

CHAPTER 1

INTRODUCTION

1.1 PREAMBLE

Musculoskeletal disorders are amongst the most common cause of occupational morbidity. Epidemiologic studies have shown that 80% of the population has presented or will present an episode of low-back pain (LBP) during their active lives (Beurskens, Vet & Koke, *et al.* 1995). LBP corresponds to over 50% of all musculoskeletal dysfunctions that cause disabilities in industrialized countries, leading to expensive treatments and high absenteeism rates amongst workers (Roland & Morris, 1983). Truck driving has often been widely associated with a high prevalence of LBP. This introductory chapter outlines the purpose and motivates why such a study is needed at this juncture.

1.2 BACKGROUND TO THE STUDY

Truck drivers comprise a large category of workers that are exposed to many risks associated with LBP. Static work posture, whole-body vibration (WBV) and manual material handling (heavy physical work) are a few of the risk factors that have been associated with LBP amongst truck drivers (Karwowski & Marras, 2000).

Occupational related LBP is related to mechanical causes, the onset of which normally occurs whilst a person is at work. The debate about occupational related LBP reflects both confusion about epidemiologic principles and gaps in the scientific literature (Punnett & Wegman, 2004) which this study would attempt to clarify.

1.3 MOTIVATION FOR THE STUDY

Among the many occupations affected by occupational related LBP is truck driving. Professional drivers present 3 times the risk for LBP when compared to workers involved in other types of work (Kelsey & Hardy, 1975). Thus, given the high incidence and prevalence of occupational related LBP amongst truck drivers and the high costs of its consequences to industry and society, many studies have been conducted to establish the most effective measures to control the symptoms of LBP. However, preventing the onset of LBP can be much more effective than focussing on the symptoms of this occupational health problem. This requires knowledge of the predictors, triggering factors and the profile of the workers who are most susceptible to the onset of LBP in the work environment.

Studies on the prevalence and knowledge of the risk factors associated with occupational related LBP are important since such studies allow not only the determination of the impact of the disease on society or on a given social stratum, but can also help to organize health services in a country to deal with such problems. Furthermore investments that are necessary for the prevention and control of occupational related LBP can be correctly channelled.

1.4 PROBLEM STATEMENT

Occupational driving has often been associated with a high prevalence of LBP. The factors that contribute to the cause and the pain are many and might include factors such as prolonged sitting, poor postures, material manual handling (heavy physical work), WBV and other non-driving related factors such as playing of contact sport and smoking.

As a result of past empirical studies and current perceptions amongst truck drivers and management alike, the current perception of truck driving is that, it is a high risk job which is associated with LBP, and needs to be validated.

1.5 AIM

The aim of this study will be to determine the prevalence of occupational related LBP in a defined cohort of truck drivers and to ascertain if certain risk factors i.e. demographic manual material handling (heavy physical work), static work posture and perceived levels of whole-body vibration are associated with truck driving and LBP.

1.6 OBJECTIVES

The objectives of the study will be:

- 1.6.1 To determine the point prevalence of LBP in truck drivers.
- 1.6.2 To determine the severity of LBP in truck drivers.
- 1.6.3 To determine if selected demographic factors, i.e. age, body mass index (BMI) of truck drivers will be associated with LBP.
- 1.6.4 To determine if the risk factors of manual material handling (heavy physical work), static work posture, perceived levels of whole - body vibration (WBV), and smoking will be associated with LBP.

1.7 RATIONAL FOR THE STUDY

The study will contribute to the discipline of Occupational Hygiene i.e. Ergonomics in three specific ways:

- 1.7.1 Data on the prevalence of occupational related LBP in truck drivers from the petrochemical sector would become available in South Africa. Presently such data does not exist.
- 1.7.2 It is envisaged that the findings of the study would further validate the existing “body of knowledge” on the risk factors and their association with truck driving and occupational related LBP.
- 1.7.3 Finally, it is envisaged that the study would prompt Occupational Hygienists, Ergonomists and the drafters of Health and Safety Legislation and Policy in South Africa to categorize truck driving as an “at risk” occupation. Currently truck driving is categorized as a risky occupation in Europe according to the Health & Safety Executive (Health & Safety Executive, 2004).

1.8 STRUCTURE OF THE THESIS

Chapter 2-Review of literature (LBP and truck driving)

This chapter will provide a review of literature both international and local on occupational related LBP and the risk factors associated with LBP and truck driving.

Chapter 3 -Materials and methods

This chapter will provide the methodology and research design used for the study. The chapter also cites the ethics approval sought before the study could commence.

Chapter 4 -Results

This chapter provides the results from the statistical analysis of the questionnaire data.

Chapter 5 -Discussion, Conclusions and Recommendations

This chapter will provide a discussion on the results, and culminate with conclusions and recommendations.

1.9 SUMMARY

This first chapter of the study provided a very succinct introduction on the theory and literature of occupational related LBP. Particular focus will be provided on the risk factors and their association with LBP and truck driving. The next chapter would provide the review of the literature on truck driving and occupational related LBP.

CHAPTER 2

REVIEW OF LITERATURE

LOW-BACK PAIN (LBP) AND TRUCK DRIVING

2.1 INTRODUCTION

LBP is one of the oldest occupational health problems in history. In 1713, Bernardino Ramazzini, the “founder” of occupational medicine, referred to ‘*certain violent and irregular motions and unnatural postures of the body by which the internal structure*’ is impaired. Ramazzini examined the harmful effects of unusual physical activities on the spine, such as the sciatica caused by constantly turning the potter’s wheel, lumbago from sitting, and hernias among porters and bearers of heavy loads (Levy & Wegman, 2000).

LBP is now an epidemic of our times, and perhaps the most common orthopaedic complaint that general medical practitioners will have to deal with (Papagerorgiou , Croft, Ferry, *et al.* 1995). LBP can generally be defined as chronic or acute pain of the lumbosacral, buttock, or upper leg region. Sciatic pain refers to pain symptoms that radiate from the back region down one or both legs whereas lumbago refers to an acute episode of LBP. In most cases of LBP, specific clinical signs are absent. Generally, low-back impairment is regarded as a loss of ability to perform physical activities; with low-back disability being defined as necessitating restricted duty or time away from the job (Bernard, 1997). The intermittent nature of LBP complicates prevalence studies. Furthermore studies on disability due to LBP are also influenced by legal and socio-economic factors.

Several cross-sectional studies on LBP have been conducted in countries like the United States, Scandinavia, Israel, The Netherlands and Belgium. The prevalence rates of LBP from these countries ranged from 30% to 92% (Karwowski & Marras, 1999). These studies were however, conducted on the general population of these countries and not on any workers from specific occupations. There has however, been specific studies on LBP on specific occupations such as truck drivers and nurses. These studies have produced varying prevalence rates from 13% to 85% (Uebel & Rae, 2009; Naude & Mudzi, 2009; Ramroop, 2006).

Truck drivers comprise a large population that are exposed to many risks in the workplace. Studies have found that high-mileage drivers have been associated with high prevalence of musculoskeletal pain (Porter & Porter, 1992; Gyi & Porter, 1998; Porter & Gyi, 2002). Drivers who were exposed to whole-body vibration for extended periods of time have also been associated with LBP (Seidel & Heide, 1986; Hulshof & Van Zanten, 1997; Bovenzi & Hulshof, 1999; Mansfield, 2005). Poor ergonomic design in some model of trucks has also been linked to neck and trunk pain (Massacesi, Pagnotta & Soccetti, *et al.* 2003).

All of the above studies have clearly indicated that there is an association with certain risk factors, driving a truck and LBP. However, most of these studies were conducted outside of South Africa or even Southern Africa. A review of literature on truck driving and LBP in South Africa, resulted in only one study being found, which was conducted amongst Refuse Truck Drivers in Kwa-Zulu Natal (Ramroop, 2006). Therefore, a need for such a study is warranted at this juncture.

2.2 THE BACK

To appreciate why the back is so vulnerable to injury, it is necessary to have a basic understanding of its constituent parts and how it functions (see Figure 2.1). This brief explanation of the spinal column and the discs will assist in the understanding of the problem of LBP.

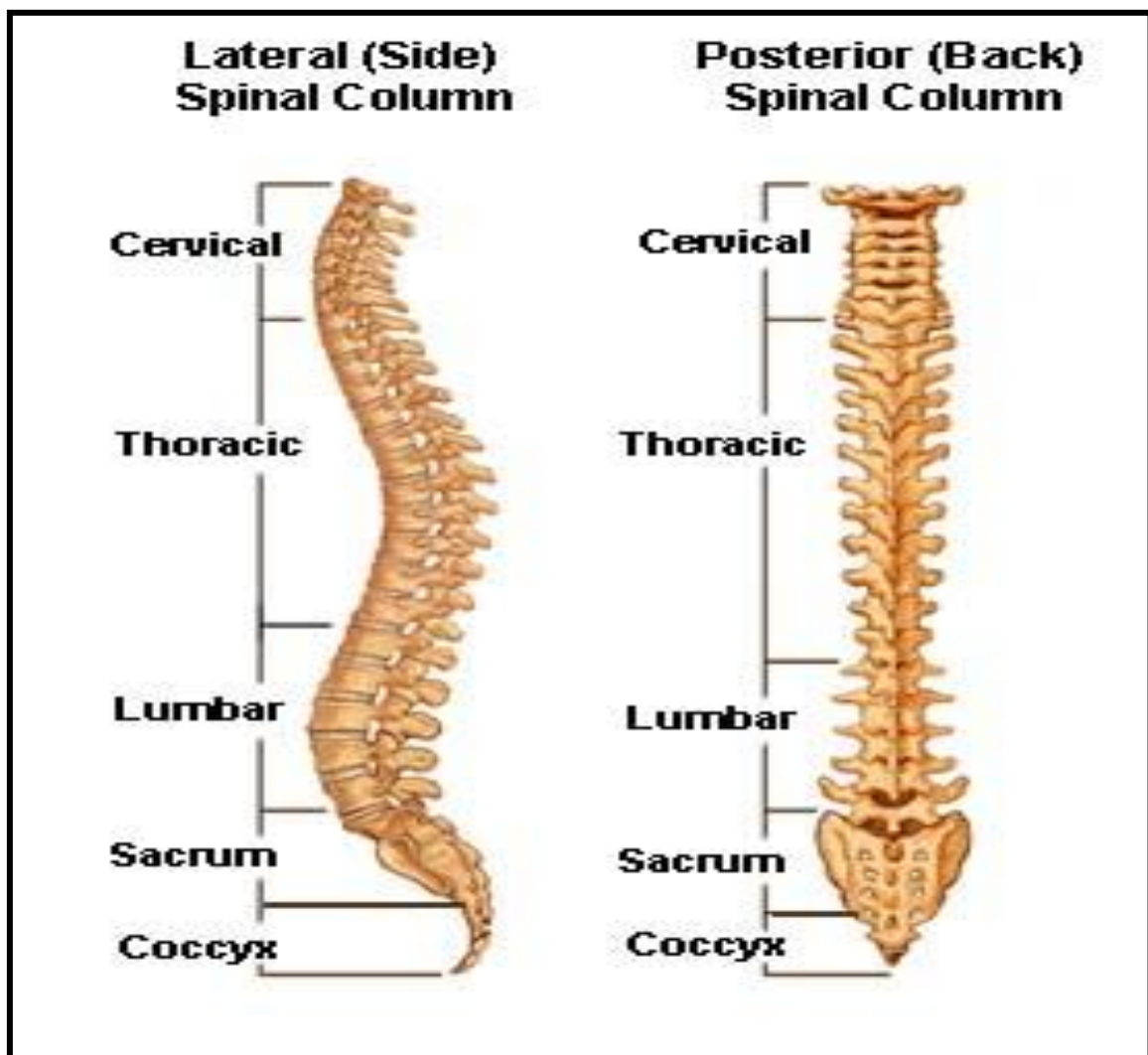


Figure 2.1 The spinal column

Adapted from Kirkaldy-Willis & Bernard, 1999.

In brief, the back consists mainly of:

Spinal cord-this is a thick cord or nerve tissue which is enclosed by the spine; and, together with the brain, it forms the central nervous system.

Vertebrae-these are the bones which act as the building blocks of the spine and they can be damaged by impact injuries such as those resulting from heavy objects dropping directly on the back from a height.

Inter vertebral discs-these are the “shock absorbers” positioned between the vertebrae and they give the spine flexibility. The discs are made up of a fibrous outer band with a fluid-filled centre. When a person stands or sits upright with an “S”- shaped spine, downward pressure is exerted evenly over the surface of the discs. If a person bends over at the waist to pick up an object, the downward pressure will be exerted unevenly over the surface of the discs, with the loading being greater on the front edge of the disc than at the rear. To compound the stress, at the same time, the viscous fluid inside the disc will be squeezed towards the rear of the disc.

Over time, the fibres on the rear section of the outer band may begin to tear and a bulge may form. The tear and bulge will become bigger if pressure is applied repeatedly and eventually the fluid from the centre of the disc may be pushed out, pressing on nerves which will cause the individual to experience pain. This is called a prolapsed (or slipped) disc.

Ligaments- these are gristly straps which stretch between bones, holding them together. In the main, they control the direction of motion, provide passive resistance and limit movement towards the end of the normal range.

Tendons-these are the means by which the muscles are attached to bones.

Muscles- these are found in pairs on either side of the spine. They provide the main stability of the vertebral column and provide passive resistance to spinal movement, the resistance increasing as they stretched.

The ligaments, tendons and muscles are susceptible to injury as a result of twisting and stretching, particularly if carried out repeatedly over a prolonged time period.

Injuries to these soft tissues are probably responsible for the majority of back injuries reported (McKeown & Twiss, 2001).

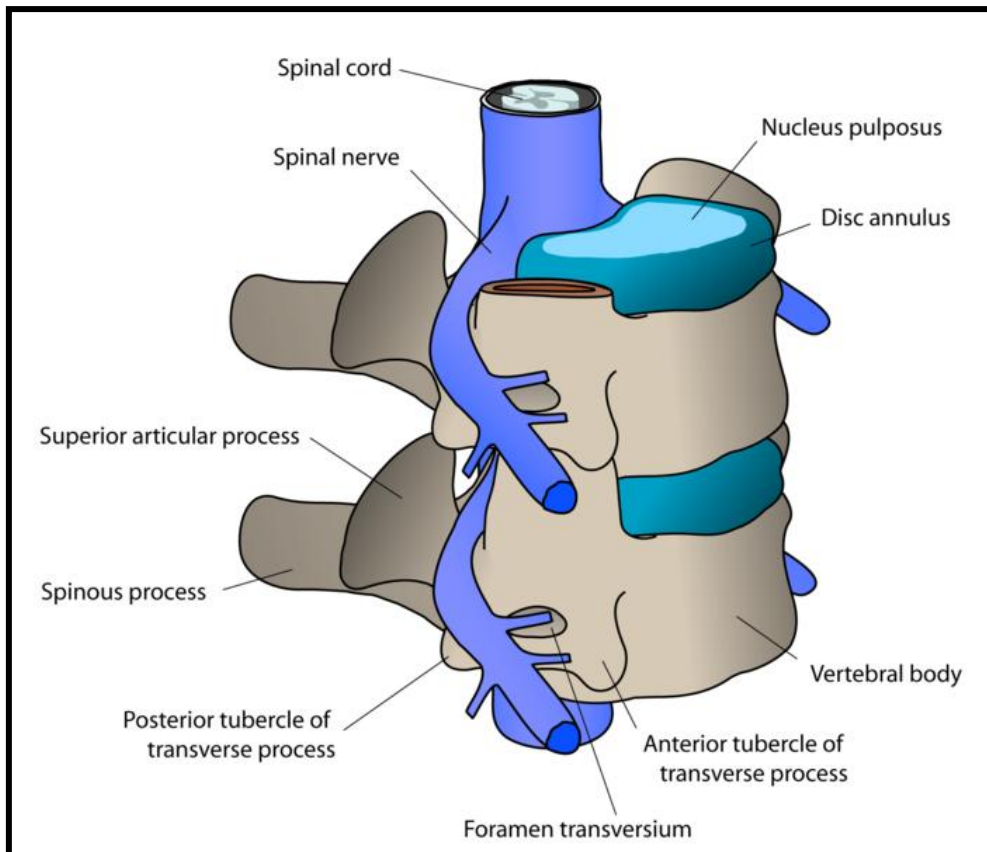


Figure 2.2 The discs

Adapted from Kirkaldy-Willis & Bernard, 1999.

2.2.1 The causes of back pain

Most back pain is due to simple mechanical problems in the spine. However, a small proportion arises as a consequence of other disorders. The causes of back pain can be classified as mechanical, fibromyalgia, inflammatory, infective, metabolic, neoplastic and referred pain (Baxter, Adams & Tar-Ching, *et al.* 2000). Mechanical problems dominate but in the majority of subjects it is not possible to make a specific diagnosis. Such patients are commonly labelled as having non-specific back pain.

Back pain may be acute, recurrent or chronic. Most acute episodes will resolve rapidly but there is always a risk of recurrence and in some patients this occurs in relation to relatively minor mechanical stresses. According to Baxter, *et al.* (2000) only a small proportion develops chronic pain and disability, but it is this group who are responsible for most of the costs associated with back disability and a burden to countries health systems. Most patients have simple backache and in these cases, the Medic, generally does not make a specific diagnosis. Most of such cases will recover rapidly.

2.2.2 Prevalence of LBP in truck drivers

Four studies reviewed, have concluded that there is a high prevalence (59%, 50.3%, 60% and 79%) of LBP in truck drivers (Andrusaitis, Oliveira & Filho, *et al.* 2006; Okunribido, Magnusson & Pope, *et al.* 2006; Robb & Mansfield, 2007; Ramroop, 2006). From the findings of the critical appraisal of the literature on LBP and truck driving together with the conclusions from the above - mentioned studies, it is hypothesized that the prevalence of LBP amongst petrochemical truck drivers in South Africa will also be high (> 60%). The findings from the above four studies would be briefly discussed below.

In the study by Andrusaitis, *et al.* (2006), of the 410 truck drivers evaluated, 242 (59%) presented with LBP, while 168 (41%) did not have LBP. Of the 242 (59%) truck drivers with LBP, 31.2% had occasional pain, 18% had constant pain, and 9.8% had experienced LBP some time in their professional lives. Several hypotheses were considered in this study one of which was that the prevalence of LBP in truck drivers would be high and the study, did, validated this hypothesis.

In a similar study by Okunribido, *et al.* (2006), it was established that LBP during the preceding 12 months was found to reach a prevalence of 50%, amongst the drivers investigated. Typically, this lasted between 1 and 6 days and in some cases was attributed to sciatica or prolapsed/degenerated vertebral discs. Other causes, such as muscle stiffness and stretched nerve were also identified. Similarly, Miyamoto, Shirai & Nakayama, (2000) reported a 50.3% prevalence of LBP, in the preceding one-month, although this data was collected from long-haul (inter-city) truck drivers, in a large chemical industry corporation, most of whom found their pain to be mild or moderate. Okunribido, *et al.* (2006) and Miyamoto, *et al.* (2000) obtained lower prevalence rates than Andrusaitis, *et al.* (2006).

In a study by Robb & Mansfield (2007) which evaluated the prevalence of LBP amongst professional drivers, most participants (81%) reported musculoskeletal problems (ache, pain, discomfort) in at least one area of their body in the past 12 months, with 2.83 problems reported on average per person. The greatest proportion of reported problems was from the low-back (60%), with high numbers reporting shoulder, knee and neck trouble (39%, 35% and 34%, respectively). Just under one third of respondents reported prevention of normal work due to musculoskeletal trouble, and just over one third reported having had trouble in the last 7 days.

Low-back trouble at some point during their life was reported by 70% of the sample. Referring to the worst episode, this was rated as 'mild' by 36.5%, 'severe' by 38.3% and 'very, very severe' by 25.2%. Those who reported more severe LBP had taken significantly more time off work during the previous year ($p < 0.05$, Chi-Square). The majority (86%) of those reporting LBP at some point during their lives claimed that the

trouble had occurred in the past 12 months. For most respondents, the number of days that they had suffered from LBP was between 1 and 30. Despite the high prevalence of LBP pain in this group, 71% stated that their work was unaffected in the previous 12 months.

Work and leisure factors were blamed for LBP in approximately equal measures. Answers in a catch-all 'other' categories pointed out factors such as posture, lifting, wear and tear and old age. A quarter of respondents reported having visited a doctor, physiotherapist or chiropractor during the last 12 months; a similar proportion to those whose reported pain was severe. About one quarter (26%) of respondents had injured their low-backs in an accident, most (79%) of which had occurred at work. Those who had ever had an accident reported significantly more musculoskeletal problems in the past 12 months than the non accident group (independent samples t-test; $p < 0.001$, two-tailed).

In the study by Ramroop (2006) who evaluated the prevalence of LBP in refuse truck drivers from a Municipality, it was found that the prevalence of LBP amongst these drivers was 79%. The point prevalence of LBP after driving was 69%, 64% indicated that they experienced pain during the past week and 51% of the respondents indicated that they were experiencing pain at the time the questionnaires was administrated to them. Of the 79% of the subjects who reported to have experienced LBP during the last 12 months, 58% indicated that the pain always spread to their legs to below their knees. A further 53% indicated that they had trouble in putting on their socks due to the spread of the pain to their legs. The studies by Rob & Mansfield (2007) and Ramroop (2006) clearly established considerable higher prevalence rates, 81% and 79% respectively.

The above four studies (Andrusaitis, *et al.* (2006); Okunribido, *et al.* (2006); Rob & Mansfield, (2007) & Ramroop, (2006) provides considerable empirical evidence that truck driving can be associated with LBP. The results from this study would therefore attempt to add to the existing body of knowledge that truck driving is associated with LBP.

Therefore one of the main hypotheses of this study is that the prevalence of LBP amongst the drivers of petrochemical tankers trucks would also be high. The reasons for formulating this hypothesis is mainly due to the fact that professional drivers spend much of their time in the seated position (static work posture) and frequently twist and bend their torsos. Also the drivers are subjected to various risk factors, which have been found to be associated LBP as concluded by various studies already cited.

2.3 RISK FACTORS AND TRUCK DRIVING

Risk factors may be individual and related to the person, bio-mechanical related to the job and psychosocial. The common risk factors found to be associated with LBP are heavy physical work, static work postures, frequent bending and twisting, lifting pushing and pulling, repetitive work, vibrations and psychological and psychosocial risk factors (Karwowski & Marras, 2000).

However, there may be other risk factors associated with LBP that relates to the worker, which includes a history of prior LBP, poor physical condition of the drivers, obesity, smoking, length of time driving and increased age (Bovenz & Battie, 1994). For the purposes of this study, the risk factors of material manual handling (heavy physical work),

static work posture, perceived levels of WBV, and other risk factors associated with the demographics of the truck drivers, and its association with LBP would only be explored.

The relationship between occupational risk factors and LBP is difficult to determine because exposure is usually difficult and sometimes impossible to quantify. Using job titles alone such as “drivers” is not appropriate. Healthy workers may well stay in the same occupation and job, while workers with LBP may leave a job and move to a less taxing one. The result is a possible shift in prevalence of LBP from heavy to light jobs (Karwowski & Marras, 1999), which creates what is known as the “healthy worker effect”.

As outlined above, there are many risk factors associated with developing LBP in individuals. Davis and Heaney (2000) have developed a conceptual model of the potential relationships among psychosocial work characteristics, bio-mechanical work demands, and LBP. This conceptual model will form the basis for further discussions on occupational-related LBP and the relationship of these risk factors and truck driving. A schematic representation of this model is shown in Figure 2.3.

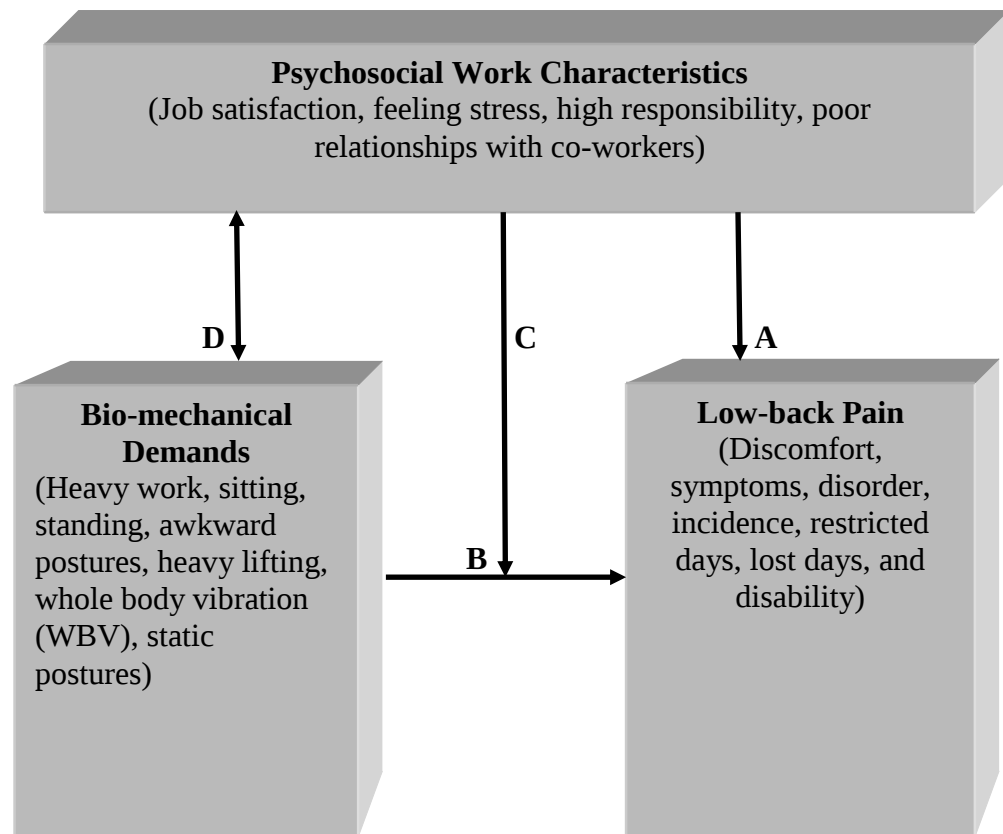


Figure 2.3 Conceptual model of the relationship between psychosocial and bio-mechanical risk factors and LBP. Adapted from Davis & Heaney, 2000.

With reference to the above mentioned model, psychosocial factors (see pathway A) and bio-mechanical factors (see pathway B) may contribute to the aetiology and progression of LBP independently. Psychosocial factors may also influence the relationship between bio-mechanical factors and LBP (see pathway C), such that bio-mechanical demands have a greater effect on LBP under poor psychosocial work conditions.

Additionally, poor psychosocial characteristics and high bio-mechanical demands may covary (e.g. tend to concentrate in similar jobs and occupations such as truck driving). This

co-variation (see pathway D) raises the possibility of confounding if both types of risk factors are present.

Therefore, the relationship between LBP and work can be very complex. Individuals may experience impairment or disability at work because of back disorders irrespective whether the latter was directly caused by job-related factors or not. The degree to which ability to work is impaired is often dependent on the physical demands of the job. Furthermore, when an individual experiences a back disorder at work, it may be a new occurrence or an exacerbation of an existing condition. Again, originally it may have been directly caused by work or by non work-related factors.

Those suffering from occupational related LBP may modify their work activities in an effort to prevent or lessen the pain. Thus, the relationship between work exposure and LBP may be direct in some cases, but not in others. This relationship will also apply to LBP experienced by workers in the different industries and job categories i.e. truck driving in the petrochemical industry. The different types of risk factors will now be discussed.

2.3.1 Material manual handling (heavy physical work)

Heavy physical work is defined as work that has high energy demands or requires some measure of physical strength. Some bio-mechanical studies interpret heavy work as jobs that impose large compressive forces on the spine (Marras, Lavender & Leurgons, *et al.* 1995). For the purposes of this study the definition for manual material handling (heavy physical work) includes activities, which range from heavy tiring tasks, covering of loads

on the trucks with tarpaulin and heavy, dynamic, or intense work associated with driving activities in the petrochemical industry.

Petrochemical truck drivers are known to perform various activities whilst on duty which fall within the above definition of heavy work (Robb & Mansfield, 2000). Depending on the company the drivers is employed in, drivers may perform the following tasks: changing of truck tyres when the truck has a puncture, covering the load transported with tarpaulin, securing the load by means of ropes, assisting in loading and off loading the trucks (Andrusaitis, *et al.* 2000). It is hypothesized that such heavy physical work performed by the drivers is associated with LBP. The study will attempt to establish if this is indeed the case for petrochemical truck drivers.

Several studies support the above hypothesis by having concluded that heavy physical work was significantly associated with LBP amongst truck drivers (Okunribido, *et al.* 2006; Van der Beek & Frings-Dresen, 1995; Hedberg, 1985). The findings from these three studies are briefly discussed below.

In the study by Okunribido, *et al.* (2006) and by Van der Beek & Frings-Dresen, (1995) it was established that lifting, pushing and carrying tasks were performed by the majority of the drivers. These activities were part of their daily work, and were in the majority of the time performed immediately after long stints of driving. The tasks were performed frequently, but loading and unloading of goods generally involved handling of light and medium weight loads (10 kg) and/or exertion of low hand forces. As previously mentioned

drivers of petrochemical trucks do perform similar tasks in addition to driving activities and it is expected that this study will find similar associations.

In the study by Hedberg (1985) it was established that loading and unloading were the most strenuous tasks performed by the group of drivers that were being studied.

The physical workload varied over the workday, such that, average heart rate ranged between 82 and 128 beats/min and the drivers tended to work at above 40% of their maximum oxygen capacity for 36% of the task time. Low physical effort was experienced by the drivers however; the high frequency of lifting immediately after driving was established as more of a problem. The high frequency lifting immediately after driving provided conditions favourable for back injury, due to reduced lumbar strength from vibration induced muscle fatigue. Petrochemical truck drivers however, do not perform any physical tasks that require high frequency repetitive activities. Hence, the evidence supports the view that the risks of whole-body vibration and heavy physical work combined can increase the prevalence of LBP in truck drivers. The risk factor of WBV would now briefly be discussed.

2.3.2 Whole- body vibration (WBV)

WBV refers to mechanical energy oscillations which are transferred to the body as a whole (in contrast to specific body regions), usually through a supporting system such as a seat or platform. Typical exposures include driving automobiles and trucks, and operating industrial vehicles such as tractors and forklifts. Most types of trucks produce some level of vibration which is transmitted via the vehicles suspension to the driver's seat and

eventually to the driver's body. Therefore, in this study it is hypothesized that WBV will be associated with LBP amongst the petrochemical truck drivers.

Petrochemical trucks normally have a horse which consists of the driver cab and engine, the tanker which varies in length and a "pap" which is a smaller length tanker at the back of the truck. Carrying a load or empty, the truck normally produces a fair amount of vibration. In this study the levels of vibration was not quantified i.e. measured formally. The perceived level of vibration was, however, established through question 18 of the study questionnaire. It must be noted that in all the studies reviewed as part of the literature review process for this study, vibration measurements were taken.

Various studies concluded have supported the hypothesis that WBV is associated with LBP, (Seidel & Heide, 1986; Kelsey & Hardy, 1975; Gruber & Ziperman, 1974; Okunribido, *et al.* 2006; Massaccesi, *et al.* 2003; Bovenzi, Rui & Negre, *et al.* 2006). These studies also suggested that LBP occurs at an earlier age in subjects exposed to vibration and that there is an increased risk of LBP in drivers of tractors, trucks, buses and aeroplanes.

In a critical review of musculoskeletal disorders and workplace factors, investigators at the National Institute of Occupational Safety and Health (NIOSH, 1997) judged that, after adjusting for potential confounders (e.g. age, smoking, physical and psychosocial work-related factors), there is strong evidence of a positive association between exposure to WBV and LBP. There is therefore, already strong evidence of a positive association between exposure to WBV and LBP and it is envisaged that this study findings would

corroborate with this existing body of knowledge. However, the very big difference in this study is the fact that no vibration measurements will be taken which might produce a different result.

In support of most studies which have concluded that WBV is a significant risk factor associated with LBP, a review of laboratory studies have also demonstrated WBV effects on the vertebrae, inter vertebral discs, and supporting musculature. Both experimental and epidemiologic evidence therefore suggests that WBV may act in combination with other work-related risk factors such as prolonged sitting, lifting, and awkward postures to cause increased risk of back disorder (Bernard, 1997). The risk factor of static work posture (being in a sedentary position for a prolonged period of time) will now be discussed.

2.3.3 Static work posture

Static work postures include isometric positions where very little movement occurs along with cramped or inactive postures that cause static loading on the muscles. For the purposes of this study static work will also include prolonged standing or sitting and sedentary work (Bernard, 1997). For the purpose of this study, the exposure will be defined subjectively and/or in combination with other work-related factors.

Petrochemical truck drivers sit for extended periods of time as part of their daily job. The drivers will be sedentary for up to 2.5 to 3 hours a day, whilst driving to their destinations to deliver their loads. Most of these drivers transport fuel from Durban to Johannesburg. A fair number of drivers also transport fuel “cross border” into neighbouring countries in Southern Africa, where being in a sedentary position could rise up to 4 - 5 hours. When

drivers wait for their loads at the refineries they also have to sit for a prolonged period of time. If the drivers do not sit and wait in their trucks with capability to move as the queue moves, then they will lose their place in the queue. This is standard loading procedure at the refineries which requires drivers to sit in their truck cabs for up to 4 hours at a time.

Therefore, driving a petrochemical truck, which entails prolonged sitting, will suggest an increased risk of LBP. Petrochemical truck drivers also frequently change their posture, whilst driving. The drivers will also often stand up from their seats for various reasons; especially, when loading product at the refineries. In this study it is hypothesized that static work posture will be significantly associated with LBP amongst petrochemical truck drivers.

Several studies indicate an increased risk of LBP in subjects with predominantly sitting work postures (Hult, 1954; Kroemer & Robinette, 1969; Lawrence, 1955; Magora, 1973; Okunribido, *et al.* 2006; Burdorf & Zondervan, 1990). However, interestingly one study did not support the hypothesis that there is an association between static work postures and LBP (Bergquist-Ullman & Larsson, 1977).

In the study by Burdorf & Zondervan (1990) a cross-sectional study comparing 33 male crane operators with non crane operators from the same Dutch steel plant, matched on age was conducted. Symptoms of LBP and sciatica were assessed by questionnaire. Activities in current and past jobs were assessed by questionnaire; exposures were rated according to level of heavy work, frequency of lifting, WBV, and prolonged sedentary posture. Crane operators were significantly more likely to experience LBP (Odd Ratio (OR) 3.6, 95% CI

1.2–10.6). Among crane operators, univariate ORs for WBV and prolonged sedentary postures were 0.66 (95% CI 0.14–3.1) and 0.49 (95% CI 0.11–2.2), respectively.

As a whole, the results from most of the above studies support the hypothesis that static work posture is associated with LBP. However, as stated, there are also other personal risk factors from the drivers themselves which are equally important and are also associated with LBP. These personal risk factors of the drivers would be now discussed.

2.3.4 Anthropometry

Weight, height, body mass index (BMI) (a ratio of weight to height squared), and obesity have all been identified in studies as potential risk factors for certain Muscular Skeletal Disorders (MSD), which includes LBP. However, the studies are not without conflicting views (Gerr & Letz, 1992; Stock, 1991; Schierhout, Meyer & Bridger, *et al.* 1995).

Physical stature changes also occur with age. After about 30 years of age, the inter vertebral disks degenerate, developing micro tears and scar tissue, fluid is lost more readily, the disk space narrows permanently, and the spinal motion segments loses stability. Therefore, it is not surprising that most occupationally induced LBP occurs in middle aged people. In the elderly disk degeneration reaches a stage where, together with other degenerative processes, the spine is stabilised but with a corresponding loss of mobility (Bridger, 1995).

Jayson (1996) states that most patients with LBP, report that the onset of LBP usually occurs between the ages 35 and 45 thereby corroborating with Bridger's (1995) view.

Jayson (1996) has established that individuals having above average height (using average European anthropometric data – 1.74m) have greater incidence of LBP than those of shorter stature. Thus, according to Jayson (1996) LBP is primarily caused by the tendency to stoop to appear shorter. Height also increases the weight and consequently the force the lower spine must support with movement. Individuals who, due to their heights, work under unfavourable ergonomic conditions have a higher probability to trigger LBP. This might well be the case in petrochemical tanker truck drivers, if the truck cabs are poorly ergonomically designed.

People who are overweight or obese and suffer from LBP may not be aware that their excess weight is actually contributing to their LBP problem. While it has not been studied thoroughly, exactly how excess weight can cause or contribute to LBP is not known. It is however, commonly known that people who are overweight often are at greater risk from suffering from LBP, joint pain and muscle strain than those that are not obese (Jayson, 1996).

The existence of a possible relationship between being overweight and LBP is reasonable. Excess weight increases the load on the spine, which can as a result increase the pressure on the inter vertebral disc and other structures of the spine, triggering pain. In this study it is hypothesized that selected demographic factors, i.e. age, body mass index (BMI) of the truck drivers will be all associated with LBP. Apart from the common risk factors and the risk factors of the drivers of the trucks, other risk factors associated with the driver lifestyle are also important. A few of these lifestyle risk factors relevant to petrochemical truck drivers will be now discussed.

2.3.5 Smoking

Several studies have presented evidence that a positive smoking history is associated with LBP, sciatica, or inter vertebral herniated disc, (Finkelstein 1995; Owen & Damron 1984; Frymoyer, Pope & Clements, *et al.* 1983; Svensson, Vedin & Wilhelmsson, *et al.* 1983; Kelsey, 1984); whereas in others, the relationship was not supported (Kelsey, 1990; Riihimäki, Tola & Videman, *et al.* 1989). However, it is still a matter of debate whether these associations really represent causal associations (Burdorf & Sorock, 1997; Leboeuf-Yde & Yashin, 1995).

A few studies have also indicated that smoking leads to reduced perfusion and malnutrition of tissues in the spine (Frymoyer, *et al.* 1983; Holm & Nachemson, 1988). If this is true, one would also expect that repetitive mechanical stress on these tissues (e.g., in the form of heavy physical work) might be more harmful than it would be to healthy tissues, and more inclined to evoke symptoms of strain in smokers than in non smokers (Ernst, 1993). By the very nature of the petrochemical industry it is presumed that many drivers do not smoke, hence an association between smoking and LBP must be farfetched.

Whilst working, smoking is strictly prohibited by law for all drivers of petrochemical trucks. Furthermore, whilst loading product in the loading gantry, smoking is also not allowed for obvious health and safety reasons. Question 3 of the questionnaire of this study, requested the drivers to indicate whether they smoke or not. In spite of the probability of smoking not being associated with LBP being high, in this study, it was hypothesized that smoking will be associated with LBP amongst the petrochemical truck drivers.

2.4 SUMMARY

The literature reviewed, critically evaluated the current evidence linking bio-mechanical and psychosocial risk factors with the prevalence of LBP. Also truck driving as a job was considered a high risk occupation that is associated with LBP. The review also established that the prevalence and severity of LBP was also significantly high amongst truck drivers.

In the next chapter the research design and methodology used in the study would be discussed.

CHAPTER THREE

MATERIALS AND METHODS

3.1 INTRODUCTION

In chapter 2, a brief discussion on the physiology of the back was presented, together with a theoretical discussion on LBP and its causes. The selected risk factors of material manual handling (heavy physical work), static work posture, whole body vibration and other personal risk factors associated with the drivers of petrochemical trucks was also discussed. In this chapter, the research design and methodology adopted in the study will be explained. The reliability and validity of the questionnaire used in this research will be also briefly discussed. Possible bias and confounding factors that may affect the study results will be explained, and the chapter ends by noting the ethical consideration undertaken in order to proceed with the study.

3.2 RESEARCH DESIGN AND METHODOLOGY

The research design is where the overall approach to test the study statement, research technique, strengths and weaknesses is named and discussed (Hofstee, 2006). As flow diagrams provide simple graphical means of representing sequence and dependency relationships of the research approach, it will be adopted in this study (Naidoo & Singh, 2010). The process flow adopted in this study is illustrated in Figure 3.1.

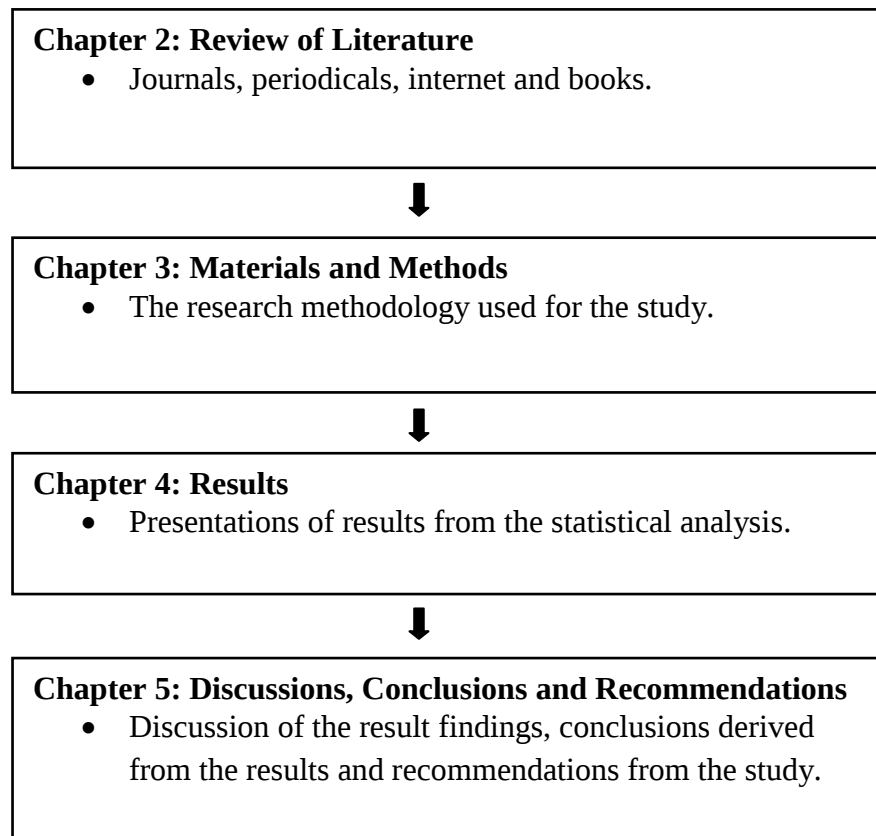


Figure 3.1 The research flow process

3.3 THE STUDY ENVIRONMENT

A Truck Stop, which is situated in the province of Gauteng, South Africa, was chosen as the study environment. The use of this Truck Stop was convenient for the researcher as it was close to the researcher's place of work, and was representative of truckers in the eastern parts of Gauteng. The researcher approached the management of the Truck Stop in December 2010, and requested permission to administer the surveys amongst the truck drivers who visited the Truck Stop. Permission was granted for conducting the surveys at the Truck Stop. Refer to Appendix 1 for the permission letter.

A Truck Stop is a purpose designed and built service station primarily for the use of truck drivers; however, other types of vehicles such as light vans/bakkies also frequent the facility. The main purpose of a Truck Stop is to provide a safe place where truck drivers can stop over, refuel their trucks, have a wholesome meal, conduct ablutions, safely communicate with their families via telephones, and be able to have some recreational activities (e.g. playing pool, watching television) and a sleep-over if necessary. Figure 3.2 illustrates a photograph of trucks parked at a typical Truck Stop.



Photograph illustrating trucks that are parked at a typical Truck Stop

Figure 3.2 Photograph illustrating trucks parked at a typical Truck Stop.

3.4 THE STUDY DESIGN

The study design chosen for this research was descriptive, cross-sectional and quantitative. This study is described as a cross-sectional study because both exposure and disease outcome are determined simultaneously for each subject. It is as if one is viewing a snapshot of the population at a certain point in time (Gordis, 2004). The main aim of the study was to establish the point prevalence of LBP amongst truck drivers, thus a prevalence (cross-sectional) study design was appropriate.

Cooper and Schindler (2001) describe the cross-sectional design as a time dimension study. The above writers stated that a cross-sectional study selects a sample of the population, and obtains information from the subjects simultaneously about both exposure and outcome. This method can help to determine whether the outcome (disease or condition) being investigated is more likely to occur in persons with a particular exposure characteristic than in the general population (Lilienfeld & Stolley, 1994).

Creswell (1994) supports Smith (1983) and they believe that quantitative research emerges from an empiricist tradition established by authorities as Comte, Mill, Newton, and Locke. Creswell (1994) reports that quantitative methods are used mainly to test or verify theories or explanations. In this context, quantitative methods identify variables to study, relate variables in questions or hypotheses use statistical standards of validity and reliability, and employ statistical procedures for analysis. Furthermore, quantitative research papers identify a problem and can generally be characterised by discussing, the purpose of the study; identifying the sample population and instruments used in discussing the

relationship between variables, research questions, steps taken in the analysis of the data and outcomes.

Perhaps, due to the ability to show validity on a numeric scale with the aid of statistical tools, Morse (1999) is of the opinion that academic and social researchers have typically been educated to show favour to quantitative methods. This view is further supported by Ulmer and Wilson (2003), who are of the opinion that when data is quantifiable, the length of the research paper can be considerably shorter in length, due to its numerical depictions of the new information. Statistical analysis and quantitative data should not be discounted and should instead be valued because of their usefulness in making comparisons across relatively large numbers of people, events, or objects. Likewise, central tendencies, distributions, correlations and aggregate patterns are best researched with quantitative analysis.

Weinreich (1996) provides the advantages and disadvantages of quantitative research and maintains that an advantage of this method is that it produces quantifiable, reliable data that can be generalized to some larger population. The greatest weakness of the method is that it de - contextualises human behaviour in a way that removes the event from its real world setting and ignores the effects of variables that have not been included in the model. From the above review, it can be suggested that quantitative research methods are more scientifically and empirically bases than qualitative research methods. It can be inferred that quantitative methods are more suited for research with large sample sizes and across wide geographies. It appears to be the preferred method of research where there are predefined hypothesis.

3.5 THE SAMPLE

A convenient sampling technique was used. There was a specific predefined group selected for this research, namely truck drivers who visited the Truck Stop in Sasolburg, Gauteng. The researcher, together with an assistant, was based at the Truck Stop for almost a month. Drivers who visited the Truck Stop during this period were personally approached by the researcher as to whether they will be willing to participate in the study. The sample obtained in this manner hence, constituted a convenience sample. The source population was all truck drivers in South Africa who visited the Truck Stop. Truck drivers from all trucking companies and authorities (including the Government, Transnet, and Petrochemical Companies) formed this source population.

The drivers were explained the main purpose of the study and its advantages to health and safety and driver wellness in general. They were afforded the opportunity to ask any questions that they might have regarding the study. Those who were willing to participate in the study were requested to sign a subject information and informed consent form (refer to Appendix 2 for the informed consent form) and then complete the questionnaire (refer to Appendix 3 for the questionnaire).

The following inclusion and exclusion criteria for the drivers were then used to identify which drivers were eligible to form part of the study sample.

Inclusion criteria:

- Drivers must be full time permanent drivers;

- Drivers must have been driving for more than twelve months;
- Drivers must be willing to participate in the study and register this formally by signing the informed consent form;
- Drivers must be able to produce their valid driving permit, driver's licence and the truck's completed vehicle daily checklist;
- Drivers must be trained as a hazardous chemical substance driver and have their verification card on them.

Exclusion criteria:

- Drivers who were in their probation period of employment;
- Drivers having a history of LBP prior to entering the driving profession;
- Drivers having LBP arising from traumatic origins (i.e. motor vehicle accident, sporting activity or any other health and safety incident).

According to Welman and Kruger (1999) it is not necessary to use a sample size bigger than 500 unit of analysis, no matter the size of the source population. A more specific guideline is found in Cohen's (1977) Tables regarding the statistical power of a study and its required sample size. Statistical power represents the likelihood of not making a Type-II error based on the research results. A Type-II error means that the null hypothesis is not rejected even though it is actually false. In contrast, a Type-I error means that the null hypothesis is rejected although it is actually true. Type-I errors are related to the alpha or significance level (and p-values) of a test, while Type-II errors are related to the power of a test and the sample size. The higher the power index, the greater the statistical power; thus

a test with 0.90 power has more statistical power than a test with 0.40 power (Rosenthal & Rosnow, 1991).

According to Cohen's Table, a sample of 300 can be used to detect a medium effect (i.e. a moderately strong relationship between variables) with a statistical power of 0.90 at a significance level of 0.01 for the following two-tailed analyses:

- A t-test or an F-test (with 1 degree of freedom), in which case a sample size of 120 is adequate.
- A correlational (r) analysis, in which case a sample size of 160 is adequate.

The sample size required to estimate back pain prevalence assuming that the estimate will be estimated to a 5% precision and the 95% confidence interval will be reported, and using estimated initial prevalence of p then a sample of approximately 400 will be required for the study. Refusal rates and spoilt questionnaires have also been considered in the estimation of the sample size. 500 ($n=500$) questionnaires were printed, but it was assumed that not all of these could be used for the data analysis. In fact, several respondents failed to complete the third part of the questionnaire and their data had to be excluded and were treated as spoilt questionnaires. Nonetheless, according to Cohen's guidelines, the final sample size of 450 ($n=450$) was more than adequate.

Cohen's Tables also indicate that a sample size of 450 is sufficient to detect a small effect (i.e. a weak relationship between variables) at the 0.05 significance level with the following two-tailed tests:

- A t-test or an F test (with 1 df) with statistical power of 0.07;

- A correlational (r) analysis with statistical power of 0.

3.6 THE RESEARCH METHOD

Different methods for the collection of primary data are available for research purposes, and include surveys, experiments, and observations (Diamantopoulos & Schlegelmilch, 1997). The type of data required for a study will largely determine the most appropriate method to be used. Sekaran (2000) defines a questionnaire as being a pre-formulated written set of questions to which respondents record their answers. De Vos (2001) enhances this definition by stating that a questionnaire is an instrument with open or closed questions or statements to which a respondent must react. According to Sekaran (2000), the questionnaire is an efficient data collection mechanism when the researcher knows exactly what is required and how to measure the variables of interest. In the current study the questionnaire method of data collection was easy to administer and it yielded the required data, and was therefore selected.

3.6.1 The questionnaire

According to Joubert (2000), most studies dealing with back disorders, whole-body vibration (WBV) and other types of exposure to risk use some type of questionnaire to elicit the responses from study subjects. These questionnaires gather important information regarding the personal characteristics of the respondents as well as their working conditions, risk factors, and exposure characteristics, information is also gained about the incidence, prevalence and severity of pain related to musculo-skeletal symptoms and disorders.

The design of a questionnaire plays a crucial role in the success of any research or study where information needs to be gathered and analysed, so that conclusions can be made. For the study, the questionnaire used was based largely on an established questionnaire namely the “Standardized Nordic Questionnaire” (SNQ). This questionnaire is known to have good validity. The SNQ was developed in 1987 and was based on other standardized medical questionnaires. The SNQ was designed to allow some standardization, and was structured so that it could be adapted for various occupational settings where relevant studies would be carried out (Kuorinka, Jonsson & Kilbom, *et al.* 1987). The SNQ consists of forced binary or multiple-choice items, and can be used as a self-administered questionnaire or in interviews. It appears useful both as a clinical screening tool and as a research instrument.

The SNQ has been used extensively in Denmark, Finland, Norway and Sweden. The general questionnaire part of the SNQ has reportedly been used in more than one hundred different projects, as well as in routine work in occupational health care services (Kuorinka, *et al.* 1987). However, the SNQ contains various questions that were not relevant for the current study. Thus only the relevant sections were used, namely those dealing with the three risk factors of heavy physical work, static work posture and perceived levels of WBV. Additional items were added according to the issues which the current study aimed to investigate. The final questionnaire used in this study is contained in Appendix 3. The researcher had previously used a similar shortened questionnaire (based on the SNQ) in a study at the eThekweni Municipality in Durban, South Africa (Ramroop, 2006).

3.6.2 Structure of the questionnaire

The adapted questionnaire consists of three parts. Part one consists of biographical and general information, plus an item about cigarette smoking. This information was considered important in determining whether selected biographical data of truck drivers were associated with LBP. Age, gender and race were self-reported. The height and weight of the drivers were physically measured by the research assistant and documented on each questionnaire in order to calculate the body mass index (BMI).

Part two of the questionnaire dealt with current and past low-back trouble, with some items asking the participant to rank his severity of pain, while others elicited information about different types of treatment. The aim here was to collect information about prevalence and severity of LBP and their duration over the past twelve (12) months, as well as over the subject's entire lifetime.

Part three of the questionnaire elicited information about the major risk factors which the drivers were exposed to. These included heavy physical work, participation in sport, static work posture, seat comfort or discomfort, perceived exposure to the levels of whole-body vibration, and the use or non-use of a back support cushion and a kidney belt.

3.6.3 Pre-testing of the questionnaire

The purpose of pre-testing is to ensure that the questionnaire meets the researcher's expectations in terms of the information that will be obtained from it. Questionnaire pre-testing is one way of identifying and eliminating those questions that could pose problems.

Only after all the challenges have been corrected can the final questionnaire be used to collect information.

In this study, formal pre-testing was conducted with drivers of a major transport company in the Gauteng area, to assess the questionnaire's usability and ease of administration before the main study took place. In total fifty drivers were randomly selected, and 100% of these drivers returned the questionnaire fully completed.

The respondents of the pilot study were instructed not to write their names or any other detail that could identify them on the questionnaires. This requirement was strictly adhered to by all drivers and there were no spoilt questionnaires.

In the pre-test stage, subjects also completed a feedback questionnaire concerning the clarity of the instructions, difficulties with the questions, questionnaire length, layout and preferred method of administration of the questionnaires. The overall feedback on the pre-testing exercise was positive. The subjects reported that they found the instructions to be clear, and the questions to be well laid out. The questions were interesting for 90% of the respondents. Twenty percent of the respondents believed the questionnaire was too long. Because of this, the researcher reduced the questionnaire's length slightly. On average, it took each driver about 20 minutes to read through the letter of information and to sign the informed consent form, and then to complete the trial questionnaire. The researcher and research assistant took approximately 10 more minutes to measure the height and weight of each driver.

Two drivers questioned the confidentiality of the information and the process. They were assured that their participation in this study was confidential and anonymous, and it was again emphasized to them that they must not write their names or any form of identification on the questionnaires.

3.6.4 Questionnaire administration

The surveys were conducted at the Truck Stop, and were administered by the researcher and a research assistant. The researcher and research assistant were present during all of the sessions. No problems were experienced during questionnaire administration.

3.6.5 Computerization and coding of the data

Data obtained from the questionnaires needed to undergo preliminary preparation before it could be analyzed. Data preparation includes (1) data editing, (2) coding, and (3) statistical adjustment of the data (Aaker & Day, 1995). Upon receipt of all the questionnaires, each questionnaire was checked to identify omissions or ambiguities in the responses. Illegible or missing answers were coded as “missing”. All questionnaires were then data-captured in Microsoft Office Excel 2007 in exactly the same format as the structure of the questionnaire. For a question which had a Yes or No answer, two rows were allowed, one for each response. A Yes answer would receive a 1 in the Yes row and a No answer would receive a 0 in the No row. Question 13 was coded as follows:

- no LBP = N/A;
- 0 = 0;
- 1-3 = Low;
- 4-6 = Moderate;

- 7-10 = High.

The questionnaire items were then divided into three sections as follows:

Demographic data, namely age, race, height, weight, body mass index (BMI – calculated from height and weight), and years of employment;

- risk factors, namely items 3, 14 – 18;
- low back trouble, namely items 6 -13, 19.

3.7 DATA ANALYSIS

Data will be analysed using descriptive and inferential statistics. SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA) was used to analyze the data. SPSS rounds of accurately to 15 decimal places. However, only up to 4 decimal places were used to display data in the tables. According to Lind & Mason (2004), descriptive statistics describes the organizing and summarising of data within a study. Together with simple graphic analysis, it forms the basis of the analysis of data.

3.7.1 Descriptive statistics

Descriptive statistics for this study included:

3.7.1.1 Frequencies and percentages

Bar graphs were used in this study to display some of the data, namely:

- Demographic variables;
- Point prevalence of LBP.

- Severity of LBP;
- Treatment modalities for LBP.

3.7.1.2 Mean

In the current study, means were calculated for each participant's scores on the two subscales of the questionnaire (RF and LBT), as well as their overall mean score for the total questionnaire. Means were also calculated for each questionnaire item separately, so that the group's average score for that item was known.

3.7.1.3 Measures of dispersion

In the current study, dispersion was mathematically calculated as the standard deviation (SD). Standard deviation is defined as the positive square root of the variance (Howell, 1999). Standard deviation is important to know when one is comparing the data sets from two (or more) different groups or samples.

The variance (SD^2) provides information about the nature of a population or sample group, the most important being whether the members of that group are widely diverse or extremely similar to each other. Groups with greater similarity between members are more homogeneous and the SD will be relatively small. Groups with widely diverse members are heterogeneous and the SD will be relatively large.

When comparing the statistical results of different groups, it is important to know whether their attributes are approximately equal, or differ in the extreme. Analyses carry more

weight when the groups being compared are similar in terms of SD. When the SDs of the groups are similar, differences which occur in the variables of interest are likely to be due to systematic influences rather than being due to random variation in the population groups being compared (Rosenthal & Rosnow, 1991 & McCall, 1990).

In the current study, SD was not particularly important because there was only one study group being examined. There was no comparison with other groups. Therefore, while the SD still provides an interesting measure of the variability of scores within this group, it was not necessary to establish statistical homogeneity.

3.7.2 Inferential statistics

Inferential statistics allows making claims about the populations, beyond that of the data, available. This type of analysis encompasses a variety of calculations to ensure that the inferences are sound and rational. In summary, inferential statistics enables confident decisions to be made in the face of uncertainty. Inferential statistics for this study included:

3.7.2.1 Chi-Square Test (Pearson's χ^2)

The Chi-Square statistic is often used for analysing categorical data (Howell 1999). Hence, the Chi-Square test helps the researcher to analyse frequency or categorical data. In the current study, the Chi-Square test was used to examine the distribution of truck drivers according to their age groups. Chi-Square was also used to compare proportions of respondents between pairs of categorical variables. One-sample Chi-Square tests were used

to test whether the proportion of respondents with low \ moderate \ high severity was significant.

The Goodness-of-Fit Test was used to determine whether the drivers were evenly spread out across all of the age groups or not. For this test, the data which would be expected under a certain hypothesis (e.g. “drivers are equally distributed across all age groups”) are compared with the actual or observed data. In this way it is possible to establish whether the spread of drivers across the age groups was likely to have been caused by chance or by a systematic influence (Rosenthal & Rosnow, 1991; McCall, 1990).

3.7.2.2 F- test and Anova

The t-test is used by researchers to determine whether groups of data differ from each other on a variable of interest (Sekaran, 2000). One of the most common comparisons is between the means of two groups, to see if the difference between means is due to chance or whether it was caused by a systematic influence. The t-test examines the statistical probability of obtaining the difference between the two means by measurement error or chance (random influences), taking into account the sample sizes. Independent Samples T-Test was used to compare means between LBP and no LBP respondents. The Binomial Test was used to test whether the proportion of LBP and non LBP drivers was significant. A p value <0.05 was considered as statistically significant.

Analysis of variance (Anova) makes use of F-tests to compare the means of several different groups all at once. Exactly the same statistical results would be found if one was,

instead, to do a t-test with every possible pair of groups. The purpose of Anova is to “determine the probability that the means of several groups of scores deviate from one another merely by sampling error” (McCall, 1990). Anova subdivides the total variance of a set of scores into its components.

In the current study, Anova was used to compare the scores of drivers in the different age categories. This was done to establish:

- Whether drivers in any specific age group/s were exposed to more risk factors than other age groups.
- Whether drivers in any specific age group/s suffered from more low-back trouble than drivers in other age groups.
- To compare means (BMI & Q5) between categories of severity.

Conventionally, the 0.05 and 0.01 levels are used by most researchers as levels of significance for statistical tests performed. These levels of significance are used to limit the risk of incorrectly rejecting the null hypothesis, or concluding a significant result erroneously. As mentioned earlier, such errors are referred to as Type-I errors. In the medical sciences where an error could have severe consequences, such errors must be kept low. Often, however, in the social sciences the consequences of a Type-I error are not so severe, and researchers are just as concerned with missing a significant result, known as a Type-II error. Aaker and Day, (1995) point out that when both Type-I and Type-II errors are equally important and equally to be avoided, levels of significance may be set slightly

lower. However, the convention is to use the 0.05 level and the current study accepted this standard.

3.8 BIAS AND CONFOUNDING FACTORS

According to Brink (1996) the biggest threat to internal validity is selection bias. In the current study this risk was minimized due to the fact that there was only one sample group, which meant that subjects did not need to be matched in terms of potential confounding variables. Thus the main risk, in terms of selection bias, was that possibly truck drivers on the route where the Sasolburg Truck Stop was located may somehow have differed from truck drivers on other South African routes. This possibility seems quite unlikely.

Another form of selection bias can occur if non-responders in a study differ systematically (in terms of exposure to risk, or outcome scores) from responders. In the current study, all of the drivers who were approached to take part in the study agreed to do so, but a number of them failed to complete the entire questionnaire and thus were discarded from the sample. It is impossible, based on the obtained data, to speculate about the reasons why some drivers completed the entire questionnaire and others did not.

Confounding occurs when the variance of one or more independent but “invisible” variables (i.e. falling outside the focus of the research) mix with the variance arising from the “legitimate” variables (i.e. those which are built into the research problem) (Joubert, 2000). Consequently, it becomes unclear whether any relationship that is found to exist does so between the dependent variable and the legitimate independent variables, or

between the dependent variable and extraneous independent variables, or both. Whenever the effects of independent variables cannot be evaluated, confounding may occur (Isaac & Michael, 1990).

3.9 VALIDITY AND RELIABILITY

3.9.1 Validity

According to Leedy (1981), validity is concerned with the soundness and effectiveness of the measuring instrument. In other words, validity refers to the degree to which one is actually measuring what one purports to be measuring (McCall, 1990). There are various types of validity. Face validity refers to a common-sense or logical assessment that the items on a questionnaire relate to the construct of interest. For example, when assessing a child's mathematical ability, one would not pose questions that pertain to language and grammar. The current study was deemed to have acceptable face validity because the questions focused either on specific experiences with low-back trouble, or on the driver's exposure to risk factors previously identified as being relevant to low-back pain. In addition, the questionnaire was based partly on the SNQ, which is an established instrument with accepted validity.

Face validity leads into construct and content validity, which cannot necessarily be proved definitively or statistically (Cilliers & Coetzee, 2003). The validation process has to be linked to the function or aim of the measurement. In the current study, the questionnaire was suited for the purpose of the research, namely to measure the risk factors of truck drivers with regard to LBP, and to measure their actual experiences of LBP. Norman and

Streiner (2008) argue that because validity is linked to an instrument's function, the construction of that instrument should be guided by its intended function. In the current study, the literature about causes and prevalence of LBP among truck drivers was explored to assist in develop the questionnaire. In addition, some of the questionnaire items were based on the SNQ, which is accepted as a valid instrument for measuring LBP.

3.9.2 Reliability

Reliability is usually assessed by calculating Cronbach's alpha for an instrument or questionnaire. This analysis determines all inter-correlations between all items of a questionnaire. However, if these comparisons are to be valid then the questionnaire must make use of a standard format for all items. The 5-point or 7-point Likert Scale is commonly used when questionnaires are designed. In this case, every item on the questionnaire has the same range of possible values and answers, namely from 0 to 5 or 0 to 7. Usually, 0 denotes "strongly agree" or "strongly disagree" while the upper limit (5 or 7) denotes the opposite pole. When questionnaires are structured this way, it is possible to compare the mean scores obtained by the entire sample on each item in turn. These item means are then correlated with each other to obtain Cronbach's alpha, which is a direct statistical reflection of the instrument's inter-item reliability.

In the current study it was not possible to make this assessment due to the fact that the items varied in terms of their mathematical ranges. The tables in the questionnaire showed the ranges for each item; many questions had only a two-point (binary) scale, with a range from 1 to 2. Others had scales of three, five, or even ten points, with corresponding

mathematical ranges from 0 to 3 or 0 to 10. The items were structured in this way because the research focused on gaining quantifiable data across multiple dimensions, rather than being an attempt at validating the actual instrument itself. Thus questions about the questionnaire's reliability were not addressed in this study.

3.10 ETHICS

The aspect of ethics in this study was carefully considered. Ideally, all research should be able to set forth a total disclosure of the aims and purposes of the study. In this regard each participant was handed an information sheet and informed consent form to read and sign. The information sheet and informed consent form is contained in Appendix 2. Participants did have the right (without prejudice) not to participate in the study, and were informed of this right. Furthermore, research participants were not placed at any risk of trauma or injury, either psychological or physical, by participating in the study. All questionnaires were completed and returned anonymously, with no individuals being identifiable at any of the stages of data analysis. Thus the condition of confidentiality was met, which ensures the right to privacy for research participants.

An application to the Human Research Ethics Committee (Medical) of the University of Witwatersrand for approval to conduct the study was made. The Committee approved the study and a clearance certificate (M10103) was issued. Refer to Appendix 5 for the clearance certificate.

3.11 SUMMARY

In this chapter, the research design and method, the study environment, sampling strategy, data collection, and statistical methodology have been explained. In the following chapter the results of the study would be presented.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

Chapter 3 discussed the research methodology that was used for the study. In this chapter the results of the statistical analysis will be presented.

4.2 DEMOGRAPHIC CHARACTERISTICS

The final sample comprised 450 drivers, 441 (98%) whom were male and 9 (2%) being female drivers. The majority of the drivers were Black 421 (94%), followed by White 20 (4%), Coloured 5 (1%) and 4 Indian (1%). The mean number of years working was 15 years and mean stature was 1.75m (male). The mean body mass index (BMI) of the drivers was 25.39 kg/m². Smokers comprised 349 (78%) of the drivers and non-smokers 101 (22%). The demographic details of the truck drivers are summarized in Tables 4.1 and 4.2.

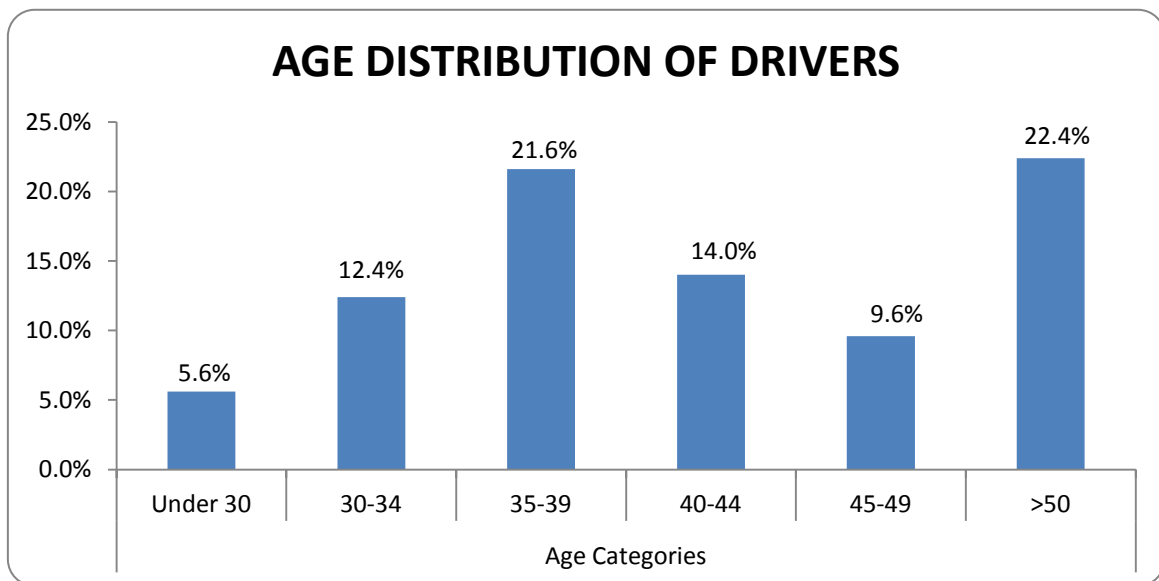
Table 4.1 Demographic details of the truck drivers

Variable	Mean	SD
Stature	1.75m	.075m
Weight	89.59kg	15.84
Body Mass Index (BMI)	25.49	4.40
Smoking	0.224	0.417

Table 4.2 Racial Group breakdown of the truck drivers

Black	White	Coloured	Indian
421	20	5	4
94%	4%	1%	1%

The age group analysis of the drivers revealed that most drivers, 101 (22.4%) were aged over 50 years. There were only 3 drivers younger than 25, therefore this age group was combined with the 25-29 category for analysis purposes. Drivers in this category consisted of 25 (5.6%) of the drivers. Two peaks in age categories were found, one in the 35-39 categories, 97 (21.6%) and the other in the over 50 age category. The age distribution of the truck drivers is shown in Figure 4.1.



The age distribution of the truck drivers

Figure 4.1 Column chart illustrating the age distribution of the drivers.

4.2.1 Age Characteristics

Analyses were conducted to determine the influence of subjects' age on the data. The age category of "younger than 25 years" having only 3 responses was excluded from all analyses, leaving six categories to be compared with each other.

Chi-SquareTest

The Chi-Square test (goodness-of-fit) was carried out to determine whether the uneven distribution of study subjects across the different age categories was likely to have resulted from chance. The results indicated a very high level of statistical significance, indicating that this distribution was definitely not random. The non-directional p-value was <0.0001 ($df=5$), indicating that there is a systematic influence acting on the way in which truck drivers tend to fall into certain age categories rather than others. Some possible reasons and influences will be discussed in the next chapter.

Age ANOVA

The Chi-Square test was used to compare the relationship between the various age groups and LBP since both variables are categorical in nature. The younger than 25 age group was combined with the 25-29 group into the younger than 30 age group since there were only 3 respondents younger than 25. The p-value indicates no statistically significant relationship at the 95% level between age and LBP ($p>0.05$). There was prevalence of back pain across all age groups. The results of the ANOVA tests are shown in Table 4.3.

Table 4.3 One-way ANOVA test on Age and LBP

Age * Q6 LBT Crosstabulation							
		Q6 LBT				Total	
		No		Yes			
		Count	% of Total	Count	% of Total	Count	% of Total
Age	Under 30	6	1.3%	25	5.6%	31	6.9%
	30-34	9	2.0%	56	12.4%	65	14.4%
	35-39	11	2.4%	97	21.6%	108	24.0%
	40-44	18	4.0%	63	14.0%	81	18.0%
	45-49	9	2.0%	43	9.6%	52	11.6%
	50+	12	2.7%	101	22.4%	113	25.1%
Total		65	14.4%	385	85.6%	450	100.0%

Chi-Square Tests

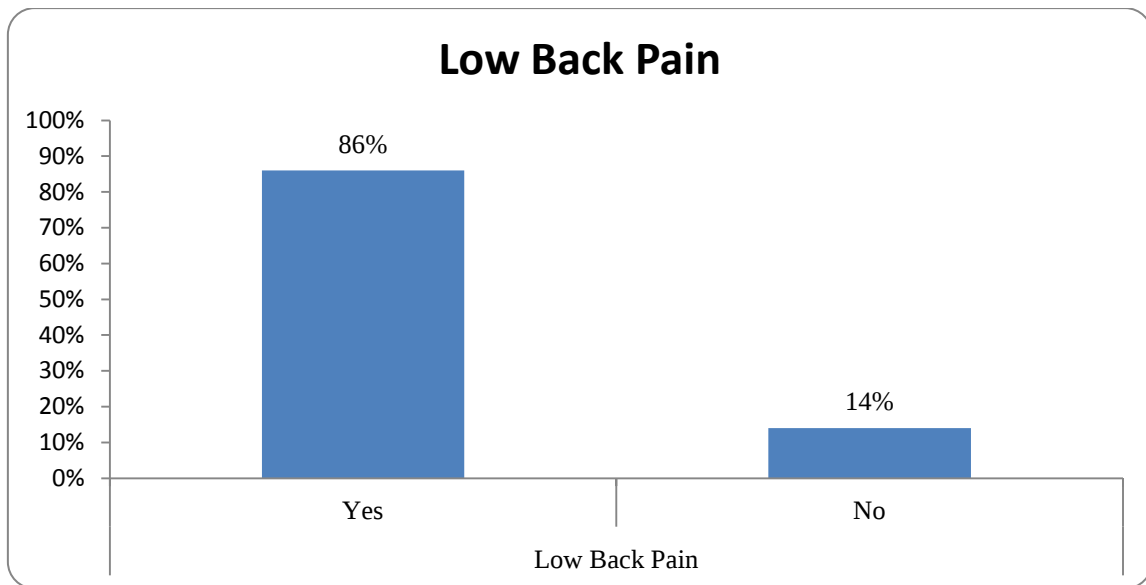
	Value	df	p
Pearson Chi-Square	7.857 ^a	5	.164

a. 1 cells (8.3%) have expected count less than 5. The minimum expected count is 4.48.

4.3 QUESTIONNAIRE ITEMS

4.3.1 Point prevalence of low -back pain

Of the 450 drivers, 385 (86%) experience LBP and 65 (14%) reported to have not experienced any form of LBP. The point prevalence of low-back pain in the truck drivers is shown in Figure 4.2.



The point prevalence of low-back pain in the truck drivers

Figure 4.2 Column chart illustrating the point prevalence of low-back pain in the truck drivers.

The Binomial Test results used to test whether the proportion of LBP was significant is shown in Table 4.4.

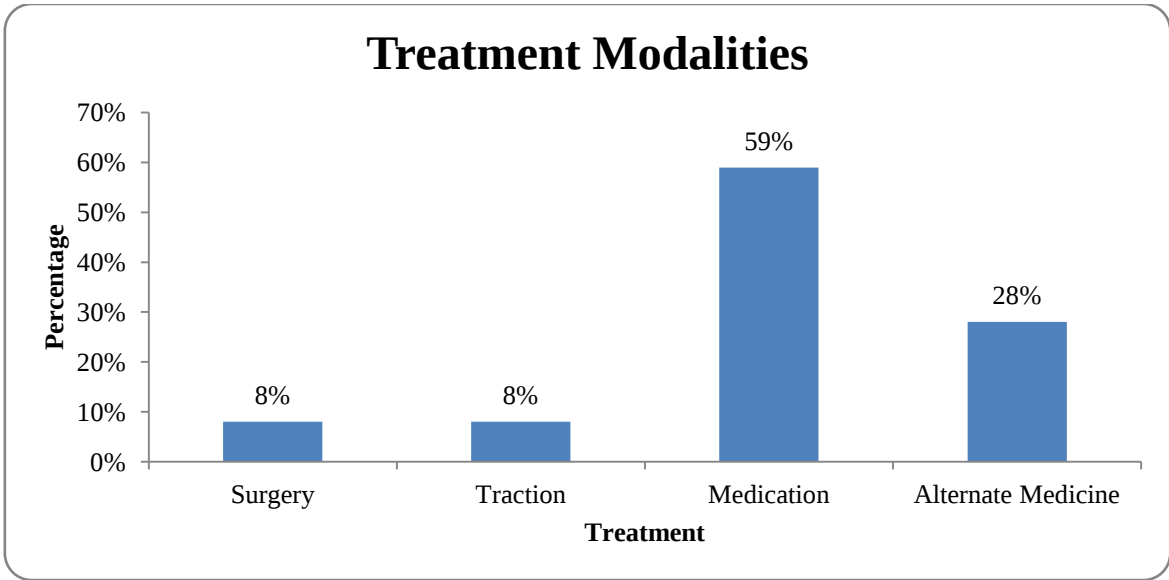
Table 4.4 Binomial Test on LBP

Binomial Test						
		Category	N	Observed Prop.	Test Prop.	p
Q6 LBT	Group 1	Yes	385	.86	.50	.000 ^a
	Group 2	No	65	.14		
	Total		450	1.00		

a. Based on Z Approximation.

The mean total length of time the drivers had LBP during the last twelve months was 3 days. Of the 385 (86%) drivers who reported to have experienced LBP, 70% indicated that

they were hospitalized for treatment. The responses to the type of treatment that the drivers received when they experienced LBP are shown in Figure 4.3.



The different treatment modalities used for low-back pain

Figure 4.3 Column chart illustrating the different treatment modalities experienced by the truck drivers for the treatment of their low-back pain.

Work activity being reduced as a result of LBP was indicated by 85% of the drivers, and 84% of the drivers indicated that they had to reduce their leisure activities as well.

4.3.2 Comparison between hospitalization and the prevalence of LBP

The Chi-Square test was used to compare the relationship between hospitalization and LBP since both variables are categorical in nature. The results indicate a significant association between hospitalization and LBP at the 95% level ($p < 0.05$).

At least 70% of LBP respondents have been hospitalized. The results of the Chi-Square test are shown in Table 4.5.

Table 4.5 Comparison between hospitalization and the prevalence of LBP

Q7- hospital * Q6 LBT Crosstabulation

		Q6 LBT				Total	
		No		Yes			
		Count	% of Total	Count	% of Total	Count	% of Total
Q7- hospital	No	65	14.4%	71	15.8%	136	30.2%
	Yes	0	.0%	314	69.8%	314	69.8%
Total		65	14.4%	385	85.6%	450	100%

Chi-Square Tests

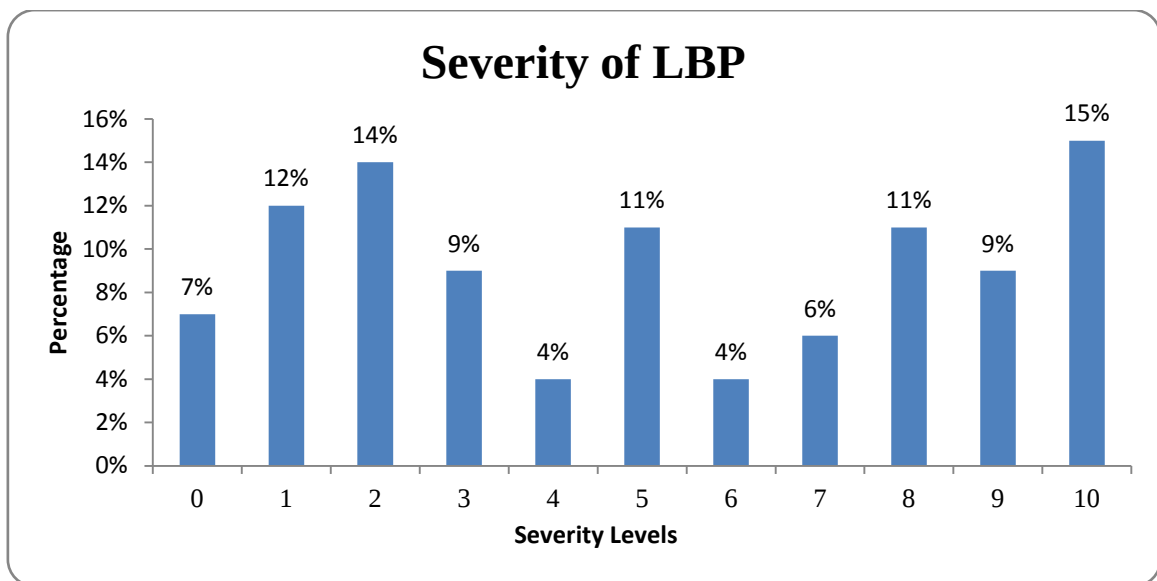
	Value	df	p
Pearson Chi-Square	175.411 ^b	1	.000

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 19.64.

4.3.3 Low-back pain Severity

Responses to question 13 on the LPB subscale were used for two purposes. The first was to assess the severity of the truck drivers' current back pain at the time of the study. These results are shown in Figure 4.4. On the scale of 0 to 10, all responses from 1 to 10 were taken as an indication of the severity of LBP amongst the drivers. 68 drivers (15%) indicated that they had pain as bad as it could be, whereas 32 drivers (7%) indicated that they suffered no back pain at all. The level of severity of LBP amongst the drivers was somewhat evenly distributed on the 0 to 10 scale.



Severity levels of low-back pain amongst the truck drivers

Figure 4.4 Column chart illustrating the severity levels of LBP among the truck drivers.

Question 13 of the questionnaire was further used to provide information about the point prevalence of LBP in the sample of truck drivers at the time of the study. On the scale of 0 to 10, all responses from 1 to 10 were taken as an indication of the presence of LBP. Thus 93% of the sample could be considered to have some degree of LBP, however minimal. Crossing-checking was done by examining the data of question 6, which asked whether respondents had ever had some form of LBP. 86% of the participants affirmed that they had experienced LBP during the course of their life.

Question 13, was also classified, into low, moderate and high as indicated in Section 3.6.5 of the research methodology chapter. The analysis indicated that 40.5 % of the LBP respondents had a high severity of LBP. The results are indicated in Table 4.6.

Table 4.6 Chi- Square Test of the Severity of LBP amongst the drivers.

Severity		Frequency	Valid Percent
Valid	No pain	28	7.3
	Low	131	34.0
	Moderate	70	18.2
	High	156	40.5
	Total	385	100.0

One-Sample Chi - Square Test

Severity			
	Observed N	Expected N	Residual
No pain	28	96.3	-68.3
Low	131	96.3	34.8
Moderate	70	96.3	-26.3
High	156	96.3	59.8
Total	385		

Test Statistics			
	Chi-Square ^a	df	p
Sev erity	105.192	3	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 96.3.

4.4 CORRELATIONAL ANALYSIS

As mentioned in Section 3.7.2 in the research methodology chapter, correlational analyses formed the bulk of this study. Numerous different correlational analyses were performed to examine possible associations between the independent variables (risk factors) and dependent variable (low- back pain).

4.4.1 Smoking

The results of the Chi - Square comparison between smoking and severity of LBP showed a statistically significant association at the 90% level ($p < 0.10$). At least 47% of the drivers who smoke have a high severity of LBP. The results of the Chi-Square analysis are shown in Table 4.7.

Table 4.7 Comparison between smoking and LBP.

Crosstab							
			Sev erity				Total
			No pain	Low	Moderate	High	
Q3- smoking	No	Count	19	103	61	115	298
		% within Q3- smoking	6.4%	34.6%	20.5%	38.6%	100.0%
	Yes	Count	9	28	9	41	87
		% within Q3- smoking	10.3%	32.2%	10.3%	47.1%	100.0%
Total		Count	28	131	70	156	385
		% within Q3- smoking	7.3%	34.0%	18.2%	40.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.578 ^a	3	.087

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.33.

4.4.2 Static work posture

The results of the Chi-Square comparison between being seated for most of the day and severity of LBP shows a statistically significant association at the 95% level ($p < 0.05$). Amongst those who are seated for most of the day, 38.8% have a high severity of LBP. The results of the Chi-Square analysis are shown in Table 4.8.

Table 4.8 Comparison between seated for most of the day and LBP.

Crosstab							
			Severity				Total
			No pain	Low	Moderate	High	
Q-17- seated	No	Count	0	4	1	14	19
		% within Q-17- seated	.0%	21.1%	5.3%	73.7%	100.0%
	Yes	Count	28	127	69	142	366
		% within Q-17- seated	7.7%	34.7%	18.9%	38.8%	100.0%
Total		Count	28	131	70	156	385
		% within Q-17- seated	7.3%	34.0%	18.2%	40.5%	100.0%

Chi-Square Tests

	Value	df	p
Pearson Chi-Square	9.702 ^a	3	.021

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 1.38.

4.4.3 Total years of driving and LBP

The results of the Chi - Square comparison between the total years of driving and LBP, shows a statistically significant association at the 95% level ($p < 0.05$). The result of this association is found in Table 4.9.

Table 4.9 Comparison between total years of driving and LBP.

		Descriptives		
		N	Mean	Std. Deviation
Q 20 (c)bmi	No pain	28	25.079	4.1568
	Low	131	24.928	4.0390
	Moderate	70	25.345	3.5714
	High	156	25.843	5.0986
	Total	385	25.386	4.4369
Q5-total years	No pain	28	12.07	6.677
	Low	131	13.64	7.853
	Moderate	69	16.23	7.407
	High	156	15.38	9.778
	Total	384	14.70	8.603

ANOVA

		F	p
Q 20 (c)bmi	Between Groups	1.065	.364
Q5-total years	Between Groups	2.624	.050

Correlations

		Q5-total years	Q13 severity
Q5-total years	Pearson Correlation	1	.120*
	p		.019
	N	449	384
Q13 severity	Pearson Correlation	.120*	1
	p	.019	
	N	384	385

*. Correlation is significant at the 0.05 level (2-tailed).

4.5 SUMMARY

This chapter provided the quantitative results of the statistical analysis of the study. In the next chapter discussions, conclusions and recommendations will be provided.

CHAPTER 5

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The previous chapter presented the results of the statistical analysis. In this chapter the empirical findings of the study will be discussed in conjunction with the literature review and in keeping with the aims and objectives of the study. The chapter concludes with recommendation which has arisen from the empirical findings of the study.

5.2 RESPONSE RATE

Similar studies involving professional drivers yielded response rates ranging from 71% to 79% (Bongers & Boshuizen, 1990). A study by Joubert (2000) involving Hyster drivers also yielded a high response rate in the both areas of his research namely, Point (100%), and Maydon Wharf (96%) in Durban, South Africa.

The excellent response rate of 90% in this study was more than sufficient and is validated by Cohen Table (1997). Cohen's Tables also indicate that a sample size of 450 is sufficient to detect a small effect (i.e. a weak relationship between variables) at the 0.05 significance level. The excellent response rate obtained in this study is attributed to the fact that, the questionnaires were administered in groups and the process was supervised by the researcher and research assistant at the Truck Stop.

5.3 DEMOGRAPHICS

The majority of the drivers being Black 421 (94%) were expected, because, presently, it is the Black population in South Africa that mainly becomes professional drivers. One of the reasons for this trend could be the high unemployment rate amongst the Black population and also the relative ease in which one can obtain a Code 14 driving licence and obtain employment. The ease of obtaining a Code 14 driving licence is due to the immense fraud and corruption in the Licensing Departments in South Africa. Obtaining a Code 14 drivers licence in South Africa has however, subsequently become much more difficult.

The mean stature (1.75m for males) was slightly higher than the mean height value for South African adult males (1.69m). The mean body mass index (BMI) of the drivers was 25.49 kg/m², being consistent with the South African male population BMI of 24.2 – 25.3 kg/m² for the age groups of 30-59 years (Bandolier, 1995).

The age distribution showed two peaks, one at ages 35-39 and the other at ages equal to and greater than 50 years. The latter was not expected, as drivers who might have had LBP would have moved into other occupations such as general administration or other office based jobs. Once again this trend of older drivers could be attributed to the current high unemployment rate in South Africa. It could also be due to the HIV / Aids pandemic in South Africa, where the active working population between the ages of 30 and 40 years have been most affected. In fact, half of all people with HIV are infected before they turn 25 and acquire AIDS, or even die, by the age of 35 (SAIRR 2001, UNAIDS 2000).

5.4 POINT PREVALENCE OF LOW-BACK PAIN

Several hypotheses were considered in this study, one of which was that the prevalence of LBP in truck drivers would be high and there would be an association between LBP and truck driving. By using questions drawn from published standardized questionnaires, these results may be compared to those of previous studies. Caution is however, required when making these comparisons as some questionnaires were administered in different languages and with slightly different wording.

The study by Mansfield and Marshall (2001), for example, asked respondents to circle areas of pain, aching or discomfort felt after rally driving and results, therefore by design, reflect instant measures (with the purpose of limiting immediate exposures to immediate pain), whereas the Nordic Musculoskeletal Questionnaire (as used in this study in a slightly modified format) records incidence of symptoms in the past year in addition to more recent troubles (i.e. ... in the past 7 days).

In this study the point prevalence of LBP of the 450 respondents to the question on whether they ever had low - back trouble was 86%. This finding is consistent with those reported in other similar investigations. In a German study of professional drivers, the prevalence of “lumbar syndrome” (defined as “any kind of symptoms in the lumbar region and in the sacral area for which a vertebral cause could be assumed after differential diagnosis”) was around 60% in operators of earth moving machines, truck drivers, and fork-lift drivers, Schwarze, Notbohm & Dupuis, *et al.* (1998) & Magnusson, Pope & Wilder, *et al.* (1996).

The 86% point prevalence found in this study was however; lower than Riihimäki, *et al.* (1989) who established a prevalence rate of 90%.

In summary, the findings of the present investigation, as well as those cited above tend to confirm the notion that driving occupations in this case petrochemical truck driving is associated with an increased risk of LBP. The prevalence of LBP can also be associated mainly with increased working hours. It is however, as mentioned, difficult to strictly compare the different studies. Prevalence studies also depend on some factors such as the number of new cases, migration of the subjects with the disease/condition, and the duration of the disease/condition. All the above factors can cause either underestimation or overestimation of the results (Loney & Stratford, 1999) which could have been the case in this study.

5.5 SEVERITY OF LOW-BACK PAIN

It was hypothesised in the study that truck driving would be associated with severe episodes of LBP. Severity of LBP was measured on the scale of 0 to 10. Zero indicated no pain at all and 10 meant pain as bad as it could be. 68 (15%) of the drivers indicated that they had experienced pain as bad as it could be, which is an issue that definitely needs further investigation. When question 13, was classified, into low, moderate and high, the analysis indicated that 40.5 % of the LBP respondents had a high severity of LBP.

85% of the drivers indicated that they had to reduce their work activities and leisure activities due to LBP. The result reflects that the observed proportion of respondents in the different categories of severity is significantly different from expected. It is however,

significant that the largest proportion of respondents have a high severity of LBT. Such severe pain experienced by the drivers is of major concern, and it is suggested that this would have other consequences such as absenteeism, decrease in production and a possible increase in accident rates in the workplace.

The finding of this study is supported by Kirkaldy-Willis & Bernard's (1999) theory that the traditional bio- medical view is reductionistic, assuming that every report of pain originates from a specific physical cause. A particular conundrum is the fact that pain may be reported even in the absence of an identified physical pathology.

However, some caveats are appropriate regarding the interpretation of the severity of LBP as calculated from question 13 of the current study. It is important to take note that the questionnaire devised for and used in the current study was not a medical diagnostic tool. It merely asked subjects to report on their own experience of back pain, and to rate that pain subjectively. No medically validated cut-off point had been established regarding the 10-point self-report scale used in question 13. Similarly, no comparable data exists from the general population which would allow one to accurately infer what level on the 10-point scale corresponds with a medical diagnosis (point prevalence) of LBP.

Therefore these results must be treated with caution and must be only regarded as speculative and exploratory. For example, it is not possible to conclude, on the basis of the current data, that truck drivers experience a severity of LBP that is any different from the general population, or from people in other occupational groups.

Irrespective of the severity there was a significant association found between LBP and being hospitalized. This finding suggests that drivers with LBP are almost certain to visit hospitals for treatment irrespective of the level of severity. Cognisance taken of the current hospital referral system in South Africa such visits could well burden the Health System of South Africa. Such visits will also add to the cost of Health and Safety Management in the Supply Chain environments of the petrochemical industry.

5.6 CORRELATIONAL ANALYSIS

Based on the theory and literature review, it was expected that there would be a number of positive correlations between the risk factors (RF) and LBP scores. A number of results were however not expected. The study concluded that there was no association between heavy physical work and LBP, between WBV and LBP and between BMI and LBP.

There were however, a few associations that were significant and these would be briefly discussed.

5.6.1 Smoking

Smokers comprised 349 (78%) of the drivers and non-smokers 101 (22%). The results of the Chi-Square comparison between smoking and severity of LBP shows a statistically significant association at the 90% level ($p < 0.10$). The hypothesis that smoking is associated with LBP can therefore be accepted. Similar findings were also found by several other epidemiological studies which were cited in the literature review of this study. These finding was however, not expected, as smoking is strictly prevented, whilst driving a petrochemical tanker and while loading product at the Gantries at refineries. However,

whether smoking is a good predictor of LBP or not is an area for further study. The finding that smoking is associated to LBP is very interesting and suggests that drivers of petrochemical trucks do smoke, albeit after hours and not whilst they drive their trucks.

As to smoking, although the literature and this study confirm its association with LBP, the causal mechanism is not fully understood. Nicotine can also influence the central nervous system by changing the perception of pain (Goldberg, Mark & Susan, *et al.* 2000). Other issues could be that the smoking habit tends to keep smokers in sedentary position and smokers tend to care less about their personal health. Therefore, the profile of smokers would be the risk factor for the occurrence of LBP, and not the smoking habit per say.

5.6.2 Static Work Posture

The results of the Chi-Square comparison between being seated for most of the day and severity of LBP showed a statistically significant association at the 95% level ($p < 0.05$). This finding was expected, and supports the hypothesis that work which involves being in a sedentary position for most of the time is associated with LBP.

The results suggest that the petrochemical truck drivers work relatively long hours each day in order to be in a sedentary position for extended periods of time. These long hours could be attributed to the fact that overtime work is frequently undertaken by most of the drivers. Such overtime work is twofold, firstly due to the nature of the petrochemical industry and secondly drivers tend to work overtime in order to supplement their income. Working extended periods of time might also suggest a compliance problem, especially with the requirements of the labour law's of South Africa were working over a certain

maximum time period is not permitted. Another factor that becomes apparent that could be related to static work posture is the issue of driver fatigue, and driver wellness in general.

5.6.3 Total years of driving and LBP

There was a significant relationship between total years of driving (Q5) and severity of LBP which was expected. However, the relationship was not strong enough in order for severity to be predicted from the length of driving time. The finding however, supports the notion that professional driving as a career can be associated with LBP. The total years of driving is also closely related to being in a sedentary position for most of the day by the drivers.

5.6.4 Age

The Chi-Square test results indicated a very high level of statistical significance, across the different age categories, indicating that this distribution was definitely not random. This high statistical significance between the different age categories and the severity of LBP was expected, and is in keeping with the physical make up of an individual.

Finding no link between age and risk exposure, was to be expected. Truck drivers are likely to be exposed to the same level of risk no matter what their age. A young driver and an elderly driver can be equally exposed to high levels of external variables such as vibration and long hours of sitting and driving a truck. This suggests that drivers of all ages tend to experience a fairly uniform level of low - back trouble. It is not possible, based on data from the current study, to speculate whether truck drivers generally have more or less pain than people of the same age within the general population (i.e. not truck drivers).

The occurrence of LBP amongst the general population increases with age and starts declining after 65 years of age, but its occurrence among younger individuals is not uncommon, although studies of specific populations have not shown any correlation between age and LBP (Guo, 2002).

5.7 LIMITATIONS OF THE STUDY

The cross - sectional nature of this study is a limiting factor. The approach is not ideal for the design of a dose - response relationship, particularly where confounding factors such as posture and the “healthy worker effect” are likely to exert a powerful influence.

Quantification of vibration exposure was adapted from Q18, and this may not have been ideal. In most studies that have been cited in this study vibration measurements were actually taken which was not the case in this study and is viewed as a limitation.

5.8 RECOMMENDATIONS

The data gathered from this study indicates that the majority of petrochemical truck drivers experienced LBP in the past 12 months. Therefore, truck driving must be considered as a high risk occupation in relation to low back trouble.

In the United Kingdom truck driving is categorized as a risky occupation and is regulated by the Physical Agents (Vibration) Directive and the UK Manual Handling Regulations (Health and Safety Executive, 2004). However, in South Africa such specific directives and regulations do not exist. Sufficient empirical evidence exists that suggests that truck driving is a high risk occupation in relation to low back trouble.

In the absence of any specific legislation and or directives and guidelines in South Africa categorizing truck driving as a risky occupation it is recommended that policy and law makers in South Africa formally categorize truck driving as a risky occupation.

Furthermore it is imperative that management of trucking companies, especially petrochemical companies ensure that a proper back management program is in place as part of their overall Health and Safety Management System.

5.9 AREAS FOR FUTURE RESEARCH

From this study, many other questions arose that were related to the research question being investigated. Unfortunately, these questions could not be answered, and hence can form the basis for future research. Any interested researcher can take up the challenge and investigate the following:

- This study concluded that the assessments of selected risk factors are associated with LBP. Additional studies using quantitative assessments are required in a continuous effort to clarify interrelations between these risk factors and LBP as a dynamic entity.

5.10 CONCLUSIONS

This study investigated the prevalence, severity and the risk factors and their association with LBP and truck driving. The following conclusions can therefore be made:

- The study indicated that the point prevalence of LBP amongst truck drivers from the petrochemical chemical industry in a specific area in Gauteng was 86%.

- The severity of LBP, measured on the scale of 0 to 10, indicated that 15% of the drivers surveyed indicated that they experienced very bad LBP i.e. pain as bad as it could be, and 40.5 % of the LBP respondents had a high severity of LBP.
- Static work posture was associated with LBP.
- The total length of time worked was associated with LBP.
- Smoking was associated with LBP.

5.11 SUMMARY

This final chapter of the study explained the results in detail. Smoking, static work posture, the total length of time worked was all associated with LBP and truck driving. The prevalence of LBP in petrochemical truck drivers was 86% and 40.5% of the drivers suffered from a high severity of LBP.

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APPENDIX 1

APPENDIX 1

APPROVAL LETTER

TO WHOM IT MAY CONCERN

Shaun Ramroop has approached the company to conduct his research surveys. He has chosen an area of research of strategic importance to the petrochemical industry in which, to date, very little research has been undertaken in South Africa.

As the Truck Stop Centre Site Manager at the company I strongly believe that research of this nature will have only positive spin-offs on both productivity and worker health and safety.

Shaun Ramroop will be assured of all the assistance and support from me and he has permission to conduct his surveys at the Truck Stop Centre - Sasolburg.

Yours faithfully
Name: Mr. Dumisani Nyembezi
Truck Stop Centre Site Manager



APPENDIX 2

SUBJECT INFORMATION SHEET AND INFORMED CONSENT FORM

INTRODUCTION

Good day. My name is Shaun Ramroop; and, I am a Masters student at the University of Witwatersrand, School of Public Health. I would like to invite you to participate in my research study entitled “Occupational related Low-back pain (LBP) in truck drivers”.

It is very important that you read this sheet and understand the purpose of this study in order for you to give informed consent. This letter provides information to help you decide if you would like to participate in the study; and, if you have any questions, please do not hesitate to ask me. If, as I hope that you do, decide to take part, then you are asked (at the bottom of this page) to sign to confirm that you understand the purpose of the study, its risk and benefits and are willing to take part voluntarily.

PURPOSE OF THE STUDY

The aim of the study is to determine the prevalence of occupational related low-back pain in a defined cohort of truck drivers and to determine if the risk factors of heavy physical work, static work posture and perceived vibration exposure are associated with truck driving and LBP.

RISK

There are no risks to you participating in the study either in a personal sense from providing information as this will be kept completely confidential or from any activity that you will have to undertake (i.e. filling-in questionnaires).

BENEFITS

Your taking part in the study will help lead to a better understanding of work - related low-back problems amongst truck drivers. It is intended for the grouped results to be provided to your employers to assist with any potential changes that will assist the industry in improving future health and safety policies, processes and procedures pertaining to occupational related LBP.

RIGHTS

Your participation is voluntary; and refusal to participate will not result in any penalty to you in any way or your company. However, we would urge you to contribute to make your own and your colleagues lives better. The researcher made application to the Human Research Ethics Committee (Medical) for approval to conduct the study. The Committee awarded a clearance certificate, M10103. However; should you have any queries regarding this study and your participation you are welcome to contact Professor PK Jones at 011-7071234.

CONFIDENTIALITY

Your confidentiality is ensured at all times and you will not be identified in any way what so ever. The data on the questionnaires will remain completely anonymous - please do not write your names on them.

I,hereby voluntarily consent to the participation in this study.

Signature :

Date:

APPENDIX 3

QUESTIONNAIRE

INTRODUCTION

Please complete this questionnaire as completely and as honestly as possible. Please **do not write your name** or any other personal identifier on any of the pages of this questionnaire.

Most of the questions simply require you to place an “x” in box. If the question requires you to write something then the question will instruct you at the beginning. If you are really struggling with an answer then please ask and I would gladly assist you.

Thank you for agreeing to take part in this survey:

SECTION ONE

BIOGRAPHICAL AND GENERAL

1. Age

Younger than 25	25-29 Years	30-34 Years	35-39 Years	40-44 Years	45-49 Years	50 years and older
1	2	3	4	5	6	7

2. Gender

Male		1
Female		2

3. Do you smoke cigarettes?

Yes		1
No		2

4. Race (Purely for study purposes)

Black	White	Coloured	Indian	Other
1	2	3	4	5

5. Employment history?

Please fill in:

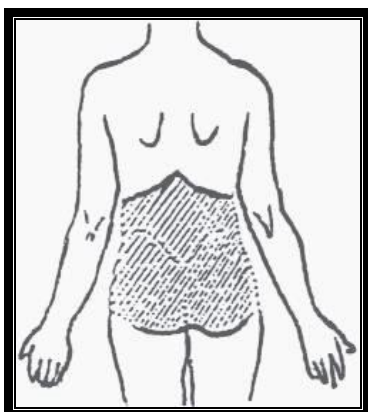
	Job title	Total duration worked for (years and months)	What was your main occupation i.e. office work, driving etc.
Current Employer			
Previous Employer			
Previous Employer			
Previous Employer			
Previous Employer			
Previous Employer			

SECTION TWO

LOW - BACK TROUBLE

How to answer this part of the questionnaire.

In the picture below, you can see the approximate location of the body parts being referred to in this question. By “low-back trouble”, we mean any ache, pain or discomfort in the darkened area.



Please answer by putting an “x” in the appropriate box – one “x” for each question. If you are in doubt as to how to answer this question please ask and I would assist you.

6. Have you ever had low-back trouble (ache, pain or discomfort in your back)?

Yes		1
No		2

If you answer No in question 6, do not answer questions 7-13.

7. Have you ever been hospitalized because of low-back trouble?

Yes		1
No		2

7.1. If **yes**, what was done to help you?

Surgery	Traction	Medication	Alternate Medicine
1	2	3	4

8. Have you seen a doctor, physiotherapist, chiropractor or other such person because of low-back trouble during the last 12 months?

Yes		1
No		2

8.1 If **yes**, what was done to help you?

Surgery	Traction	Medication	Alternate Medicine
1	2	3	4

9. Have you ever had to change jobs or duties because of low-back trouble?

Yes		1
No		2

10. If **yes**, did the change help your back problem?

Yes		1
No		2

11. What is the total length of time that you have had low-back trouble during the last twelve (12) months?

0 days	1-7 days	More than 30 days, but not every day	Every day
1	2	3	4

12. Has low - back trouble caused you to reduce your activity during the last 12 months?

12.1 Work activity:

Yes		1
No		2

12.2 Leisure activity:

Yes		1
No		2

13. If a **zero (0)** means **no pain**, and a **ten (10)** means **pain as bad as it could be**, on this scale of 0 to 10, what is your level of your low-back pain? Put an “x” in the box that best describes your pain:

0	1	2	3	4	5	6	7	8	9	10

SECTION THREE

SELECTED RISK FACTORS

Heavy Physical Work

14. Other than the actual driving, does your job entail strenuous or heavy physical work (i.e. loading/unloading)?

Yes		1
No		2

15. Do you take part in any physical sport?

Yes		1
No		2

15.1 If you have answered **yes**, to question 15, please write the average duration per week spent on the sport?

Rugby.....hours
Soccer.....hours
Cricket.....hours
Hockey.....hours
Other..... hours

Static Work Posture

16. For how long in a day do you drive your truck?

1-3 Hours	4-7 Hours	+8 Hours
1	2	3

17. Would you say that you are seated for most of your work day?

Yes		1
No		2

Perceived Whole – Body Vibration (WBV) exposure

17a. During the past week, did you drive your truck?

Yes		1
No		2

If **no**, please do not answer the rest of the questions.

If **yes**, please give the following information:

b. Make and model of the truck (eg. Scania, Mercedes Atego, if known):

.....

c. Year(s) of manufacture (if known):

.....

d. For the truck you drive, please place an “x” marking the seat comfort on the following 1-7 scale: 1 being very comfortable and 7 being very uncomfortable.

1	2	3	4	5	6	7

e. Does the truck you drive have a suspension seat?

Yes		1
No		2

f. Does the driver's seat of the truck have?

i) armrests?

Yes		1
No		2

ii) an adjustable lumber (back) support?

Yes		1
No		2

g. If **yes**, do you find this easy to adjust?

Yes		1
No		2

18. How would you rate the perceived levels of WBV produced by the truck that you drive?

Very high		1
High		2
Medium		3
Low		4

19. Do you do the following to reduce the perceived levels of WBV?

19.1 Use a cushion for back support and or comfort?

Yes		1
No		2

19.2 Use a back/kidney belt?

Yes		1
No		2

You have completed the questionnaire

Thank you very much for your participation

FOR RESEARCHER'S USE ONLY:

DATE:

HEIGHT:.....

WEIGHT:.....

APPENDIX 4



School of Public Health

Medical School, 7 York Road, Parktown 2193, South Africa ▪ Telephone +27-11-717 2507 ▪ Fax +27-11-717 2084

E-mail: andrew.swanepoel@wits.ac.za

Monday, June 04, 2012

Postgraduate Office
University of the Witwatersrand

Dear sir/madam,

Re: MPH Research protocol – S Ramroop

This letter serves to confirm that I am supervising Mr. Ramroop and that I have recently reviewed his protocol and that the edits he made addressed the assessor's comments to my satisfaction. Therefore I request that he can proceed with his project.

Thank you for your assistance.

Yours sincerely,

A handwritten signature in black ink, which appears to read "Andrew Swanepoel". The signature is written in a cursive style with a horizontal line underneath the name.

**MR ANDREW SWANEPOEL
ACADEMIC CO-ORDINATOR:
MPH/DPH in the field of OCCUPATIONAL HYGIENE**

APPENDIX 5

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr Shaun Ramroop

CLEARANCE CERTIFICATE

M10103

PROJECT

Occupational-Related Low Back Pain (LBP) in
Truck Drivers (New title)

INVESTIGATORS

Dr Shaun Ramroop.

DEPARTMENT

School of Public Health

DATE CONSIDERED

29/10/2010

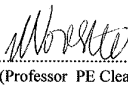
DECISION OF THE COMMITTEE*

Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 25/11/2010

CHAIRPERSON


(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Andrew Swanepeol

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...