THE PHYSICAL ACTIVITY STATUS AND THE IMPACT OF LIFESTYLE BEHAVIOURS ON WORKPLACE PRODUCTIVITY AND ABSENTEEISM OF TRANSNET EMPLOYEES

BY

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DECLARATION

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

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ABSTRACT

Increased sitting time, insufficient physical activity and sub-optimal body composition are all contributing to the global disease burden. This is made evident by increases in obesity, type II diabetes, cardiovascular diseases (i.e. hypertension and strokes), cancer and other non-communicable diseases resulting in absenteeism and reduced productivity in the workplace. The global rise in sitting time and physical inactivity is caused, in part, by changes in transport convenience, work roles and technological advancements. Employees working in office environments or driving trains sit for prolonged periods; something which is evident in the industry that Transnet operates in. Sitting time and physical inactivity are independent risk factors for non-communicable diseases with poor nutrition, smoking, alcohol consumption and psychological wellbeing, being separate constructs. The purpose of the study is to determine the levels of sedentary behaviour, physical inactivity, obesity, nutrition, alcohol consumption, smoking, non-communicable disease risk, mental wellbeing and their association with productivity and absenteeism in office workers and train drivers at Transnet Freight Rail, Durban.

A cross-sectional study was done with 40 participants, 20 office workers and 20 train drivers. Stature (175.80 ± 9.43 cm) and body mass (83.85 ± 20.31 kg) were measured; and body mass index calculated (26.98 ± 5.37 $kg.m^2$). Physical activity levels, sedentary behaviour, body mass index and other lifestyle factors were explored using an amended version of The Health and Wellbeing survey, a self-report measure.

The results revealed that there was a high prevalence of sedentary behaviour (train drivers = 7.85 ± 2.21 and office workers = 8.3 ± 1.03), particularly among office workers. Most of the participants had a relatively high body mass index, placing in the overweight and obese category, particularly among train drivers. The prevalence of physical inactivity was marginally higher for office workers compared to train drivers. There were significantly ($p<0.05$) higher levels of physical activity within train drivers with a moderate effect size. There were limited associations found between lifestyle factors and sickness absenteeism and worker productivity. Obesity had the most prominent relationship with non-communicable diseases, followed by high levels of sedentary behaviour, not meeting physical activity guidelines, obesity, overweight, and prolonged sitting time at work. A significant and moderate correlation was found between obesity and absenteeism (train drivers: $r = 0.32$ and office workers: $r= 0.46$), however, no associations were found between sedentary behaviour, physical activity and fruit and vegetable intake and absenteeism. Lastly, the association between physical activity and productivity among the train drivers was low negative ($r=-0.15$) which was not significant ($p>0.05$). The associations between physical activity and productivity among office workers, however, was both

significant ($p<0.05$) and moderate positive ($r=0.39$). The vegetable intake among the office workers showed a significant ($p<0.05$) moderate positive association with productivity ($r=0.49$). The association between vegetable intake and productivity among the train drivers was not significant ($p>0.05$) and low positive ($r=0.16$). There was a significant ($p<0.05$) and moderate positive association between fruit intake and productivity among both train drivers ($r=0.43$) and office workers ($r=0.47$). No significant associations between sedentary behaviour and obesity and productivity were found.

The current study provided new insight into the risks associated with lifestyle factors of office workers and train drivers in the transportation sector. The poor lifestyle factors, together with the high prevalence of sedentary behaviour and physical inactivity, provide ideal opportunities for future interventions to focus on workers productivity and overall wellbeing. The job design of train drivers and office workers does not place significant importance on employee health and wellness. Essentially they are not "healthy" but they work productively, giving reason as to why employee wellness is not a priority for employers. The current findings of the study suggest that adopting regular physical activity, healthy dietary patterns and reduced sitting time should be promoted as key components of lifestyle interventions for the prevention of non-communicable diseases in office workers and train drivers.

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GLOSSARY

- **Transnet Freight Rail:** Heavy haul freight rail company that specializes in the transportation of freight
- **Non-communicable diseases:** Chronic diseases of long duration and slow progression related to an individual's lifestyle
- **Musculoskeletal disorder:** injury or disorder of the muscles, nerves, tendons, joints, cartilage and spinal discs.
- **Human Factors Ergonomics:** The scientific discipline concerned with the fundamental understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall systems performance
- **METs:** Metabolic equivalents. One MET is defined as the energy you use when you're resting or sitting still
- **Sedentary behavior:** Any waking behavior with an energy expenditure of $\leq$ 1.5 METs while in a sitting or reclining posture.
- **Physical activity:** Bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure
- **Body mass index:** A key index for measuring overweight and obesity in individuals (weight kg/height m^2)
- **VO_2:** How much oxygen your body consumes, including at rest
- **Dietary approaches to stop hypertension (DASH):** An eating plan to lower or control blood pressure
- **Coronary heart disease:** A type of heart disease that develops when the arteries of the heart cannot deliver enough oxygen-rich blood to the heart
- **Disability adjusted life years:** A measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death
- **South African demographic and health survey (SADHS):** aims to provide a better understanding of the health status of the population in South Africa
- **Cardiovascular mortality:** death attributable to myocardial ischemia and infarction, heart failure, cardiac arrest because of other or unknown cause, or cerebrovascular accident

CHAPTER I

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Workers involved in occupations where there is no substitute to sitting are known as compulsory sedentary workers. These include but are not limited to, train drivers and office workers (Mato, 2016; WHO, 2008). At Transnet, there are workers that do both physical and sedentary tasks, although, sitting based tasks appear to be most prevalent. Sitting for prolonged periods is not offset by leisure time physical activity and is seen as an independent risk factor for non-communicable diseases (Straker, Coenen, Dunstan, Gilson, Healy, 2016; Panahi & Tremblay, 2018). How long workers at Transnet sit for at work and outside of the workplace is not known. Given the proportion of time many adults spend at work, the occupational domain is an important area for consideration of its contribution to sedentary behaviour (Straker et al., 2016). Further, we have also changed the way we behave at home, with our peers and in our communities (Mato, 2016). Our modern lifestyle has resulted in reductions in physical activity globally (Brownson, Boehmer & Luke, 2005; Knuth & Hallal, 2009; Kohl, Craig, Lambert, Inoue, Alkandari, Leetongin & Lancet Physical Activity Series Working Group, 2012). It is assumed that these reductions in physical activity are accompanied by parallel increases in sedentary behaviour (Owen, Healy, Matthews & Dunstan, 2010; Thorp, Healy, Winkler, Clark, Gardiner, Owen & Dunstan, 2012). Linked to this, are other lifestyle behaviours that are often affected by work and other life stressors including nutrition, cigarette smoking and alcohol consumption (Daneshmandi, Choobineh, Ghaem & Karimi, 2017; Tremblay, Colley, Saunders, Healy & Owen, 2010).

Time spent in sedentary activities is independently related to poor health and mortality (Parry & Straker, 2013). Sedentary behaviour can be understood as any waking behaviour with an energy expenditure of ≤1.5 METs while in a sitting or reclining posture (González, Fuentes & Marquez, 2017; Sedentary Behaviour Research Network, 2012). Adults, on average, spend 9.3 hours per day in sedentary activities such as sitting at a computer or driving; about 56% of an individual's waking hours (Owen et al., 2010). In South Africa, around 47% of adults live a sedentary lifestyle (Micklesfield, Pedro, Kahn, Kinsman, Pettifor, Tollman & Norris, 2014). Even in those sufficiently active, long periods of time spent sitting increases the risk of cardiovascular disease, diabetes, some cancers and all-cause mortality (Wilmot, Edwardson, Achana, Davies, Gorely, Gray, Khunti, Yates & Biddle, 2012; de Rezende, Lopes, Rey-Lopez, Matsudo & do Carmo Luiz, 2014). Furthermore, musculoskeletal disorders and fatigue are common in these compulsory sedentary workers (Zungu &

Ndaba,2009; Robinson & Burnett, 2005; Tse, Flin & Mearns, 2006). Limited research is available on the health behaviours and health profiles of individuals working within the transport industry, particularly in South Africa (Mato, 2016).

In addition to reducing sedentary behaviour, physical activity has a major influence on health as it helps to maintain a healthy body and mind and reduces the risk of disease (Wilson, Kirtland, Ainsworth & Addy, 2004; Despres, 2015). Physical activity can be defined as 'bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure' (Miles, 2007; WHO, 2020). This description includes the full range of human movement from competitive sports and exercise to activities involved in daily living such as gardening or house cleaning (Miles, 2007). Globally, 81% of adolescents aged 11-17 years and around 23% of adults aged 18 years and over were insufficiently physically active in 2019 (WHO, 2020; Guthold, Stevens, Riley & Bull, 2020). In South Africa, the prevalence of physical inactivity at work, at home, for transport and flexible time has been estimated to be between 43% and 49% of waking hours in South Africans 15 years and older (Micklesfield et al., 2014).

In today's era, workplaces represent an ideal opportunity for new initiatives to encourage physical activity (Genin, Dessenne, Finaud, Pereira, Dutheil, Thivel & Duclos, 2018). There is clear evidence that increasing the employees' level of physical activity has beneficial effects on their health (Genin et al., 2018). We are currently living in an inconsistent time where our society has become more technologically focused, favouring strategies to minimise the amount of physical activity with more time dedicated towards sedentary behaviours; while on the other hand, there is growing interest and concern for a healthy lifestyle (Thivel, Tremblay, Genin, Panahi, Riviere, Duclos, 2018).

Creating a healthy workplace that does no harm to the mental or physical health, safety or wellbeing of workers is a moral imperative (Burton, 2010; Maslach, Schaufeli & Leiter, 2001). Introducing incidental movement into the work routine has been reported to reduce occupational sitting and body mass index (Puig-Ribera, Bort-Roig & Giné-Garriga, 2017). Body mass index is a key index for measuring overweight and obesity in individuals (weight kg/height m^2) (Mitchell, Bottai, Park, Marshall, Moore & Matthews, 2014). There are positive associations between sedentary behaviour and a higher body mass index (Mitchell et al., 2014; Shields & Tremblay, 2008). Most studies, however, are cross-sectional and cannot conclusively distinguish that sedentary behaviour leads to an increase in body mass index (Mitchell et al., 2014). It is important to understand this fully in order for employees to change their behaviour and further engage in health-promoting activities. The impact of excess weight in the workplace has been investigated with a number of studies detailing the increase

in prevalence of obesity across occupational groups (Kudel, Huang & Ganguly, 2017). Although preliminary studies suggest that obesity may differentially impact work productivity and costs, based on occupational requirements, there is a lack of research looking into the impact of obesity across occupations, and findings have therefore varied (Kudel, Huang & Ganguly, 2017; Rodbard, Fox & Grandy, 2009).

Sub-optimal diet has been defined as one of the leading risk factors for death and disability worldwide (Lim, Vos, Flaxman, Danaei, Shibuya, Adair-Rohano & Aryee, 2013: US Burden of Disease Collaborators, 2013). Up to 4% of the global disease burden has been related to an unhealthy diet, which is an adjustable lifestyle factor (Fransen, Boer, Beulens, de Wit, Bueno-de-Mesquita, Hoekstra, May & Peeters, 2017). There is a large amount of evidence to support the benefits of the consumption of fruit and vegetables (Dias, 2012). Fruit and vegetables contain many vitamins, minerals, fibre and other components that contribute to good overall health as well as reduced risk of strokes, diabetes and other chronic diseases (Dias, 2012). A study conducted in 2000, by the World Health Organization established that globally, 2.7 million deaths (4.9%) were as a result of a lack of consumption of fruit and vegetables, and that 26.7 million (1.8%) disability-adjusted life years were lost as a result of low fruit and vegetable consumption (Lock, Pomerleau, Causer & McKee, 2004). A lack of fruit and vegetables in an individual's diet has been ranked as the 12th main risk factor for mortality in the world (WHO, 2008).

Alcohol consumption is a major public health issue worldwide, being responsible for a large burden of morbidity and mortality annually (Addo, Cook, Galbete, Agyemang, Klipstein-Grobusch, Nicolaou, Danquah, Schulze, Brathwaite, Mockenhaupt, Beune, Meeks, Aikins, Bahendaka, Owusu-Dabo & Smeeth, 2018). The consumption of alcohol also increases the risk of non-communicable diseases and having direct toxic effects on all organs of the body (de Sio, Tittarelli, Martino, Buomprisco, Perri, Bruno, Pantano, Mannocchi, Marinelli & Cedrone, 2020). The overuse of alcohol is responsible for 5.1% of the global disease burden, causing three million deaths per year (de Sio et al., 2020). Many studies have looked into the relationship between alcohol and work (de Sio et al., 2020). They show that alcohol contributes greatly to absenteeism and the risk of injuries, and negatively influences productivity and work performance (Mullahy & Sindelar, 1996; Ames & Bennett, 2011; de Sio et al., 2020).

In South Africa, approximately 17.6% of adults smoke tobacco, according to the South African National Health and Nutrition Examination Survey (Le Roux, 2020). Smoking is one of the major preventable causes of disease and premature death globally, with nearly one billion people who smoke

worldwide (Reddy, Zuma, Shisana, Jonas & Sewpaul, 2015). There is a direct link between smoking and coronary heart disease, with a two to four-fold increase in mortality from coronary heart disease in chronic smokers in comparison to non-smokers (Report of Surgeon General, 2004). Smoking is the second leading risk factor for the global burden of disease, being responsible for 6.3% of disability-adjusted life-years lost, and causing six million deaths annually (Reddy et al., 2015).

Physical inactivity, sedentary behaviour, high body mass index, poor dietary habits, smoking and a large consumption of alcohol have been associated with the onset of non-communicable diseases, particularly that of obesity (Kruk, 2014; NCD Alliance, 2017). The four overarching non-communicable diseases are cardiovascular diseases, chronic respiratory diseases, diabetes and cancer (Global Health Watch, 2012; Sharma, 2013). They are caused, to a large extent, by four behavioural risk factors namely; components of economic transition, rapid urbanization and lifestyles associated with the 21st century i.e. a lack of physical activity, harmful uses of alcohol and tobacco, an unhealthy diet and high levels of sedentary behaviour (Global Health Watch, 2012). The largest result of these risk factors fall increasingly on low- and middle-income countries (Al-Nakeeb, Lyons, Collins, Al-Nuaim, Al-Hazzaa, Duncan & Nevill, 2012).

By increasing physical activity, reducing sedentary behaviour and decreasing cigarette and alcohol consumption, 3.2 million non-communicable disease-related mortalities globally per year could be prevented (WHO, 2020; de Sio et al., 2020). Non-communicable diseases have collectively been responsible for almost 70% of all deaths worldwide (WHO, 2020; Kruk, 2012). Solid and sustained action is important in preventing the exposure to non-communicable disease risk factors such as addressing the social determinants of diseases and strengthening health systems so that they provide appropriate and timely treatment and care for those with established diseases (Global Health Watch, 2012). There are a number of opportunities in a workplace setting to both accelerate and facilitate healthy choices, provide treatment for those with health conditions, and tackle stigma and discrimination, with positive impacts throughout working life and beyond (NCD Alliance, 2017; Robinson & Burnett, 2005; Tse, Flin & Mearns, 2006). While non-communicable diseases are not the focus throughout, the behaviours focused on, directly impact the risk for non-communicable diseases.

Employed adults spend a quarter of their lives at work and the pressure and demands of work may affect their dietary intake, activity levels, time spent sedentary, and/or cigarette and alcohol consumption, which may negatively impact on productivity levels (Schulte, Wagner, Ostry et al., 2007). Productivity is a component of the workplace that is important to consider as it is affected by the health of employees (Sparks, Faragher & Cooper, 2001). Health-related productivity loss happens

when health conditions increase work-related absences (absenteeism) and/or decrease performance while at work (presenteeism), creating a heavy burden on industry (Holden, Scuffham, Hilton, Ware, Vecchio, Whiteford, 2011; Joish & Brixner, 2004). Research has shown that among all preventable chronic conditions, injuries to the back are the most costly in terms of productivity loss (Goetzel, Hawkins, Oziminkowski & Wangs, 2003; Pronk, Katz, Lowry & Payfer, 2011; Joish & Brixner, 2004). However, the literature on total health-related productivity loss, such as absenteeism attributable to the exposure of prolonged sitting, is lacking, particularly in the transportation industry in South Africa (Mato, 2016).

The productivity of workers is a mixture of time off work being absent, due to an illness, and time at work but with lowered levels of productivity while at work (Beaton, Bombardier, Escorpizo, Zhang, Lacaille, Boonen, Osborne, Anis, Strand & Tugwell, 2015). Productivity loss is highly contextualised (Beaton et al., 2015); it is a person-environment state where the demands of a given job (physical, social, psychological aspects) are weighed against the ability of the person in that specific job (Beaton et al., 2015). Proper attention to workers' health and safety is required as unhealthy personal and work practices (e.g. smoking, drinking, sedentary lifestyle and a lack of exercise) results in chronic and non-communicable diseases; further resulting in absenteeism, increased costs and decreased productivity (Burton, 2010). This is, however, unknown in office workers and train drivers at Transnet. Statistics from Occupational Care South Africa and Statistics South Africa (2017) show that 15% of South African employees miss work each day, and one in three people who are absent are actually physically ill. There has been a 500% increase in absenteeism since 2001 indicating substantial growth and an area where wellness interventions could assist (Terblanche, 2017).

Mental health issues are common in the working population (LaMontagne, Martin, Page, Reavley, Noblet, Milner, Keegel & Smith, 2014), with anxiety and depression being the most frequent causes of occupational disability (Chopra, 2009). The need for promoting mental health in the workplace is becoming more and more recognized as it is an important determinant in their overall health (Rajgopal, 2010), and maximizing workplace performance (Burton, 2010). Mental health problems impact employees and the business through absenteeism and negatively impact on productivity (Rajgopal, 2010). It is anticipated that this impact is greatest in developing countries (Chopra, 2009). Workplace factors may cause illness as well as prolong disability associated with mental illness (Chopra, 2009).

1.2 STATEMENT OF THE PROBLEM

Transnet is the largest and most important part of the freight logistics chain that delivers goods to each and every South African. The divisions within Transnet include working in an office environment and/or manual labour. The prevalence of sitting time, levels of physical activity in various domains, both at work and outside of the work environment, as well as other general lifestyle behaviours such as diet, cigarette smoking and alcohol consumption is not known at Transnet Freight Rail.

1.3 STUDY OBJECTIVES

The objectives of this study are to determine office workers and train drivers working at Transnet, South Africa, with respect to the following:

1. Prevalence of sedentary behaviour, physical inactivity, obesity, nutrition, alcohol consumption, smoking and non-communicable disease risk.
2. Mental wellbeing in this cohort of workers.
3. Associations between lifestyle behaviours on workplace productivity and absenteeism.

1.4 AIM

The aim of the study was to determine the physical activity status and the impact of lifestyle behaviours on workplace productivity and absenteeism of Transnet employees. More specifically:

1. To determine the prevalence of sedentary behaviour, physical inactivity, obesity, nutrition, alcohol consumption, smoking habits and non-communicable disease risk of Transnet train drivers and office workers, Durban.
2. To determine the mental wellbeing of Transnet train drivers and office workers, Durban.
3. To determine the associations between lifestyle behaviours; sedentary behavior, physical inactivity, obesity, nutrition, consumption of alcohol, smoking and non-communicable disease risk on workplace productivity and absenteeism of Transnet train drivers and office workers, Durban.

1.5 SUMMARY

Given the proportion of time many adults spend at work, the occupational domain, in this case Transnet Freight Rail Durban, is an important area for consideration of the physical activity levels and the impact of lifestyle behaviours on workplace productivity and absenteeism. The prevalence of sitting

time, levels of physical activity in many sectors, both at work and outside of the work environment, as well as other general lifestyle behaviours such as diet, cigarette smoking and alcohol consumption is not known at Transnet Freight Rail, Durban. It is deduced that there are reductions in physical activity, and are accompanied by parallel increases in sedentary behaviour (Owen et al., 2010; Thorp et al., 2012). Linked to this are other lifestyle behaviours that are in most cases affected by work and other life stressors including cigarette smoking, alcohol consumption and nutrition (Daneshmandi et al., 2017; Tremblay et al., 2010).

CHAPTER II

REVIEW OF LITERATURE

This chapter aims to outline and inform the argument that there is a need to investigate lifestyle factors: sedentary behaviour, physical inactivity, body mass index, nutritional intake, smoking, alcohol consumption and mental wellbeing among workers in the transportation industry, and to find any associations with workplace productivity and absenteeism. The chapter begins with the importance of developing a healthy workplace. The next section investigates health in South Africa, the transport industry and its impact on health, systems theory in human factors ergonomics and the Social Ecological Model, human factors and ergonomics and rail systems ergonomics.

The next section concentrates on the three key topics that jointly captures the rationale for this study. Section A defines sedentary behaviour and provides information regarding the factors impacting sedentary behaviour, prevalence of sedentary behaviour in working adults, sedentary behaviour and health, breaks in sedentary behaviour, introduction to physical activity and the chronic disease reduction, the guidelines individuals need to follow in terms of physical activity, physical activity in urban and rural areas as well as the barriers and enablers to physical activity participation. Section B provides an overview of the literature looking into non-communicable diseases. The behavioural and biomedical risk factors are explored. Section C looks into biological effect and mental wellbeing of train drivers and office workers' in relation to the work they are performing. Following this is an overview of worker productivity and absenteeism, and a summary of the chapter.

2.1 IMPORTANCE OF DEVELOPING A HEALTHY WORKPLACE

The World Health Organization (2008) have defined a healthy workplace as “a place where everyone works together to achieve an agreed vision for the health and wellbeing of workers and the surrounding community”. Aside from the fact that creating a healthy workplace that does no damage to the mental or physical health, safety or wellbeing of workers is an ethical obligation (Burton, 2010; Baker, Coleman & Sormin, 2002), it should be seen as an opportunity to improve the experience of the workforce and provide opportunities for increased productivity and efficiency. A healthy workplace should offer an open, available and accepting environment for people with varying backgrounds, demographics, skills and abilities (Burton, 2010; Baker, Coleman & Sormin, 2002), and should be ingrained in the strategic management of an organisation (Burton, 2010; Karlsson, 2010).

Positive outcomes in the workplace derive from multiple factors, including the productivity and efficiency of the environment (Jaskiewicz & Tulenko, 2012); the health which strengthens employee motivation, happiness and mental wellbeing. By integrating considerations with regards to health, safety and wellbeing of the workforce, a sustainable approach to managing the operational environment can be achieved. Key drivers of workplace health and wellbeing are flexible and dynamic, but include the psychosocial work environment, organisation of work tasks, workplace culture and availability of personal health resources (Burton, 2010; Shamian & El-Jardali, 2007; Grawitch, Gottschalk & Munz, 2006; Burton, 2010).

There is an extensive understanding among global agencies, such as the World Health Organization and the International Labour Organization that the health, safety, and wellbeing of workers, who make up nearly half of the global population, is of utmost importance (Burton, 2010; Sparks et al., 2001). The large economic cost of problems associated with health and safety at work hinders economic growth and, in turn, affects the competitiveness of businesses (Burton, 2010), especially in the transport industry (Dobson, 2015). From a health perspective, roughly two million women and men die each year because of occupational accidents and work-related illnesses (Burton, 2010; Hamalainen, Takala & Saarela, 2009). The World Health Organization (2020) have said that workplace conditions account for more than a third of back pain, 16% hearing loss, nearly 10% of lung cancer, and 8% of the burden of depression (Burton, 2010), highlighting the need to explore lifestyle factors associated with workers, with this study focusing on the Transnet Freight Rail. Developing a healthy workplace has been proven to reduce occupational accidents and work-related illnesses, further reducing absenteeism (Burton, 2010).

Hazards that put danger to physical safety of workers include mechanical/machine hazards, slips and falls from heights, sitting for long periods of time, ergonomic hazards such as repetitive motion, awkward posture and excessive force or risks of work-related train crashes or manual material handling affecting the body (Burton, 2010). Despite most countries having legislation implemented in order to prevent these hazards from happening, they continue to occur at a troubling rate (Milch & Laumann, 2016). The estimated accident rate, being that which requires at least three days absence from work, ranges from a low of 600 per year per 100 000 workers to a high of 23 000 workers (Milch & Laumann, 2016). The human and economic toll of these accident statistics is immeasurable (Burton, 2010). However, the effects of employee lifestyle factors on health and wellbeing are equally important and impactful.

The relationship between occupation and disease burden is complex as in many cases it may take years for a disease to become evident in a worker, and then the link to workplace exposure may be unclear or not recognized (Burton, 2010). Importantly, occupational diseases and cumulative injuries have been grossly under reported and are generally under recognized (Burton, 2010), further exacerbating the problem.

An unhealthy and unsafe workplace can lead to work-related stress which often results in accidents and injuries (Danna & Griffin, 1999). It is a growing concern in the current state of the economy, where employees are facing more cases of being overworked, lack of job satisfaction and low levels of autonomy (Bickford, 2005; Kortum, Leka & Cox, 2010). The business case identifies how an unhealthy and unsafe workplace can lead to work-related stress which can result in accidents and injuries. This in turn could lead to absenteeism, short and long term disability, health insurance which can lead to workers compensation claims increasing costs and decreasing productivity, further, leading to business failure which is illustrated in Figure 1. Employees need to understand the signs that show that they are feeling stressed together with the employers being aware of the effects that stress has on their employees' health as well as on company profits (Bickford, 2005). This is a very important concept to take into consideration.

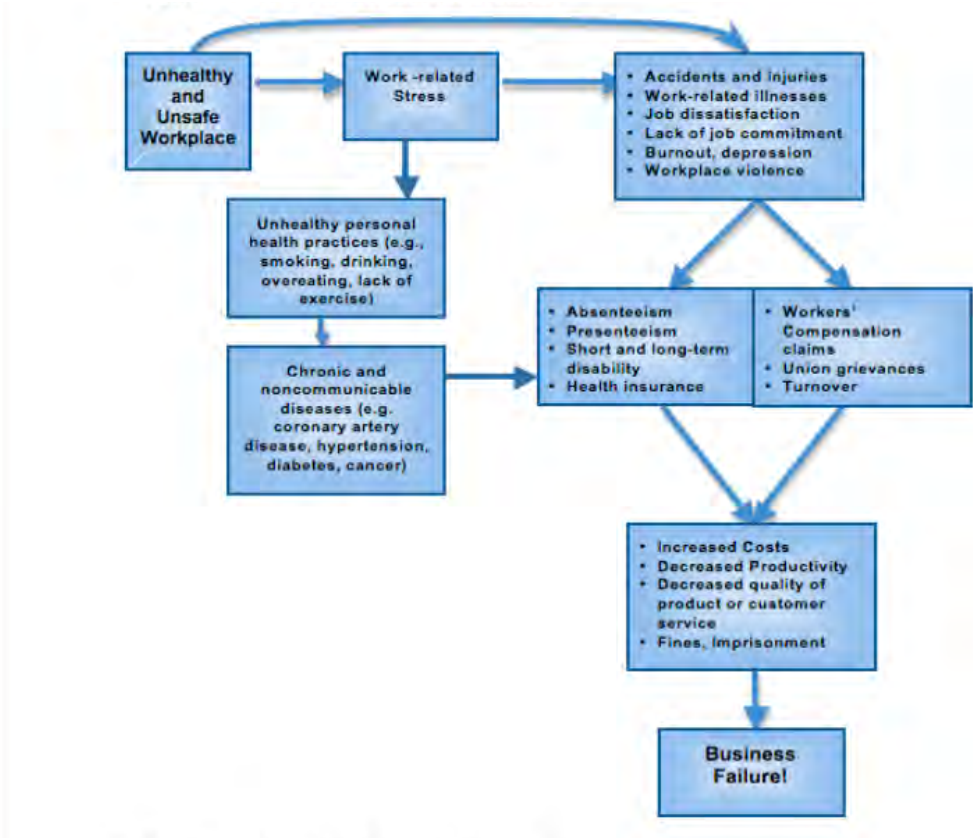

Figure 1: The business case showing how an unhealthy and unsafe workplace can lead to work-related stress, resulting in accidents and injuries (Image taken from Burton, 2010).

2.2 HEALTH IN SOUTH AFRICA

The focus of this section is health in South Africa and, for comparative purposes, links with global data will be made. A recent analysis has shown that the poorest countries have the highest burden of disease despite the prevalence of known cardiovascular risk factors increasing with levels of income (Johnston, Mendis & Mathers, 2009). Data from South Africa has shown a rise in the prevalence of hypertension and obesity with increasing wealth, but quality-of-care indicators, namely the control of hypertension and asthma, were negatively associated with wealth, further indicating an important role that improved health services might have in reducing health inequalities (Schneider, Bradshaw, Steyn, Norman & Laubscher, 2009). The burden of disease related non-communicable diseases is expected to increase substantially in South Africa over the next few decades if measures are not taken in order to stop the trends occurring (Mayosi, Flisher, Lalloo, Sitas, Tollman & Bradshaw, 2009). Information looking into the extent of, and risk factors for, non-communicable diseases in South Africa is important for effective support and action (Mayosi et al., 2009).

In 1972, Walker predicted that increasing urbanisation and a rise in socio-economic status in developing populations would increase their propensity for obesity. With South Africa being a middle-income country with rapid urbanisation occurring and a rise in socio-economic status, they face a severe and growing obesity epidemic (Bosire, Cohen, Erzse, Goldstein, Hofman & Norris, 2020).

2.3 THE TRANSPORT INDUSTRY AND ITS IMPACT ON HEALTH

The transport industry contributes greatly to the country's economy, especially within domestic, regional, and international trade (Simpson, De Bod, Fourie & Havenga, 2011). The freight logistics in South Africa is a large factor and stimulus into how the country does business (Simpson et al., 2011; African Development Bank Group, 2015). South Africa has the 14th longest rail network in the world. (Simpson et al., 2011). The rail network is managed by the Department of Public Enterprises via Transnet, which is the largest railroad and heavy transporter in southern Africa, with about 21000km of rail network, of which about 1500km are heavy haul lines (South Africa's transport network, 2017). South Africa's rail infrastructure is responsible for about 80% of Africa's total and it connects the ports with the rest of the country (Mathabatha, 2015). The government has made enhancing the country's rail network a priority where the main aim is to increase the volumes of freight rail and market share of rail container traffic (South Africa's transport network, 2017; Mathabatha, 2015). South Africa is an export-driven economy, where freight commodities have to be delivered safely and reliably (Mathabatha, 2015). Therefore, due to the large role this sector plays it makes sense to ensure that employees involved are all kept in good health. This industry functions with many different components to it, however, due to the gap in research and the effects the industry has on them, train drivers and office employees will be the focus of this study.

The transportation industry is a grouping of companies that provide services moving people, goods, or the infrastructure to do so (Kenton, 2018; Lemke & Apostolopoulos, 2015). There are many different industries within the transportation industry namely air freight and logistics, airlines, marine, road and rail, and transportation infrastructure (Kenton, 2018). Freight transportation specifically, is a primary component of all supply-chain and logistics systems (Ranaiefer & Amelia, 2011). The rail transportation industry has become one of the most reliable methods of transport in terms of safety (Ranaiefer & Amelia, 2011). Trains are fast, and the least affected by usual weather turbulences like rain or fog, compared to other transport mechanisms. Rail transport is better organized than any other medium of transport, with fixed routes and schedules. Its services are more certain, uniform and regular compared to other modes of transport (Ranaiefer & Amelia, 2011). However, they are run by drivers

who operate in an occupational setting with interconnected and huge stressors (Apostolopoulos, Peachy, Sonmez, 2011).

The lifestyle attached to the transportation industry is accountable for high levels of obesity, metabolic syndrome and mental illness such as stress, depression, anxiety and fatigue (Apostolopoulos, Peachy, Sonmez, 2011). The culture, environment and job demands being that of irregular hours, enforced sedentarism, high stress, poor nutrition, driving conditions, smoking, alcohol consumption, and sleep deprivation are all factors contributing to ill health within the industry (Shattell, Apostolopoulos, Sonmez & Griffen, 2010; Juul-Kristensen & Jensen, 2005). There is very little information of office workers in the transportation industry. However, studies on general office workers show that they are faced with very similar job demands (Clemes, O'Connell & Edwardson, 2014). Therefore, the train drivers and office employees' health conditions deserve attention in their own right (Dahl, Kaerlev, Jensen, Tuchen, Hannerz, Nielsen & Olsen, 2009; Apostolopoulos, 2012), aiding in improving their overall health and wellness.

Workers from the transport sector can be defined as "compulsory sedentary workers" where high amounts of sitting are largely assumed, however no studies have measured such behaviours (Filtness & Naweed, 2017; Mato, 2016). The National Transport Commission classifies train driving as a high-level safety critical job (Loukzadeh, Zare, Mehrparvar, Mirmohammadi & Mostaghaci, 2012). Those involved in critical safety work are known as those whose action or inaction, as a result of ill-health, may directly result in a serious incident affecting the public or the rail network (Loukzadeh et al., 2012). The health and fitness of workers in this industry, particularly their attentiveness and vigilance to their job is important (Loukzadeh et al., 2012). Having a greater understanding of the lifestyle behaviours, specifically that of sedentary behaviour and physical activity, will help in informing the development of interventions targeting improvements in these behaviours in the transport sector, further reducing absenteeism and improving productivity of employees (Filtness & Naweed, 2017). This is without risk to his or her own or others health and safety (Loukzadeh et al., 2012).

Transnet functions as an integrated freight transport company. The divisions within Transnet all include working in an office environment and/or manual labour (Transnet, 2020). Transnet is made up of five operating divisions that work together and complement each other (Transnet, 2020). These divisions include Transnet freight rail, rail engineering, national ports authority, port terminals and Transnet pipelines (Transnet, 2020). It is therefore evident that there is a broad array of workers

performing different tasks in and outside of the office environment, resulting in the health of the employees being of great importance to make sure the company is run effectively.

2.4 SYSTEMS THEORY IN HUMAN FACTORS ERGONOMICS AND THE SOCIAL ECOLOGICAL MODEL

Even small changes in a part of a system can have ripple beneficial or nonbeneficial effects on the entire system (Wilson, 2014). If individuals make small changes to health and wellbeing practices, it may impact the bigger system and its performance (Wilson, 2014). In order to understand this, we can look at all aspects that make up a system namely systems focus, context, the interactions of the system, holism, emergence, and embedding brought about by Wilson (2014). Together with Wilson's (2014) notions, the social ecological model can be used which looks at the individual, interpersonal aspects, organizations and environmental factors which together constitute a system (Meader, Lang, Davis & Molloy, 2016; Mayosi et al., 2009) and needs to be taken into consideration when investigating the lifestyle factors that impact the overall health and wellbeing of the workers at Transnet.

We live in an era in which the dominant causes of morbidity and mortality are strongly linked to human behaviour at the individual, community, and government levels (Stokols, 2004). A very important challenge for the 21st century is to develop programs and policies that will establish a health-promotive environment at local, regional, and global levels (Stokols, 2004). Those that reduce the individuals exposure to health-threatening conditions and support their efforts to encourage wellness on a personal and collective level (Stokols, 2004). The extent of this task comes from the complex web of health-determining factors that impose on individuals, organizations and whole communities (Stokols, 2004). Although these complexities make the task of promoting human wellness seem scary, celebrating the small victories approach to social problems suggests that as gradual health promotion and environmental protection strategies are adopted in local communities, they can put forward a positive influence on population health (Stokols, 2004).

The social ecological model ties in very well with Transnet's philosophy where all their divisions work closely together on all levels, from a holistic point of view, linking with Wilson's systems theory. The viability of a comprehensive model is rather questionable. The aforementioned arguments justify aiming for a more essential modelling concept. The reasons for this are: to describe the human environment system holistically, considering all interacting factors and; to coordinate different areas of design that are usually objects of separate consideration.

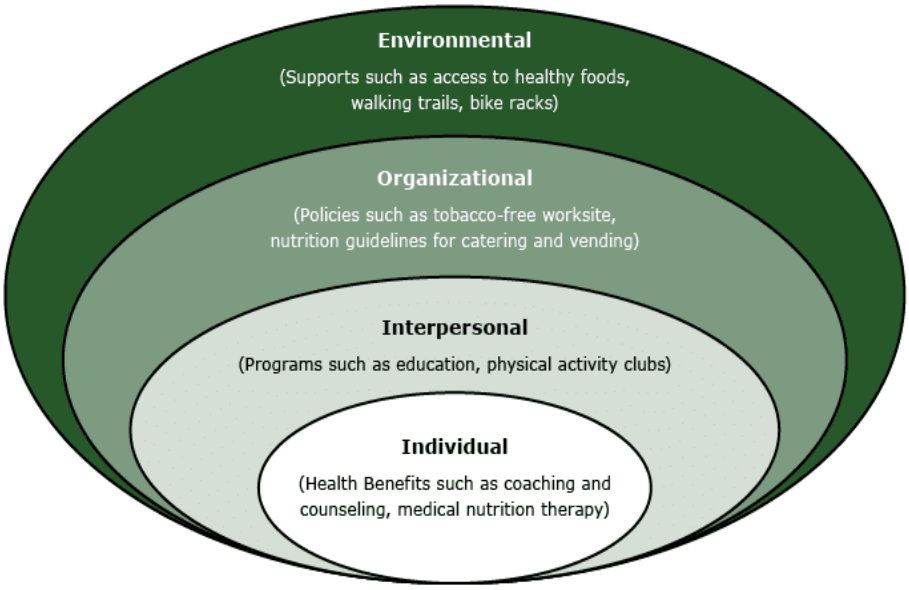

Figure 2: The Social Ecological Model (Image taken from Meader et al., 2016).

The social ecological model shows that in order to understand human development, the entire ecological system in which growth occurs needs to be taken into account being that of individual, interpersonal, organizational and environmental factors (Mayosi et al., 2009). It is important to acknowledge the bigger picture and to take into consideration historical background as to why individuals are spending far too much time in sedentary behaviours or not performing any physical activity (Mayosi et al., 2009).

The focus to date on factors that influence sedentary behaviours has mostly been on individual level factors such as biological, psychological and behavioural (O'Donoghue, Perchoux, Mensah, Lakerveld, van der Ploeg. Bernaards, Chastin, Simon, O'Gorman & Nazare, 2016). However, it has become misleading that these are not stand-alone factors and addressing them independently will not result in a significant change in sedentary behaviours. The current rationale is that factors that influence sedentary behaviour can be conceptualized using the socio-ecological model (O'Donoghue et al., 2016). This model highlights that focus should not only be on individual behavioural factors but also on the multiple-level factors that influence the specific behaviour in question, thus focusing on the interrelationships between individuals and the social, physical and policy environment (O'Donoghue et al., 2016). The socio-ecological model provides a framework that facilitates mapping the many domains of sedentary behaviour, while at the same time assuming multiple levels of influence

understanding that small changes are at a micro level and have a ripple effect (O'Donoghue et al., 2016).

A review study done that investigated sedentary behaviour associations in adults found a number of intrapersonal factors relating to sedentary behaviour, several which are non-modifiable such as gender and age (O'Donoghue et al., 2016). However, they did not find many factors or correlates outside of the individual. Potentially, important factors such as the built, physical, social and policy environments need to be acknowledged and since the publication of that review there have been a number of studies that have investigated the environmental influences on sedentary behaviours, both at an individual and community level. These factors need systematic identification so that they can be considered together with individual level and social correlates in the development of interventions to address sedentary behaviours (O'Donoghue et al., 2016).

Ecological models are used to provide a framework for integrating multiple theories and serve as a meta-model to ensure that environmental and policy factors are taken into consideration when developing wide-ranging approaches to studying and intervening on health behaviours (Sallis & Owen, 2015). Environmental and policy influences that are indicators of ecological models are specific to certain health risks and behaviours (Elder, Lytle, Sallis, Young, Steckler, Simons-Morton, Stone, Jobe, Stevens, Lohmin, Webber, Pate, Saksvig & Ribisl, 2007). Ecological models need to be tailor-made for each behaviour or health condition, such as office work, driving a train or performing manual labour within the train maintenance control sector of Transnet. Models need to be tailor-made to each population because different tasks are being performed in different settings using different equipment therefore the implementation of strategies could differ for each group, however, components of the model could be used across the different working groups (Elder et al., 2007). There are very little studies on the environmental and policy correlates of most health behaviours. Therefore, behaviour-specific ecological models must often be based on consent of practitioners and participants. Despite the difficulties of applying ecological models, substantial progress is being made (Elder et al., 2007).

Interest in ecological models is particularly strong in the physical activity field because physical activity is done in specific settings and there are consistent associations with a wide range of environmental variables (Elder et al., 2007). Several physical activity-specific multilevel models have been proposed that involve variables at an individual, social, environmental and policy levels (Elder et al., 2007). No ecological model, however, has been reported that is able to guide the development of a major-level physical activity intervention. Creating healthy workplaces is becoming more

common within many companies. Roughly 50% of employers that have more than 50 employees offer some type of workplace health promotion program. Very few employers implement wide-ranging evidence-based interventions that reach all employees and achieve desired health and cost outcomes (Meador et al., 2016).

It is important to note that targeted interventions can contribute to the bigger system performance and so small changes at a small level should not be ignored. Often, when just focusing on the whole system where the problems seem almost impossible to solve due to the complexity of them, one needs to go down to levels and see if small changes can impact the larger system (Meader et al., 2016).

Given that employed individuals spend half of their waking time at work, workplaces are the best places to present an opportunity to influence and improve individual health behaviours (Meador et al., 2016). Noted long term benefits of comprehensive workplace health promotion interventions include improved health outcomes, reduced absenteeism, improved employee morale, higher employee retention, and reduced health care costs (Meador et al., 2016). A 2004 national worksite study found that only 6.9% of employers offer comprehensive programs as defined by Healthy People (2010). Comprehensive interventions influence health at the individual, interpersonal, organizational, and environmental levels. Such interventions make sure that workplace policies, benefits, built environment, programs, and evaluation work together in synergistic ways to create healthy workplaces (Meador et al., 2016). Examples of this is providing information to employees about the importance of physical activity being more effective when there are appropriate facilities, time and opportunities to be physically active during the workday (Meador et al. 2016).

There has been an increase in the evidence on the success of using health education programmes by health professionals in the workplace (Schouw, Mash & Kolbe-Alexander, 2020). Many of these programmes do not include the environmental changes that aid in making healthy choices easy and sustainable (Schouw, Mash & Kolbe-Alexander, 2020). The work environment in South Africa is now monitored by legislation and policies in organizations which, most of the time, is the responsibility of the health and wellness departments found within the human resource management units in the organizational structure (Schouw, Mash & Kolbe-Alexander, 2020). Actions need to be implemented in order to take on the predicted increase of non-communicable diseases over the next two decades in South Africa (Schouw, Mash & Kolbe-Alexander, 2020). While there are a number of wellness programmes in the workplace, there is no South African guideline on preventing non-communicable diseases in the workplace and there may be a need for such a guideline to be informed by local

evidence. Single-component interventions have very little effect on the risk of non-communicable diseases. Focused attention should be given to multi-component interventions that make healthy eating and physical activity part of employees' daily schedules (Schouw, Mash & Kolbe-Alexander, 2020).

2.5 HUMAN FACTORS AND ERGONOMICS

Human factors and Ergonomics focuses on the nature of interactions between people and systems, i.e. everything that surrounds people at work and outside their working environment (Karwowski, 2005; Carayon & Smith, 2000). Human Factors and Ergonomics looks at the individual and how their behaviours influence work and how work influences their behaviours (Dul, Bruder, Buckle, Carayon, Falzon, Marras, Wilson & van der Doelen, 2012). Ergonomics promotes a holistic approach in which considerations of physical, organizational, cognitive, environmental, and other relevant factors are taken into account (Zink & Fischer, 2013; Henrick, 2000).

Human factors ergonomics has a unique combination of three fundamental characteristics being; 1) it takes a systems approach, 2) it is design driven and 3) it focuses on two closely related results being that of performance and wellbeing (Dul et al., 2012). The International Ergonomics Association (2003) defines ergonomics as "the scientific discipline concerned with the fundamental understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human wellbeing and overall systems performance" (Bridger, 2018). Based on this knowledge, human factors' goal is to reduce human error, increase productivity, and enhance safety and comfort focusing primarily on the interaction between the human and the object of interest (Zink & Fischer, 2013; Wilson, 2000; Henrick, 2000). By looking at the different lifestyle factors of the workers at Transnet freight rail one can understand if there are any factors that need particular attention in order to make the system run smoothly, specifically aiming at increased productivity and reduced absenteeism.

Instead of lost work days and high medical expenses due to compensation claims, it is more cost effective to implement ergonomics and ergonomic equipment, as it increases an employee's comfort (Dobson, 2015). An employee that is comfortable while working is less likely to fatigue, further increasing his/her productivity (Dobson, 2015; Carayon & Smith, 2000). It is important to note that ergonomics cannot be managed as an additional discipline but rather should be integrated between other disciplines (Göbel & Zschernack, 2012).

2.6 RAIL SYSTEMS ERGONOMICS/HUMAN FACTORS

2.6.1 Background of rail ergonomics

An operational railway is a complex engineering system made up of a variety of technologies (Wilson, Norris, Clarke & Mills, 2016). The way in which this engineering system is organized shows whether it provides the levels of safety and reliability individuals want. The technologies are assorted, and the individual aspects may be at any stage of their life cycle, from origin and design through to commissioning, servicing repair and maintenance, to replacement. The human is at the centre of this complex system. The emergence of ergonomics or human factors as a discipline in its own right within rail is a major step forward in the search for a high performing and effective railway system (Wilson et al., 2016).

When taking a systems ergonomics perspective, the rail network and business create a system that must balance reliability of service, quality of service and safety of staff and passengers in a situation of limited capacity (Wilson et al., 2016). The importance of human factors to safety at every level and function of the railway is increasingly becoming accepted (Clarke, 1998). The addition of ergonomics to information interfaces, trackside signals and signage, job and team design, communications and processes, will improve system reliability as well as safety. The understanding of ergonomics within the railway context will aid in decision making in the business, together with contributing to maximizing the networks efficient use through more effective planning, maintenance and operations (Clarke, 1998).

SECTION A:

2.7 SEDENTARY BEHAVIOUR, PHYSICAL ACTIVITY AND HEALTH

2.7.1 Sedentary Behaviour – an introduction

Sedentary time has been found to be independently related to poor health and mortality (Parry & Straker, 2013). The term sedentary behaviour has in the past been used equally with the lack of physical activity however these two terms are not the same because an individual can still meet or go above the public health guidelines for physical activity and still spend a large amount of time sitting (Sugiyama, Healy, Dunstan, Salmon & Owen, 2008). Sedentary behaviour can be understood as any waking behaviour with an energy expenditure of ≤1.5 METs while in a sitting or reclining posture (González1, Fuentes & Márquez, 2017; Sedentary Behaviour Research Network, 2012). Some common examples

of sedentary behaviour include sitting in motorized transport, at work on your computer and watching television (Pate, O'Neil & Lobelo, 2008). A larger proportion of the workforce is now employed in low activity occupations such as office work and train drivers. To date, there is no research that specifically investigates the contribution of sedentary work to the overall sedentary exposure therefore resulting in risk (Parry & Straker, 2013).

Saunders, Chaput & Tremblay, (2014) shows in figure three that sedentary behaviour and physical activity are separate notions. An individual could be sufficiently active yet still spend majority of their day sitting which increases the risk of cardiovascular disease, diabetes, some cancers and all-cause mortality (Wilmot et al., 2012; de Rezende et al., 2014). Meta-analysis conducted on the relationship between sedentary time and physical activity further contest the construct that meeting physical activity guidelines, independent of sedentary behaviour, will provide physiological benefits. Thus, the levels of physical activity should be investigated independently of sedentary behaviour when attempting to develop an understanding of the roles that both play on the health of an individual (Hamilton, Hamilton & Zderic, 2014).

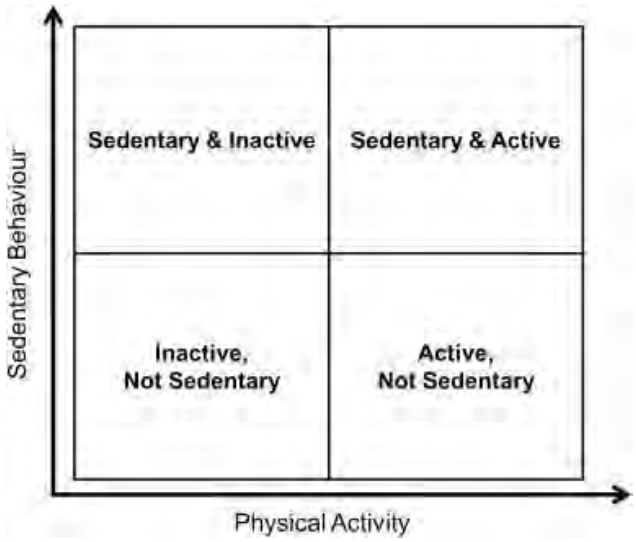

Figure 3: Sedentary behaviour and physical activity being separate constructs (Saunders, Chaput & Tremblay, 2014).

On the one hand, there is an optimal amount of time spent in physical activities to promote positive health effects, while on the other hand, there is an ideal amount of time spent in sedentary behaviour, beyond which developing chronic disease is more likely (González1 et al., 2017). It is important to

note that being physically active is not enough, but one also needs to avoid too much time spent in sedentary behaviours (González1 et al., 2017). A person can still be at risk if they meet the required routine physical activity but sits for the majority of the day (González1 et al., 2017). A meta-analysis by Liu and colleagues (2015), including 71 studies, came to the conclusion that complying with the current physical activity recommendations reduces cancer mortality in both the general population and cancer survivors by 13%.

2.7.1.1 Factors impacting sedentary behaviour

In today's era there has been an economically driven shift towards a highly mechanized, computer-driven world where daily living consists of low levels of physical activity and high levels of physical inactivity, supplemented by occasional bouts of recreational sport, and leisure activities (Heath, 2015). Technological advances, societal influences and environmental changes have had a negative impact on the way we spend our time at work, travelling and during our leisure activities (Health, 2015). These changes have favored a progressive switch from physically demanding tasks to knowledge-based work or mental activity imploring an enhanced cognitive demand (Panahi & Tremblay, 2018). 'Occupational sitting' is a term coined to describe the time spent sitting at work, often using a computer or driving machinery, which has increased in modern times (Straker et al., 2016). Our modern lifestyle has led to large reductions in physical activity all around the world (Brownson, Boehmer & Luke, 2005; Knuth & Hallal, 2009; Kohl et al., 2012) which is therefore giving rise to increases in sedentary behaviour (Owen et al., 2010; Thorp et al., 2012). According to the data reported by Owen et al., (2010) adults, on average, spend 9.3h per day in sedentary activities, i.e. about 56% of an individual's waking hours. In contrast, leisure time moderate-vigorous physical activity contributes only 4% (Owen et al., 2010). While sedentary workers may be less exposed to many of the hazards associated with more physically demanding occupations such as manual laborers, sedentary workers may gain less of the benefits of moderate-vigorous physical activity and be exposed to more of the potential harmful prolonged and uninterrupted sedentary behaviour consequences (Parry & Straker, 2013).

Screen-based leisure activities such as television watching and internet use, and screen-based work activities namely computer use for work reasons, have often been considered together while they may not trigger the same stress response and/or use of substrate (Panahi & Tremblay, 2018). From a physiological perspective, the biological requirements and effects of physical and cognitive work are not the same. Mental work, for instance, may greatly increase glycaemic instability namely wide fluctuations in blood glucose concentrations, resulting in an increase in the desire to eat and therefore higher energy intakes (Panahi & Tremblay, 2018). Thus, the problems of sedentariness may not only

be attributed to a lack of movement, but also to the stimulation provided by replacing activities. In a context where there is exposure to cognitive work, novel strategies to increase physical activity and improve energy balance regulation are required (Panahi & Tremblay, 2018).

2.7.1.2 Prevalence of sedentary behaviour

Sedentary lifestyles pose many health risks in children and adults in South Africa (WHO, 2009). Roughly half (47%) of all South African adults live sedentary lifestyles, which is more than double the global average of 23% giving insight into it being one of the most inactive countries in the world (Micklesfield et al., 2014).

Many studies have indicated that office workers spend 65% to 82% of their working hours sedentary (Clemes, O'Connell & Edwardson, 2014; Thorp et al., 2012), which in total is 63% of their total daily sedentary time on workdays (Parry & Straker, 2013). Furthermore, when putting together the time spent sedentary at work and during leisure time office workers had approximately 10 hours per day sedentary (Clemes et al., 2014). There have been recent interventions such as sit stand workstations, however occupations such as train drivers do not allow for this. According to a study by Yang, Hipp, Lee, Tabak, Dodson, Marx & Brownson (2017), variations in occupational sitting across different professions are evident. They found that 1668 participants employed in business and office settings spend more time daily sitting at work (median 330 minutes) compared to service and blue-collar employees that do more labour (median 30 minutes). Very little worksite supports and strategies were specifically that of sitting, however factors such as having a full-time job, larger employer size, schedule flexibility, and stair prompt signage were associated with less occupational sitting (Yang et al., 2017).

Results from the 2003/2004 National Health and Nutrition Examination Survey demonstrated that children and adults in the United States spend ~7.7 h/day of their waking time engaged in sedentary behaviours such as watching television, playing passive video games, being on their computer, long periods of time sitting and motorized transportation (Panahi & Tremblay, 2018). This equates to approximately 40 hours per week, which is congruent to the findings that employees sedentary activities have increased from 26 hours to 38 hours per week in the United States (Genin et al., 2018). Further compounding the problems related to sedentary behaviour in the workplace, is the cultural shift towards engaging in sedentary based activities during leisure time, which has integrated into the culture of the modern workforce (Genin et al., 2018).

When looking into other occupational settings, very little evidence is available for professional driver' sedentary behaviours (Morris & Crawford, 1958), who are somewhat referred to as "compulsory sedentary workers" due to the fact that they have no other choice but to sit during their working hours, which are in most cases for a long period of time (Von Wielligh, 2014).

2.7.1.3 Sedentary behaviour and health

A systematic review and meta-analysis performed by Biswas, Faulkner, Bajaj & Silver (2015), indicated high effects of long periods of time sitting and the implications it has on health. This review observed that compared to those with the lowest amount of sedentary time, those experiencing the highest amount of time sitting had a 13% increased risk of cancer incidence, a 14% increased risk of cardiovascular disease incidence, a 17% increased risk of cancer mortality, an 18% increased risk of cardiovascular disease mortality, a 24% increased risk of all-cause mortality and an 81% increased risk of type II diabetes incidence (Biswas et al., 2015).

2.7.1.4 Breaks in sedentary time and health

Breaks in sedentary time are linked to lower body mass index and waist circumference together with other beneficial metabolic risk profiles (Henson, Davies, Bodicoat, Edwardson, Gill, Stensel, Tolfrey, Dunstan, Khunti & Yates, (2016). Breaking up prolonged sitting lessens postprandial glucose and insulin responses (Dunstan, Kingwell, Larsen, Healy, Cerin, Hamilton, Shaw, Bertovic, Zimmet, Salmon & Owen, 2012). Consistent inclusion of high-calorie meals high in processed carbohydrates and saturated fat into ones diet can lead to transient overstated postprandial spikes in glucose and lipids, which encourage oxidative stress that produces a biochemical inflammatory force, endothelial dysfunction, and sympathetic hyperactivity (Ceriello, Esposito, Piconi et al., 2008; O'Keefe & Bell, 2007). These postprandial expeditions, when frequent occurrences, can create a space conducive for the development of atherosclerosis and cardiovascular disease (O'Keefe & Bell, 2007; Ceriello, Davidson & Hanefield, 2006). Postprandial glucose levels and insulin sensitivity are beneficially affected by regular moderate-intensity exercise training or regular breaks in sedentary behaviour (Aldred, Hardman & Taylor, 1995).

Recent epidemiologic findings have also shown 2-h plasma glucose to be positively coupled with objectively measured light-intensity activity (Healy, Dunstan & Salmon, 2007). Light-intensity activity may be effective for reducing postprandial glucose, and corroborative experimental evidence exists. In middle-aged women, 15- 40-min bouts of light-intensity activity both led to a decrease in the acute blood glucose response to a carbohydrate rich meal relative to 2-h seated rest (Nygaard, Tomten,

Høstmark, 2009). Compared with sitting, light non exercise activities of intensities between 1.1 and 2.7 METs can improve the action of insulin in young men and women (Stephens, Granados, Zderic, Hamilton, Braun, 2011). Together with this, 20 minutes of light exercise (40% of maximal power output) performed 45 minutes post the ingestion of a standardized pre-exercise carbohydrate load in young men resulted in similar glucose and insulin responses to that of moderate and vigorous intensity (65% and 80%) (Achten & Jeukendrup, 2003).

Together with this, Howard et al., (2013) showed that breaking up sitting time with low or moderate-intensity physical activity reduced the increase in haematocrit, haemoglobin and red blood cell count and the reduction in the amount of plasma detected during uninterrupted sitting. In contrast to this, Newsom, Everett, Hinko & Horowitz (2013), found that moderate-intensity (50% VO_2max) or high intensity (65% VO_2max) exercise performed after 7 hours prolonged sitting has no impact on the reactions in insulin and glucose, to a meal directly after the exercise. It did however have an impact on increasing insulin sensitivity the following day when compared to 8 hours of continual sitting in obese physically inactive adults (Newsome et al., 2013).

2.7.2 Physical Activity

2.7.2.1 Physical activity – an introduction

Physical activity can be defined as 'bodily movement that are produced by the contraction of skeletal muscle and that substantially increases energy expenditure' (Miles, 2007; WHO, 2020). This description includes the full range of human movement from competitive sports and exercise to activities involved in daily living such as gardening or house cleaning (Miles, 2007). A lack of physical activity has moved drastically up the list of global causes of death to fourth place, following high blood pressure, smoking and diabetes. Globally 81% of adolescents aged 11-17 years and around 23% of adults aged 18 years and over were insufficiently active in 2019 (WHO, 2020; Guthold et al., 2020). In South Africa, the prevalence of physical inactivity at work, at home, for transport and flexible time has been estimated to be 43% to 49% in South Africans 15 years and older (Micklesfield, Pedro, Kahn, Kinsman, Pettifor, Tollman & Norris, 2014). Although, it is claimed that subjective measures of physical activity have under-estimated actual levels of physical activity (Department of Health, 2015).

Physical activity intensity refers to the rate at which the activity is being performed or the magnitude of the effort required to perform an activity or exercise (WHO, 2020). The intensity of different forms

of physical activity varies between people depending on their age, interest, ability and access (Miles, 2007). Moderate intensity requires a moderate amount of effort and a noticeable increase in heart rate (WHO, 2020). Activities of moderate intensity includes brisk walking, gardening or domestic house work whereas vigorous intensity requires a larger amount of effort and causes a substantial increase in a heart rate and increased ventilation (WHO, 2020). Activities of vigorous intensity include running, dancing, moving heavy loads or aerobics (WHO, 2020). Whereas muscle-strengthening activities include a progressive weight-training program, weight bearing calisthenics, stair climbing, and similar resistance exercises that use the major muscle groups in a form of resistance training (Haskell, Lee, Pate, Powell & Blair, 2007).

Over the past decades, there has been a shift in the activity profile of individuals with vigorous physical activity and sleep being partly replaced by cognitive work, resulting in various health impacts (Panahi & Tremblay, 2018). Most research done today focuses on non-occupational physical activity, some has looked into physical activity at work and the relationship with leisure activity (Parry & Straker, 2013). Early self-reported studies have found that workers in low activity professions reported high levels of leisure time physical activity, showing that these workers were trying to compensate for their lack of occupational activity (Parry & Straker, 2013).

2.7.2.2 Physical activity and chronic disease reduction

The important influence of physical activity on chronic disease reduction and increased longevity has been well established (Wilson et al., 2004). Physical activity has a major influence on health as it helps to maintain a healthy body, mind and reduces the risk of disease (Wilson et al., 2004).

Barlow, Kohl, Gibbons & Blair, (1995) published the first report including analyses specifically designed to evaluate the relation of cardiorespiratory fitness to mortality in individuals classified as normal, overweight, or obese based on the body mass index. Based on their results these investigators suggested the hypothesis that moderate to high levels of cardiorespiratory fitness protect against much, if not most, of the increased mortality that accompanies overweight and obesity (Barlow et al., 1995).

Regular physical activity is proven to have multiple health benefits contributing to an overall increased quality of life (WHO, 2020). Health benefits include the treatment and prevention of non-communicable diseases, hypertension, weight control and improved mental health (WHO, 2020). Not only does regular physical activity provide health benefits but physically active societies can save on

economic costs of healthcare and the use of fossil fuels contributing to cleaner air and less congested and safer roads (WHO, 2020).

Progress to increase physical activity and reduce sedentary behaviour in South Africa has been slow, which may be due to a lack of awareness, capital, cultural values, urban vs. rural living, working conditions and environmental barriers (González1, Fuentes & Márquez, 2017). However, the rise of non-communicable diseases and sedentary related diseases is astronomical, placing a heavy burden on South Africa, therefore emphasizing the importance of increasing levels of physical activity and reducing sedentary behaviour for the health of South Africans within the workplace (González1, Fuentes & Márquez, 2017).

2.7.2.3 Physical activity guidelines

Human beings should engage in appropriate physical activity suited to their age and ability (Sparling, Owen, Lambert & Haskell, 2000). Guidelines and recommendations of physical activity have been set by the World Health Organization to create awareness and inform populations of the type, intensity and amount of physical activity they should carry out to benefit and optimize their health and ultimately prevent diseases (Bull, Al-Ansari, Biddle, Borodulin, Buman, Cardon, Carty, Chaput, Chastin, Chou, Dempsey, DiPetro, Ekelund, Firth, Friedenreich, Garcia, Gichu, Jago, Katzmarzyk, Lambert, Leitzmann, Milton, Ortega, Ranasinghe, Stamatakis, Tiedemann, Troiano, van der Ploeg, Wari & Willumsen, 2020). The current recommendations for physical activity from the World Health Organization and the national statistics are as follows:

2.7.2.3.1 Children and adolescents aged 5-17years:

Should engage in at least 60 minutes of moderate to vigorous-intensity physical activity daily and activities that strengthen muscle and bone should be carried out at least three times per week (Bull et al., 2020; WHO, 2020). Strengthening activities include playing sports such as soccer or gymnastics.

2.7.2.3.2 Adults aged 18–64 years:

Adults aged 18-64 years old are recommended to engage in at least 150 minutes of moderate-intensity physical activity throughout the week or at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity (Bull et al., 2020). For further health benefits, adults should increase their moderate-intensity physical activity to 300 minutes per week, or equivalent. Muscle-strengthening activities should be done involving major muscle groups on two or more days a week such as resistance training

2.7.2.3.3 Adults aged 64 years and older:

Adults within this age group are recommended to engage in some form of physical activity, no matter what their age, weight, health problems or abilities are. Older people are more vulnerable and fragile making physical activity an important factor to aid in strengthening both bones and muscles. Older adults who have stopped physical activity, or who are starting a new physical activity, should start at a level that is easily manageable and gradually build up the recommended amount, type and frequency of activity. Guidelines recommend at least 150 minutes of moderate-intensity physical activity throughout the week, or at least 75 minutes of vigorous-intensity throughout the week, or an equivalent combination of moderate- and vigorous-intensity (Bull et al., 2020). However, those with poor mobility should perform physical activity to enhance balance and prevent falls, three or more days per week. Muscle-strengthening activities will also help to prevent falls and poor mobility, and should involve major muscle groups, two or more days a week.

While the guidelines set out by the World Health Organization (2020), of 150 minutes of moderate physical activity per week, have been widely accepted, recent literature has brought light to the fact that, in general, people's understanding of this term is inconsistent. As a result, an addition to the guideline is that moderate physical activity can be classified as physical work that requires a minimum of 45% of the maximal oxygen uptake of an individual (Hamilton, Hamilton & Zderic, 2015). Although recommendations and guidelines serve to increase health benefits, following the recommendations of physical activity alone will not suffice (Bull et al., 2020).

2.7.2.4 Physical activity in urban and rural areas

In rural areas and lower-class population's physical activity is generally a lot higher but often not by choice (Wilson et al., 2004). Within the production industries, rural areas specialize in production jobs, while professional, research, and management jobs are more often situated in cities This division of labour stems as much from the small size and remoteness of rural areas (Wilson et al., 2004). Specialization in production jobs has made rural areas more susceptible than urban areas with regards to experiencing high levels of musculoskeletal disorders mainly that of the lower back (McGranahan, 1988).

As reflected by the department of health in South Africa (DHS) (2003), 49.4% and 66% of urban black males and females were inactive, while only 22.2% of males and 12.4% of females were sufficiently

active (Peer, Bradshaw, Laubscher & Steyn, 2009). Together with this, it was reported that physical inactivity was higher in urban individuals, which was linked to an increased risk of cardiovascular disease within this population group (Department of Health, 2015; Sparling, Noakes, Steyn, Jordaan, Jooste, Bourne & Badenhorst, 1994). In urban areas, daily physical activity is reduced due to automotive transport, online shopping, television and computer entertainment and the job requirements of the upper-class population are generally office related jobs, differing to that of the lower-class population (González1 et al., 2017). However, leisure physical activity may be greater than rural areas due to access and the capital to go to a gym, sports clubs, dance classes etc. Rural areas and lower-class populations may not have the same facilities and access in comparison to urban areas and upper-class populations (González1 et al., 2017; Miles, 2007). In contrast, the daily physical activities in rural areas may be increased due to travel differences of walking to the bus stop or riding a bike instead of driving a car, together with job requirements in the poorer populations generally require more physically intensive work such as domestic labour (Miles, 2007).

The lower-class population in some cases are unable to afford domestic labour therefore they do their own domestic work in conjunction with their daily jobs (Miles, 2007). Physical activity may not be the leading cause for non-communicable diseases and other lifestyle caused conditions, nonetheless, poor diet, tobacco and alcohol use can be just as damaging (Van Zyl, Van der Merwe, Walsh, Groenewald & Van Rooyen, 2012).

2.7.2.5 Barriers and enablers to physical activity participation

Barriers and enablers to physical activity participation can be in the form of psychological, environmental, physical, health and cultural. According to Sparling et al., (2000) there have been several national campaigns aimed at increasing awareness regarding physical activity and health, such as National Wellness Day. However, these initiatives lack a broad-based infrastructure for implementation, as well as financial support and community awareness for sustainability (Sparling et al., 2000).

2.7.2.5.1 Personal barriers and enablers

To effectively promote physical activity, it is important that barriers are understood (WHO, 2020). Barriers may be perceived as a lack of time for activity, poor knowledge and experience of physical activity, low tolerance to exercise due to a low fitness level, low self-esteem and motivation or an incorrect assumption to how much physical activity is required (Miles, 2007). Conversely, psychological enablers could be the opposite such as the want and motivation to be healthy thus

engaging in optimal physical activity (Miles, 2007). Other barriers may include cost, family obligations and lack of time due to working demands, (Miles, 2007).

2.7.2.5.2 Environmental barriers and enablers

Environmental barriers of physical activities differ from population to population. In urbanized populations traffic and congested roads, the fear of crime, the design of certain neighbourhoods not being conducive for physical activity and a declining need for physical activity in the home, work place and community (Wilson et al., 2004). Rural and urban populations may both face barriers such as crime or a lack of places and equipment to support physical activity (Wilson et al., 2004). Rural and lower-class populations may also lack physical education in schools giving reason into why some individuals are unaware of the importance of physical activity and health.

SECTION B:

2.8 Non-communicable disease

Much of the burden of non-communicable diseases is as a result of environmental and lifestyle factors, including tobacco use, sedentary lifestyle and decreased physical activity (Miranda, Kinra, Casas, Smith & Ebrahim, 2008). These major non-communicable diseases include type II diabetes, cancer, chronic lung disease, depression and cardiovascular disease (Mayosi et al., 2009).

Non-communicable diseases have collectively been responsible for almost 70% of all deaths worldwide (WHO, 2009). The World Health Organization (2009) estimated an increase of 28% in South Africa of non-communicable diseases in 2004. These estimates place the burden of non-communicable diseases in South Africa as two to three times higher than in developed countries (WHO, 2009). These diseases are on the increase in rural communities in South Africa , affecting poor people living in urban communities and are leading an increase in the demand for chronic disease care (Tollman, Kahn, Sartorius, Collinson, Clark & Garenne, 2008; Groenewald, Bradshaw, Daniels, 2008). According to the WHO (2020), by increasing physical activity and reducing sedentary behaviour 3.2 million non-communicable disease-related mortalities globally per year could be prevented (Kruk, 2014).

New evidence links excessive sitting in adults with these lifestyle related non-communicable diseases (O'Donoghue et al., 2016). They are caused, to a large extent, by four behavioural risk factors namely; components of economic transition, rapid urbanization and lifestyles associated with the 21st century

i.e. a lack of physical activity, harmful uses of alcohol and tobacco, and an unhealthy diet (Global Health Watch, 2012; González1 et al., 2017). The lifestyle experienced by those working in the office environment and train drivers compel against that of a healthy lifestyle. Rather, these occupations are accountable for high levels of non-communicable diseases indicating room for research in such a sector, aiming for optimal health for both office workers and train drivers. The transport industry plays such a large role in our economy and the amount of train drivers and office workers involved to make sure it runs smoothly is huge. Therefore, it is important to make sure that their health is a number one priority.

Inadequate physical activity is one of the leading risk factors for global mortality and is on the rise in many countries, adding to the burden of non-communicable diseases and affecting the overall health worldwide (Booth, Gordon, Carlson & Hamilton, 2000). People who are insufficiently active have a 20% to 30% increased risk of mortality in comparison to people who are sufficiently active (WHO, 2020). There is, however, a lack of measurement of all relevant non-communicable diseases which highlights a potential area for future research (Booth et al., 2000).

2.8.1 Behavioural Risk Factors

2.8.1.1 Poor Diet

There is a large amount of evidence to support the benefits of the consumption of fruit and vegetables (Dias, 2012). Fruit and vegetables contain many vitamins, minerals, fibre and other components that contribute to good overall health as well as reduced risk of strokes, diabetes and other chronic diseases (Dias, 2012). A study conducted in 2000, by the World Health Organization estimated that globally, 2.7 million deaths (4.9%) were as a result of a lack of consumption of fruit and vegetables, and that 26.7 million (1.8%) disability-adjusted life years were lost as a result of low fruit and vegetable consumption (Lock et al., 2004). A lack of fruit and vegetables in an individual's diet has been ranked as the 12th main risk factor for mortality in the world (WHO, 2009), highlighting the fact that there is enough evidence to support the need for an increase in the consumption of fruit and vegetables (Mozaffarian, 2016; Mente, de Koning, Shannon & Anand, 2009).

Up to 4% of the global disease burden has been related to an unhealthy diet, which is an adjustable lifestyle factor (Fransen et al., 2017). Sub-optimal diet has been found to be the leading risk factor for death and disability worldwide (Lim et al., 2013). It has been found that dietary patterns are

significantly associated with cardiovascular disease, overweight and obesity, type II diabetes and cancer, together with other lifestyle factors such as low levels of physical activity levels (Jezewska-Zychowicz, Gębski, Guzek, Świątkowska, Stangierska, Plichta. & Wasilewska, 2018). The main problems are associated with high consumption of sugar, foods rich in refined grains, salt, saturated fats and trans-fatty acids which in turn are associated with the non-communicable diseases mentioned (Mozaffarian, 2016).

The World Health Organization (2020) recommend that adults should eat at least five portions of fruits and vegetables per day in order to reduce the risk of non-communicable diseases. It should also be noted that there is a strong relationship between diet and physical activity. Those who exercise more simultaneously need to eat more in order to have enough energy for physical activity (Manore, 2014).

There have been misconceptions among the South African urban population group with regards to exactly what healthy and unhealthy food is, especially with women (Charlton et al., 2004). Many women in a South African cohort believed certain food groups were healthy, which were in fact the opposite (Charlton, Brewitt & Bourne, 2004). Over half the participants were under the impression that polony, which is a highly processed fat, was a low-fat food, and considered potatoes as having no fat (Charlton, Brewitt & Bourne, 2004). These women also believed cheese, which is high in fat, would aid in weight loss (Charlton, Brewitt & Bourne, 2004). There is therefore a need to better educate the public regarding a healthy diet.

Further, high levels of sedentary behaviour and low levels of physical activity are associated with the consumption of unhealthy foods in adults (Jezewska-Zychowicz et al., 2018). There was also a link to an increase in obesity as well as to a higher probability of developing chronic diseases (Jezewska-Zychowicz et al., 2018). It is understood that mental work increases glycaemic instability such as wide fluctuations in blood glucose concentrations, resulting in an increase in the desire to eat, particularly greasy, fatty foods (Panahi & Tremblay, 2018). Dietary patterns have been attracting attention in the last decades. However, the associations between dietary patterns and physical activity are still unclear. The associations between them and potentially modifiable components such as particular sedentary behaviours is important to identify (Jezewska-Zychowicz et al., 2018).

2.8.1.2 Stress levels

Stress in the workplace can be defined as “the harmful physical and emotional responses that occur when the requirements of a job do not match the needs of a worker” (Faghri & Mignano, 2013).

Workplaces with high stress, characterized by high job demands and low job control has been associated with increased risk for cardiovascular disease, high blood pressure and high blood sugar (Faghri & Mignano, 2013; Bunker, Colquhoun, Esler, Hickie, Hunt, Jelinek, Oldenburg, Peach, Ruth, Tennant & Tonkin, 2003). Employees that have high stress have reported to have poor eating habits (Lim et al., 2013), low levels of physical activity, a high consumption of alcohol and smoking (Faghri & Mignano, 2013) as well as psychological issues such as anxiety and depression (Bunker et al., 2003).

In 1988 the National Heart Foundation of Australia published a report named "Stress and cardiovascular disease" (Bunker et al., 2003). It was found that there is strong evidence of an independent association between depression, social isolation and lack of quality social support and the causes and prognosis of coronary heart disease. Together with this, there was a causal association between chronic life events, work-related stresses such as job control, demands and strain, anxiety disorders or panic disorders, and coronary heart disease (Bunker et al., 2003).

Something that is of great importance, however, is not commonly understood is that psychosocial conditions associated with the organization of work can also act as risk factors (Burton, 2010). The idea that psychosocial stress can contribute to, or cause, musculoskeletal disorders is not intuitively obvious, and much research is being done to determine the mechanisms by which this occurs (Bickford, 2005). Many different physiological mechanisms that occur during stress contribute to this relationship, together with increases in non-voluntary muscular tension and cortisol levels, changes in the perception of pain and decreases in muscle repair and blood testosterone levels (Bickford, 2005; Burton, 2010).

2.8.1.3 Physical inactivity

Physical inactivity, as stated previously is defined as an activity level insufficient to meet public health guidelines (Department of Health, 2015) which has been confirmed to be the fourth leading risk factor for global mortality worldwide (6% of deaths globally) (Lee, Shiroma, Lobelo, Puska, Blair & Katzmarzyk, 2012), accounting for deaths related to coronary heart disease, type II diabetes and breast and colon cancers (WHO, 2009). The World Health Organization (2020) have stated that physical inactivity is estimated to be the main cause of approximately 30% of ischemic heart disease burden. The frequency of inactivity varies considerably within and between countries and can be as high as 80% in some adult subpopulations (WHO, 2020). Physical inactivity in adults is said to be the highest in the Eastern Mediterranean, America, Europe and Western Pacific regions, and is lowest in the South-East Asia region (WHO, 2020). These rates of physical inactivity increase with economic

development, as a result of the influence of changing patterns of transportation, use of technology, urbanization and cultural values (Heath, 2015).

2.8.1.4 Smoking and alcohol consumption

Alcohol consumption is a major public health issue worldwide, being responsible for a large burden of morbidity and mortality annually (Addo et al., 2018). Alcohol has been proven to be a psychoactive substance containing toxic properties that are highly addictive (de Sio, 2020). The consumption of alcohol increases the risk for non-communicable diseases, having direct toxic effects on all organs of the body (de Sio et al., 2020). The overuse of alcohol is responsible for 5.1% of the global disease burden, causing three million deaths per year (de Sio et al., 2020).

Studies have shown that smoking and drinking increases the risk of throat and oesophageal cancer (Report of Surgeon General, 2004). According to epidemiological studies there is a direct link between smoking and coronary heart disease where the main findings suggest that there are two to four-fold increases in mortality from coronary heart disease in chronic smokers in comparison to non-smokers (Report of Surgeon General, 2004). The Framingham study which had a sample of 2282 men who were middle-aged indicated that post ten years of follow-up, the relative risk of coronary heart disease mortality was twofold higher in men who smoked up to 20 cigarettes a day and threefold higher amongst those smoking more than 20 cigarettes a day (Kannel, 1964).

There is strong evidence for a dose-response relationship between volume of alcohol consumed and the risk of disease which has been depicted by using the J-shaped curve (Corrao, Rubbiati, Bagnardi, Zambon & Poikolainen, 2000). This indicates that low-to-moderate levels of consumption of alcohol being less than two drinks per day, being associated with lower coronary heart disease incidence and mortality; yet for higher average volumes of alcohol consumption, the risk relation reverses (Corrao et al., 2000).

Many studies have looked into the relationship between alcohol and work (de Sio et al., 2020). These show that alcohol contributes greatly to absenteeism and the risk of injuries, as well as negatively influencing productivity and work performance (Mullahy & Sindelar, 1996; Ames & Bennett, 2011; de Sio et al., 2020).

Many cultures have certain beliefs when it comes to drinking alcohol. Traditionally, it was not accepted for native African women to drink alcohol (Setlalentao, Pisa, Thekisho, Ryke & Loots, 2010). This is supported by Mphi (1994), where he states that women in Lesotho are not allowed to drink any alcohol.

The consumption of alcohol has a long history in South Africa (Schneider, Norman, Parry, Bradshaw, Pluddemann & South African Comparative Risk Assessment Collaborating Group, 2007). Household surveys show that currently, approximately 50% of men and 20% of women drink alcohol in South Africa. One third of the current drinkers in the South African Demographic and Health Survey (SADHS) of 1998 reported risky drinking over weekends (five or more drinks per day for men and three or more per day for women).

Those involved in the operating of heavy duty machinery, such as truck driver are the most affected by the use of alcohol and are subject to risk factors and risky behaviours that can have a negative impact on their health, the general safety on the road and the work that they perform (Bragazzi, Dini, Toletone, Rahmani, Montecucco, Massa, Manca, Guglielmi, Garbarino, Debarbieri & Durando, 2018).

2.8.1.5 Sleep

Sleep is an important part of an individual's life, as it maintains physical and emotional health (Perry, Patil, Letitia & Presley-Cantrell, 2013). There are three main factors which regulate when sleep occurs, a homeostatic factor, a circadian factor, and a behavioural factor (Fossum, Nordnes & Storemark, 2014). The homeostatic factor is the feeling of sleepiness which is dependent on the length of prior sleep and the duration of wakefulness (Fossum et al., 2014). The circadian factor is the internal timing and overall duration of sleep (Fossum et al., 2014).

As the work environment is a turbulent and often challenging environment, employees may find it difficult to maintain regular sleep patterns because of personal or work stresses; thus reducing quality sleep hours (Colligan & Higgins, 2006). There is substantial literature exploring the effects of reduced sleep quality on perceptual, cognitive and motor ability; work productivity; as well as perceived levels of wellbeing (Fossum et al., 2014).

2.8.2 Biomedical Risk Factors

2.8.2.1 Obesity

According to The World Health Organization (2000), obesity is defined as having a body mass index of at least 30 kg/m^2 which has been linked to a range of physical and psychiatric conditions (Kudel, Huang & Ganguly, 2017). Obesity prevalence is increasing globally and contributes greatly to the growing burden of non-communicable diseases (Cois & Day, 2015). South Africa is particularly affected by this increasing trend and cross-sectional evidence has suggested that socioeconomic and behavioural variables are possible drivers (Van Der Merwe, 2006; Cois & Day, 2015). The determinants of overweight and obesity in low-middle income countries are not well understood and could potentially be driven by the changes in dietary behaviours and physical activity, together with environmental factors and stresses (Nurwanti, Hadi, Chang, Chao, Paramashanti, Gittelsohn & Bai, 2019). Diets have become higher in calories, fats, salt and sugars and physical activity levels have reduced (Nurwanti et al., 2019).

Obesity and its associated co-morbidities have become a condition that is normalised in some occupations. Very little is being done to reduce the prevalence of obesity in the transport sector (Bosire et al., 2020). If no measures are put in place to stop the rise in obesity, studies suggest that by 2030, obesity will affect more than 1.3 billion people (Yusuf, Rangarajan & Teo, 2014). This will further result in a large increase in the disease burden from cardiovascular disease, diabetes and cancer which affects predominantly low and middle-income countries due to rapid urbanisation and nutrition transition (Bosire et al., 2020).

Body mass index is a key index for measuring overweight and obesity in individuals (weight kg/height m^2) (Mitchell et al., 2014). Body mass index is an estimate of body fat and is a good gauge of your risk of disease (Mitchell et al., 2014). The higher your body mass index the higher your risk for certain non-communicable diseases such as heart disease, high blood pressure, type II diabetes, problems breathing and certain cancers, anxiety, depression and sleep disorders (Jung, 1997; Addo, Nyarko, Sackey, Akweongo & Sarfo, 2015). The validity of body mass index in predicting body fatness is well-established in different age, gender and racial groups (Attaur-Rasool & Shirway, 2012). There is an association between an individual's body mass index and the risk of death (Zheng et al., 2011). As an individual's body mass index increases, so does the risk for cardiovascular disease, coronary artery disease and heart failure (Figure 4).

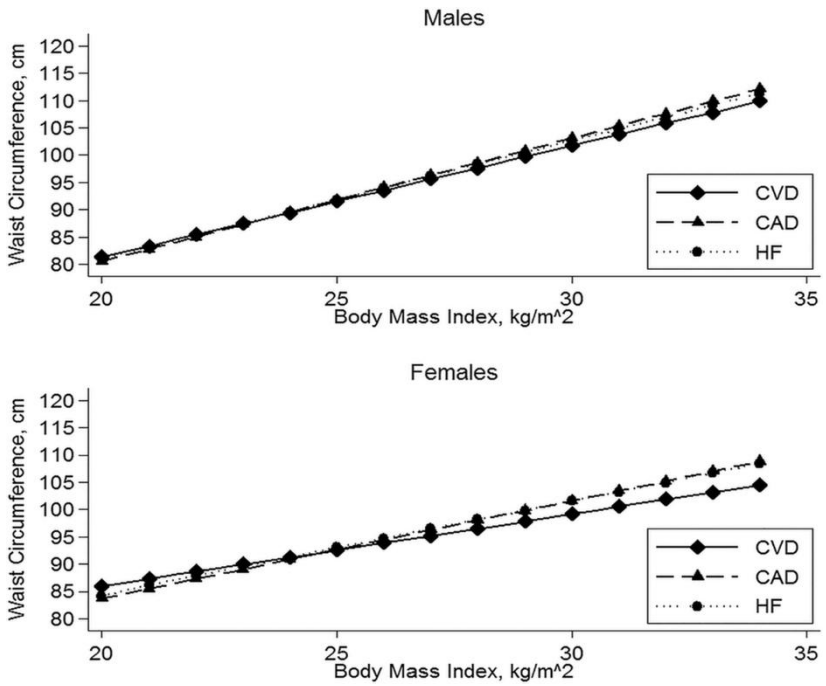

Figure 4: As your body mass index increases, so does your risk for cardiovascular disease, coronary artery disease and heart failure (Zheng et al., 2011).

*Key: kg/m$^{\wedge 2}$: kilograms per metre squared

Train drivers are at high risk for excess weight-gain, obesity and related comorbidities due to the very nature of their job (Von Wielligh, 2014) and shift based work schedule (Amani & Gill, 2014). Exposure to the transportation work environment and obesity are driving forces behind disease and injury for train drivers (Von Wielligh, 2014). In addition, increased body mass index and associated comorbidities negatively impact work performance (Apostolopoulos, Peachy & Sonmez, 2011).

Train drivers from Yazd Railway in Iran, where found to have a higher prevalence of overweight than the general population of Yazd (Loukzadeh et al., 2012). This was directly linked to low levels of physical activity in the drivers. Another study by Reem & Casolin (2007) done on Australians also found a higher prevalence of obesity in train drivers compared to the general population.

In this same study by Loukzadeh et al. (2012), 88% of the train drivers did not have optimal physical activity. With this, it was found that excess weight was associated with an increased risk of coronary artery disease, together with a high prevalence of dyslipidaemia which is related to obesity, unhealthy diet, shift work and a lack of exercise (Loukzadeh et al., 2012).

Recent studies have highlighted the rise in obesity across industries and occupational groups (Kudel et al., 2014; Pereira, Ki & Power, 2012). A cross-sectional study done on the Dutch population indicated that obesity was predictive of developing musculoskeletal symptoms, particularly in workers who had jobs with low physical workloads where the job requires repetitive motions, awkward body posture (Kudel et al., 2014). Gates, Succop, Brehm, Gillespie & Sommers, (2008) suggests that there is a relationship between excess weight and impaired productivity in a sample of manufacturing employees. Particularly, employees with a body mass index of 35 kg/m^2 reported a health-related productivity loss of almost 5.0% and they required additional time to finish physically demanding tasks (Kudel et al., 2014). Similarly, Tucker & Friedman (1998) and Jans, van den Heuvel, Hildebrandt & Bongers (2007) posit that increased levels of obesity among workers increases both the duration and frequency of absenteeism and a reduction in productivity. Cawley, Rizzo & Haas (2007), looked into the costs that were unsettled as a result of obesity-related absenteeism across a number of primarily office-based positions. It was found that costs were different among occupations, with Management and Professional occupations sustaining the highest costs per worker (Cawley, Rizzo & Haas, 2007).

The Southern African region is particularly affected by this rising trend in body mass index (Cois & Day, 2015). Within South Africa, a middle income country undergoing rapid epidemiologic transition, there is concern (Cois & Day, 2015). In 2008, the average body mass index at population level was estimated at 26.9 kg/m^2 in the male population group (vs a world average of 23.8 kg/m^2) and 29.5kg/m^2 among females (vs a world average of 24.1kg/m^2). There is, however, very little data on body mass index within the South African rail industry.

Smoking is associated with a greater waist circumference however lower rates of increase in body mass index (Cois & Day, 2015). Rates of changes in body mass index was higher in rural than urban areas, and inversely related to the frequency of physical exercise (Cois & Day, 2015). There is a strong positive trend in body mass index which remains in South Africa and obesity prevalence is likely to increase (Cois & Day, 2015). Trends are not standardized, and high risk groups are those with a high socioeconomic status, rural dwellers and young women, and modifiable risk factors (physical inactivity) should be a focus (Cois & Day, 2015).

According to a study done looking into the body mass index classification of office workers, it was found that the baseline of all characteristics of the subjects had a normal distribution. Mean (±SD) age was 40.65 (±7.86) years (Attaur-Rasool & Shirway, 2012). Mean height and body mass of the office

workers was 168.63 (±6.85) cm and 75.68 (±13.83) kg respectively. The mean body mass index was 26.53 (±4.14) kg/m^2. The sample included 79 normal (34,96%)(body mass index 18.5 -24.9 kg/m^2), 102 overweight (45.13%)(body mass index 25 – 29.9 kg/m^2) and 45 obese (19.91%) (body mass index ≥ 30 kg/m^2) individuals.

The national prevalence of overweight and obesity in train drivers was reported to be 48% and 15% respectively in 2013 (Loukzadeh et al., 2012). The overall prevalence of obesity and overweight among US office workers in a study by Gu, Charles, Bang, Ma, Andrew, Violanti & Burchfiel (2015) was 79.6% (26.2% obese and 53.4% overweight). Data presented on train drivers shows a greater risk of obesity, hypertension and hyperlipidaemia, and carbohydrate metabolism disorders such as diabetes mellitus (Von Wielligh, 2014).

In low-middle income countries the prevalence of overweight and obesity is typically higher in urban areas while underweight is usually higher in rural areas (Nurwanti et al., 2019; Vorster, Wissing, Venter, Kruger, Malan, de Ridder, Veldman, Steyn, Margetts & McIntyre, 2000). Individuals in urban areas are more diverse when it comes to what they eat. Those residing in rural and semi-urban areas, are known for adding salt to regular cooking foods and salted foods such as fish and meat are eaten often (Nurwanti et al., 2019). The association between dietary behaviour and the prevalence of obesity remains unclear (Nurwanti et al., 2019).

2.8.2.2 High blood pressure

High blood pressure, otherwise known as hypertension, happens when an individual's blood pressure increases to above 140/90mmHg (BHF, 2015). Hypertension generally occurs over a period of several years and most of the time individuals don't notice any symptoms (Holland, 2020). Even if someone doesn't show any symptoms, it can still cause serious damage to your organs and blood vessels, particularly that of the kidneys, eyes, heart and brain (Holland, 2020).

A sedentary lifestyle is a major risk factor for heart and cardiovascular disease. A person who is less active and less physically fit has a 30%-50% greater chance of having hypertension than those that are more active (Makoff & Stoppler, 2020). Clinical trials have shown that physical activity may reduce blood pressure in hypertensive and normotensive (those with normal blood pressure) individuals, independent of changes in body mass (Makoff & Stoppler, 2020). It has also been found that aerobic exercise is a suitable treatment and can also play a role in the prevention of hypertension (Sharman & Stowasser, 2009). Even without changes in body mass, individuals who participate in

aerobic exercise regularly tend to have reductions in resting blood pressure (Kelley & Kelley, 2018). The reduction in blood pressure does not seem to depend on the frequency or intensity of aerobic exercise or on the type of exercise an individual is performing (Makoff & Stoppler, 2020). Studies have shown that all forms of exercise seem to be effective in reducing blood pressure. Although aerobic exercise appears to have the greatest effect on blood pressure in hypertensive individuals than those without (Makoff & Stoppler, 2020).

The influence of long working hours on elevated blood pressure is related to sympathetic nerve activity and concentrations of counterregulatory hormones that accompanies psychosocial stress and physical activity (Nakanishi, Yoshida, Nagano, Kawashimo, Nakamura & Tatara, 2001).

Changes to one's lifestyle can play an important role in the treatment and prevention of hypertension (Slama, Susic & Frohlich, 2002). The prevalence of hypertension in a study by Loukzadeh et al. (2012), done on train drivers from Yazd in central Iran was 19% which was lower than the general population, with 25.6%. This is contrast to some reports that showed that the drivers were more frequently hypertensive compared to the general population (Loukzadeh et al., 2012). This discrepancy can be because of the different age of the study populations, having a mean $\pm$ SD of 36 ($\pm$ 8.9) for the combined population group (Loukzadeh et al., 2012).

According to the American Heart Association (2019), office workers who spend long hours on the job are more likely to have high blood pressure, including a type that can go undetected during a routine medical appointment. Working 41 to 48 hours each week has been linked to a 54% greater chance of having masked hypertension and a 42% greater likelihood of having sustained hypertension (American Heart Association, 2019). Almost 19% of office workers requiring very little physical demand, had sustained hypertension, including employees who were already consuming high blood pressure tablets (American Heart Association, 2019). More than 13% of the workers had masked hypertension and were, obviously, not receiving treatment for high blood pressure. It was found that the link between working for long hours and high blood pressure was the same for men as for women (American Heart Association, 2019). There is, however, very little data on the association between sitting for long periods of time and hypertension in South African office workers.

A systematic review done by Bosu (2016), showed that physical inactivity, unhealthy diet, smoking and harmful alcohol use have been associated with increased risk of hypertension. When looking at the association between physical activity levels and hypertension, it was found that the prevalence of

hypertension was significantly higher among those with low levels of physical activity compared with those with moderate or intense physical activity levels (Bosu, 2016). Workers whose jobs were physically demanding such as automobile workers, mil operators and plantation workers appeared to have a lower prevalence of hypertension than those with jobs that are largely sedentary (Bosu, 2016). Hypertension was also found to be significantly more frequent in those that drink alcohol compared to those that don't (MacMahon, 1987). Regular and moderate drinking was found to be associated with hypertension (MacMahon, 1987), together with medium and heavy smokers (Roerecke & Rehm, 2014). The strongest risk factors associated with hypertension in telecommunication workers in Dakar were diabetic, age ≥ 40 years compared to < 40 years, being overweight (25.0-29.9 $kg.m^2$) and male sex (Bosu, 2016). It was found that diabetic bankers in Lagos, Nigeria, were 4.3 times as likely as those without diabetes to have diastolic hypertension (Bosu, 2016).

2.8.2.3 Diabetes

Diabetes is a disease that occurs when an individual's blood glucose is too high (Centres for Disease Control and Prevention, 2017; Von Wielligh, 2014). Blood glucose is your main source of energy and comes from the food you eat. Insulin is made by the pancreas which aids in getting glucose from food into your cells to be used for energy (Centres for Disease Control and Prevention, 2017). The body is unable to produce insulin, or it doesn't make use of the insulin the body produces (International diabetes federation, 2020). As a result glucose stays in your blood and doesn't reach your cells. Over time high levels of glucose are associated with damage to the body and failure of various organs and tissues (International diabetes federation, 2020) especially the eyes, kidneys, nerves, heart and blood vessels (American Diabetes Association, 2005).

There are two main types of diabetes:

Type I: Most common in children however can also occur at any age. Individuals with this type of diabetes are required to take insulin every day to maintain blood glucose levels under control, in order to stay alive (Centers for Disease Control and Prevention, 2017). If you have type I diabetes your body does not produce insulin. Your immune system attacks and destroys the cells in your pancreas that make insulin (Diabetes care, 2005).

Type II: This type of diabetes is responsible for about 90% of all diabetes cases and is more common in adults (International diabetes federation, 2020). An individual with type II diabetes does not make good use of the insulin that is produced and so they are required to follow a strict diet and physical activity routines (Centers for Disease Control and Prevention, 2017).

Obesity and a sedentary lifestyle triggers the development of insulin resistance (Adegbija, 2016). The cause is complex and possibly a result from a combination of genetic and environmental factors (Adegbija, 2016). An individual with type II diabetes experiences some or all of the symptoms. These include increased thirst, a dry mouth, nausea, increased urination, fatigue, blurred vision, dizziness, headaches, weight gain, mood swings, increased appetite, itchy infections on the skin and sores and wounds which take long to heal (Adegbija, 2016). Individuals who demonstrate high levels of sedentary time, both at work and at home, are shown to have a 73% greater chance of developing metabolic syndromes, once body mass index and moderate physical activity levels have been accounted for (Edwardson, Gorely, Davies, Gray, Khunti, Wilmot, Yates & Biddle, 2012).

There is a strong relationship between sitting for long periods of time and type II diabetes. Diabetes and impaired glucose tolerance are characterized by peripheral insulin resistance (Wilmot et al., 2012). The hazards of high levels of sitting were initially highlighted in the 1950s with a twofold increase in the risk of a myocardial infarction in London bus drivers in relation to active bus conductors (Wilmot et al., 2012). The study by Loukzadeh et al. (2012), highlights this, indicating that the prevalence of diabetes was found to be almost the same as that reported among males in the general population. Reasoning for such could be due to shift work of train drivers which causes glucose intolerance and insulin resistance (Loukzadeh et al., 2012). Wilmot and colleagues (2012) conducted a meta-analysis which further found that high volume of sedentary behaviour is associated with increasing risk of suffering from type II diabetes by 112%.

There is an association between severe obesity and the development of type II diabetes which has resulted in the development of the term “diabesity” (Chadt, Scherneck, Joost & Al-Hasani, 2000). Majority of those individuals with type 2 diabetes are obese, emphasizing the pivotal role of increased intra-abdominal fat as a risk factor for diabetes (Chadt et al., 2000).

2.8.2.4 Cancer

The lifestyle factors of physical activity and sedentary behaviour are increasingly being researched for their link with cancer (Kerr, Anderson & Lippman, 2017). According to Kerr, Anderson & Lippman, (2017), physical inactivity is inversely associated with, and sedentary behaviour is directly associated with, an increased risk of more than ten types of cancer. Being active decreases your risk of cancer, but sedentary behaviour is an independent risk factor (Kerr, Anderson & Lippman, 2017). Even if you perform 30 minutes or more of exercise each day, if you’re sedentary for most of the day, you still have an increased risk for cancer (Kerr, Anderson & Lippman, 2017).

Cancer is growing in South Africa, and the health infrastructure and allocation of resources will not be able to deal with it unless large changes are made (Beck & Falkson, 2001). Of all cancers, the most common remain breast, prostate and testicular, and these also have the highest survival statistics if diagnosed timeously (Kamshoff, Buffart, Schep, van Mechelen, Brug & Chinapaw, 2010). Cancer survival rates have increased in recent years, with 56% of males and 62% of females surviving the disease and treatment (Kamshoff et al., 2010). With increased survival, comes a greater awareness of the importance of the maintenance of optimal health in this population (Velthuis, May, Koppejan-Rensenbrink et al., 2010). More attention to the quality of life and functional abilities of those who have survived is warranted, and interventions to improve daily living and working ability is needed (Velthuis et al., 2010). Physical activity is an intervention that may address the broad range of quality of life issues following cancer diagnosis including physical, functional, psychological, emotional and social well-being (Velthuis et al., 2010).

More than ten million people are diagnosed with cancer worldwide; with improvement in early detection and treatment, increasing numbers of patients can be expected to be alive five years post-diagnosis (Rajarajeswaran & Vishnupriya, 2009). The treatments that are currently being used are toxic in a number of ways and produce negative short and long term physiologic and or psychological effects including pain, decreased cardio respiratory fitness, cancer related fatigue, reduced quality of life and suppressed immune function (Rajarajeswaran & Vishnupriya, 2009). Physical activity is an attractive cancer preventative strategy and reduces the risk of certain cancers (Rajarajeswaran & Vishnupriya, 2009).

2.8.2.5 Musculoskeletal disorders

Musculoskeletal disorders are a form of physical injury that can be discussed in the context of occupational diseases (Burton, 2010). Similarly to illnesses, a musculoskeletal disorder cannot be immediately diagnosed, and may take days, month's or at times even years of exposure before it affects the worker (Feyer et al., 2000). Together with age, as a risk factor for musculoskeletal disorders (Stefánsdóttir, 2016), are awkward posture and poor form repetition, which are often found in jobs with a large physical component particularly those that have an element of monotony (Feyer, Herbison, Williamson, de Silva, Mandryk, Hendrie & Hely, 2000; Burton, 2010). The jobs might involve heavy labour or be "white collar", by design, with a large amount of time spent working at a computer (Burton, 2010), as experienced by office workers at Transnet.

Occupational circumstances and manipulation of the physical form of employees have the potential to cause musculoskeletal injuries or disorders. Of the potential causes of harm, sitting for long periods of time is identified by Ryan, Dall, Granat & Grant (2011) as a primary concern for employee health. Musculoskeletal disorders range in their impact on individuals and can be classified as either acute or chronic (Punnett & Wegman, 2004). Back injuries, as a result of prolonged sitting, have the highest prevalence among the musculoskeletal disorders (Luttmann, Jager & Griefahn, 2003). Furthermore, muscular inactivity has been identified as a potential cause for back injuries (Burton, 2010). Employees among the 'compulsory sedentary workers' occupations, experience increased sitting time at work and lower sitting interruptions, both of which increase the likelihood of developing musculoskeletal disorders (Luttmann, Jager & Griefahn, 2003) . Other ergonomic factors such as static work postures, hand positioning, lower arm support, repetitive work movements and the use of a keyboard are associated with an increased risk of musculoskeletal disorders, and are all occupational activities part of the duties of office workers and train drivers at Transnet (Zungu & Ndaba, 2009).

Many people in Western industrial nations suffer from back pain, having a prevalence of up to 90% in their lifetime (Zemp, Fliesser, Wippert, Taylor & Lorenzetti, 2016; Louw, Morris & Grimmer-Somers, 2007). Chronic low back pain has an international prevalence of 23% resulting in it being the most common form of chronic pain (Zemp et al., 2016; Louw, Morris & Grimmer-Somers, 2007). There are a number of psychosocial and physical aspects that may be the reason behind the development, together with its progression into a chronic condition (Zemp et al., 2016). Literature is, however, lacking with regards to linking the causation to any specific factor (Louw, Morris & Grimmer-Somers, 2007). In addition, with these aspects, static loading, physical and psychological stress, are additional pressures present in the transportation industry which involves many office workers who work behind the scene in order to keep the industry functioning properly.

SECTION C:

2.9 BIOLOGICAL EFFECT AND MENTAL WELLBEING

Mental health issues are common in the working population (LaMontagne et al., 2014), with anxiety and depression being the most frequent causes of occupational disability (Chopra, 2009). The need for promoting mental health in the workplace is becoming more and more recognized as it is an important determinant in their overall health (Rajgopal, 2010), and maximizing workplace performance (Burton, 2010). Mental health problems impact employees and the business through absenteeism and negative

impact on productivity (Rajgopal, 2010). It is anticipated that this impact is greatest in developing countries (Chopra, 2009). Workplace factors may cause illness as well as prolong disability associated with mental illness (Chopra, 2009).

There are a number of biological structures that may be responsible for the drop in the risk of chronic diseases through routine physical activity (WHO, 2020). According to large-scale survey studies in several countries, there has been substantial evidence based on there being a relationship between a positive mood and participation in moderate-physical activity (Fox, 1999). Further, evidence has shown that physical activity interventions can affect immediate reduction in anxiety and stress (WHO, 2020). The study done by Fox (1999), has concluded that there is sufficient evidence that physical activity can reduce clinical depression.

Of particular importance is the understanding of the relationship between diet and mental health risk factors (Owen & Corfe, 2017). The consumption habits of individuals has the ability to either positively or negatively impact on the risk of mental disorders (Rajgopal, 2010).

There has been a general understanding that mental illnesses among workers can negatively affect employees work performance (Burton, 2010). Most mental illnesses have multiple causes, including family history, health behaviours, gender, genetics and access to support groups (Rajgopal, 2010; LaMontagne et al., 2014). According to Gupta, Samra & Agrawal, (2009) at the Consortium for Organizational Mental Healthcare, they have come to a conclusion that "workplace factors may increase the likelihood of the occurrence of a mental disorder, make an existing disorder worse and/or may contribute directly to mental distress (demoralization, depressed mood, anxiety, burnout, etc)". Mental distress may not reach the level of a diagnosable mental disorder, and yet be a source of considerable suffering for the employee" (Gupta, Samra & Agrawal, 2009).

In the past thirty years, research has shown that various situations in the workplace can be considered psychosocial hazards because they are related to the psychosocial and social conditions of the workplace rather than physical conditions, and they can be harmful to mental (and physical) health of workers which are otherwise known as work stressors (Gupta, Samra & Agrawal, 2009).

In the 1970s Karasek stated that certain job factors, particularly that of high demand and low control or decision latitude, greatly increased the risk of a number of physical and mental illnesses or disorders, including anxiety and depression (Burton, 2010). They developed a very well-known principle called

the demand-control-support theory of strain put onto an individual as a result of their job. Due to the nature of our society, it has been found that women tend to hold jobs with lower control than men, and so they are more adversely affected than men (Burton, 2010).

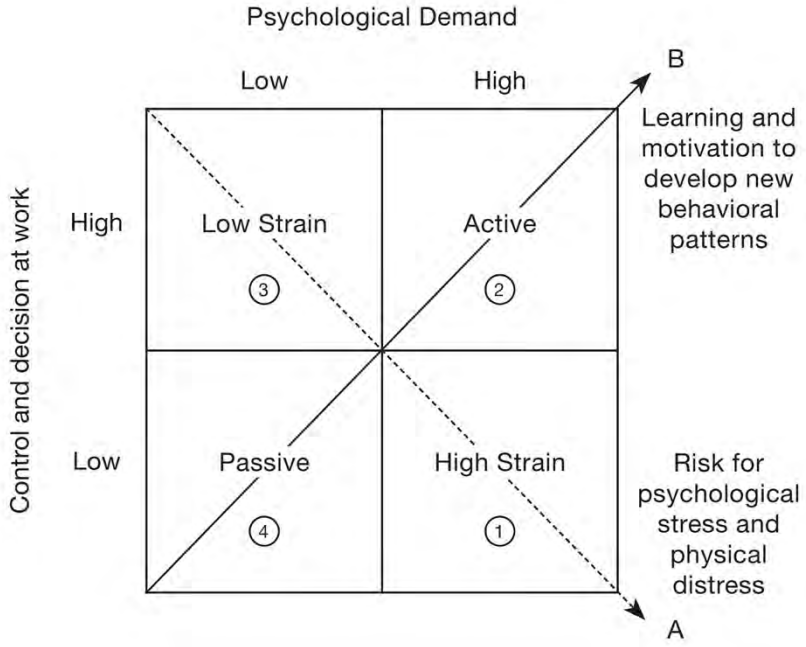

Figure 5: The demand-control support theory of strain (Karasek, 1970).

Figure 5 highlights the notion that when job demands are high and employees feel pressured, gaining control of the job and developing strong relationships with others helps to cope with stress (Van der Doef & Maes, 2010; Karasek, 1979). According to this theory, employees working in a high-strain job (high demands-low control) experience the lowest wellbeing.

Workplace hazards are an evident threat to the wellbeing of employees, however, the threat posed by psychosocial hazards can, in turn, present as physical safety issues if not dealt with appropriately (Burton, 2010). Elements that affect the mental state of a worker are often a result of a disagreement between the job requirements and the level of control that an employee has in their role. Consequently, the ability of a worker to identify and alleviate the threat of a physical threat of life or limb may become diminished (Mato, 2016). Further resultant effects on the psychosocial state of an employee, due to workplace pressures, may drive certain lifestyle factors such as poor sleep habits, alcohol consumption, feelings of depression and anxiety (Bickford, 2005).

A study conducted by Loukzadeh et al., (2012) on 483 train drivers of Yazd Railway in central Iran

found that only 65.1% of the train drivers were fit for duty. This means that they were in a good physical, mental, and emotional state which allows them to perform the essential tasks of their work in a manner that does not threaten the safety or health of them or the people around them (Miller, 1996). The remaining 34.9% experienced a number of psychiatric disorders such as depression and other mood disorders (Loukzadeh et al., 2012).

2.10 WORKER PRODUCTIVITY AND ABSENTEEISM

Based on current literature in the field, the measurement of productivity is multifaceted (Beaton et al., 2015). The productivity of workers is a mixture of time off of work being absenteeism, due to an illness, and time at work but with lowered levels of productivity (Beaton et al., 2015). In simple terms, productivity is the output per unit of input, for example production output per labour hours (Phelps, 2010). Within a workplace, the productivity of a worker is dependent and influenced by many factors such as technology and market force (Beaton et al., 2015). For a society or industry, the productivity of a worker is one of many factors that contribute towards indicators of success within the workplace or the wellbeing of the business or society as a whole (Beaton et al., 2015). When looking at the health economics side of productivity in the workplace, the loss of worker productivity as a result of an illness is considered in the indirect costs of the analysis (Beaton et al., 2015). Alterations in labour input i.e. the number of work days lost because of an illness, are translated directly to lost productivity using market wage rates (Beaton et al., 2015). It is also important to look at the individual worker perspective, where there is interest in measuring individual worker productivity in order to describe the impact of a condition on ability to work, or the effects of an intervention such as work station changes on the ability of a person to work productively (Phelps, 2010; Beaton, 2015). With this said, the productivity of the worker is measured as an outcome state. Loss of either type of productivity (cost or ability/difficulty) has in most cases been calculated by days absent from work (absenteeism) (Beaton et al., 2015).

Productivity is multifaceted (Chen, Hannon, Laing, Kohn, Clark, Pritchard & Harris, 2015). It is a person-environment state where the demands of a given job (physical, social and psychological factors) are weighed against the capacity of the person in that job (Beaton et al., 2015). The relationship between worker health/ability and productivity loss is not a direct one where more pain and disability will result in a direct, predictable change in productivity levels. It is one where the person is trying to adapt, and modifications may be made to the job in order to achieve a return to work or to avoid work absence/difficulties. This can also vary with disease activity over time (Beaton et al., 2015).

Contextual factors play a large role in affecting the productivity of a worker (Chen et al., 2015). The International Classification of Functioning, Disability, and Health places contextual factors into two broad groups being personal and environmental factors. According to Badley (2008), contextual factors are those that are "scene setters", defining the nature of the job, or the features of the person that precede the illness episode. Hours of work done, methods used to do the job required, equipment, proximity to transportation together with the age, gender, and height of the worker are known as these "scene setters". Badley (2008) also states that "barriers" are seen as a second group of contextual factors where these are in most cases more modifiable and could potentially include the ability to accommodate the disease flare, ability to share work or modify duties, access to benefits, supervisory support and support for roles at home (Badley, 2008).

A common conception among employers is that numerous lifestyle factors impact on absenteeism and workplace productivity and can increase the number of sick days taken by up to 10% and simultaneously cause a decrease in productivity (Robroek, van den Berg & Plat, 2011). Most research has focused mainly on the impact of body mass index on work productivity and costs without taking into consideration the requirements of the job, where the results have shown the negative effects of obesity on these outcomes (Kudel et al., 2014). Body mass index within the obese category has been associated with greater absenteeism among United States workers than those workers with a normal body mass index (Kudel et al., 2014). Van Wormer & Boucher, (2015), however, indicated otherwise, where employed adults in the cohort who quit smoking, moderated alcohol use, increased the consumption of fruit and vegetables, or increased physical activity over two years did not have less productivity loss compared to those whose lifestyle factors remained stable.

A Canadian based study with a group of 56,971 participants found that obesity was an independent predictor of absenteeism and presenteeism (2015). It was highlighted that obese individuals with cardiometabolic risk factors namely diabetes, hyperlipidaemia, and/or hypertension, reported greater impairments in productivity. Higher medical costs than individuals within the normal weight category, with the same risk factors indicating the unique influence of obesity to less beneficial outcomes was also reported (Kudel et al., 2014). There was also an association between excess weight and impaired health and work productivity, together with the increased utilization of health care resources among workers in the United States having a large impact on the societal burden of obesity due to many companies covering the health insurance costs of their employees (Kudel et al., 2014). Moreover, among employed United States adults, annual direct i.e. medical expenditure and indirect i.e. work productivity loss amounted to $73.1 billion, where nearly two-thirds of these costs were sustained by

obese workers having a body mass index of >35 kg/m^2. Obesity accounted for up to 12.6% of annual absenteeism and over $8 billion in associated costs (Kudel et al., 2014). There is a large gap in research on the productivity levels of South African workers.

In the past ten years the production and service industries across the globe have put in large amounts of energy into improving productivity and the quality of work done (Laurig & Vedder, 2018). The process of restructuring has generated hands on experience which shows that productivity and quality of work are directly related to the design of working conditions (Laurig & Vedder, 2018). One direct economical measure of productivity being that of how the costs of absenteeism through illness are affected by working conditions. Therefore it should be possible to increase productivity and quality to avoid absenteeism by paying more attention to the design of working conditions (Laurig & Vedder, 2018).

2.11 SUMMARY

Our modern lifestyle has resulted in reductions in physical activity globally (Brownson et al., 2005). It is assumed that these reductions in physical activity are accompanied by parallel increases in sedentary behaviour (Owen et al., 2010; Thorp et al., 2012). Linked to this are other lifestyle behaviours that are often affected by work and other life stressors including nutrition, cigarette smoking and alcohol consumption (Daneshmandi et al., 2010). All of which are contributing to the global disease burden, decreased productivity and increased absenteeism rates. Even though legislation has been implemented in order to improve the health and wellness of employees in the transport industry, there still remains a negative image globally due to the high levels of physical inactivity, sedentary behaviour and body mass index; further resulting in non-communicable diseases worldwide, ultimately reducing productivity and increasing absenteeism rates.

CHAPTER III

RESEARCH METHODS

This chapter outlines the study design, ethics, recruitment and participants, measurement with information regarding the amended version of the Health and Wellbeing Survey (section 1 and section 2), statistical procedures and lastly, dissemination of results.

3.1 STUDY DESIGN

The study used a sample of convenience using workers current tasks at Transnet and included both train drivers and office employees. The measuring instrument used was an amended version of a structured questionnaire called The Health and Wellbeing Survey (Appendix E) (Rochdale Borough Council, 2020). It was structured with questions pertaining to physical and mental issues relating to work and home life. Participants were asked general questions about their lifestyle, nutrition, hydration, alcohol consumption, physical activity levels, general wellbeing, sedentary behaviour while doing both recreational and non-recreational activities, productivity levels and amount of time absent as a result of work.

3.1.1 The amended version of the Health and Wellbeing Survey

The amended version of The Health and Wellbeing Survey was administered in hard-copy to both office workers and train drivers at Transnet Freight Rail, Durban.

This survey was adapted and has been used in many studies in both developed and developing countries around the world. The amended version of The Health and Wellbeing Survey is important in developing a holistic view of health within the workplace.

The questionnaire was organized into two sections where section one was the health and wellbeing part and section two was the needs part, which was amended to include questions relating to absenteeism and productivity. The questionnaire was used in order to determine associations with workplace health measures among Transnet employees. This survey took approximately 10-15 minutes to complete.

3.1.1.1 SECTION 1: Health and Wellbeing Survey

Employee demographics age (years), body mass (kg), stature (cm) and gender were asked. Information regarding lifestyle factors: smoking, nutrition, hydration, alcohol consumption, physical activity, mental wellbeing and time spent sitting were also asked.

3.1.1.2 SECTION 2: The Needs Assessment Survey

Employees were given a list of activities and asked which ones they would prefer to be included in Transnet's workplace health and wellbeing program. Together with this, absenteeism was tested by asking individuals how often in a year they take time off of work because of an illness or physical pain caused by work.

Absenteeism was measured using self-reported number of days absent in a year. Productivity was measured using this same method, whereby a scale rating of how productive employees are on a scale from 0 (not productive) to 9 (very productive) was provided.

Considering the socio-ecological model, this study focused specifically on individual and lifestyle factors to investigate the associations between lifestyle factors: sedentary behaviour, physical inactivity, body mass index, nutritional intake, smoking, alcohol consumption and mental wellbeing among workers in the transportation industry.

3.2 ETHICS

The study was approved by the Rhodes University Ethical Standards Committee and the Department of Human Kinetics and Ergonomics Ethics Committee (reference number HKE- 2020-1169-3331; Appendix A). During the informed consent process, an information letter was provided which explained the purpose of the study, protocol and highlighted that all data will be collected for research purposes which would be kept strictly confidential with anonymity being ensured (Appendix B). Individuals were made aware that they could withdraw from the study at any point without prejudice. Permission to test the employees was given from the head of the health and safety department at Transnet and all employees gave their written, informed consent prior to participation.

3.3 RECRUITMENT AND PARTICIPANTS

The participants from this study were train drivers and office employees, recruited from the Transnet freight rail Durban branch. Information was sent to all employees following approval by the head of

health and safety at Transnet and the operations manager at the Durban branch. Those that consented to participate were included in the final analyses. Sixty questionnaires were handed out in batches of 20 over a three week period. Following this, ten office workers (n=10) and ten train drivers (n=10) who received hard copy questionnaires were immediately excluded from the study due to them being unable to physically hand back the questionnaires, as a result of the COVID-19 lockdown levels. Thus, 40 employees completed the overall study. Data collection took place during June 2020. A quantitative approach in the form of statistical analysis was used in order to ensure a rich description of the lifestyle experienced by both train drivers and office employees at Transnet, Durban. Participants were recruited via the operations manager at Transnet freight rail, Durban.

Additional inclusion criteria were as follows:

- Employees between the ages of 21 and 65 years old, due to the nature of the questions asked.
- Employees who were proficient in English so that there was no information lost in translation.
- Having at least one year of experience in their field (train driver or office worker) in order to get a true reflection of the lifestyle attached.
- Work > 4 days per week as this will be able to give an accurate description of the effects of a full time office worker or train driver.
- Not physically disabled or handicapped in order to isolate the effects of office workers and train drivers lifestyle.
- Not pregnant as this could be a factor for physical and/or mental health issues.

3.4 STATISTICAL PROCEDURES

All results were analysed using the Statistica software package Version 8 (Statistica©, Statsoft Inc). Descriptive statistics were first carried out in order to obtain mean and standard deviation responses for all variables. Independent T-tests were conducted on all variables in order to determine any significant differences between train drivers and office workers.

Correlation analyses were also carried out to assess for any significant relationships between variables, which were set at a 5% level of significance. Pearson's correlation coefficient was calculated for particular variables, following which the significance of the correlation was determined using the t-statistic. The t-statistic was used to find the critical limit for acceptance or rejection of the null hypothesis, using the t-distribution table and degrees of freedom. The categories of association strength

used were 0.0 – 0.2 being negligible, 0.3 – 0.4 being moderate and 0.5 – 0.8 was considered a large degree of association.

Cohens d was used to calculate the effect size between the differences of the variables, to find the magnitude of the experimental effect. The significance of the effect size was also determined to ascertain its statistical relevance using 5% level of significance. The categories used were 0.0 – 0.2 being a small effect size, 0.3 – 0.4 being moderate and 0.5 – 0.8 was considered a large effect size.

3.5 DISSEMINATION OF RESULTS

Participants, operational managers and head of health and safety at Transnet were given feedback in the form of 1) A written report and 2) Results to form part of future workshops, aimed to address areas of "health and wellness in the workplace". Feedback included a copy of the results shortened into the format of a journal post completion of the study. The feedback was distributed to interested employees as a way of saying thank you for participation, with the hope of individual interest in improving health and wellness in the workplace.

CHAPTER IV

RESULTS

Firstly, the results of the train drivers and office workers age, stature, body mass, medical disorders and overall body mass index classifications are presented. Thereafter the prevalence of sedentary behaviour, physical inactivity, obesity, nutrition, alcohol consumption, smoking and non-communicable disease risk are presented for both train drivers and office workers separately (Research Objective 1). Following this, an investigation into the mental wellbeing of the train drivers and office workers is presented (Research Objective 2). Finally, correlation analyses were done to describe the degree of association between these same lifestyle factors and workplace productivity and absenteeism of employees (Research Objective 3).

It is important that the following results are seen in the context of the study's broader limitations and the current, global pandemic. After consultation with the head of health and safety at Transnet Freight Rail, Durban, the number of participants was reduced from 80 to 60, with questionnaires handed out in batches of 20 over three weeks, to mitigate the interpersonal exposure of the virus in the workplace. Following this, ten office workers (n=10) and ten train drivers (n=10) who received hard copy questionnaires were immediately excluded from the study due to them being unable to physically hand back the questionnaires, as a result of the COVID-19 lockdown levels. Thus, 40 employees completed the overall study. Generally, the response rate of written questionnaires is 73.2% with 63.4% filling in a complete questionnaire (Kongsved, Basnov, Holm-Christensen & Hjollund, 2007). In this study, the response rate was 66.67%, which could be as a result of individuals not having enough time, they could be concerned about private information being used, or not being interested as they do not see any benefit.

Further, the Hawthorne effect on participants needs to be considered, as the participants' own opinion and perceptions were used which is not always accurate and weakens the internal validity of the results (Macefield, 2007). This is a common problem when the participant is aware that they are being studied (Macefield, 2007). However, since these factors cannot be controlled fully in real circumstances, the external validity of the results is reasonably high.

Due to the large amount of data obtained, only moderate to large differences and significant associations will be discussed in order to reduce the number of tables and figures in this section. For an in-depth overview, the calculations of the effect size for the mean values are found in Appendix G.

4.1 PRELIMINARY RESULTS

Age, stature, body mass, body mass index and medical disorders

Train drivers: *Male* (n=16); age: 41.56 ± 7.87 years; stature: 1.75 ± 0.09m; body mass: 83.09 ± 10.2kg; *Female* (n=4), age: 39.25 ± 9.00 years; stature: 1.68±0.03m; body mass: 70.00 ± 9.13kg. Similarly, 20 office workers (n=20) completed the study. **Office workers***: Male* (n=14), age: 47.57 ±10.02 years; stature: 1.80 ± 0.09m; body mass: 93.29 ±15.74 kg; *Female* (n=6); age: 45.5 ± 8.64 years; stature: 1.67 ± 0.02m; body mass: 62.17 ± 10.48kg. The office workers were significantly ($p<0.05$) older than the train drivers (Table 1).

Table 1. Participants characteristics (mean ± standard deviation).

	Train Drivers		**Office Workers**	
	Male	**Female**	**Male**	**Female**
No. participants (n=)	16	4	14	6
Age (years)	41.56 ± 7.87	39.25 ± 9.00	47.57 ±10.02*	45.5 ± 8.64*
Stature (m)	1.75 ± 0.09	1.68±0.03	1.80 ± 0.09	1.67 ± 0.02
Body mass (kg)	83.09 ± 10.52	70.00 ± 9,13	93.29 ±15.74	62.17 ± 10.48

*refers to significance at $p<0.05$ between office workers and train drivers

The majority of the participants did not experience any medical disorders (Figure 6). Of those that did, musculoskeletal disorders of the lower back were the most common among train drivers (n=4) and office workers (n=3). The results were similar for both groups, in that 14 train drivers and 13 office workers did not experience any medical problems. High blood pressure and diabetes were reported least by both groups (n=1 for train drivers and n=2 for office workers).

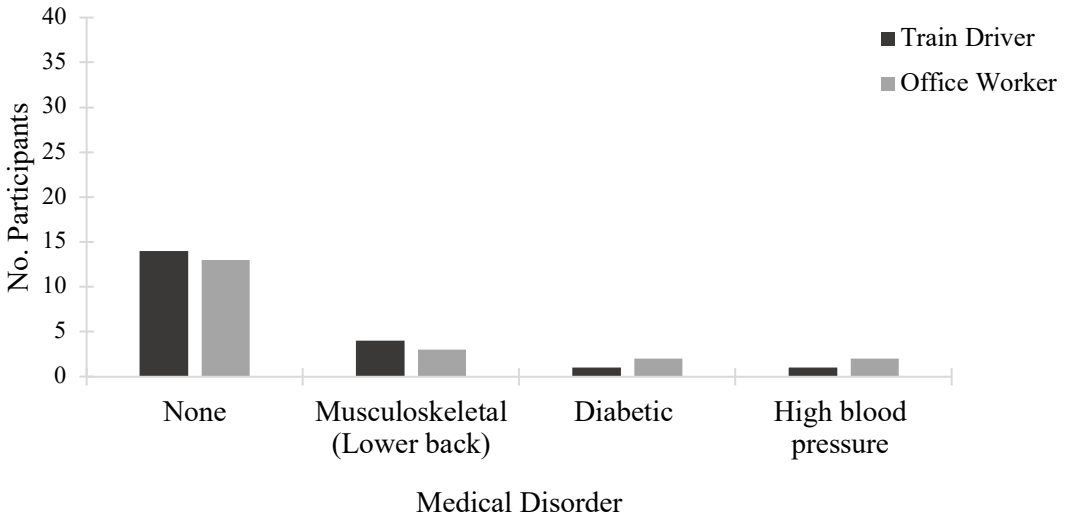

Figure 6 Medical disorders experienced by participants

Table 2. Distribution of body mass index of train drivers (n=20) and office workers (n=20)

	Train Drivers	Office Workers
BMI Category (kg/m^2)	**N (%)**	**N (%)**
Underweight ($\leq$ 18.5)	0 (0)	1 (5)
Normal (18.6 – 24.9)	7 (35)	8 (40)
Overweight (25.0 – 29.9)	10 (50)	5 (25)
Obese (30 – 39.9)	3 (15)	6 (30)
Morbidly obese ($\geq$ 40)	0 (0)	0 (0)

Where: BMI represents body mass index

While 35% of the train drivers presented with a body mass index within the 'normal' range (18.56-24.9 kg.m^2), 40% of office workers fell in this category, with a small effect size (d=0.21). In contrast, there was a large effect size (d=0.69) where 25% of office workers and half (n=10) the train drivers were in the 'overweight' category (25.0-29.9 kg.m^2). Thirty percent of the office workers presented with a body mass index within the 'obese' category with 15% of train drivers falling in this range, presenting a moderate effect size (d=0.55). Therefore, more train drivers are overweight and more office workers are obese. No train drivers were in the underweight category, however 5% of the office workers were. Importantly, there was no statistically significant ($p>0.05$) differences between train drivers and office workers.

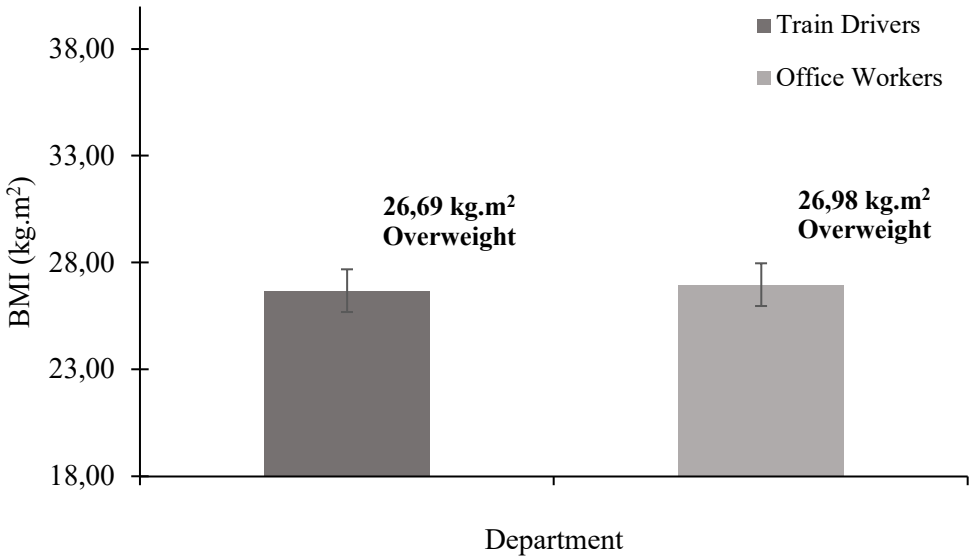

Figure 7. Mean (± standard deviation) body mass index classification of train drivers and office workers.

The mean body mass index classifications for the office workers was 26.98 kg.m^2 which was similar (d= 0.06) to that of the train drivers (26.69 kg.m^2), but not statistically significant (p>0.05). The mean classification for both train drivers and office workers were within the 'overweight' category.

4.2 LIFESTYLE FACTORS

4.2.1 Physical Activity

Table 3. Number of sessions per week (mean ± standard deviation) physical activity is performed

Sessions per week	Department	
	Train Driver	**Office Worker**
20 mins. vigorous intensity	2.50 ± 1.36	1.95 ± 1.15*
30 mins. Walking	2.60 ± 1.79	1.60 ± 1.39*
30 mins. other moderate intensity	1.70 ± 1.87	0.85 ± 1.39*

* refers to significance at p<0.05 between office workers and train drivers

Train drivers did moderately (d=0.41) and significantly (p<0.05) more sessions of 20 minutes of vigorous intensity excercise (2.50 ± 1.36) per week than office workers (1.95 ± 1.15; Table 3). Similarly, train drivers did 2.60 ± 1.79 sessions of 30 minutes walking, which is moderately (d=0.58)

and significantly ($p<0.05$) more than office workers who did 1.60 ±1.39 sessions. Train drivers also did moderately ($d=0.48$) and significantly ($p<0.05$) more sessions per week of 30 minutes of other moderate intensity exercise (1.70 ± 1.87) compared to office workers (0.85 ± 1.39). Ultimately, train drivers are more physically active than office workers.

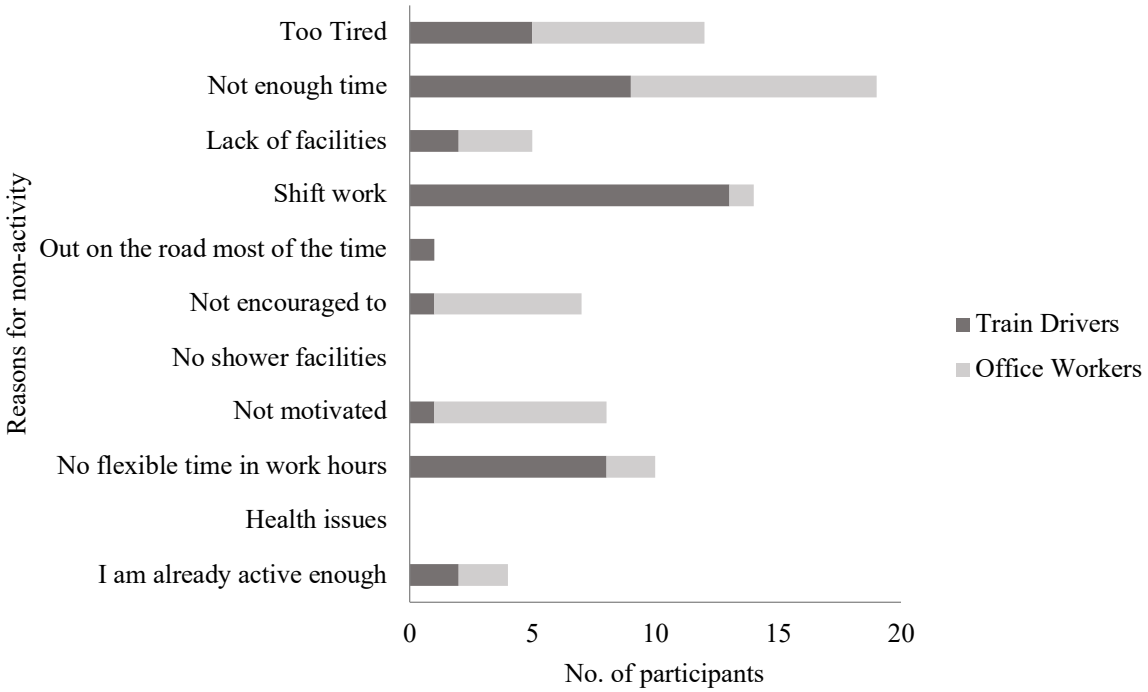

Figure 8. Reasons why participants do not do more physical activity

The main reasons why train drivers are not engaging in physical activity include the time restrictions of shift work (n=13), a lack of time (n=9) and a lack of flexibility in their work bound time (n=8). Other reasons include being too tired to engage in physical activity (n=5), a lack of facilities (n=2), being out on the road/rail for most of the day (n=1) and a lack of encouragement (n=1). Of the 20 train drivers, only two indicated that they were already active enough. No participants indicated that shower facilities or health issues affected their physical activity levels.

Half (n=10) of the office workers indicated a lack of time as the main reason for their lack of participation in physical activity. Other indications include being too tired (n=7), not feeling motivated (n=7) and a lack of facilities (n=3). Notably, more office workers indicated a lack of encouragement (n=6) compared to train drivers. Less office workers indicated a lack of flexible work bound time (n=2) and shift work (n=1), compared to train drivers. No participants listed being out on the road, a lack of shower facilities or other health issues as reasons.

Table 4. Occupational physical activity

	Train Driver		Office Worker	
	Male	**Female**	**Male**	**Female**
No. participants	16	4	14	6
Yes	8	3	4	0
No	8	1	10	6

More train drivers (50%) spend time at work doing physical activity compared to office workers who do no physical activity at work (Table 4). Further, female train drivers are more active at work than males. Office workers do very little physical activity at work, where four (28.57%) male office workers and female office workers were physically active at work.

4.2.2 Sedentary behaviour

Table 5. Time (hours and minutes) spent sitting at work on a typical day

	Department	
	Train Driver	**Office Worker**
Hours sitting at work	7.85 ± 2.21	8.30 ± 1.03

Office workers spend marginally more (d=0.25) hours sitting at work (8.30 ± 1.03) than train drivers (7.85 ± 2.21). However, the difference is not statistically significant ($p>0.05$), considering a five day work week (Table 5).

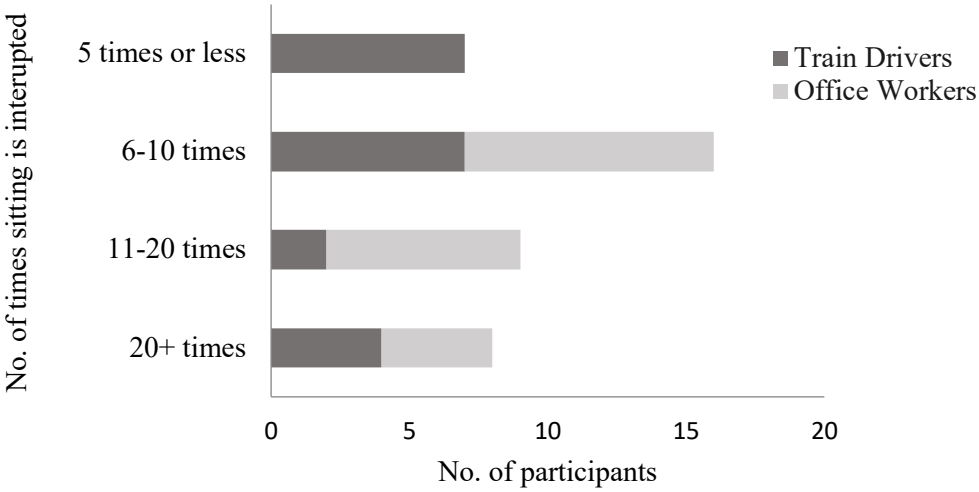

Figure 9. Number of times participants interrupt their sitting at work

Sitting interruptions for train drivers consisted of five times or less (n=7), 6-10 times (n=7), 11-20 times (n=2) and 20+ times (n=4). Sitting interruptions for office workers were more frequent with all participants indicating that their sitting is interrupted at least five times per day (n=20).

4.2.3 Smoking

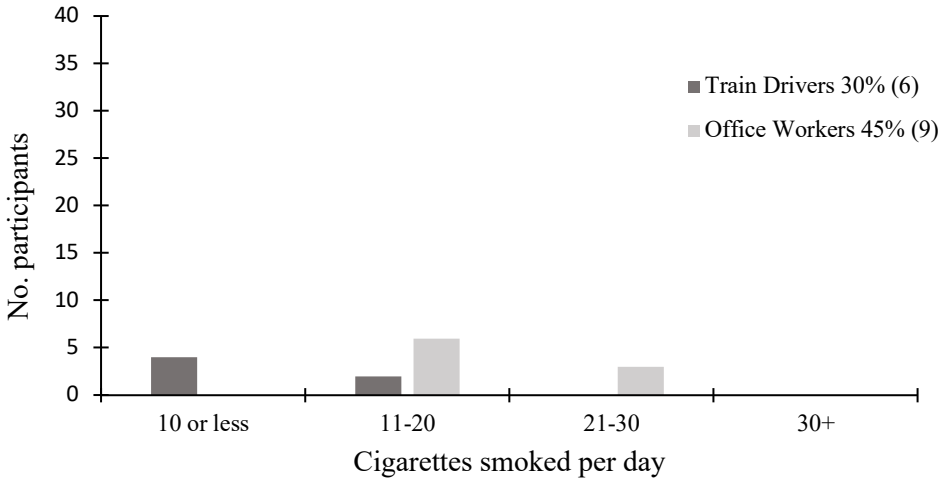

Figure 10. Number of cigarettes smoked per day

Just under half of the office workers (45%) smoke daily, compared to one third (30%) of train drivers. Four train drivers smoke 10 or less cigarettes per day, two smoke 11 to 20 per day and none smoke 21 or more. Six office workers smoke 11 to 20 per day and 3 smoke 21 to 30 cigarettes per day. In general, office workers have a higher proportion of smokers who also smoke more.

4.2.4 Nutrition

Table 6. Servings (mean ± standard deviation) of vegetables and fruit per day.

	Department	
	Train Driver	**Office Worker**
Servings of vegetables/day	1.85 ± 0.93	1.9 ± 0.97
Servings of fruit/day	1.6 ± 0.68	1.4 ± 0.75

Table 6 shows that office workers consume similar (d=0.05) servings of vegetables per day (1.90 ± 0.97), compared to train drivers (1.85 ± 0.93). This is the same for the intake of fruit (d=0.27). There were no significant (p>0.05) differences between train drivers and office workers vegetable and fruit intake, respectively.

Table 7. The amount of days (mean ± standard deviation) train drivers and office workers eat junk food per week outside of work, and the amount of days junk food is consumed at work per week.

	Department	
	Train Driver	**Office Worker**
Junk food per week outside of work*	2.35 ± 1.53	3.05 ± 1.50
Junk food per week at work	2.4 ± 1.57	2.85 ± 1.63

* refers to significance at $p < 0.05$

Office workers consumed significantly (p<0.05) more (d=0.44) junk food both outside of work and during work (d=0.27) (Table 7).

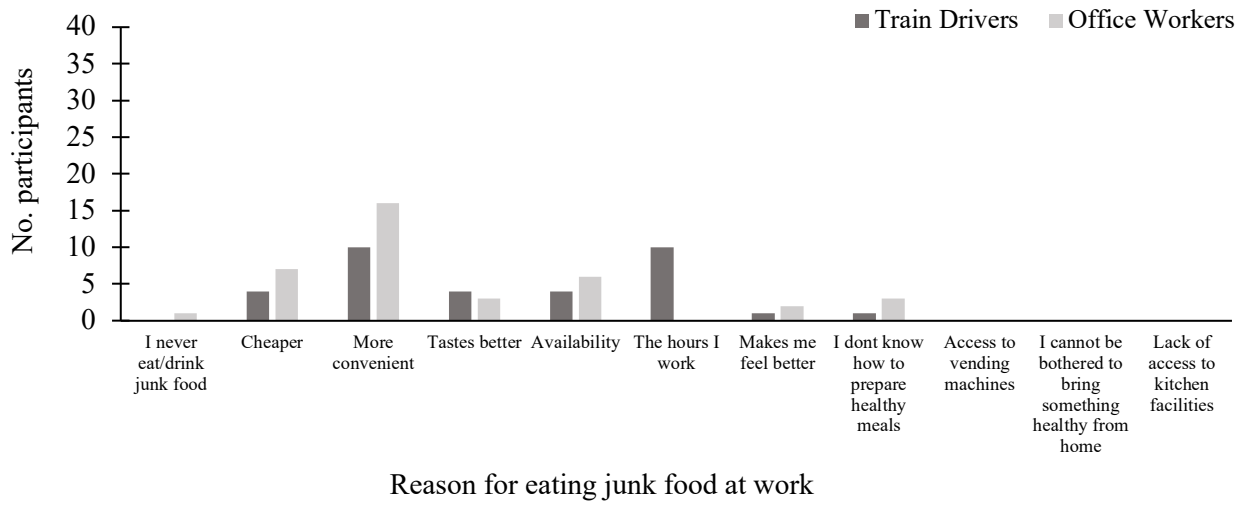

Figure 11. Reason why participants eat junk food at work

Train drivers' main factors for consuming junk food were equally convenience and the hours they work, with 10 participants (50%) indicating for each (Figure 11). Alternate reasonings for the consumption of junk food were the cheaper prices, availability of junk food and a preference of taste. A similar trend is shown in office workers, with the main reason for consuming junk food being that it was more convenient (n=16). Seven office workers reported that it was cheaper to eat junk food and six reported because of the availability of junk food. Other reasons include a preferred taste (n=3) and a lack of knowledge around preparing healthy meals (n=3). Notably, only one office worker and no train drivers never eat/drink junk food.

4.2.5 Alcohol consumption

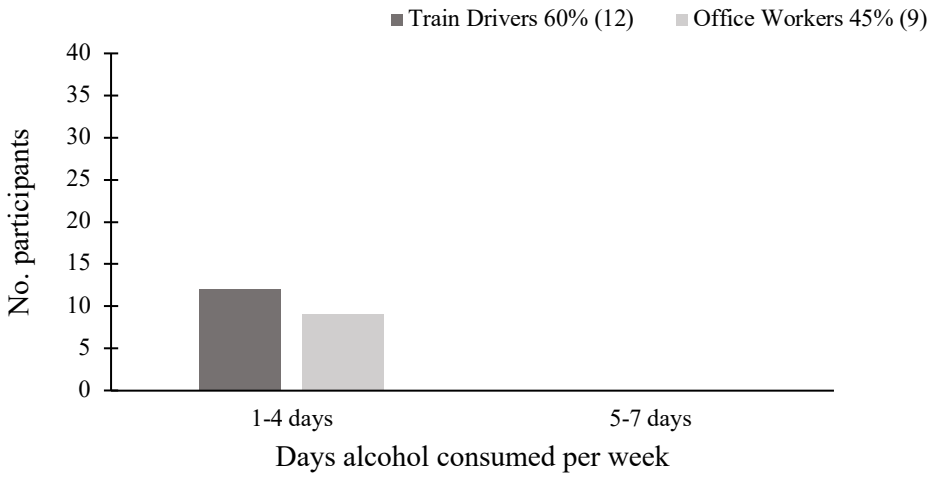

Figure 12. Number of days participants consumed alcohol per week

Twelve (60%) train drivers drink alcohol one to four days per week (Figure 12). The prevalence of alcohol consumption was less in the office workers (45%). No participants reported consuming alcohol more than four days per week.

4.3 PSYCHOSOCIAL FACTORS

Workers were asked questions regarding their mental health and how they have been feeling in the past four weeks.

4.3.1 Mental Wellbeing

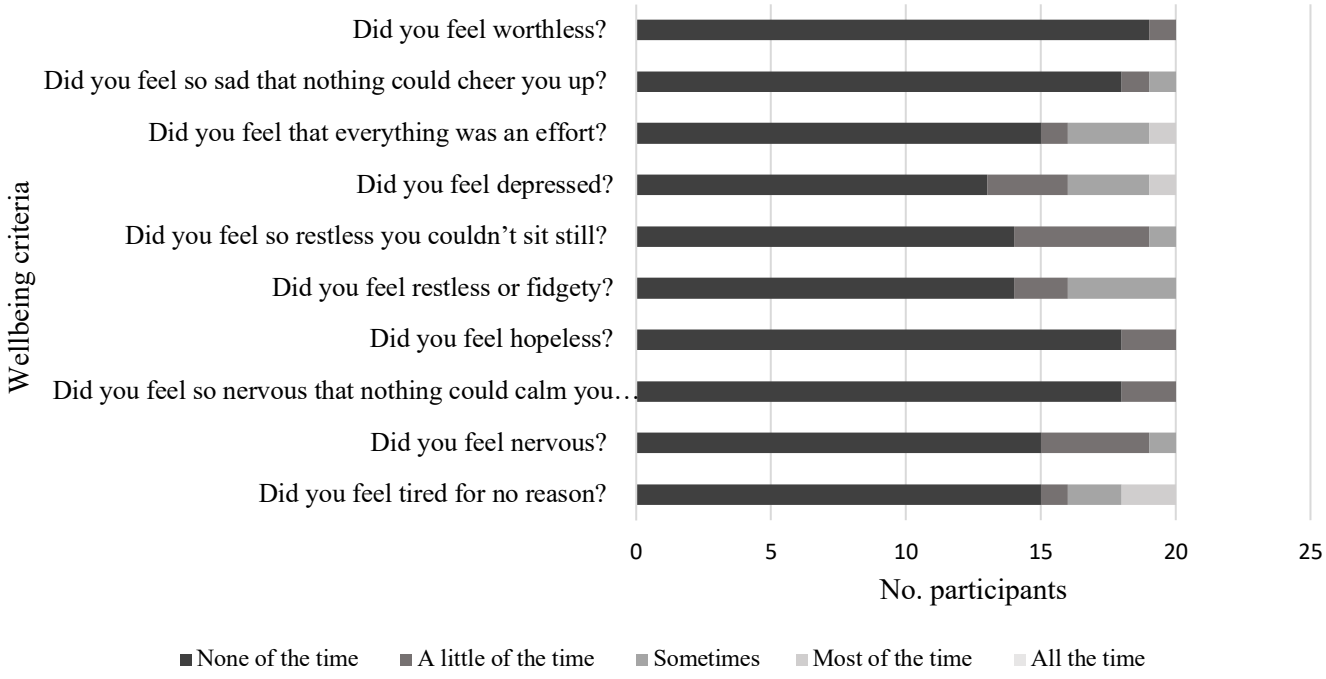

Figure 13. Mental wellbeing of train drivers

Overall mental wellbeing appeared good (Figure 13). The main feelings were of depression (n=7), restlessness (n=6), fidgety (n=6), feeling like 'everything was an effort' (n=5), nervous (n=5), tired (n=5), 'so nervous that nothing could calm them down' (n=2), hopeless (n=2), sad (n=2) and worthless (n=1).

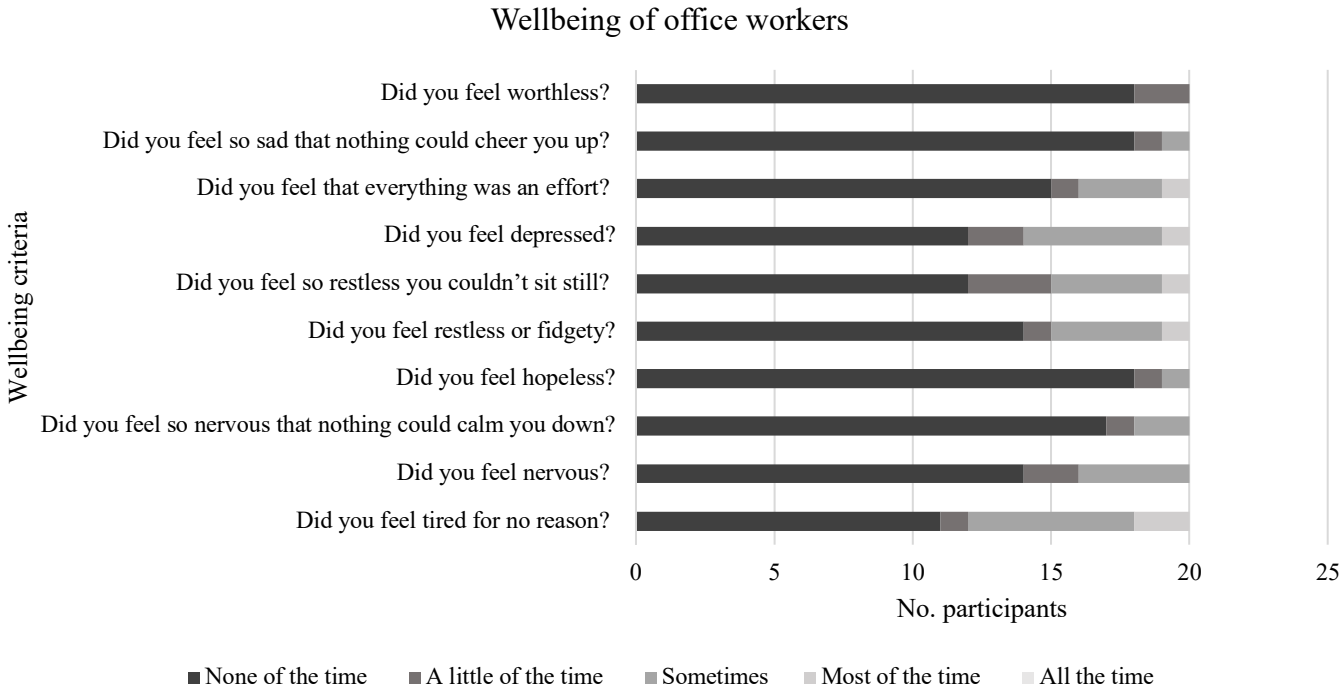

Figure 14. Mental wellbeing of office workers

The mental wellbeing of the office works was also fairly good (Figure 14). Feelings of tiredness were experienced the most (n=9), followed by depression and restlessness (n=8). Other emotions experienced were fidgety (n=6), nervous (n=6), 'everything was an effort' (n=5) and 'so nervous that nothing could keep them calm' (n=3). Hopeless, worthless and sadness were experienced by two office workers.

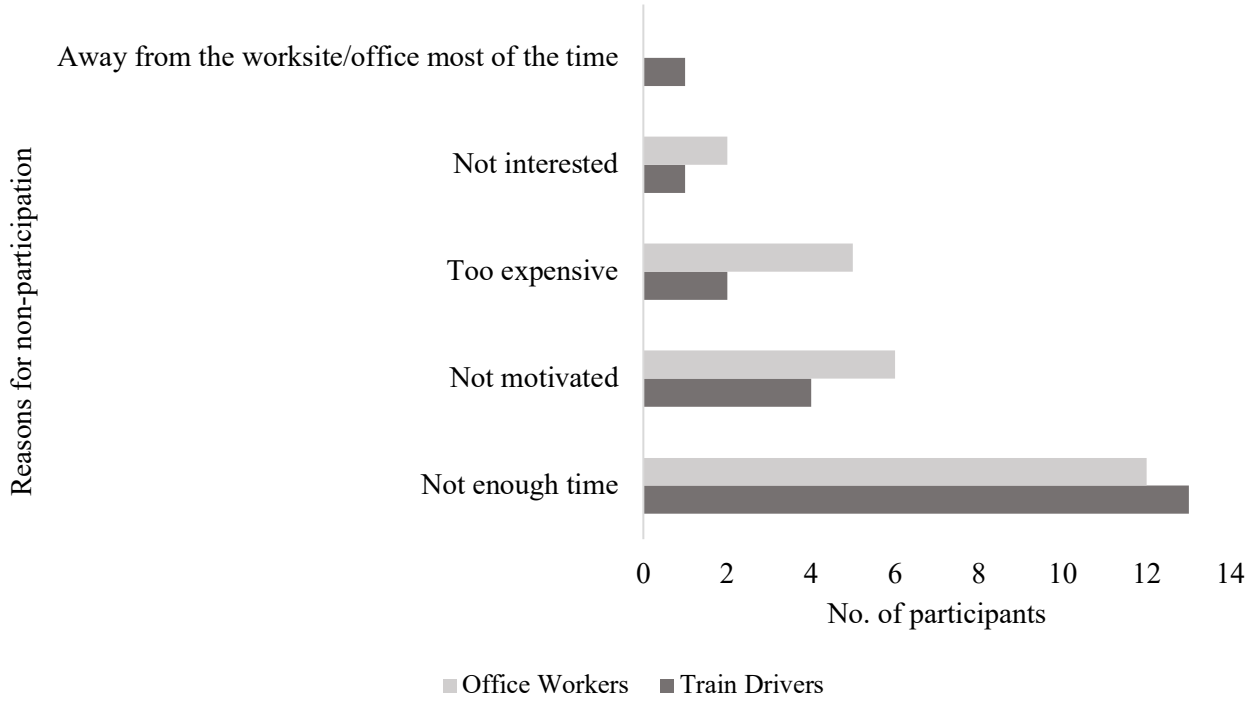

Figure 15. Factors affecting participation in workplace health and wellbeing activities

The main reasons behind non-participation in workplace health and wellbeing activities for office workers was not having enough time (n=12), not motivated (n=12), too expensive (n=5) and lack of interest (n=2) and none said due to being away from the office most of the time. Similar trends were shown for train drivers, where not having enough time was the main reason (n=13). Six drivers indicated that they were not motivated while two stated that it is too expensive. One said because they were not interested and that they were away from the worksite most of the time.

4.3.2 Needs Assessment

Workers were asked questions regarding what they would like to be included in a potential health and wellbeing program, together with when they would prefer it to occur and how often.

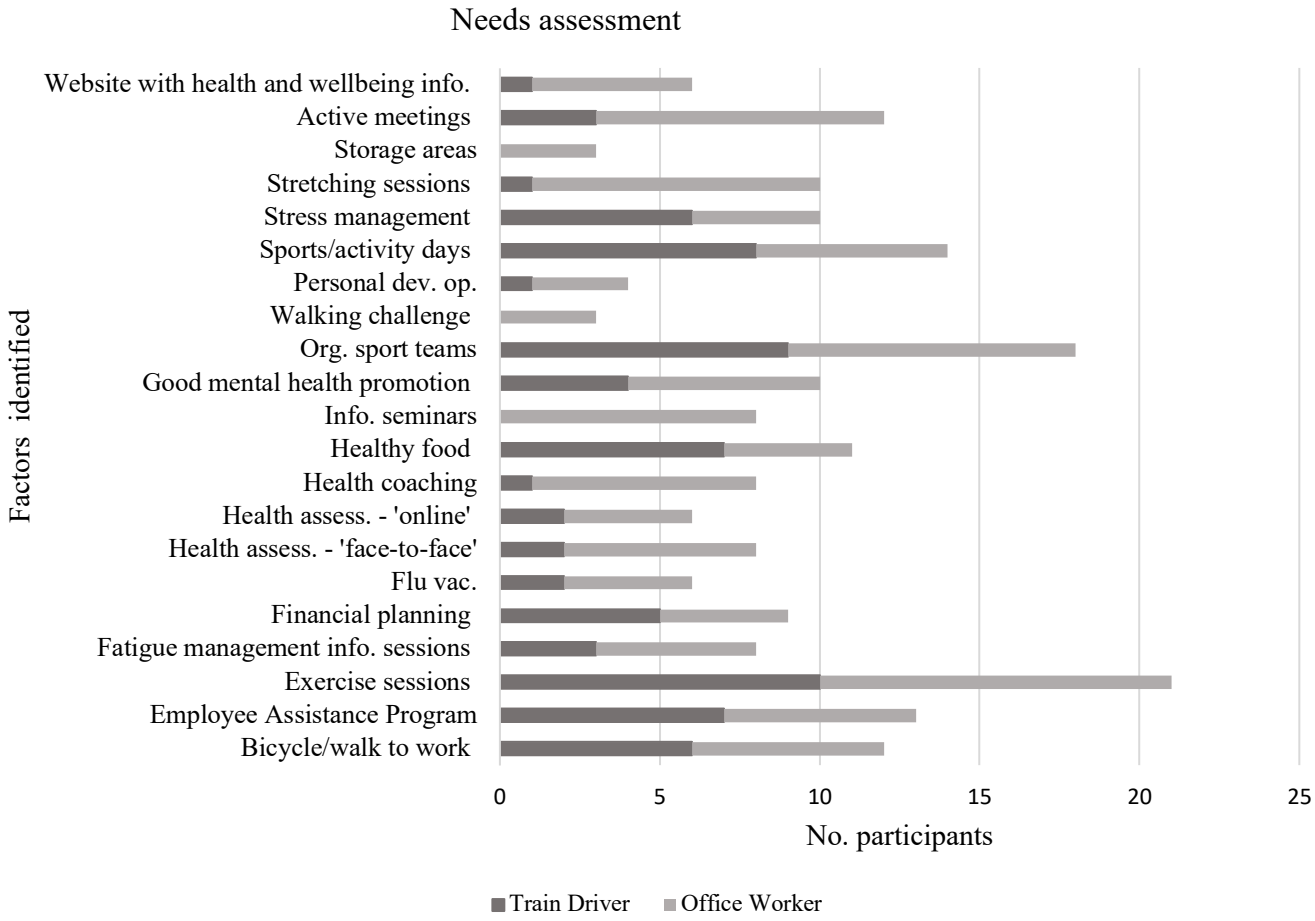

Figure 16: Factors identified for consideration into a potential health and wellbeing program

The most common factors identified by train drivers and office workers for the inclusion into a potential health and wellbeing program were active meetings (n=3 and n=9), sports/activity days (n=8 and n=6), organizations sports teams (n=9 for both train drivers and office workers) and exercise sessions (n=10 and n=11).

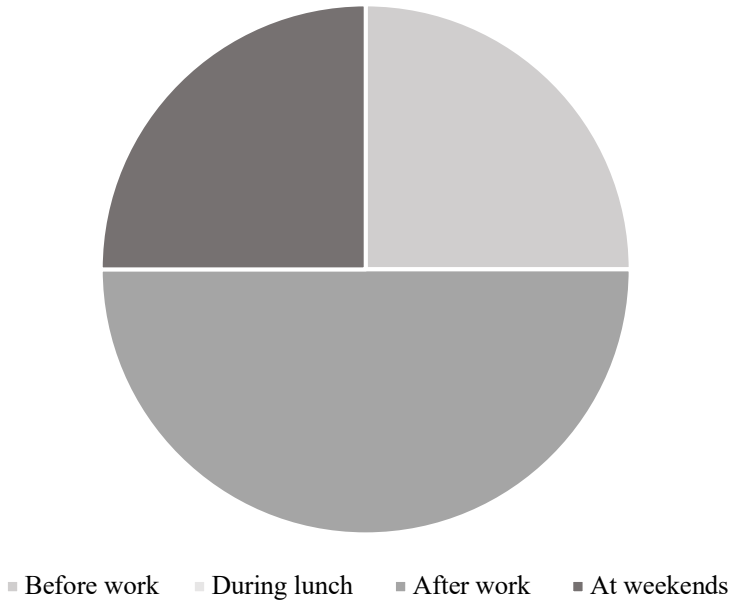

Figure 17: Preferable time train drivers wanted wellness program to occur

The preferred time train drivers wanted the employee wellness program to occur was after work with 50% of employees saying so, with only 25% wanting it at the weekends and another 25% saying before work. None stated they wanted it during lunch time.

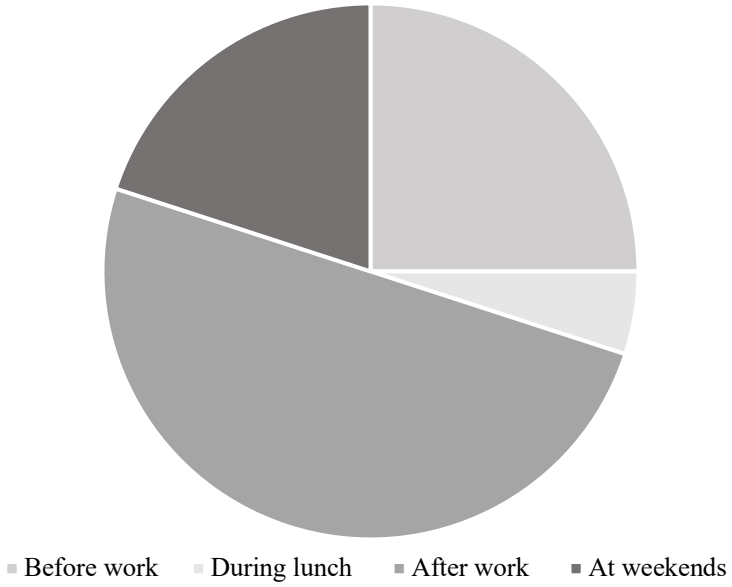

Figure 18: Preferable time office workers wanted wellness program to occur

Office workers preference was after work (50%), then before work (25%), followed by at the weekends and lastly during lunch (5%).

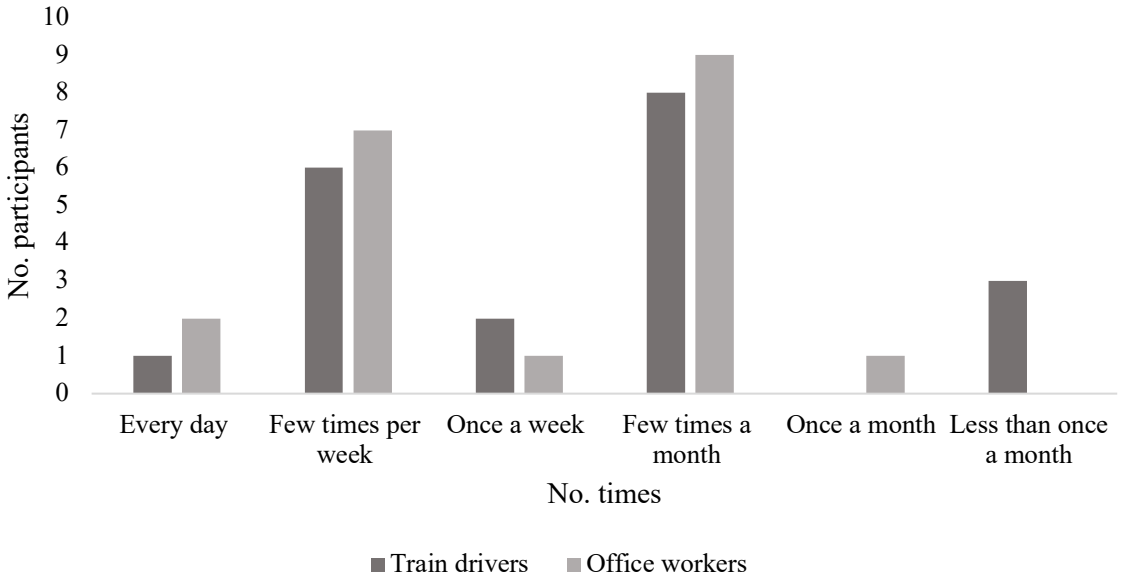

Figure 19: How often employees would attend a wellbeing activity

Meeting a few times a month was the most popular by both office workers and train drivers (n=9 and n=8), followed by a few times per week (n=6 and n=7), with the least popular being once a month for train drivers and less than once a month for office workers with none saying so for each.

4.4 ABSENTEEISM

Table 8. Time off of work due to an illness caused by work (days per year)

	Department	
	Train Driver	**Office Worker**
No. participants	20	20
Absent	3.55 ± 1.85	2.95 ± 1.32

Table 8 displays the number (mean ± standard deviation) of days participants took time off of work due to an illness caused by work. This excludes any sick days due to reasons other than work. Train drivers were absent 3.55 (± 1.85) days in a year, and office workers were absent 2.95 (± 1.32) days in a year, which was not statically significant ($p>0.05$).

There was a non-significant positive but weak (r=0.30) correlation between sedentary behaviour and absenteeism, among the train drivers. Among office workers, there was also a non-significant positive

and weak correlation (r=0.36) between sedentary behaviour and absenteeism. The relationship between physical activity and absenteeism among both the train drivers and office workers was negligible (r=0.19 and r=0.14), with no difference.

In terms of the association between fruit intake and absenteeism, there was a negligible (r=0.02 for the office workers) and low (r=0.23 for the train drivers), correlation which was not different. Further, there was no significance (p>0.05) in the association between vegetable intake and absenteeism (r=0.08) among the office workers. Noteworthy, is the significant (p<0.05) moderate positive (r=0.42) association between vegetable intake and days absent per year among the train drivers.

There was a significant (p<0.05) positive and moderate correlation (r=0.46) between obesity and absenteeism among the office workers. Among the train drivers, however, there was moderate positive (r=0.32) association between obesity and absenteeism which was not significant (p>0.05).

4.5 PRODUCTIVITY

Table 9. Productivity levels (0- Not productive, 9- Very productive) on a typical workday

	Department	
	Train Driver	**Office Worker**
No. participants (n=)	20	20
Productivity	7.95 ± 1.12	7.55 ± 1.10

Mean productivity levels of train drivers, 7.95 (± 1.12), was not significantly different (p = 0.12) to office workers , with a reporting of 7.55 (± 1.10).

There was no difference in the negligible (r=0.03) association between sedentary behaviour and productivity among both the train drivers and office workers (r=0.06). The association between physical activity and productivity among the train drivers was low negative (r=-0.15) which was not significant (p>0.05). The association between physical activity and productivity among office workers, however, was both significant (p<0.05) and moderate positive (r=0.39).

The vegetable intake among the office workers showed a significant (p<0.05) moderate positive association with productivity (r=0.49). The association between vegetable intake and productivity among the train driver cohort was not significant (p>0.05) and low positive (r=0.16). There was a significant (p<0.05) and moderate positive association between fruit intake and productivity among

both train drivers (r=0.43) and office workers (r=0.47). There was no significant (p>0.05) association between obesity and productivity for both the train drivers (r=0.03) and office workers (r=0.12).

4.6 SUMMARY

The main findings of this study indicated that there was a high prevalence of sedentary behaviour (train drivers = 7.85 ± 2.21 and office workers = 8.3 ± 1.03), particularly among office workers. The prevalence of physical inactivity was marginally higher for office workers than train drivers. Most of the participants had a relatively high body mass index, falling in the overweight and obese category, particularly among train drivers. Train drivers demonstrated significantly (p<0.05) higher participation in exercise sessions. Largely, the lifestyle factors presented weak associations with both absenteeism and productivity. The lifestyle factors that produced the strongest associations with productivity and absenteeism were fruit and vegetable intake and obesity levels.

CHAPTER V
DISCUSSION

It is well established that increased sitting time, insufficient physical activity and an elevated body mass index and other lifestyle factors are all contributing to the rise of non-communicable diseases, both globally (Wen Ng & Popkin, 2012) as well as in developing countries such as South Africa (WHO, 2020). However, the prevalence to which different lifestyle factors that affect the employees in the transport industry, particularly office workers and train drivers, is not well known. The aim of this chapter is to communicate the findings of this study in a systematic way, in relation to the literature, which focuses on addressing the following: (1) Explore the prevalence of sedentary behaviour, physical inactivity, obesity, nutrition, alcohol consumption, smoking and non-communicable disease risk (2) Mental wellbeing in this cohort of workers (3) Explore the associations between lifestyle behaviours on workplace productivity and absenteeism.

The main findings of this study indicated that there was a high prevalence of sedentary behaviour (train drivers = 7.85 $\pm$ 2.21 and office workers = 8.3 $\pm$ 1.03), particularly among office workers. Most of the participants had a relatively high body mass index, placing in the overweight and obese categories, particularly among train drivers. The prevalence of physical inactivity was marginally higher for office workers than train drivers. There were significantly ($p<0.05$) higher levels of physical activity within train drivers with a moderate effect size. There were limited associations found between lifestyle factors and sickness absenteeism and worker productivity. Obesity had the most prominent relationship with non-communicable disease, followed by high levels of sedentary behaviour, not meeting physical activity guidelines, obesity, overweight, and prolonged sitting time at work. A significant and moderate correlation was found between obesity and absenteeism, however, no associations were found between sedentary behaviour, physical activity and fruit and vegetable intake and absenteeism. Lastly, significant and moderate correlations between physical activity and fruit and vegetable intake and workplace productivity were established. No significant associations between sedentary behaviour and obesity and productivity were found.

5.1 BIOMEDICAL RISK FACTORS

5.1.1 Obesity

Train drivers and office workers were considered overweight or obese respectively, which is seen to be a global public health concern known to increase the risk for other non-communicable diseases

(Kruger, Puoane, Senekal & van der Merwe, 2005). It has also been linked to an increased risk of musculoskeletal injuries particularly with low physical workloads, repetitive work, awkward body postures and prolonged sitting (Kudel et al., 2014; Pereira, Ki & Power, 2012).

More than half of the office workers (Table 2: Pg. 64), and train drivers (Table 2: Pg. 64), were either overweight (25.0 – 29.9 kg/m^2) or obese (30 – 39.9 kg/m^2) which is supported by current literature (Addo et al., 2015). The prevalence of obesity within the train driver population group was lower than within the office worker sample and the prevalence of obesity for office workers in the current study (Table 10: Pg. 80) is higher than Pakistan office workers (Attaur-Rasool & Shirway, 2012). The differences in obesity levels between the sample and the international study may be accounted for by the increased impact of socioeconomic and behavioural variables in emerging countries, who generally have poor diets (Van Der Merwe, 2006; Cois & Day, 2015).

Table 10: Comparison of anthropometric data from 2012 (study by Attaur-Rasool & Shirway) and 2020 (current study) for office workers.

	General Information	
	Attaur-Rasool & Shirway	**Current Study**
Age (years)	40.65 ± 7.86	46.94 ± 9.90
Stature (cm)	168.63 6.85	175.80± 9.43
BM (Kg)	75.68 13.83	83.85 ± 20.31
BMI (kg.m^2)	26.53 4.14	26.98 ± 5.37

Where BM represents: body mass; BMI: Body Mass Index (mean values); Columns highlighted in green represent current data

Office workers in this study were 8.17 kg heavier and had a 0.45 kg.m^2 higher body mass index than the Pakistan worker sample (Attaur-Rasool & Shirway, 2012). This is particularly in the male sample. It must be noted, however, that the findings from the study by Attaur-Rasool & Shirway (2012) represent international statistics from Pakistan office workers only, not in the transportation industry, while the current data represents South African statistics on freight rail office workers from Durban only. However, data was unavailable for comparisons to be made for train drivers in the transport industry.

Consistent with findings by Nurwanti et al (2019), the present study had participants who live in urban areas and had an increased body mass index and higher levels of obesity. In low-middle income countries, the prevalence of overweight and obesity is typically higher in urban areas while underweight is typically higher in rural areas (Nurwanti et al., 2019; Kruger, Venter & Vorster, 2001). The fact that participants involved in this study were typically from urban areas may account, in part, for the high levels of obesity, consistent with similar findings in other studies (Nurwanti et al., 2019; Kruger, Venter & Vorster, 2001).

5.1.2 High Blood Pressure

There was no significant relationship between total physical activity (MET-mins/week), vigorous or moderate activity, and high blood pressure, a finding that is supported by past research on black South Africans (Charlton et al., 1997). In the present study it was shown that, although high blood pressure was low for train drivers (5%) and office workers (10%), physical activity levels were also low. Train drivers spend 7.85 ± 2.21 hours sitting at work each day and office workers spend 8.30 ± 1.03 hours. Staff may have under reported their sitting times as it is well established that those who sit for long periods at work are more likely to have high blood pressure (American Heart Association, 2019; Makoff & Stoppler, 2020). Working 41 to 48 hours each week, which the current sample is exposed to, has been linked to a 54% greater chance of having masked hypertension and 42% greater likelihood of having sustained hypertension (American Heart Association, 2019). It is however unknown how many employees had masked hypertension.

When looking at the levels of physical activity and hypertension, it was found that the prevalence of hypertension was higher among those with low physical activity compared with those with moderate or high levels of physical activity. A study showed that physical inactivity, unhealthy diet, smoking and harmful alcohol use have been associated with increased risk of hypertension (Bosu, 2016). Thus, although the current sample did not have high levels of hypertension, the addition of other poor lifestyle behaviours may, over time, result in hypertension and other chronic diseases of lifestyle.

Regular and moderate drinking was found to be associated with hypertension, together with medium and heavy smokers (Bosu, 2016). The strongest risk factors associated with hypertension in telecommunication workers in Dakar were diabetic, age ≥ 40 years compared to < 40 years, being

overweight (25.0-29.9 kg.m^{-2}) and male sex (Bosu, 2016), which is reflected in the current study where those that experienced hypertension were all males above 40 years old and 75% (n=15) were in the obese category, with 25% (n=5) being in the normal weight category.

5.1.3 Diabetes

Diabetes was not common in this sample (n=1 in train drivers and n=2 in office workers). As this group had a number of other risk factors such as obesity and high levels of sedentary behaviour, there is a possibility that they were unaware that they have diabetes or insulin resistance. Previous research has shown an association between a high volume of sedentary behaviour and an increased risk of type II diabetes of 112% (Wilmot et al., 2012). However, the large number of variables, such as physiological processes on a molecular level and diet, that impact on an individual's susceptibility to diseases, make it difficult to determine a causal relationship between sedentary time and disease burden (Hamilton, Hamilton & Zderic, 2015).

The prevalence of obesity among the sample group is high, however, the reported incidents of diabetes is low. Prevailing reasoning for this relationship can be attributed to studies that have identified that the majority of people who have type II diabetes fall into the obese category, however the general prevalence of type II diabetes is fractional compared to obesity (Chadt et al., 2018). Those in this sample that represent the obese category (Train drivers: 15%; Office workers: 30%) present a significant risk factor of developing diabetes. Of further importance is the notion that fat distribution plays a significant role in the risk of developing type II diabetes (Chadt et al., 2018). Individuals with increased intra-abdominal fat levels develop insulin resistance more frequently (Chadt et al., 2018). The current study measured obesity in the form of body mass index and thus, the fat distribution profiles of the sample group are not known and is should be considered in future research.

Diseases involved in occupations together with cumulative injuries have been largely under reported and generally under recognized (Burton, 2010), which can be portrayed in the very small number of individuals who reported diseases in this particular study. In many cases, it may take years for a disease to become evident in a worker, and so the link to workplace exposure may not be very clear or unrecognized (Burton, 2010).

5.1.4 Musculoskeletal Disorders

This sample of workers at Transnet, on average, spend 7.85 (±2.21) hours (Train Drivers) and 8.3 (±1.03) hours (Office Workers) sitting per day. The sample group experienced multiple sitting interruptions in a working day with the majority of workers experiencing eight or more interruptions per day. Most of the workers (82.5%) meet the guidelines outlined by the WHO (2009), as they sat for a maximum of 55 minutes per sitting session (Ryan et al., 2011).

There were small differences in the relationship between time spent sitting and musculoskeletal disorders. Workers who display higher frequencies of dynamic patterns of movements in their day-to-day occupation experience a lower prevalence of back and neck injuries (Cormac et al., 2011), which could account for the lower than expected reporting of musculoskeletal disorders among the workers at Transnet. Of the 40 participants that were studied, 17.5% (4 Train Drivers and 3 Office Workers) reported experiencing musculoskeletal disorders.

Something that is of great importance, however, which is not commonly understood is that psychosocial conditions associated with the organization of work can also act as risk factors (Burton, 2010). The idea that psychosocial stress can contribute to, or cause, musculoskeletal disorders is not intuitively obvious (Burton, 2010). According to the wellbeing assessment of office workers, they indicated higher levels of stress, which could act as an indicator for musculoskeletal disorders (Burton, 2010). However, the sample group reported greater levels of musculoskeletal disorders amongst train drivers, contrary to the anticipated outcomes based on variables such as sedentary behaviour, physical activity, and body mass index. Many different physiological mechanisms that occur during stress contribute to this relationship, together with increases in non-voluntary muscular tension and cortisol levels, changes in the perception of pain and decreases in muscle repair and blood testosterone levels (Burton, 2010).

5.2 LIFESTYLE FACTORS COMPARISON

5.2.1 Smoking and Alcohol Consumption

The national prevalence of alcohol consumption among the South African population (StatsSa, 2017) is lower than that among the employees at Transnet, where 30% of females and 60% of males regularly consume alcohol compared to the national average of 18.4% (females) and 53.8% (males).

The high consumption of alcohol by the train drivers has been shown previously in those involved in the operating of heavy duty machinery, such as truck drivers (Bragazzi et al., 2018). This can impact other risk factors and have a serious impact on their health, the general safety on the road and the work that they perform (Bragazzi et al., 2018).

In general, office workers (45%) had a higher proportion of smokers train drivers (30%). The relative risk of coronary heart disease mortality is twofold higher in men who smoke up to 20 cigarettes a day, and threefold higher amongst those smoking 20 cigarettes or more a day (Kannel, 1964). In this sample, 30% of office workers smoke up to 20 cigarettes per day and 15% smoke 20 or more cigarettes per day. Of the train drivers, 10% smoke up to 20 per day and none smoke 20 or more in a day. This indicates that 55% of the participant group engages in smoking habits that have the potential to cause lasting and sustained harm to their health.

Employees that have high stress have reported to have poor eating habits, low levels of physical activity, a high consumption of alcohol and cigarettes as well as psychological issues such as anxiety and depression (Faghri & Mignano, 2013). Although, in this study, even though office workers reported more stress, they consumed less alcohol than the train drivers. The cigarette consumption patterns, confirm the relationship between stress and cigarette usage, where 15% more office workers smoke, in comparison to train drivers.

5.2.2 Nutrition

Although there is a large amount of evidence to support the benefits of the consumption of fruit and vegetables (Dias, 2012), the workers in this study consumed low levels of fruit and vegetables.

Train drivers and office workers consumed notably less than the recommended daily amount of five portions of fruit and vegetables per day (WHO, 2019). The train drivers eat, on average, 1.55 less servings than recommended and the office workers, 2.35 less servings than the recommended daily amount. These poor nutrition habits can increase the risk of obesity, diabetes, and coronary heart disease (Mozaffarian, 2016) within both sample groups, particularly office workers. This contributes to the 4% of the global disease burden caused by a sub-optimal diet (Fransen et al., 2017; Lim et al., 2012; US Burden of Disease Collaborators, 2013).

The large amount of junk food consumed by the sample group could be attributed to the mental work conducted, which greatly increases glycaemic instability such as wide fluctuations in blood glucose

concentrations (Panahi & Tremblay, 2018). This results in an increase in the desire to eat, particularly greasy, fatty foods (Panahi & Tremblay, 2018). It is apparent that office workers consumed significantly more junk food meals outside of work per week in comparison to train drivers (Table 7: Pg. 68). Office workers also consumed marginally more (d=0.27) meals per week at work than train drivers, with no significance shown. In addition, office workers spent more time mentally consumed by their computers compared to train drivers.

Many of the participants classified certain food groups as healthy, which were in fact not, which has been shown to be the case particularly among urban black South African women (Charlton, Brewitt & Bourne, 2004). Poor eating habits could be related to being ignorant and/or having a lack of education in terms of nutrition as well as the role in which adverts and marketing plays which promote the consumption of fast food high in fats (Charlton, Brewitt & Bourne, 2004). It is understood that the perceptions of food groups were not tested in this study, however, it is assumed that many individuals are undereducated given the lack of understanding with regards to healthy eating and the health benefits that come thereafter. This requires further investigation.

Simultaneously, sedentary behaviours that involve activities with very low levels of energy expenditure performed in a sitting position were found to be associated with the consumption of unhealthy foods in adults (Jezewska-Zychowicz et al., 2018), explaining the relationship found between dietary intake and obesity, particularly among office workers. There was also a link to an increase in obesity (Jezewska-Zychowicz et al., 2018), which can be shown in the current study, as well as to the higher probability of developing chronic diseases.

There were noteworthy inconsistencies in the office workers. Naturally, those who exercise more are assumed to simultaneously need to eat more to have enough energy for physical activity. While office workers consumed more than train drivers, they did not exercise more. Information regarding the associations between dietary patterns and physical activity are, however, still unclear (Jezewska-Zychowicz et al., 2018).

5.2.3 Physical Activity

The global percentage of leisure time adults spend doing moderate-vigorous physical activity is approximately 4% daily (Owen et al., 2010; WHO, 2020) which is higher that this sample with an average of 0.79% time spent daily doing moderate-vigorous physical activity (1.28 ± 1.68 sessions

per week). Physical inactivity results in 9% of premature deaths worldwide, yet 23% of adults worldwide (WHO, 2020; Guthold et al., 2020) and roughly 40% of South Africans are dangerously physically inactive (Micklesfield et al., 2014). This is evident in the sample group where more than half (n=12) of the office workers and train drivers were found to be physically inactive, highlighting the fact that employees are not reaching the recommended levels of physical activity for good health.

The majority of the workers at Transnet do not meet the global recommendations for physical activity of 30 minutes of moderate intensity exercise, five times a week (WHO, 2020). There is an association between participating in physical activity and a reduction in cardiovascular risk (WHO, 2020), and, although no associations were calculated, the present study reveals that the workers partake in low levels of physical activity and reported a low incidence of cardiovascular risk, with 5% of train drivers and 10% of office workers reporting that they have high blood pressure.

Findings from the study indicate that train drivers perform more physical activity outside of work, than office workers (Table 3: Pg. 64). The reasons for the lack of physical activity outside of work, by the office workers include: being too tired (35%), not having enough time (50%), not being motivated (35%) and/or encouraged to (30%). The female train driver population group were sufficiently active (75%) compared to the male train driver sample (50%). Accounting for the low levels of physical activity outside of work, are the personal and environmental barriers. Personal barriers experienced by the workers, including a lack of time, motivation and education, are consistent with the barriers presented in previous literature (Miles, 2007).

However, the male population was the bigger population group, showing inconsistencies in this finding, as males are typically involved in more on-the-job manual labour which results in increased physical activity levels (Sparling et al., 1994). The current study further suggested that only 28.57% of male office workers were physically active at work, with 0% of females (Table 4: Pg. 66). This is likely due to the job design and specification that office workers are typically exposed to. Increased computer-based work results in less physical activity levels for office workers whereas train drivers are also sometimes involved in manual labour such as train maintenance as well as activities performed when waiting for the train to arrive prior to sitting for lengthy periods of time.

Urban males and females were inactive (49.4% and 66%), with only 22.2% of males and 12.4% of females being sufficiently active, in 2003 (Peer et al., 2013). In contrast to this, in the current sample, which includes participants in an urban area, 18.75% of male and 0% of female train drivers were sufficiently physically active outside of work, whilst both male and female office workers had 0% of the participants being sufficiently active. The Department of Health, South Africa (DHS) (2003),

further showed that physical inactivity was higher in urban individuals and linked to increased risk of cardiovascular disease within this population group. Although the current data does not appear to match this trend, it is important to note that urban national data includes individuals from both the commercial as well as the informal sector. This inclusion of active job types requiring physical movement, as opposed to the current data which includes individuals from mainly sedentary behaviour jobs (office bound and train driving) is a likely explanation for these differences.

A similar finding can be found to The Department of Health, South Africa (2003), where within the current sample, the majority of daily physical activity took place outside of the workplace with office workers (85%) and train drivers (95%). This is likely to be related to the fact that employees are involved in occupations requiring very little movement throughout the day, which typify the transportation industry particularly that of train drivers and office workers. Early self-reported studies have found that workers in low activity professions reported high levels of leisure time physical activity, showing that these workers were trying to compensate for their lack of occupational activity (Parry & Straker, 2013). It must be noted however, that since both diet and physical activity relied on self-reporting, which is known to have limitations in terms of accuracy and reliability (Pitta et al., 2006), particularly in obese individuals, causal relationships may have been missed or misinterpreted.

Furthermore, the updated guidelines by the World Health Organization (2018), that moderate physical activity requires the activity to involve movement that results in at least 45% of the participants VO^2 max, likely resulted in an overestimation of moderate physical activity levels as most participants will not have access to this information when performing activities. The resultant effect of this additional guideline is that sample groups, including the employees at Transnet, may have underestimated the requirements for activity to classify as ‘moderate physical activity’ and thus have simultaneously over-estimated their participation in such activities as well as not benefited from the physiological outcomes of the activity (Hamilton, Hamilton & Zderic, 2015). This outcome may contribute to the significant reporting of obesity and body mass index categories among the sample group.

5.2.4 Sedentary Behaviour

The fact that individuals in this study were in “compulsory sedentary” jobs may account, in part, for the high obesity and sedentary behaviour findings, consistent with national and international trends (Von Wielligh, 2014). Occupational sitting times overall among train drivers and office workers is on average 8.08 hours which is approximately 50.5% of an individual’s waking hours. This equates to approximately 40 hours per week, which is congruent to the findings that employees' sedentary

activities have increased from 26 hours to 38 hours per week in the United States (Genin et al., 2018). It is important to note that comparisons here are from different population groups. Furthermore, adults on average spend 9.3 hours per day in sedentary activities, which is around 56% of an individual's waking hours (Owen et al., 2010). Further compounding the problems related to sedentary behaviour in the workplace, is the cultural shift towards engaging in sedentary based activities during leisure time, which has integrated into the culture of the modern workforce (Genin et al., 2018).

Of the sample group, only seven indicated that they experience indications of musculoskeletal disorders. Noteworthy, was a finding regarding age as a risk factor for musculoskeletal disorders (Stefánsdóttir, 2016). The economically active population with the highest reported incidence of musculoskeletal disorders is 45 - 59 years old (Stefánsdóttir, 2016). This might account for the low reporting of musculoskeletal disorders among the workers at Transnet, whose mean age is 41.10 (± 7.91) years and 46 (± 9.90) years for train drivers and office workers. Thus, although the existing prevalence is low, the high amount of sedentary behaviour contribute to future musculoskeletal disorders.

Experimental research has shown that breaks in sedentary time are linked to lower body mass index and waist circumference together with other beneficial metabolic risk profiles (Henson et al., 2016). The office workers in this study had more sitting interruptions even though they were more obese than the train drivers. The current study is cross-sectional and cannot conclusively distinguish that sedentary behaviour leads to an increase in body mass index, further contributing to the limitations of the study.

Sedentary behaviour and physical activity are considered separate notions (Saunders et al., 2014). It is understood that an individual could be sufficiently active yet still spend the majority of their day sedentary. This, however, is not the case in the train driver population, as they spend the majority of their day sitting, and only did 2.5 sessions per week of 20 minutes of vigorous-intensity physical activity which is below the recommended amount of 75 minutes of vigorous-intensity physical activity per week (WHO, 2019).

From a psychological perspective, the biological requirements and effects of physical and cognitive work are not the same (Panahi & Tremblay, 2018). Mental work, for instance, greatly increases glycaemic instability such as wide fluctuations in blood glucose concentrations, resulting in the desire to eat and therefore higher energy intakes (Panahi & Tremblay, 2018). This phenomenon becomes a driver of food and drink intake, which poses a health threat to those workers who experience mental effort in their jobs, coupled with sedentary behaviour. The increased intake of calories is not always

linked with an increase in physical activity and thus a risk of obesity and increased body mass index is presented (Nurwanti et al., 2019).

5.3 PSYCHOSOCIAL FACTORS

5.3.1 Mental Wellbeing

Maintaining mental wellbeing in the workplace is a vital component of maximizing workplace performance (Burton, 2010); with physical activity being a key driver of mental wellbeing (Fox, 1999). Of the train drivers, 35% experienced feelings of depression while 40% of office workers experienced feelings of depression. Such levels of depression have the potential to negatively impact on the productivity and performance of workers, however, the self-reported productivity levels among the sample group remained high despite the reporting of poor-mental health indicators. What can be deduced is that focussing on workplace stressors and striving for a lifestyle that involves more physical activity, can further improve the productivity levels of the workers (WHO, 2020). By engaging in more physical activity programs, employees have the potential to benefit from an immediate and material improvement in their mood and sense of wellbeing (Fox, 1999). The prevailing reasons for the sample groups reported lack of physical activity and participation in wellbeing programs is having a lack of time and not being motivated. These factors are within the control of the employers and are a result of job design and satisfaction, which supports the notion that workplace stressors play a primary role in mental health and overall wellbeing (Samra, 2009).

According to the demand-control theory, employees working in a high-strain job (high demands-low control) experience the lowest wellbeing (Van der Doef & Maes, 2010; Karasek & Theorell, 1979), which gives reason behind why the number of reported workplace mental issues are so high within both train drivers and office workers.

The eating habits of individuals play a substantial role in their overall wellbeing and health. Of particular importance is the understanding of the relationship between diet and mental health risk factors (Owen & Corfe, 2017). The consumption habits of individuals has the ability to either positively or negatively impact on the risk of mental disorders (Dog, 2010). The sample group demonstrates a below-suggested consumption rate of fruit and vegetables, coupled with a high rate of junk food and a high level of alcohol consumption.

Although not investigated in this study, the findings in the survey show that employees need the support of an organizational culture with workplace practices that allow them to recover from stress

and function at their best at all times. The amended version of The Health and Wellbeing survey (Rochdale Borough Council, 2020) only shows a small portion of South African transportation companies, including employee wellbeing and attitudes and opinions related to workplace policies and practices (LaMontagne et al., 2014).

5.4 THE NEEDS ASSESSMENT SURVEY

The workplace provides a great platform as a large number of the working population can be reached and multiple levels of influence of behaviour can be targeted specifically that of diet and physical activity (Quintiliani, Sattelmair & Sorensen, 2007). Implementing workplace health promotion provides a safe and healthy work environment, enhances individual self-esteem, increases job satisfaction, and of course improved sense of health and general wellbeing for the employee (WHO, 2020). The current study shows that the most common factors identified by train drivers and office workers for the inclusion into a potential health and wellbeing program were active meetings (n=3 and n=9), sports/activity days (n=8 and n=6), organizations sports teams (n=9 for both train drivers and office workers) and exercise sessions (n=10 and n=11). All of which include physical activity, aimed at promoting a healthier lifestyle away and reducing levels of non-communicable disease (Quintiliani, Sattelmair & Sorensen, 2007). Due to lifestyle behavioural choices being a factor contributing to a large proportion of chronic diseases globally, evidence-based strategies are needed in order to improve behavioural risk factors such as physical activity and healthier eating habits (Quintiliani, Sattelmair & Sorensen, 2007).

The organization benefits from a workplace health promotion program as it portrays a positive and caring image, improved staff morale, reduced staff turnover, reduced absenteeism, increased productivity and reduced risks of fines and litigation (WHO, 2020). Half (50%) of the train drivers and office workers stated that the best time for these workplace programs to occur were after work, and wanted them to happen a few times a month with eight train drivers and 9 office workers suggesting this.

The World Health Organizations Global Strategy on Diet, Physical Activity and Health in 2004 highlights the workplace as an important setting for the promotion of health in Point number 62:
"Workplaces are important settings for health promotion and disease prevention. People need to be given the opportunity to make healthy choices in the workplace in order to reduce their exposure to risk. Further, the cost of employers of morbidity attributed to noncommunicable diseases is increasing

rapidly. Workplaces should make possible healthy food choices and support and encourage physical activity". Further, the WHO stipulated that health promotion and prevention of non-communicable diseases should be postulated in the workplace. This should be done by promoting physical activity and a healthy diet and encouraging mental health within the workplace.

5.5 PRODUCTIVITY AND ABSENTEEISM

It is clear in the current study that employees took time off of work due to an illness or injury at work (Table 8; Page 75), indicating that it is an important component of the workplace to consider (Sparks, Faragher & Cooper, 2001). In comparison to statistics from Occupational Care South Africa (2017) and Statistics South Africa, it was found that 15% of South African employees miss work each day, and one in three people who are absent are physically ill. This however was not the case in the current study. There has been a 500% increase in absenteeism, across all industries, since 2001 indicating substantial growth and an area where wellness interventions could assist (Terblanche, 2017).

The absenteeism among the workers in this sample group was relatively low at 3.55 (±1.85) and 2.95 (±1.32) days per year for train drivers and office workers respectively. The result of days absent by employees creates a financial burden on companies and workload increases for those present, both of which affect the workplace environment negatively. The relationship between environmental factors and absenteeism have been previously studied and reviewed. The present study reflects weak positive correlations between absenteeism and time spent sitting, however the lack of statistical significance detracts from the ability to draw conclusions that can be compared to entire populations in other studies. Further, there was a very small association between days absent per year the levels of activity performed by the workers. This outcome is somewhat contradictory to the results of Kodel et al., (2014) who suggests that body mass index can be an indicator of absenteeism in the workplace. It must be highlighted that absenteeism numbers are rather low in the current study. Even though the questionnaire was anonymous, employees may have felt compelled to answer a certain way. It is speculated that reporting of injuries experienced by the employees may not be truly reflective for fear of being ostracized and losing their jobs, furthering hindering the results.

A key outcome of the present study suggests that there is very little material relationship between the lifestyle factor profile of a worker and their absenteeism and productivity, contradictory to literature by Robroek et al., (2001). Significant associations were, however, found between obesity and workplace absenteeism, the outcome of which has been replicated in numerous studies (Tucker &

Friedman, 1998; Jans et al., 2007; Robroek et al., 2011). In general, the data and previous literature suggest that increase levels of obesity lead to an increase in both the duration and frequency among the working population. Further significant associations were found between fruit consumption and productivity in both office workers and train drivers. The impact of shift work did not influence the fruit intake levels or associations with productivity, when comparing the train drivers and office workers, as was published in a review done by Amani & Gill (2014). Further outcomes of association between sedentary behaviour and physical behaviour were not significant, contradicting some of the conclusions developed by Amani & Gill (2014). Stronger evidence in the association between physical activity and productivity was found, supporting previous studies (Robroek et al., 2011). Although this study is cross-sectional in nature and cannot determine the outcome of lifestyle interventions, Van Wormer et al. (2015) conducted a longitudinal study that reflected the same conclusion. Correlations between productivity and obesity and time spent sitting were weak which conflict with the ideas presented by Robroek et al. (2011).

A noteworthy relationship between excess weight and impaired productivity in a sample of manufacturing employees was previously found (Gates et al., 2008). Particularly, employees with a body mass index of 35 $kg.m^2$ reported a health-related productivity loss of almost 5% and are required additional time to finish physically demanding tasks (Kudel et al., 2014). The sample group of the current study, however, were involved in sedentary job types which accounts for the difference in findings.

Of significant importance is the distinction in findings between job types that are physically demanding and labour intensive as opposed to sedentary job design and roles. This study highlights the limited, if at all present, role of lifestyle factors on productivity and absenteeism, which may be different for other industries or job types. It can be seen that obesity, smoking, alcohol consumption, and the intake of junk food has conflicting, but not significant, impacts on workplace productivity. What can be concluded is that there are only certain lifestyle factors, namely obesity, fruit intake and physical activity, that present associations with productivity and absenteeism. The rest of the lifestyle factors cannot be used to predict significant associations with productivity and absenteeism. Although not determined in the present study, there is a notion that suggests that obesity and sedentary behaviour can act as predictors of non-communicable disease risk and, in turn, absenteeism (Apostolopoulos et al., 2011).

5.6 LIMITATIONS AND FUTURE RESEARCH

The most evident limitation of this study was only using subjective methods to collect data, with the majority of the questions being self-reported. While self-reported measures are inexpensive and feasible for use as a surveillance tool in large scale studies, they demonstrate consistently poor validity, which is highly affected by recall-bias associated with self-report questionnaire (Atkin et al., 2012). Further, the tendency of under-estimating self-reported sedentary time, physical (in)activity, alcohol consumption, smoking as well as dietary habits could be a result of increased awareness, and the participants longing to represent themselves in a positive light further enhancing self-esteem and aligning with socially acceptable norms (Urda, Larouere, Verba & Lynn, 2017). However there is no information on whether this bias is differential over time (Urda et al., 2017; Briggs, 2014).

Another limitation to the study is the use of body mass index calculations. This method can be misleading especially during the aging process and menopausal transition when muscle mass can be converted to body fat mass which does not necessarily implicate a change in body mass index. Body mass index varies between individuals and populations and the use of a universal body mass index classification is unlikely to account for ethnic differences in body fat distribution (Carrero & Avesani, 2015). Muscular individuals with low proportion of body fat may be misclassified as overweight or obese.

Further, all data was collected during a global pandemic (COVID-19) which limited the possible sample size due to participants testing positive for the virus, and management stopping any external personnel from entering the premises. This therefore does not encompass and represent an entire population of train drivers and office workers at Transnet. Conclusions from this sample specifically may therefore not be indicative of trends for the whole company but rather just the Durban branch.

Since only limited data exists on the lifestyle factors of South African train drivers and office workers, specifically in KwaZulu-Natal, Durban, this current research project bridges an evident gap that exists in the literature. With this said, it is recommended that future province-specific research be carried out particularly in areas where there is very limited data, or no data at all. This will further allow for specific trends across different population groups to be analysed, providing an overall perspective on the prevalence of lifestyle factors on non-communicable diseases for train drivers and office workers in transport companies. It is recommended that where possible, accurate objective measurement of the variables should be conducted both through self-reporting and clinical observations such as blood

samples so that the reliability and validity of data may be ensured. In addition, due to the study being cross-sectional, it cannot conclusively distinguish trends over a period of time and so it is recommended that a longitudinal study be done.

Despite the limitations, exploring the relationship of prolonged sitting, as opposed to total sitting time, is meaningful because total sitting time may be a more comprehensive measure of total worker exposure to sitting, although it does not account for the effect of static posture, which is known to be associated with back pain. Further research is needed to look at cumulative exposures of sitting on back pain, such as those during leisure, commuting and during work as high overall sitting time may have an independent and interactive effect with prolonged sitting and/or physical inactivity.

Drawing attention to the lifestyle-related and behavioural drivers of risk, particularly obesity, poor dietary habits and physical inactivity, it is recommended that studies assessing which specific behavioural aspects drive risk, would yield more conclusive information on behavioural modifications, which in turn could play a large role in reducing the burden of risk within these individuals.
Sleep was not determined, however, can impact on cognitive and motor ability, work productivity as well as perceived levels of wellbeing.

It is anticipated that the knowledge and insights gained from this research project will assist in identifying specific risks that individuals experience in the workplace, and those that pose the most serious threats to employees working in the transportation industry and to create a better understanding of the behavioural mechanisms governing and underpinning different risks. It is hoped that this study will inform future research, so that in the face of many other disease risks and lifestyle related factors, the health status of these individuals in the transportation industry improve.

CHAPTER VI

CONCLUSION AND PRACTICAL APPLICATIONS

6.1 CONCLUSION

The current study aimed to determine the levels of sedentary behaviour, physical activity and body mass index and other lifestyle factors among office workers and train drivers at Transnet Freight Rail, explore the mental wellbeing of the cohort, and to further describe the associations between these lifestyle factors and workplace productivity and absenteeism.

The levels of physical activity among the sample group was low both in the workplace and during leisure time, with most workers not meeting the guidelines for physical activity set by health bodies. This could contribute to the high levels of obesity and higher average body mass index.

A particularly noteworthy finding in the current study was that the sample group demonstrated elevated levels of sedentary behaviour in the workplace, mostly as a result of their job design and requirements. Importantly, there was no significant impact on productivity and absenteeism, despite the sedentary behaviour. Although it is well established that prolonged periods of sedentary behaviour increases the risk factors for non-communicable diseases, the current prevalence of noncommunicable diseases was low. However, this was self-reported and many chronic lifestyle diseases develop over time and often go unnoticed for long periods of time.

A worrying finding was that the nutrition intake among the sample group proved to be particularly poor, with both cohorts of the sample group not meeting the recommended daily amount for fruit and vegetable intake and exceeding the recommendations for junk food. Various factors were determined to explain the poor nutrition patterns of the sample group which gives rise to the potential for further research.

The high levels of smoking of the sample group was more prevalent than alcohol consumption patterns, however, both were higher than the national averages. Links have been drawn between workplace stress and social patterns as drivers of both alcohol and cigarette consumption. The increased risk exposure to disease, as a result of such behaviour, is noteworthy.

A significant and moderate correlation was found between obesity and absenteeism, however, no associations were found between sedentary behaviour, physical activity and fruit and vegetable intake

and absenteeism. Lastly, significant and moderate correlations between physical activity and fruit and vegetable intake and workplace productivity were established. No significant associations between sedentary behaviour and obesity and productivity were found.

The job design of train drivers and office workers does not place importance on employee health and wellness. Essentially they are not "healthy" but they work productively. Giving reason as to why employee wellness is not a priority for employers. The current findings of the study suggest that adopting regular physical activity, healthy dietary patterns and reduced sitting time should be promoted as key components of lifestyle intervention for the prevention of non-communicable diseases in office workers and train drivers.

In an occupation such as office workers and train drivers, where frequent sedentary behaviour is common, it is crucial that future research aims to take on an integrated approach to investigate physical activity and body mass index in office workers and train drivers and its effect on subsequent productivity and absenteeism. The findings of this study add to the limited body of knowledge specific to lifestyle factors in office workers and train drivers in the transportation industry and it is anticipated to stimulate further applied investigation in this area.

6.2 PRACTICAL APPLICATIONS

The following practical applications are based on the outcomes within this thesis. The results:

- Suggest that there is a need to develop approaches that free employees from their chairs and render them more active.
- Provide incentives to prioritise health and wellbeing and provide workshops to educate employees on the benefits of being healthy.
- Advise the employer on building a supportive organisational culture and raising awareness of the adverse health effects of prolonged sitting may be important for improving individual-level and organisational-level motivation for change.
- Recommend creating awareness around mental health in the workplace, given the large amount of employees who experienced poor mental wellbeing.
- Highlight the need for employers to monitor employees independently using clinical methods as opposed to self-reported measures.
- Require more research to be afforded to establishing associations between lifestyle factors of the transport industry in South Africa, and workplace productivity and absenteeism.

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APPENDIX A: FINAL ETHICAL CLEARANCE LETTER

RHODES UNIVERSITY
Where learners learn

Human Ethics subcommittee
Rhodes University Ethical Standards Committee
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11 May 2020

Shamae ZIMMERMANN

Email: g15z1342@campus.ru.ac.za

Review Reference: 2020-1169-3331

Dear Dr. Christie

Title: Physical activity, sedentary behavior and body mass index: associations with workplace health measures among Transnet employees

Principal Investigator: Dr. Candice Christie

Collaborators: Miss Shamae Zimmermann,

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) sub-committee.

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloging number allocated.

Sincerely,

APPENDIX B: PARTICIPANT CONSENT FORM AND INFORMATION TO PARTICIPANTS

RHODES UNIVERSITY
Where leaders learn

Physical activity, sedentary behaviour and body mass index: associations with workplace health measures among Transnet employees

Thank you for your interest in participating!

The Needs survey consists of two sections namely The Health and Wellbeing section as well as the Needs section. Your personal information will be kept strictly confidential, and you are able to withdraw from the study at any point as this study is completely voluntary.

Please fill in the information below:

Age:	
Sex (M/F):	
Type of industry (office employee/train driver):	
Medical disorders (Y/N and please specify):	

PLEASE READ THE BRIEFING SHEET ON THE NEXT PAGE

If you are happy to continue with the study. Please sign/initial here:

SIGNATURE: ……. **DATE: ……**

Information to Participants

Thank you for your interest to participate in my research project.

Aim of the study

Increased sitting time, insufficient physical activity and sub-optimal body composition are all contributing to the global disease burden. The global rise in sitting time and physical inactivity is caused, in part, by changes in transport convenience, work roles and technological advancements. Transnet being in the transportation industry, results in workers being at a high risk of these non-communicable diseases making it a suitable company to explore, and so the aim of this study is explore; 1- Levels of sedentary behaviour and physical inactivity among office workers and train drivers at Transnet; 2- Associations between lifestyle factors: sedentary behaviour, physical inactivity, nutrition, alcohol consumption, cigarette consumption and psychological wellbeing and non-communicable disease risk among office workers and train drivers at Transnet; 3- Associations between these same lifestyle factors and workplace productivity and absenteeism; 4- Association between lifestyle factors and body mass index among office workers and train drivers at Transnet.

Sample characteristics

Male and female office workers and train drivers at Transnet Freight Rail who speak English.

Procedures

This study will require you to answer a variety of questions ranging from general questions, to nutrition, hydration, alcohol consumption, physical activity, wellbeing and time spent sitting. The survey will take approximately 10 to 15 minutes to complete.

Your personal information will be kept strictly confidential, and you are able to withdraw from the study at any point as this study is completely voluntary. Feedback with regards to the study will be given to you unless requested elsewise. Thank you for showing interest in participating in the study. Please do not hesitate to contact me if you have further questions.

Yours sincerely,

Sharnae Zimmermann	Candice Christie	RU Ethics Coordinator
sharnaezimmermann@gmail.com	c.christie@ru.ac.za	s.manqele@ru.ac.za
0848888576	(0)46 603 8470	

APPENDIX C: GATEKEEPER LETTER

RHODES UNIVERSITY

Makhanda • 6140 • South Africa

DEPARTMENT OF HUMAN KINETICS AND ERGONOMICS

[13-03-2020]

Dear Edith Mufamadi

Re: Invitation to conduct research at your institution

Sharnae Zimmermann (under the supervision of Candice Christie) is a Human Kinetics and Ergonomics postgraduate student at Rhodes University carrying out research on health and safety within the transportation industry. The aim of this research is twofold; 1- To describe the associations between lifestyle factors: sedentary behaviour, physical activity, and body mass index on sickness absenteeism; and 2 – To describe the associations between these same lifestyle factors and workplace performance. The participation and cooperation of your institution is important so that the results of the research are accurately portrayed.

This research will be undertaken in the form of a survey questionnaire with office employees and train drivers. The data to be collected from this research will be reported only as a collective combined total. The identity of your employees who voluntarily consent to participate will be treated with complete confidentiality. The collection of these data will require from each participant roughly 10-15 minutes to complete.

Information regarding the average wage for both train drivers and office workers is required in order to conduct research on absenteeism and productivity of the workers. This information will aid in this research study greatly in terms of improving both productivity and absenteeism of the workers. Information received will be held with the utmost confidentiality.

We look to you for guidance in identifying office employees and train drivers at your institute that would be suitable to this survey (at a time and date that suites them). If you have questions or wish to verify the research, please feel free to contact us.

If you would like your institution to participate in this research, please complete and return the attached form.

Thank you for your time and I hope that you will find our request favourable.

Yours sincerely,

Sharnae Zimmermann	Candice Christie	
Research Student	Supervisor	RU Ethics Coordinator
sharnaezimmermann@gmail.com	c.christie@ru.ac.za	s.mangele.ru.ac.za

APPENDIX D: INSTITUTION CONSENT FORM

'Physical activity, sedentary behaviour and body mass index: associations with workplace health measures among Transnet employees'

Institution Consent Form

RHODES UNIVERSITY
Where Leaders Learn

Participation Consent
I consent for you to approach office employees and train drivers to participate in the study 'Physical activity, sedentary behaviour and body mass index: associations with workplace health measures among Transnet employees', and to receive information regarding employee wages.
I acknowledge and understand:
• The role of the institution is voluntary. • I may decide to withdraw the institution's participation at any time without penalty. • Employee's office workers and train drivers will be invited to participate and that permission will be sought from them too. • Only employees who consent will participate in the project. • All information obtained will be treated in strictest confidence. • The employees' names will not be used and individual employees will not be identifiable in any written reports about the study. • Participants may withdraw from the study at any time without penalty. • A report of the findings will be made available to the institution. • I may seek further information on the project from Sharnae Zimmermann on sharnaezimmermann@gmail.com • Or c.christie@ru.ac.za if need be.

Full Name:	
Position:	
Signature:	
Date:	

APPENDIX E: AMENDED VERSION OF THE HEALTH AND WELLBEING SURVEY

Section 1

HEALTH AND WELLBEING SURVEY

TRANSNET

Thank you for participating in the Transnet health and wellbeing survey.

This survey asks you about eating and hydration, physical activity, alcohol consumption, smoking habits, and wellbeing, and will take you approximately 10-15 minutes to complete.

Your participation is voluntary, but we encourage you to participate as it will provide important information on the health of employees at Transnet. The survey does not request your name, email address or postal address. All information collected will be treated as private and confidential, in accordance with current privacy legislation.

Please fill out the following survey, and return it to Main office by the end of the week.

GENERAL

Height (estimate): _____ cms

Weight (estimate): _____ kgs

SMOKING

1. Do you smoke?

❑ Yes ❑ No (go to question 2)

1a. How keen are you to stop smoking? (please circle)

0 = not keen at all / 7 = very keen

0 1 2 3 4 5 6 7

1b. When you wake up each day, how soon do you smoke your first cigarette?

- ❑ More than 60 minutes
- ❑ 31-60 minutes
- ❑ 5-30 minutes
- ❑ Less than 5 minutes

1c. How many cigarettes do you smoke on a typical day?

- ❑ 10 or less
- ❑ 11 – 20
- ❑ 21 – 30
- ❑ More than 30

NUTRITION

- *1 serving of fruit = medium sized apple/orange/banana or 2 apricots/kiwi fruit or ½ cup tinned fruit*
- *1 serving of vegetables = ½ cup cooked vegetables or 1 cup salad vegetables*

2. How many servings of vegetables (including fresh, frozen and tinned vegetables) do you usually eat each day?

- ❑ One serving or less
- ❑ Two serving
- ❑ Three serving
- ❑ Four serving
- ❑ Five serving
- ❑ Six or more servings
- ❑ Don't eat vegetables

3. How many servings of fruit (including fresh, frozen and tinned fruit) do you usually eat each day?

- ❑ One serving or less
- ❑ Two serving
- ❑ Three or more servings
- ❑ Don't eat fruit

4. How many days of the week do you usually eat junk foods that are high in fat, salt or sugar (such as deep-fried foods, hot chips, pies, pastries, chocolates, lollies, etc)?

- ❑ None
- ❑ One day
- ❑ Two days
- ❑ Three days
- ❑ Four days
- ❑ Five days
- ❑ Six days

- ❑ Seven days

5. **During working hours, how many days of the week do you usually eat junk foods that are high in fat, salt or sugar (such as deep-fried foods, hot chips, pies pastries, chocolates, lollies, etc)?**

   - ❑ None
   - ❑ One day
   - ❑ Two days
   - ❑ Three days
   - ❑ Four days
   - ❑ Five days
   - ❑ Six days
   - ❑ Seven days

6. **Why do you usually choose fast food instead of something you prepared yourself? (Please tick all that apply)**

   - ❑ I never eat/drink fast food
   - ❑ Cheaper
   - ❑ More convenient
   - ❑ Tastes better/good
   - ❑ Availability
   - ❑ The hours I work
   - ❑ Makes me feel better when I am stressed
   - ❑ I don't know how to prepare healthy meals to take to work
   - ❑ Access to vending machines
   - ❑ I cannot be bothered to bring something healthy from home
   - ❑ Lack of access to kitchen/food preparation facilities

HYDRATION

7. **On average, during your normal working day, how many glasses (250 ml) of fluid (water, cordial, soft drink, juice, milk, coffee, tea) do you consume? (Please circle one)**

   1 2 3 4 5 6 7 8+

8. **On average, during your normal working day, how many glasses (250 ml) of plain drinking water do you consume? (Please circle one)**

   1 2 3 4 5 6 7 8+

ALCOHOL

1 standard drink is equivalent to

- *375 ml mid-strength beer (3.5% alcohol by volume)*

- *100 ml red wine (13% alcohol by volume)*
- *30 ml high-strength spirits (40% alcohol by volume)*

9. Do you drink alcohol at all?

❑ Yes ❑ No (go to question 13)

10. How many days of the week do you drink?

❑ 1-4 days
❑ 5-7 days

11. How many standard drinks do you have on a typical day when you are drinking?

❑ 1-2
❑ 3 or more

12. On any single occasion do you ever consume 5 or more standard drinks?

❑ Yes ❑ No

PHYSICAL ACTIVITY

13. How many times a week do you usually do:

a) 20 minutes or more of vigorous-intensity physical activity that makes you sweat or puff and pant (for example, heavy lifting, digging or jogging)?

0 1 2 3 4 5 6 7+ times

Two 10-minute sessions count as one 20-minute session.

b) 30 minutes or more of walking (for example, walking from place to place for exercise or recreation)?

0 1 2 3 4 5 6 7+ times

Three 10-minute sessions (or two 15-minute sessions) count as one 30-minute session.

c) 30 minutes or more of other moderate-intensity physical activity that increases your heart rate or makes you breathe harder than normal (for example, carrying light loads, slow cycling)?

0 1 2 3 4 5 6 7+ times

Three 10-minute sessions (or two 15-minute sessions) count as one 30-minute session.

14. How much of your total activity occurs in work time? (Work time does include travelling to and from work.)

- ❑ None
- ❑ Some
- ❑ Most
- ❑ All

15. Please indicate reasons why you are NOT more physically active (tick all that apply).

- ❑ Too tired
- ❑ Not enough time
- ❑ Lack of facilities
- ❑ Shift work, especially nights or overtime
- ❑ Out on the road most of the time
- ❑ Not encouraged to
- ❑ No shower facilities
- ❑ Not motivated
- ❑ Not enough flexible time in work hours
- ❑ Health issues
- ❑ I am already active enough

WELLBEING

16. The next ten questions are about how you have been feeling in the past four weeks.

	None of the time	A little of the time	Some of the time	Most of the time	All of the time
In the past four weeks, about how often did you feel tired for no good reason?					
In the past four weeks, about how often did you feel nervous?					
In the past four weeks, about how often did you feel so nervous that nothing could calm you down?					
In the past four weeks, about how often did you feel hopeless?					
In the past four weeks, about how often did you feel restless or fidgety?					
In the past four weeks, about how often did you feel so restless you could not sit still?					
In the past four weeks, about how often did you feel depressed?					
In the past four weeks, about how often did you feel that everything was an effort?					
In the past four weeks, about how often did you feel so sad that nothing could cheer you up?					
In the past four weeks, about how often did you feel worthless?					

TIME SPENT SITTING

17. Please estimate the number of hours that you spend at your workplace on a typical day. (Please circle)

0 1 2 3 4 5 6 7 8 9 more than 9

18. Please estimate the number of hours that you spend sitting at your workplace, including during meal and snack breaks, on a typical day. (Please circle)

0 1 2 3 4 5 6 7 8 9 more than 9

19. How many times, on a typical day while at your workplace, do you interrupt your sitting, e.g. by standing up, walking somewhere or getting a drink?

- ❑ 5 times or less

- ❑ 6-10 times
- ❑ 11-20 times
- ❑ More than 20 times

Section 2

NEEDS ASSESSMENT SURVEY

1. **Which of the following would you most like included in Transnet's workplace health and wellbeing program? Please tick all that apply. Note that it will not be possible to implement all chosen activities, but your response will help identify areas of interest.**

- ❑ Bicycle or walk to work activities
- ❑ Easily accessible stairwells
- ❑ Employee Assistance Program
- ❑ Exercise/physical activity sessions
- ❑ Fatigue management information sessions
- ❑ Financial planning support
- ❑ Flu vaccinations
- ❑ Health assessments – 'face-to-face'
- ❑ Health assessments – 'online'
- ❑ Health coaching to address physical activity or nutrition issues
- ❑ Healthy food options available (e.g. fruit bowls, vending machines, canteens)
- ❑ Information seminars/workshops
- ❑ Injury prevention/rehabilitation services
- ❑ Lunch/break room
- ❑ Activities that promote good mental health
- ❑ Organisation sport team(s)
- ❑ Pedometer event or walking challenge
- ❑ Personal development opportunities for life skills
- ❑ Shower and change facilities
- ❑ Smoking cessation programs (e.g. Quit smoking program)
- ❑ Sports/activity days
- ❑ Stress management programs and strategies
- ❑ Stretching sessions
- ❑ Storage areas (e.g. bike storage, lockers)
- ❑ Subsidised membership to off-site facilities/programs
- ❑ 'Walk and talk' or active meetings
- ❑ Website with health and wellbeing information
- ❑ Workplace massage

2. **When would you prefer these activities to occur?**

- ❑ Before work
- ❑ During lunch time
- ❑ After work
- ❑ At weekends

3. **How often would you attend a workplace health and wellbeing activity (if offered this frequently)?**

- ❑ Every day
- ❑ A few times a week
- ❑ Once a week
- ❑ A few times a month
- ❑ Once a month
- ❑ Less than once a month

4. **What factors would *stop* you from participating in workplace health and wellbeing activities?**

- ❑ Not enough time
- ❑ Not motivated
- ❑ Too expensive
- ❑ Not interested
- ❑ Out on the road/away from the worksite or office most of the time
- ❑ Other (please specify) _____

5. **What other health and wellbeing initiatives would you like to see implemented at Transnet?**

_____
_____
_____
_____

6. **Roughly, how often in a year do you take time off of work because of an illness or physical pain caused by work?**

_____
_____
_____
_____

7. **What factors in the workplace limit the amount of work you are able to produce in a day? (Eg. Back pain)**

_____
_____
_____
_____

8. **On a typical workday, how productive are you? (0- Not productive, 9-Very Productive)**

0 1 2 3 4 5 6 7 8 9

Thank you for your time.

APPENDIX F: RESEARCH AGREEMENT

RESEARCH AGREEMENT

Physical activity, sedentary behaviour and body mass index: associations with workplace health measures among Transnet employees

Between

TRANSNET SOC LTD
(Hereinafter referred to as "Transnet")

And

Research Student Name & Surname
Sharnae Vanessa Zimmermann

Mark with X

Internal Student		**External Student**	X

Whereas:

The student has been granted permission to conduct research at Transnet SOC Ltd for the period insert date.

UNDERTAKING BY THE STUDENT

The student undertakes to:

1.1. Submit proof that the research request was approved by (insert name of the entity/portfolio responsible)

1.2. Submit and/or disclose:

- A letter from the University/ institution stating the objective of the research,
- Topic to be researched,
- Approved bursary letter for internal students Methodology to be used to collect data,
- Duration of the research, and
- Disclose the category of employees to be impacted by the research

Confidentiality

2.1 The research student agrees to treat sensitive data with confidentiality.

2.2 The research student undertakes not to disclose to any party any information obtained from Transnet during the research without prior written consent from Transnet. agrees to disclose data collected with Transnet.

2.3 Transnet reserves the right to have access to any data collected and to the results of the study.

2.4 Transnet reserves the right to withhold access to and/or publication of sensitive and confidential data.

Data Collection Methods

3.1 Data collection shall be done in a structured fashion to avoid disruption of normal business activities.

3.2 Where interviews are conducted, confidentiality and anonymity of the Respondents shall be ensured and respected by the student.

3.3 The research student is responsible to schedule his/her own data collection sessions once access is granted.

3.4 Transnet will not be held liable for inadequate data or late submissions, should data collection be disrupted in any way, such as business disruptions, non-attendance of interviewees, etc.

3.5 Upon completion of the research, the student is required to submit a hard / soft copy of the final research report to Transnet.

Cost

4.1 Transnet will not be liable for any cost incurred during the research period in the company.

4.2 Any budgeted activities on the student's research plan will be carried by the student at his/her own cost.

4.3 Transnet part-time bursary students will be governed by their bursary contract.

Indemnity

5.1 Transnet will not be liable for any injuries or loss of life suffered by the student during the research period in its premises.

5.2 Transnet will not be liable for any damage to or losses of personal belongings by the student whilst in Transnet premises during the research period.

Domicilium

6.1 The research student elects as his/her *domicilium citandi et executandi* as address where service of documents and notices may be effected, as (which must be a street address):

Research Student:

5 Knoll Place
Westville
Durban
3629

Transnet:

_____

_____

_____

Jurisdiction

7.1 The parties agree to the jurisdiction of the Magistrates' Court in respect of any litigation arising from the conclusion of this agreement

Signature of Transnet Rep:

Deena Naidu

Name and Surname

Signed at Durban on this 6th day June 2019.

Witness: for Transnet SOC Ltd

1. ....
Name Signature

2. ....
Name Signature

Signature of Research Student:

...Sharnae Zimmermann.....

Name and Surname:

Signed at: .....Durban.....on this: ..8th.....day .....April.....2020.

Witnesses: Research Student

1. Scott Hiron..... .....
   Name Signature

2. Daniel Sibbald..... .....
   Name Signature

APPENDIX G: EFFECT SIZE CALCULATIONS

APPENDIX

Effect size calculations:

Correction formula used for small sample size (less than 50)

1) **BMI classification of train drivers and office workers**

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{26{,}98 - 26{,}69}{4{,}5}\right) \times \left(\frac{40-3}{40-2{,}25}\right) \times \sqrt{\frac{40-2}{40}}$$

d = 0.06

2) **Vegetables**

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{1{,}90 - 1{,}85}{0{,}9388}\right) \times \left(\frac{40-3}{40-2.25}\right) \times \sqrt{\frac{40-2}{40}}$$

d = 0.05

3) **Fruit**

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{1{,}6 - 1{,}4}{0{,}716}\right) \times \left(\frac{40-3}{40-2.25}\right) \times \sqrt{\frac{40-2}{40}}$$

d = 0.27

4) **Junk food per week outside of work**

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$d = (\frac{3,05-2,35}{1,539}) \times (\frac{40-3}{40-2.25}) \times \sqrt{\frac{40-2}{40}}$

d = 0.44

5) Junk food per week at work

$d = (\frac{m_1-m_2}{SD\ pooled} \times (\frac{N-3}{N-2.25}) \times \sqrt{\frac{N-2}{N}}$

$d = (\frac{2,85-2,40}{1,596}) \times (\frac{40-3}{40-2.25}) \times \sqrt{\frac{40-2}{40}}$

d = 0.27

6) 20 mins of PA

$d = (\frac{m_1-m_2}{SD\ pooled} \times (\frac{N-3}{N-2.25}) \times \sqrt{\frac{N-2}{N}}$

$d = (\frac{2,5-1,95}{1,271}) \times (\frac{40-3}{40-2.25}) \times \sqrt{\frac{40-2}{40}}$

d = 0.41

7) 30 mins of walking

$d = (\frac{m_1-m_2}{SD\ pooled} \times (\frac{N-3}{N-2.25}) \times \sqrt{\frac{N-2}{N}}$

$d = (\frac{2,6-1,6}{1,661}) \times (\frac{40-3}{40-2.25}) \times \sqrt{\frac{40-2}{40}}$

d = 0.58

8) 30 mins of other moderate intensity exercise

$d = (\frac{m_1-m_2}{SD\ pooled} \times (\frac{N-3}{N-2.25}) \times \sqrt{\frac{N-2}{N}}$

$d = (\frac{1,7-0,85}{1,679}) \times (\frac{40-3}{40-2.25}) \times \sqrt{\frac{40-2}{40}}$

d = 0.49

9) Hours sitting at work

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{8,3-7,85}{1,716}\right) \times \left(\frac{40-3}{40-2.25}\right) \times \sqrt{\frac{40-2}{40}}$$

d = 0.25

10) Absenteeism

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{3,55-2,95}{1,613}\right) \times \left(\frac{40-3}{40-2.25}\right) \times \sqrt{\frac{40-2}{40}}$$

d = 0.36

11) Productivity

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{7,95-7,55}{1,109}\right) \times \left(\frac{40-3}{40-2.25}\right) \times \sqrt{\frac{40-2}{40}}$$

d = 0.35

12) BMI categories

- Normal

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{22,62-22,22}{1.71}\right) \times \left(\frac{15-3}{15-2,25}\right) \times \sqrt{\frac{15-2}{15}}$$

d = 0.21

- Overweight

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{29{,}10 - 28{,}06}{1{,}35}\right) \times \left(\frac{15-3}{15-2{,}25}\right) \times \sqrt{\frac{15-2}{15}}$$

$$d = 0.69$$

- Obese

$$d = \left(\frac{m_1 - m_2}{SD\ pooled}\right) \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

$$d = \left(\frac{32{,}98 - 31{,}70}{1{,}88}\right) \times \left(\frac{9-3}{9-2{,}25}\right) \times \sqrt{\frac{9-2}{9}}$$

$$d = 0.55$$