hopeful about the future.	☐	☐	☐	☐
6. I felt fearful.	☐	☐	☐	☐
7. My sleep was restless.	☐	☐	☐	☐
8. I was happy.	☐	☐	☐	☐
9. I felt lonely.	☐	☐	☐	☐
10. I could not "get going."	☐	☐	☐	☐

Dietary Assessment

Think about your eating habits over the past year or so. Approximately how often do you eat of the following foods? Tick one box for each food.

Fruit/vegetables/fibre	Never/Once or less than once per month	2-3 times per month	1-2 times per week	3-4 times per week	5+ times per week
Fruit (not counting juice)	☐	☐	☐	☐	☐
Green salad	☐	☐	☐	☐	☐
Potatoes with skin	☐	☐	☐	☐	☐
Other vegetables	☐	☐	☐	☐	☐

Do you currently feel that you are following a healthy diet?

☐ No, and I have no intention of following a healthy diet in the next 6 months.

☐ No, but I intend to follow a healthy diet in the next 6 months.

☐ I am trying to follow a healthy diet, but I am not always successful

☐ Yes, I have been following a healthy diet, but for LESS than 6 months.

☐ Yes, I have been following a healthy diet for MORE than 6 months.

☐ Although I am currently following a healthy diet, in the past I have followed a healthy diet for more than 3 months.

Beverage consumption

Instructions:

In the past month, please indicate your response for each beverage type by marking an "X" in the bubble for "how often" and "how much each time".

1. Indicate how often you drank the following beverages, for example, if you drank 5 glasses of water per week, mark 4-6 times per week.
2. Indicate the approximate amount of beverage you drank each time, for example, if you drank 1 cup of water each time, mark 1 cup under "how much each time". NOT in the milk categories.
3. Do not count beverages used in cooking or other preparations, such as milk in cereal.
4. Count milk added to tea and coffee in the tea/coffee with cream beverage category

	HOW OFTEN (MARK ONE)							**HOW MUCH EACH TIME (MARK ONE)**				
Type of Beverage	**Never or less than 1 time per week (go to next beverage)**	**1 time per week**	**2-3 times per week**	**4-6 times per week**	**1 time per day**	**2+ times per day**	**3+ times per day**	**Less than 6 fl oz (3/4 cup)**	**8 fl oz (1 cup)**	**12 fl oz (1 1/2 cups)**	**16 fl oz (2 cups)**	**More than 20 fl oz (2 1/2**

												cups)
Water	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
100% Fruit Juice	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sweetened Juice Beverage/ Drink (fruitades, lemonade, punch, Sunny Delight)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Whole Milk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Reduced Fat Milk (2%)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Low Fat/Fat Free Milk (Skim, 1%, Buttermilk, Soymilk)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Soft Drinks, Regular	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diet Soft Drinks/Artificially Sweetened Drinks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

(Crystal Light)												
Sweetened Tea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tea or Coffee, with cream and/or sugar (includes non-dairy creamer)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tea or Coffee, black, with/ without artificial sweetener (no cream or sugar)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Beer, Ales, Wine Coolers, Non-alcoholic or Light Beer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hard Liquor (shots, rum, tequila, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wine (red or white)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Energy & Sports Drinks (Red Bull, Rockstar, Gatorade, Powerade, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other (list):	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Section 5: Physical activity

The next questions are about the time you spend doing different types of physical activities. This includes activities you do at home, at work, travelling from place to place and during your spare time. You are requested to answer the questions even if you don't consider yourself to be an active person.

	• **Occupation-related Physical Activity (paid or unpaid work):** *When answering the following questions, think back over the **past 12 months** and consider (think of) **a usual week**:*		
1	Does your work involve <u>mostly</u> sitting or standing still, **OR** walking for very short periods (less than 10 minutes)?	YES ..... 1 NO 2	——□4
2a	Does your work involve <u>vigorous</u> activities, (<u>like</u> heavy lifting, digging, or heavy construction) for **at least 10 minutes** at a time?	YES ..... 1 NO 2	——□3a

2b	In **a usual week**, how many days do you do <u>vigorous</u> activities as part of your work?	┌──┬──┐ DAYS_ │ │ │ └──┴──┘ └──┘	
2c	On a usual day on which you do <u>vigorous</u> activities, how much time do you spend doing such work?	_____ HOURS _____ MINUTES	
3a	Does your work involve <u>moderate-intensity</u> activities (<u>like</u> brisk walking or carrying light loads) for **at least 10 minutes** at a time?	YES ..... 1 NO 2	──□4
3b	In **a usual week**, how many days do you do <u>moderate-intensity</u> activities as part of your work?	┌──┬──┐ DAYS_ │ │ │ └──┴──┘ └──┘	
3c	On a usual day on which you do <u>moderate-intensity</u> activities, how much time do you spend doing such work?	_____ HOURS _____ MINUTES	
4	How long is your usual workday?	_____ HOURS _____ MINUTES	
• **Travel-related Physical Activity:** *Other than activities that you've already mentioned; I*			

	would like to ask you about the way you travel to and from places (to work, to shopping, to market, to church, etc.).		
5a	Do you walk or use a bicycle (pedal cycle) for **at least 10 minutes** at a time to get to and from places?	YES ..... 1 NO 2	—□6
5b	In **a usual week**, how many days do you walk or cycle for at least 10 minutes to get to and from places?	DAYS_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	
5c	On a usual day, how much time do you spend walking and cycling for travel	_____ HOURS _____ MINUTES	
	• **Non-work related and leisure time Physical Activity:** *The next questions ask about activities you do in your leisure or spare time, for recreation or fitness. Do not include the physical activities you do at work or for travel already mentioned*		
6	In your leisure or spare time do you do any vigorous or moderate-intensity physical activity lasting **more than 10 minutes** at a time?	YES ..... 1 NO 2	——□ 9
7a	In your leisure or spare time, do you do any <u>vigorous</u> activities (<u>like</u> running or strenuous sports, weightlifting) for **at least 10 minutes** at a time?	YES ..... 1 NO 2	—□8 a

7b	IF YES, in **a usual week**, how many days do you do <u>vigorous</u> activities as part of your leisure or spare time?	DAYS_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	
7c	How much time do you spend doing this on a usual day?	_____ HOURS _____ MINUTES	
8a	In your leisure or spare time, do you do any <u>moderate-intensity</u> activities (<u>like</u> brisk walking, cycling or swimming) for **at least 10 minutes** at a time?	YES ..... 1 NO 2	——□ 9
8b	IF YES, in **a usual week**, how many days do you do <u>moderate-intensity</u> activities as part of your leisure or spare time?	DAYS_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	
8c	How much time do you spend doing this on a usual day?	_____ HOURS _____ MINUTES	
	• **Sitting / Resting Activity:** Now I would like to ask you about the time spent *sitting or resting, not including sleeping, **in the <u>past 7 days</u>**. This may include time sitting at a desk, visiting friends, reading, or sitting down to watch television **during working hours and leisure or spare time***.		

9.	Over the **past 7 days**, how much time did you spend sitting or reclining (lying) on a **usual day (exclude sleeping)**?	_____ HOURS _____ MINUTES	

APPENDIX 4: MEASUREMENTS SHEET

Anthropometric measures

Height (cm)		
Weight (kg)		
Waist circumference (cm)		
Hip circumference (cm)		
Calf circumference (cm)	Left	Right

Blood Pressure

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

Bloods

	Reading
Blood glucose	
Total cholesterol	

APPENDIX 5: PERMISSION LETTER

ASCENDIS MANAGEMENT SERVICES
(Pty) Ltd

RE: Permission to conduct research

Prof. Prof Clement Penny

Chair

Human Research Ethics Committee (Medical)
University of the Witwatersrand

Dear Sir,

The purpose of this letter is to inform you that I give Dr Philippe Gradidge, Principal Investigator permission to conduct the research titled Developing an intervention to promote health in the workplace: Uhlelo lokuthuthukisa impilo (Programme for Health Promotion) at Ascendis Health.

Sincerely,

Chantal Burgers

Group HR Manager

APPENDIX 6: ETHICAL CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Philippe Gradidge et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180347

NAME: (Principal Investigator)	Dr Philippe Gradidge et al
DEPARTMENT:	Centre for Exercise Science and Sports Medicine School of Therapeutic Sciences Ascendis-Pharma, Johannesburg
PROJECT TITLE:	Developing an Intervention to Promote Health and Wellness in the Workplace: Uhlelo Lokuthuthukisa Impilo (Programme for Health Promotion)
DATE CONSIDERED:	06/04/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	07/06/2018

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **March** and will therefore be due in the month of **March** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 7: TURNITIN REPORT

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ORIGINALITY REPORT

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