The prevalence and associated risk factors of low back pain in an automotive production company.

By

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I, Tarnia Raad, do declare that this dissertation is representative of my own work in both conception and execution and that the use of work by others has been duly acknowledged in the text.

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Dedication

This is dedicated to my mother, who has supported me above and beyond the call of duty. I have a great deal of love and respect for you and I am truly grateful for all you have sacrificed for me. Thank you so much for all you have done for me over the years. I am so blessed to have you in my life.

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The diagnosis is our Responsibility,
the subluxation and adjustment is our Identity.
The patient is our Focus,
and our profession must be our Passion.

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Thank you for the wisdom of my teachers,
the enthusiasm from my fellow interns, the gratitude of my patients and
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Abstract

Objectives:

To determine the prevalence and associated risk factors of low back pain (LBP) in an automotive production company, evaluating the relationship between selected risk factors, type of occupational activity and the prevalence of LBP.

Methods :

This was a descriptive study at a large automotive production company entailing 200 physical production employees and 200 sedentary employees. Using a cross sectional study design, a retrospective analysis investigated the LBP prevalence, by means of a questionnaire. Individuals reported on demographics, injury location, injury aetiology, injury nature, extent of treatment rendered and time lost from work. Additionally, data was obtained regarding smoking, occupational stress and fitness.

Results:

A significant difference was found between sedentary and manual employees with regards to age, gender, ethnicity, marital status, education and medical aid. Similarly a significant difference between the groups was found for the point prevalence of LBP, current LBP description (sharp, shooting, dull aching, stabbing and catching pain descriptions), past LBP description (catching pain description), sidedness/ location of pain as well as associated features of the current LBP (viz. pins and needles, pain to the knees, numbness, bed rest, absence from work, pain at work and pain on weekends) and associated features of past LBP (viz. pins and needles, pain to the knees, numbness, bed rest, absence from work, pain at work and pain on weekends). There were no noted psychosocial factor that impacted on a difference between the groups, but there was a significant difference between the manual and sedentary employees with regards to absenteeism.

Conclusion:

A significant rate of LBP was reported amongst both the sedentary (59.6%) and the manual (89%) employees, implying that the costs to the company are relatively high. It is, therefore, suggested that the company looks at a variety of strategies to reduce the burden of LBP in their employees.

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Definitions:

Body mass index (BMI):

BMI is an estimate of a person's body fat, based on an adult's height and weight. It is used to screen for weight categories that may lead to health problems. According to the Centres for Disease Control and Prevention, a BMI below 18.5 is considered underweight, 18.5-24.9 is normal; 25-29.9 is overweight and over 30 is obese (Pollack *et al.,* 2008).

Concurrent validity:

This is measured when a particular tool produces similar results when compared with another tool already known to be trustworthy (Bernard, 2000). This is also called *criterion* validity by Mouton (2002).

Construct validity:

Measures how accurately answers to questions reflect theoretical predictions of a particular construct (Bernard, 2000).

Face validity:

This type of validity is a subjective judgment by those involved in the research, that the questionnaire is designed to measure what it is supposed to measure (i.e. does it answer the research question), and whether the sample being measured is representative of the traits being measured by the instrument (Leedy, 1997). In other words, face validity refers to whether "on the face of it" the questionnaire seemed unambiguous, valid and easily interpreted by the people taking part in the focus group (Hicks, 2004; Bernard, 2000).

Incidence:

A measure of the number of new cases of a disease found within a certain population over a certain period of time (Bernard, 2000).

Low back pain (LBP):

Pain between the area of the last ribs superiorly and the gluteal fold inferiorly (Walker *et al.,* 2004; Maniadakis and Gray, 2000).

Manual employee:

According to Yip (2004), Harkness (2003) and Vingard and Nachemson (2000) manual is defined in each of these studies as sitting for less than one hour (Yip, 2004) or less than two hours (Harkness 2003; Vingard and Nachemson, 2000). Therefore, for this study a manual employee is defined as someone having to spend greater than four hours / majority of their working day away from their desk or busy with manual tasks, irrespective of whether they are office bound or linked to the production lines.

Mechanical low back pain (LBP):

Kirkaldy-Willis and Bernard (1999) describe LBP as any acute or chronic pain, stiffness or ache that affects the low back. In addition, Borenstein *et al.,* (1995) describe mechanical LBP as LBP of a musculoskeletal origin, either due to overuse of a normal anatomical structure (e.g. muscle strain) or due to injury or deformity of a normal anatomical structure (e.g. a herniated intervertebral disc).

A more recent definition defines low back pain as pain that extends from the thoracic diaphragm to the pelvic diaphragm (noted as the area on the body surface being between the twelfth ribs bilaterally and the gluteal folds bilaterally) (Nyland and Grimmer, 2003).

Musculoskeletal injury (MSI):

MSI is an umbrella term for a number of injuries and disorders of the muscles, nerves and supporting structures (e.g. intervertebral discs) (Kessler *et al.,* 2003).

Obesity:

Obesity occurs when a person has too much body fat. Obesity is not the same as being overweight; a person is considered obese when they weigh 20% or more of the maximum desirable weight for their height (Quinn, 2008). A person with a BMI over 27 is classified as overweight where as, a person with a BMI over 30 is classified as obese (Pollack *et al.,* 2008).

Occupational disease:

This tem defines a disease for which there is a direct occupational cause-effect relationship between hazard exposure at work and disease (e.g. smoke inhalation and lung disease) (Armstrong *et al.,* 1993).

Overuse syndromes:

A result of repetitive stress to body structures (Quinn, 2008).

Period prevalence:

The number of persons with a given disease or condition over a specific period of time (Gerstman, 2003).

Point prevalence:

The number of persons with a given disease, condition during a specified point in time (Gerstman, 2003).

Prevalence:

Defined as the proportion of people in a given population that have a symptom or disease at a particular time (Borenstein *et al.,* 1995).

Risk factor:

Characteristics (e.g. ethnicity, gender, age, height, obesity) or variables (e.g. smoking, occupational exposure levels) associated with increased probability of a toxic or adverse health effect (Karwowski and Marras, 1999).

Sedentary employee:

According to Yip (2004), Harkness (2003) and Vingard and Nachemson (2000), sedentary is defined in each of these studies as sitting for more than five hours or more than two hours. Therefore, for this study, a sedentary employee is defined as someone having to spend more than four hours / majority of their working day sitting at their desk, irrespective of whether they are office bound or linked to the production lines

Sprain:

Injury resulting from the stretch or twist of the joint and causes various degrees of stretch or tear of a ligament or other soft tissue supporting the joint (Quinn, 2008).

Strain:

A strain occurs when a muscle becomes overstretched and tears. It is also called a "pulled muscle," and can be caused by an accident, improper use of a muscle, or overuse of a muscle (Delee *et al.,* 2003, Frontera and Silver, 2002; Marx *et al.,* 2002).

Stress:

Fishkin (1989) defines stress as the result of any demand, either internal, external or both, that causes a person mentally and physically to re-adjust just in order to maintain a sense of balance.

Stretching:

Any therapeutic manoeuvre designed to elongate shortened soft tissue structures and thereby increase flexibility (Quinn, 2008).

Validity:

“The term validity means that the measurements are correct (i.e. the instrument measures what it is intended to measure, and that it measures this correctly)” (Goddard and Melville, 2001).

Work-related musculoskeletal injuries (WRMSIs):

Punnet and Wegman (2004) and Boudreau and Wright (2003) recognize WRMSIs as being work-related when performance of work activities and the work environment play a significant role in the development of an injury.

Chapter One:

1.1 Introduction

Low back pain (LBP) is a common clinical health and work related musculoskeletal disorder (Coole *et al.,* 2010; Chen *et al.*, 2005; Manchikanti, 2000; Picavet, 1999). Manchikanti (2000) concluded that the incidence of chronic LBP at 3-months, 6-months, and 12-months ranges from 35% to 79%. Whereas lifetime prevalence has been noted as ranging from 5% - 95% (Bell and Burnett, 2009; Dagenais *et al.,* 2008). These high prevalence's and incidences have been linked to two opposing occupational categories: the first includes static work postures (Roffey *et al*., 2010b; Glover *et al.,* 2005; Davis and Heaney, 2000; Pope *et al.*, 1991) and the second manual labour (Roffey *et al.*, 2010a; Roffey *et al.*, 2010c; Roffey *et al.*, 2010d; Roffey *et al*., 2010e; Wai *et al.*, 2010a; Wai *et al.,* 2010b; Pope *et al.,* 1991; Damkot, 1984). These two occupational categories require two different forms of intervention strategies (Gilad and Kirschenbaum, 1987) in order to combat the impact of LBP (Bell and Burnett, 2009; Dagenais *et al.,* 2008). This is of particular relevance in that Gilkey *et al.,* (2007) indicate that there is a paucity of literature in this regard.

LBP is an extremely common symptom (Dagenais *et al.,* 2008; Chen *et al.*, 2005) that is the described as pain in the lumbar spine or the sacral region and may be associated with pain referral (Morris, 2006; Haldeman, 2005; Bergman *et al.,* 1999). Although there are various definitions of LBP, the most common is pain between the area of the last ribs superiorly and the gluteal fold inferiorly and is laterally bounded by an imaginary line connecting the most lateral aspects of these structures (Dagenais *et al.*, 2010; Walker *et al.,* 2004; Maniadakis and Gray, 2000).

LBP consists of dull aches, stiffness and may be acute, subacute or chronic in nature and is often associated with impairment of the patient's daily activities (Bell and Burnett, 2009; Ghaffari, 2006). The impact of LBP can be seen from the literature that has focused on documenting the prevalence's of LBP in various population groups over time (see Table 1.1):

Table 1.1: Review of epidemiology of Low Back Pain (Adapted from Dyer, 2012)

Authors	Study type	Prevalence		Region / population
Frank *et al.,* (1996)	Epidemiological study	Lifetime	50% - 80%	General*
Bovenzi, (1996)	Intervention study	Lifetime	66.4% - 83.8%	Country not specified Tractor drivers and control drivers
		12 -months	65.5 - 82.9 %	
		7-days	45.6% - 62.4%	
Hillman *et al.,* (1996)	Epidemiological study	Lifetime	59%	Country not specified General*
		1-year	39%	
		Point	19%	
Cassidy *et al.,* (1998)	Epidemiological study	Lifetime	84%	Saskatchewan / Canada General*
		6-months	69%	
		Point	29%	
Loney and Stratford, (1999)	Review of literature	Lifetime	59% - 84%	Global General*
		Point	14% - 29%	
Picavet and Schouten, (2003)	Epidemiological study	12-months	44.4%	Netherlands Population unspecified
Waddell, (2004)	Epidemiological study	Lifetime	50% - 80%	USA General*
Galukande *et al.*, (2005)	Incidence study			Uganda Hospital based
Ghaffari, (2006)	Epidemiological study	1-year	65% 46%	UK / Sweden General*
Dagenais *et al.*, (2008)	Review of literature	Lifetime	5% - 65%	Global General*
		2- weeks	15%	
Bell and Burnett, (2009)	Review of literature	Lifetime	60% - 90%	Global Specific occupations -mostly labour intensive
Helfenstein-Junior *et al.,* (2010)	Review of current knowledge of LBP	Lifetime	50% - 80%	-

*Refers to the sample as taken from the general population as opposed to specific work related populations.

The findings from Table 1.1 concurs with a systematic review of the global LBP prevalence which concluded that only 8% of studies were conducted in developing countries, but only one in Africa (Walker, 2000), with even less information available on specific population groups. This is of particular relevance in that, Gilkey *et al.,* (2007) and Galukande *et al.*, (2005) still note that there is a paucity of literature on both personal and workplace factors that specifically deal with issues of LBP in relation to indigenous population groups and the developing countries.

Notwithstanding this skewed representation of global LBP prevalence, a number of intervention studies in various industries, has focused on interventions to combat LBP in the workplace, these include office workers (Sjorgen *et al.,* 2006), railroad workers (Suni *et al.,* 2006), airline personnel (Hlobil *et al.,* 2005), military personnel (Larsen *et al.,* 2002; Amako *et al.,* 2003; Helmhout *et al.,* 2004), nursing care aides / geriatric nurses (Horneij *et al.,* 2001; Gundewall *et al.,* 1993; Dehlin *et al.*, 1981; Dehlin *et al.,* 1978), postal workers

(Daltroy *et al.,* 1997), hospital staff (Oldervoll *et al.,* 2001; Donchin *et al.,* 1990), copper smelters (Shinozaki *et al.,* 2001); manufacturing staff (Kellett *et al.,* 1991), tractor drivers (Bovenzi, 1996) and carpenters (Gilkey *et al.,* 2007). Similar to the findings from Table 1.1, the majority of these studies are again from developed / first world countries. Limited information is available on developing countries, with the exception of China (Shinozaki *et al.,* 2001). No study could be found within the particular context of South Africa investigating the occupational LBP.

These intervention studies have attempted to address LBP in order to reduce its impact. However, they presuppose that the lifetime prevalence's of LBP are similar in all these work environments. This, however, was shown to be unsubstantiated in a study by Kim *et al.*, (2010), where different reporting mechanisms, changes in reporting mechanisms and changes within ergonomic measures within a company were found to significantly affect prevalence's and associations between LBP and predisposing factors (*p* values ranged from <0.01 to 0.64, with the only factors <0.05 being gender and age and all work related factors being <0.05). It was, therefore, recommended that studies be individualized to specific companies to accurately measure the impact of LBP before intervention strategies are developed, in order to monitor changes (if implemented). In this way, the effects of LBP as an important clinical, social, economic, and public health problem affecting the population indiscriminately can be more specifically and effectively addressed (Kim *et al.,* 2010; Dagenais *et al.,* 2008; Cherkin, 2002; Coulter *et al.*, 2002; Karwowski and Marras, 1999; Hurwitz *et al.,* 1998).

Based on the above literature assumptions, it is anticipated that for employees of the automotive industry that LBP may represent a major health problem due to its inherent high prevalence and major consequences for the individual and the employer, including disabilities and work leave in labour intensive industries (Bell and Burnett, 2009). This is further supported by the specific physical activities employed in the automotive industry that have been noted as well as known risk factors for LBP in the literature (Prangley, 2010; Albert, 2009; Dasappa 2007; Pereira, 2009; Fyfe, 2006; Ginanneschi *et al*., 2006; Ramroop *et al*., 2006; Smith *et al.*, 2006; Glover *et al.,* 2005; Manek and MacGregor, 2005; Vieira, Kumar and Narayan, 2005; Vlok, 2005; Rupert and Ebete, 2004; Sjolie, 2004; Van den Heuvel *et al*., 2004; Kovacs *et al*., 2003; West and Gardner, 2001; Cromie, Robertson and Best, 2000; Docrat, 1999; van der Meulen, 1997; Bork *et al*., 1996; Tim, 1996; Pope *et al*., 1991). These factors predisposing to LBP are strongly related to the occupational tasks

taking place in the automotive industry (Roffey *et al.*, 2010a; Roffey *et al*., 2010b; Roffey *et al.*, 2010c; Roffey *et al.*, 2010d; Roffey *et al*., 2010e; Wai *et al.*, 2010a; Wai *et al.,* 2010b; Cholewicki, Grauer and Simpson, 2006; Manchikanti, 2000).

Examples include sedentary activities (viz. employees maintaining static work postures and individuals who predominantly sit behind a desk for long periods (four hours or more) (Roffey *et al*., 2010b; Glover *et al.,* 2005; Davis and Heaney, 2000); and manual activities (viz. lifting, twisting, lifting while twisting (Wai *et al.*, 2010a), pulling, pushing (Roffey *et al.*, 2010a), carrying and lowering (Wai *et al.*, 2010a). It has been suggested that LBP in the work situation for the general manual labour population may intensify when dealing with heavy objects (Roffey *et al*., 2010e; West and Gardner, 2001), doing heavy manual labour, having cumulative load exposure (Roffey *et al*., 2010d; Cromie, Robertson and Best, 2000) or working more than 40 hours a week (Roffey *et al*., 2010d; Rupert and Ebete, 2004).

Thus, Burdorf and Elders, (1997); Reichelt and Conrad (1995), have, over the years suggested that there are specific risk factors that are exacerbated, within specific occupational activities or specific professions (e.g. manual labour / sedentary employees) and that these should be further investigated. This is supported by Ghaffari (2006), who indicated that there are numerous and significant consequences of LBP, and the associated increase of absence from work, lost productivity and unsatisfactory management cause a corresponding increase in economic costs (Bell and Burnett, 2009; Ghaffari, 2006).

Therefore, this research aimed at determining the prevalence and associated risk factors of LBP in an automotive production company. As a result, the findings of this research would potentially support and allow for the development of intervention strategies to limit the detrimental impact of LBP (Cherkin, 2002; Coulter *et al.*, 2002; Picavet, 1999; Hurwitz *et al.,* 1998; Hurwitz, 1994; Gilad and Kirschenbaum, 1987), which would benefit stakeholders within the automotive industry (Rupert and Ebete, 2004; Nyland and Grimmer, 2003).

1.2 Aim of study

The aim was to determine the prevalence and associated risk factors of low back pain in an automotive production company in South Africa.

Objectives of study were to determine and then compare the following between the sedentary and manual employees:

- The demographics,
- The prevalence and characteristics of LBP,
- The psychosocial risk factors of LBP,
- The rate of absenteeism in relation to LBP.

The null hypotheses of this study were:
There will be no difference between the sedentary and manual employees in terms of:

- The demographics,
- The prevalence and characteristics of LBP,
- The psychosocial risk factors of LBP,
- The rate of absenteeism in relation to and LBP.

1.3 Benefits

Coole *et al.,* (2010), Manchikanti (2000), Karwowski and Marras (1999), Picavet (1999), indicate that LBP is one of the most common health and work related musculoskeletal complaints (Pope *et al.,* 1991; Damkot, 1984), which contributes significantly to morbidity, disability, and economic loss (Coole *et al.,* 2010; Dagenais *et al.,* 2008; Karwowski and Marras, 1999). By determining the prevalence, distribution of LBP, possible contributing and associated risk factors can be identified, quantified and utilised to develop intervention strategies to limit the negative impact LBP has on society (Gilad and Kirschenbaum, 1987) and inform future policy and practice (Griffith *et al.*, 2007). These intervention strategies would be multi-factorial (Cherkin *et al.,* 2002; Coulter *et al.*, 2002; Hurwitz *et al.,* 1998 Hurwitz, 1994), provided that there is good communication between the role players and sufficient information is available for them to share a common grounding (Coole *et al.,* 2010). These stakeholders include the:

- Health care practitioners (including chiropractors) whose role it is to prevent, treat and rehabilitate musculoskeletal complaints (Morris, 2006). This requires that they be enabled to understand the needs and requirements of the patients who are employees within various industrial contexts (Wai *et al.*, 2010a; Wai *et al.,* 2010b).

- The company, who would be able to facilitate changes within the work space / work environment (Bongers *et al.*, 2006; Davis and Heaney, 2000) or incorporate employee assistant schemes (Wynne-Jones *et al.*, 2007; Cherkin, 2002); in order to limit exposure to factors identified as possible contributors to the LBP, as this decreases the cost to the employer (Coole *et al.,* 2010; Dagenais *et al*., 2008; Cholewicki, Grauer and Simpson, 2006; Waddell, 1999).

- The employees, who would be able to understand the context in which they would benefit from company employee assistant schemes in order to improve not only their productivity but also overall health (Dagenais *et al*., 2008; Bongers *et al.,* 2006; Glover *et al.,* 2005; West and Gardner, 2001; Cromie *et al.,* 2000).

This research, looking at comparing the sedentary to the manual employee, would allow for the development of intervention strategies that are of particular interest to the respective groups and also highlighted the differences in needs (if any) between them (Gilkey *et al.,* 2007). Without identification of the specific risk factors affecting employees it is very difficult to develop preventative programmes and strategies (Gilkey *et al.,* 2007) and, therefore, reduce its economic impact (Dagenais *et al.*, 2008). Thus, identifying these risks may also effectively prepare employees for the hazards and risks they will face in the workplace (Rupert and Ebete, 2004; Nyland and Grimmer, 2003).

Additionally, this research will aid in addressing the paucity of literature with regard the South African context, with the majority of studies stemming from Europe, America, the Far East and Australia / New Zealand (Bell and Burnett, 2009; Dagenais *et al.,* 2008; Hartvigsen *et al.,* 2004). Highlighting a concern raised by Gilkey *et al.*, (2007), that there are only a few studies available on indigenous and developing countries.

1.4 Limitations

Questionnaire studies depend on the fact that the researcher is required to rely on participant responses (Dyer, 1997; Mouton, 1996). Therefore, in this research, it was assumed that employees would be open and honest when responding to the questions in the questionnaire and that their responses would be reflective of their reality at the time of questionnaire completion.

Further, it was noted that English is required by the company in terms of its standard operating procedure when prospective employees are employed. Therefore, the questionnaire was only made available in English, although this may not necessarily have been the first language for some employees. Thus, language may have played a role in the understanding of the questionnaire (Baynham, 1995; Scollen and Scollen, 1995).

1.5 Conclusion

From this chapter, it can be noted that it is important to characterize the type of LBP that particular population groups suffer from in order to determine the appropriate prevention strategies. Therefore, Chapter Two presents the literature as pertinent to this study, followed by the methodology applied in this study. In contrast, Chapter Four presents the findings of this study in the context of the automotive industry, with Chapter Five contextualizing these results in the literature. Finally, Chapter Six concludes the study highlighting the important findings and also suggests recommendations for future studies.

Chapter Two:

2.1 Introduction to the Low Back

This chapter investigates, and explains the anatomy of the lumbar spine and elaborates with an in depth explanation of the osseous structures, muscles, ligaments and nerve supply. The epidemiology, aetiology, risk factors, treatment and the implications of LBP will also be investigated.

2.2 Anatomy of the Low Back

2.2.1 Definition of the low back

In lay terms, the extent of the back comprises of the anatomical structures that constitute the posterior aspect of the trunk, inferior to the neck and superior to the buttocks (Moore and Dalley, 1999). In contrast, the gluteal region refers to the area from the superior buttocks, which is the level of the iliac crests to the gluteal folds bilaterally, separating the thighs from the buttocks (Standring, 2008; Moore and Dalley, 1999). In the context of these two anatomical definitions, the clinical definition for the low back usually refers to that area which lies between the 12^{th} ribs superiorly and the bilateral gluteal folds inferiorly, thus incorporating the inferior aspects of the back and the entire gluteal region and is bounded laterally by the mid-axillary line (Galukande *et al*., 2005; Anderson, 1997).

2.2.2 Osseous structures

In the above region, the skeletal structure of the low back consists of five lumbar vertebrae, the five fused sacral vertebrae (sacrum) and the four fused coccygeal vertebrae (coccyx) (Standring, 2008; Moore and Dalley, 1999).

2.2.2.1 Lumbar vertebrae

A typical lumbar vertebra consists of a vertebral body (anterior vertebral element), a vertebral arch and seven processes (posterior vertebral elements) (Moore and Dalley, 1999).

The anterior vertebral element or lumbar vertebral body is a large, cylindrical bone which supports weight distribution throughout the vertebral column and, therefore, supports increasing body weight, down the spinal column. Therefore, the vertebral body is made up of greater numbers of vertical trabeculae (as compared to horizontal trabeculae), enclosed by a thin external layer of smooth compact bone, called the epiphyseal rim (the principle function of which is the attachment of the intervertebral disc and related ligaments) (Yochum and Rowe, 2005; Moore and Dalley,1999; Cox, 1990).

In contrast, the posterior elements of the vertebral body are smaller and consist of the vertebral arch, created by the union of the pedicles and lamina bilaterally as well as the singular spinous process. The pedicles are generally short, stout cylindrical processes that project posterior from the vertebral body to meet two broad, flat plates of bone called the laminae, which in turn fuse to form the terminal spinous process (Yochum and Rowe, 2005; Moore and Dalley, 1999; Cox, 1990). Arising from the interface of the pedicle and laminae (a region known as the pars interarticularis), are bilateral transverse processes for the attachment of the major muscular movers of the spine (Standring, 2008). Also arising from this region are the four articular processes (two superior and two inferior), each bearing an articular surface known as the facet (Cramer and Darby, 2005). The superior and inferior facets meet to form the two zygopophyseal joints present in each motion segment (Bergman and Peterson, 2011; Beck, 2009; Standring, 2008; Moore and Dalley, 1999; Bergman *et al*., 1993).

Together the vertebral arch and the posterior surface of the vertebral body form the circular boundary of the vertebral foramen (Bergman and Peterson, 2011; Beck, 2009; Standring, 2008; Clancy and McVicar, 2002; Bergman *et al*., 1993). Lateral views of the vertebrae show superior and inferior indentations called vertebral notches between the anterior and posterior bony elements, which aid the formation of the intervertebral foramen. These foramina are additionally bound by the intervertebral discs that lie between successive

vertebral bodies and posteriorly by the facet / zygopophyseal joints (Cramer and Darby, 2005; Haldeman, 2005; Bogduk and Twomey, 1987).

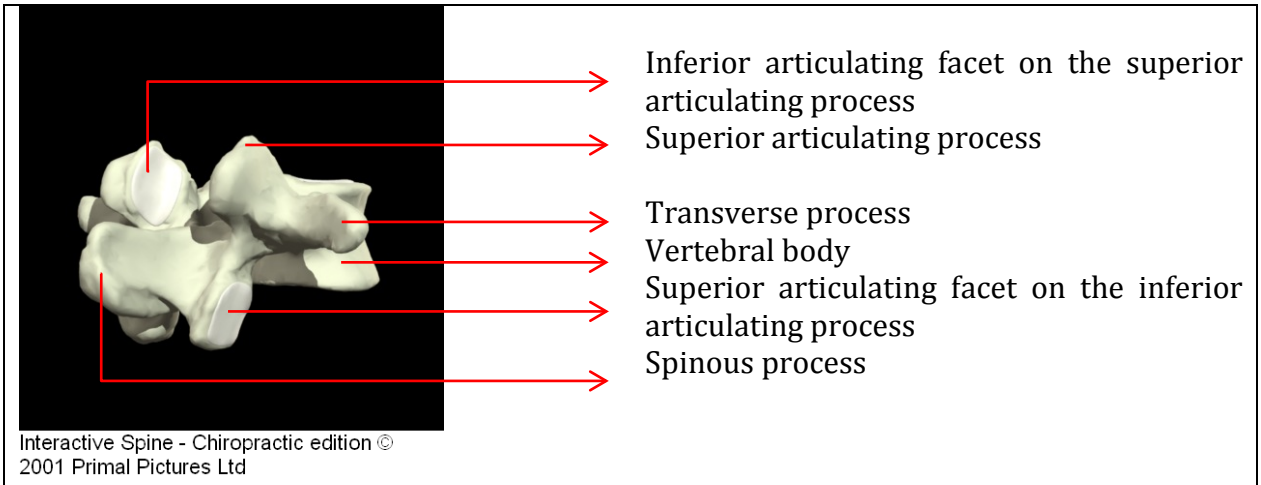

Figure 2.1 The vertebral body posterolateral view

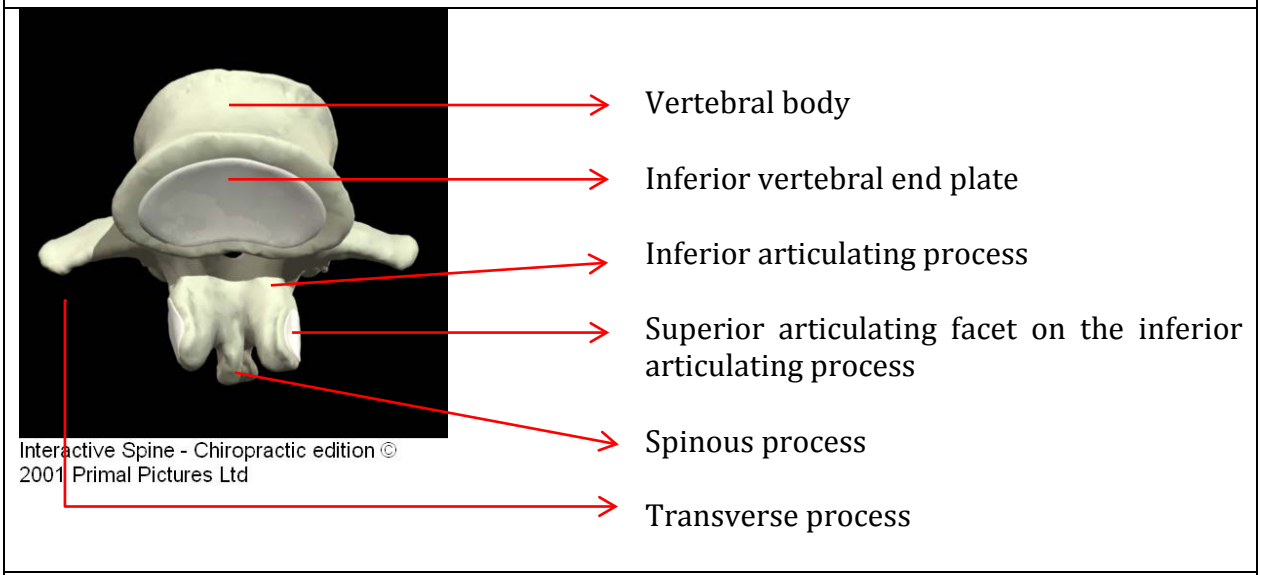

Figure 2.2 The vertebral body anteroinferior view

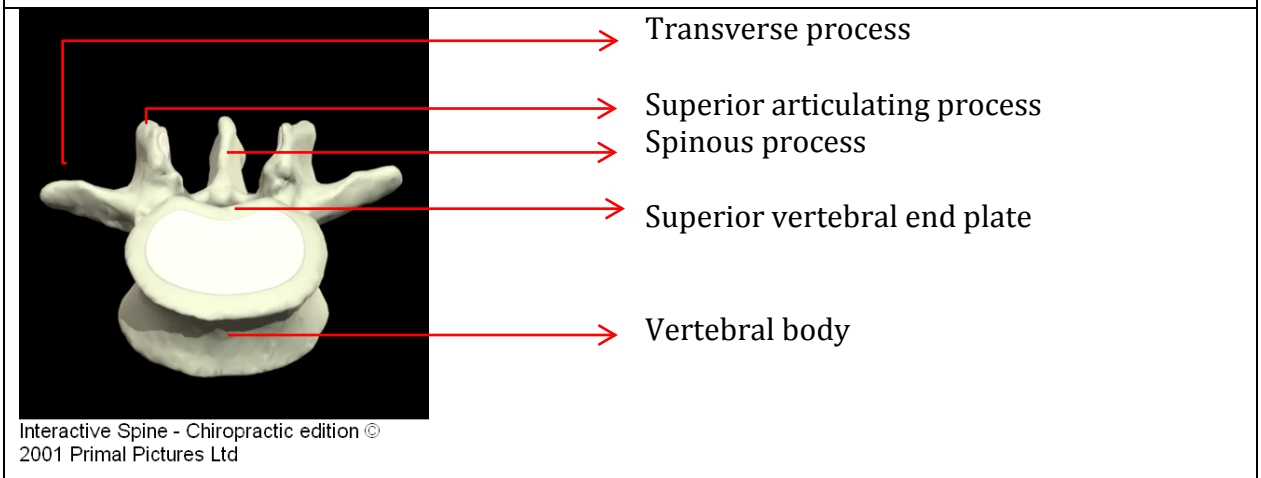

Figure 2.3 The vertebral body anterosuperior view

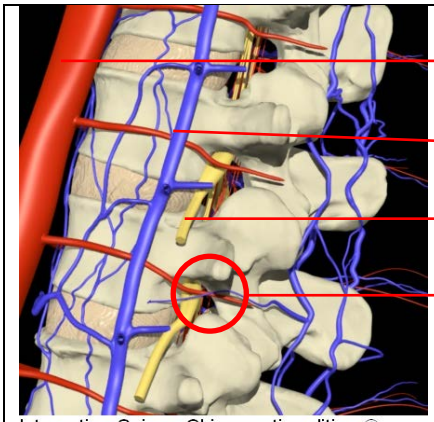

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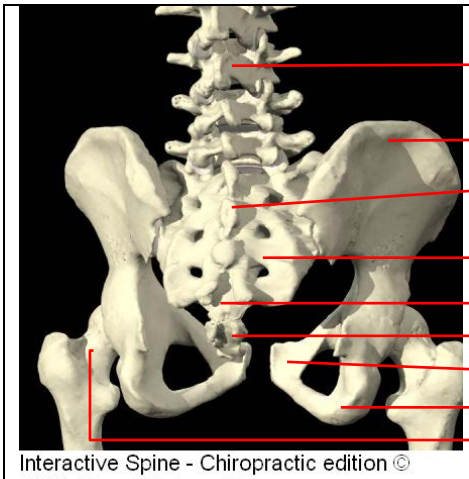
Figure 2.4 The intervertebral foramen

2.2.2.2 The sacrum and coccyx

In contrast to the lumbar spine, which facilitates movement, the sacrum is required to be more rigid in that it is responsible for the transfer of weight from the body to the pelvis and onward to the lower extremities. Therefore, it is composed of five fused vertebral segments, that forms an inverted triangular shape, with the apex inferiorly and the promontory superiorly. The sacrum, therefore, unlike the lumbar spine does not have transverse processes, but it does have a median and lateral sacral crests for the attachment of muscular and ligamentous structures (Yochum and Rowe, 2005; Moore and Dalley, 1999 Cox, 1990).

Similar to the lumbar spine, the sacrum has “intervertebral foramina” referred to as sacral hiatuses, which like the lumbar spine; facilitate the exit of neural structures from the sacral canal. Additionally, the inferior most part of the sacrum has two sacral cornua (which bound the inferior end of the sacral canal), which allows for the filum terminale to exit the inferior most part of the sacrum and allows it to attach to the coccyx. Reciprocally, the coccyx has two coccygeal cornua that assist with the protection of the filum terminale (Martini *et al.,* 2012; Standring, 2008; Yochum and Rowe, 2005; Moore and Dalley, 1999; Cox 1990).

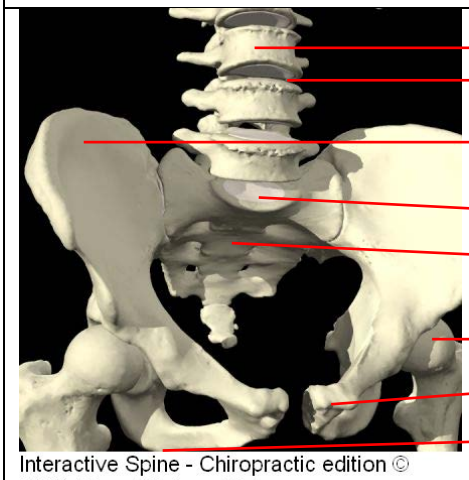


Vertebral body (lumbar)

Iliac bone
Median sacral ridge

Sacral foramina
Sacral cornua
Coccygeal cornua
Pubic bone
Ischial bone
Femoral neck between femoral head and the shaft of the femur

Figure 2.5 The Sacroiliac ligaments - posterior



Vertebral body
Intervertebral disc

Iliac bone

Sacral promontory
Anterior surface of the sacrum

Femoral head
Pubic bone

Ischial bone

Figure 2.6 The Sacroiliac ligaments - anterior

2.2.3 Articulations and ligaments

The low back is characterized by the following joints (Martini *et al.,* 2012; Standring, 2008; Yochum and Rowe, 2005; Moore and Dalley, 1999; Cox, 1990):

- The 12th costotransverse / costovertebral joints bilaterally,
- The zygopophyseal (facet) joints,
- Intervertebral joints (intervertebral discs) and
- The sacroiliac joints.

2.2.3.1 The 12th costotransverse joints

This is the last set of joints between the 12th ribs bilaterally and the transverse process and vertebral body respectively. The former being bound by an articular capsule and supported by inferior, superior and medial costotransverse ligaments. By contrast, the costovertebral joints are bound by a capsule and a singular ligament referred to as the radiate ligament, which lies posterior and lateral to the anterior longitudinal ligament (which provides some support to the radiate ligament) (Martini *et al.,* 2012; Standring, 2008; Yochum and Rowe, 2005; Moore and Dalley, 1999).

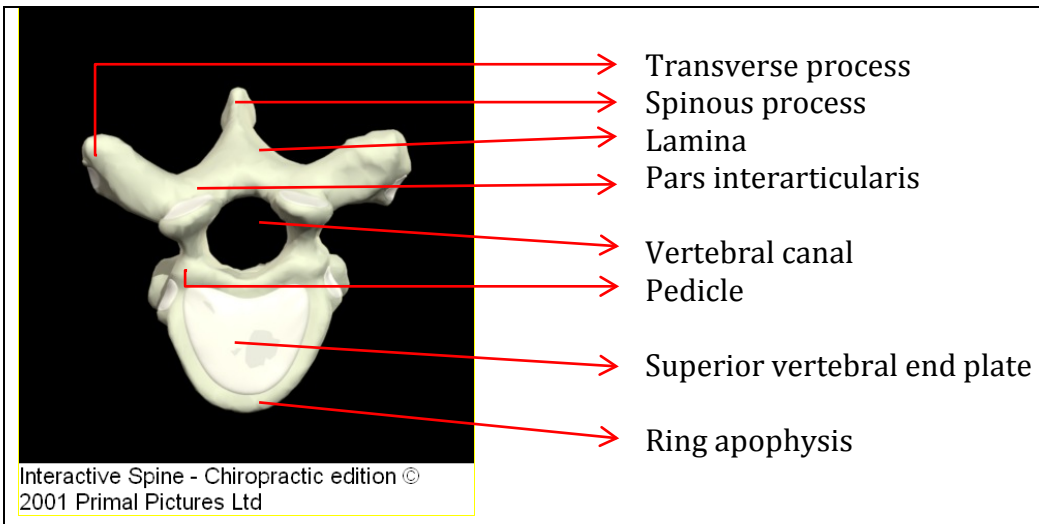
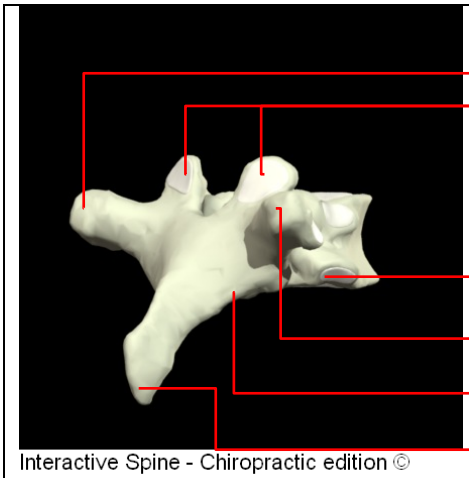


Figure 2.7 The rib articulations with the vertebral bodies

2.2.3.2 The Zygopophyseal (Facet) joints

The facet joints are paired joints found at each vertebral level and formed by the union of the superior articulating facet (from the inferior articular process of the vertebra above) and the inferior articulating facet (from the superior articular process from the vertebra below). These facets are bound by an articular capsule, which is supported anteriorly by the ligamentum flavum and has little support posteriorly as there are no re-inforcing ligamentous structures (Martini *et al.,* 2012; Standring, 2008; Yochum and Rowe, 2005; Moore and Dalley, 1999).



Transverse process
Inferior articulating facets of the superior articulating processes

Superior articulating facets of the inferior articulating processes
Transverse process

Lamina
Spinous process

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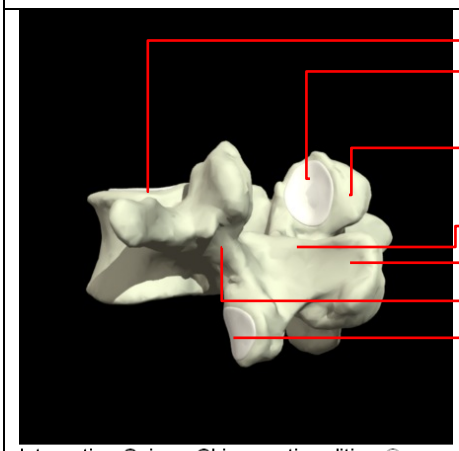
Figure 2.8 The facet joints – A



Superior vertebral end plate
Inferior articulating facets of the superior articulating processes
Superior articulating processes

Lamina
Spinous process
Pars interarticularis
Superior articulating facets of the inferior articulating processes

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Figure 2.9 The facet joints – B

2.2.3.3 Intervertebral joints (intervertebral discs)

The intervertebral joints are formed between the vertebral bodies, where the discs are responsible for acting as shock absorbing cushions between these rigid structures. The discs are formed externally by an annulus fibrosis that is composed of layers of lamellae (which insert into the ring apophysis of the vertebral bodies) and internally by the nucleus pulposus that is formed by a gel-like mucoid substance. In the case of the former, the lamellae are juxtaposed at right angles to each other, such the annulus can be deformed by different rotary forces, but still protect and contain the gel-like nucleus pulposus (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1999).

Anteriorly, the disc is supported by the anterior longitudinal ligament (ALL) that passes from the anterior atlanto-occipital membrane to the anterior aspect of the coccyx. At each vertebral level over the region of the disc the anterior longitudinal ligament (ALL) broadens to fuse with the anterior lamellae of the disc for support, before narrowing over the vertebral body again (Bogduk and Twomey, 1987). This process of broadening and narrowing occur along then entire length of the spine, being broadest in the lumber spine and narrowest in the region of the coccyx (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1999).

Posteriorly, the disc is supported by the posterior longitudinal ligament (PLL) (Bogduk and Twomey, 1987) which, much like the ALL expands at the level of the disc to provide support and then narrows as it passes through between the pedicles on either side. The PLL extends from the tectorial membrane superiorly to the sacral cornua inferiorly (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1999).

Collectively, the ALL and PLL allow for disc protection in all movements with the exception of the posterolateral aspect of the disc, where little protection is provided by either ligament, and therefore, this makes this portion of the disc most vulnerable to protrusion, herniation and subsequent sequestration. This, therefore, is also a common cause of lateral canal stenosis (Magee, 2007; Morris, 2006; Reider, 1999).

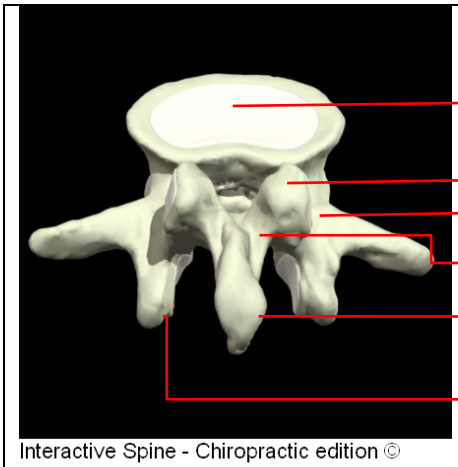

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Figure 2.10 The intervertebral disc

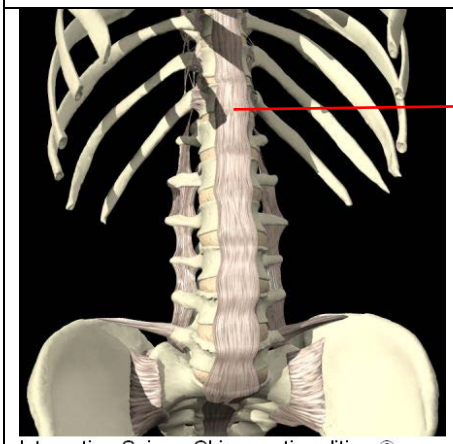

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Figure 2.11 The anterior longitudinal ligament

2.2.3.4 The Sacroiliac joints

The sacroiliac joints are found bilaterally between the sacrum and the ilia of the os coxae (Martini *et al.,* 2012; Standring, 2008; Yochum and Rowe, 2005; Moore and Dalley, 1999). These joints are required to be highly stable for the transfer of body weight from the spine to the extremities, and are therefore, highly interlocking joints that show little movement ability (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1999). This arrangement prevents easy dislocation and lessens the strain on the support ligaments of the joint. Although attempts have been made to assess the motion in the SI joint, its biomechanical function remains largely unknown (Morris, 2006; Cassidy *et al.,* 1988). Joint movements are coupled, consisting mainly of x-axis rotation and z-axis translation (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1999; Cassidy *et al.,* 1988).

In addition, the joints are supported by the following ligaments:

- Anterior sacroiliac ligament (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1998; Cox, 1990):
    - These ligaments are composed of short strong fibres that are supported superiorly by the iliolumbar ligaments (transverse process of the anterior sacroiliac as it passes over the promontory to the fifth lumbar vertebra to the iliac crest (horizontal portion) and attaches to the ilium inferiorly)). In addition, the anterior sacroiliac ligaments are re-inforced by the anterior interosseous ligaments that lie just beneath it and form part of the capsule.
- Posterior sacroiliac ligament (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1998; Cox, 1990):
    - This is the posterior counterpart of the anterior sacroiliac ligament, but not as strong as the anterior sacroiliac ligament and draws support from the posterior musculature and the thoracolumbar fascia to ensure optimal support for the sacroiliac joints. Inferiorly, the ligament blends with the sacrotuberous ligaments inferiorly.

- Interosseous ligaments (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1998):
    - These ligaments fuse with the capsule and are found between the joint surfaces of the sacroiliac joint. They are responsible for limiting the amount of distractive forces imparted into the sacroiliac joint by the weight of the body.

- Sacrotuberous ligaments (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1998; Cox, 1990):
    - The sacrotuberous ligament originates from the posterior superior (posterior superior and inferior iliac spines), and inferior (lateral sacral crests and lateral margin of the coccyx) aspects of the sacrum to the ischial tuberosity.
    - These bilateral ligaments are responsible for supporting the sacroiliac joints by limiting the amount of x-axis rotation of the sacrum (i.e. movement of the promontory anteriorly and inferiorly or the sacral apex posteriorly and superiorly), thereby stabilising the sacroiliac joint and its movements.

- Sacrospinous ligaments (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1998; Cox, 1990):
    - The sacrospinous ligament originates from the lateral margins of the sacrum and coccyx and inserts the ischial spines bilaterally.
    - Similar to the sacrotuberous, the sacrospinous also limits the amount of sacral nutation and x-axis rotation of the sacrum.

- Sacrococcygeal ligaments (Martini *et al.,* 2012; Standring, 2008; Moore and Dalley, 1998)
    - These ligaments attach from the sacral cornua to the coccygeal cornua posteriorly and assist in supporting the sacro-coccygeal joints.

Further support for the sacroiliac joint arises from the muscles of the low back, as outlined in 2.2.5. The SI joint is surrounded by some of the largest and most powerful muscles in the body. None of these muscles cross the joint or are known to directly influence joint movement. However, contraction of these muscles place shear and moment loads on the joint surfaces, hence influencing any movement at the SI joint (Morris, 2006; Bergman *et al.,* 1993; Mierau *et al.,* 1989).

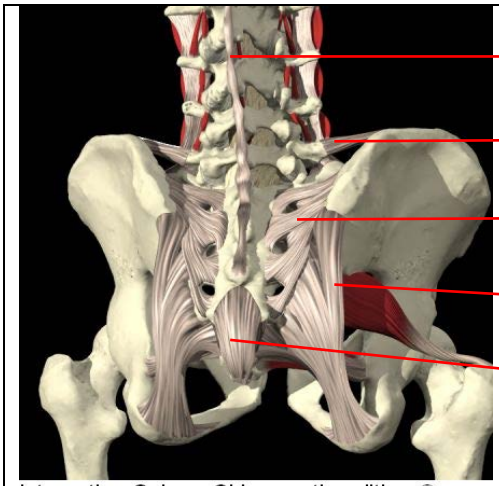

Figure 2.12 The posterior sacroiliac ligaments

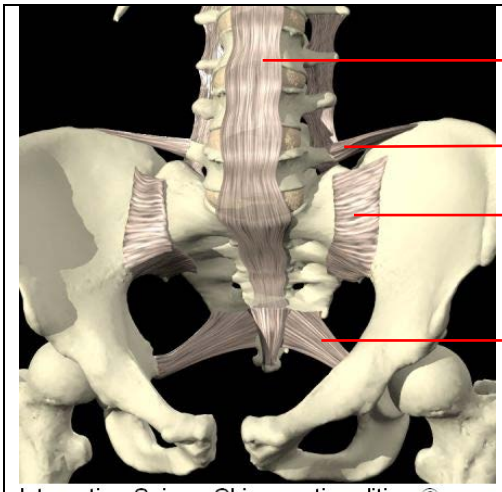

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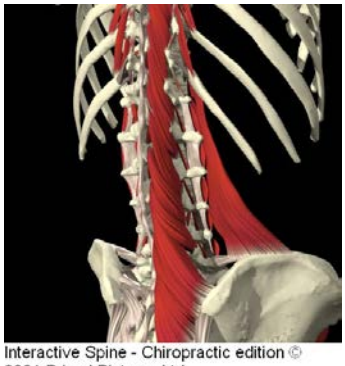
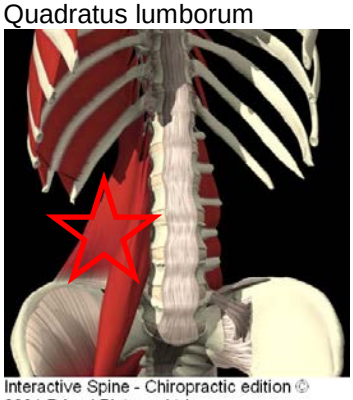
Figure 2.13 The anterior sacroiliac ligaments

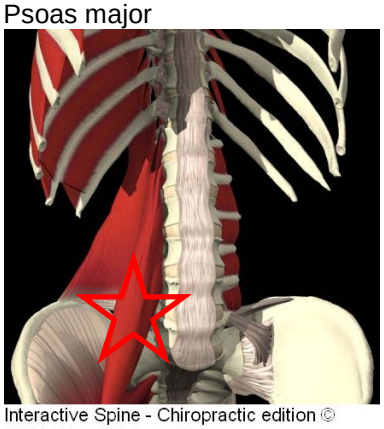
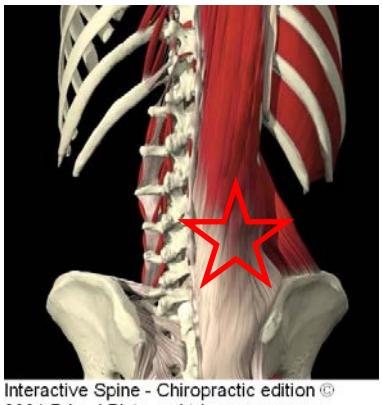
2.2.5 Muscles of the low back

2.2.4.1 Muscles descriptions

Table 2.1: Muscles influencing the lumbar spine adapted from Moore and Dalley (1999) and Dyer (2012)			
MUSCLE	**ORIGIN**	**INSERTION**	**INNERVATION**
External Oblique	External surfaces and inferior borders of 5th-12th ribs.	Linea alba in midline, pubic tubercle and anterior half of iliac crest.	Inferior 6 thoracic nerves and subcostal nerve.
Internal Oblique	Lateral half of the inguinal ligament, the anterior two-thirds of the iliac crest and thoracolumbar fascia.	Cartilages of the 10th-12th ribs, linea alba and pubis through the conjoined tendon.	Ventral rami of inferior 6 thoracic nerves and the first lumbar nerves.
Multifidus  **Figure 2.14 The Multifidus muscle**	Base of a vertebral spinous process.	Fibres cross 2-4 segments throughout the thoracic and lumbar spine and attach to a transverse process.	Dorsal primary rami of spinal nerves. The lumbar multifidus are arranged so that fibres moving a particular segment are innervated by the nerve of that segment.
Rectus Abdominus	Pubic crest and pubic symphysis.	Costal cartilage of the 5th-7th ribs and xiphoid process.	Ventral rami of inferior 6 thoracic nerves.
Quadratus lumborum  **Figure 2.15 The Quadratus lumborum**	Medial half of inferior border of 12th rib and the tips of the first four lumbar transverse processes.	Internal lip of iliac crest and iliolumbar ligament.	Branches of lumbar plexus arising from T12 and L1-L4 spinal nerves.
Transversus abdominus	Lateral third of the inguinal ligament, iliac crest, thoracolumbar fascia and the internal surfaces of 7th-12th costal cartilages.	Midline linea alba via the rectus sheath and to the pubis through the conjoined tendon.	Branches from the 8th-12th intercostal nerves innervate the transversus abdominus as well as the first lumbar nerves.

2.2.4.2 Muscle actions

Table 2.2: Principle muscles producing movements of the lumbar intervertebral joints (adapted from Kirkaldy-Willis and Bernard, 1999; Gatterman, 1990)

Flexion	Extension	Lateral bending	Rotation
Bilateral action of:	Bilateral action of:	Unilateral action of:	Unilateral action of:
Rectus abdominis Psoas major  Interactive Spine - Chiropractic edition © 2001 Primal Pictures Ltd **Figure 2.16 The psoas muscle**	Erector spinae Multifidus  Interactive Spine - Chiropractic edition © 2001 Primal Pictures Ltd **Figure 2.17 The erector spinae**	Multifidus Internal and external Obliques Quadratus lumborum	Rotatores Multifidus External Oblique Acting with opposite Internal Oblique

2.2.6 The innervation of the lumbar spine, sacrum and coccyx

The segmental innervation of the facet joints, arise from the lumbar dorsal rami, which are branches of the spinal nerve at each level and each side respectively. This dorsal ramus divides to form the medial, median and lateral branches of the dorsal ramus. Of these, the medial branch supplies the facet joint posteriorly, by supplying the joint capsule. Anteriorly, the capsule is supplied by ascending, descending and transverse branches of the sinuvertebral nerve (recurrent meningeal nerve – a branch of the spinal nerve root as it exits the intervertebral foramen), which are responsible for supplying the ligamentum flavum and the anterior portion of the facet joint capsule. It has been noted in some anatomy texts that a single facet joint may be supplied by the relevant segmental level as well as the level above and the level below the respective segment (Martini *et al.,* 2012; Cramer and Darby, 2005; Standring, 2008).

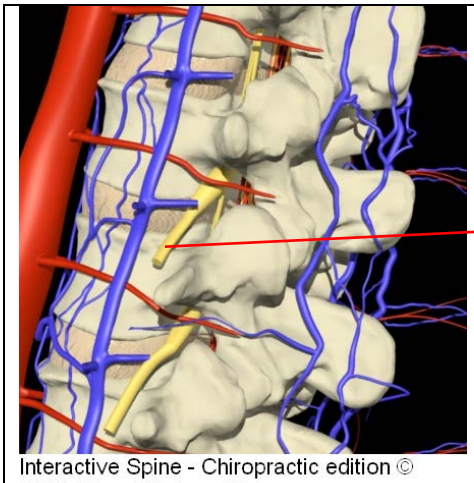


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Figure 2.18 The innervation of the lumbar spine

In contrast to the above, the segmental supply of the SI joint ranges from L2-S4. The L4-L5 levels innervate the anterior aspect of the joint, whilst the posterior aspect receives innervation from S1-S2 levels (Martini *et al.,* 2012; Cramer and Darby, 2005; Standring, 2008; Mierau *et al.,* 1989). In addition, plexiform networks formed by the posterior primary rami of the L5-S4 segments innervate the posterior aspect of the SI joint. The accessory ligaments of the SI joint receive fibres from L1-S2 (Martini *et al.,* 2012; Standring, 2008; Walters, 1993). Mechanosensitive afferent units have been identified in the SI joint and adjacent tissues (Sakamoto *et al.*, 2001).

2.2.5.1 Joint receptors

As a result of the innervation of the joints, muscles and related structures, the low back is prone to developing pain that arises out of this complex neurological arrangement. Therefore, this next section looks briefly at the receptors that are present and the impact this has on the presentation of LBP.

2.2.5.2 Intra-articular receptors

Neurological receptors are specialized cells that change their properties in response to specific stimuli. In this context, receptors that respond to physical or mechanical stimuli are termed mechanoreceptors. Joint receptors are principally mechanoreceptors, but can also act as proprioceptors. Therefore, joint receptors have two major functions in that they provide position sense (proprioceptive information) about the relationship of different body segments, and that they initiate protective reflex arcs / mechanisms to prevent joint injury and help stabilize the joint (Hopkins and Ingersoll, 2000).

The four different types of mechanoreceptors joints include (Freiwald, Reuter and Engelhardt, 1999):

Type 1- Ruffini bodies / Ruffini end organs

These are the second most common type of receptor type in joints (Freiwald, Reuter and Engelhardt, 1999), which are classified as slow-adapting receptors principally within joint capsules. These receptors have a very low threshold and respond to very slight changes in ligament tension and capsular pressure (Hopkins and Ingersoll, 2000).

Type 2- Vater-Pacini bodies

Similarly, these receptors are found in the capsules and ligaments. Their principle function is the rapid uptake and transport of information from the afferent tissues to the spinal cord. They only become active in joint movements (accelerations or decelerations). Thus, the Vater-Pacini sensors have a low threshold for mechanical stimulation, but adapt rapidly (acting as dynamic mechanoreceptive transducers) (Freiwald, Reuter and Engelhardt, 1999).

Type 3- Golgi tendon organs

These are found in the muscle-tendon bond / interface. Therefore, these receptors are similar to the Ruffini bodies (localized in the joints), but they provide information regarding joint position / proprioception (Freiwald, Reuter and Engelhardt, 1999).

Type 4- Free nerve endings

Free nerve endings by contrast, are non-specialized, non-encapsulated, unmyelinated (finely myelinated) receptors. With this structure, they function as pain receptors. Therefore, these nerve endings are found throughout the joint tissue and related soft tissues (Hopkins and Ingersoll, 2000).

2.2.5.3 Extra-articular receptors

Muscle spindles are extra-articular receptors that are located within muscle. The intrafusal fibres are innervated by type I alpha nerve fibres, which stimulate motor neurons (Solomon, Schmidt and Adragna, 1990). The afferents of the muscle spindle are type II nerve fibres that synapse with spinal ganglia. Type II afferents also stimulate the motor neurons but their effect is generally multi-segmental. They have a promoting effect on the agonist and an inhibitory effect on the antagonist muscle at the given innervation level (Freiwald, Reuter and Engelhardt, 1999).

2.3 Originators of pain

Based on the above distribution of receptors, Vlok (2005) developed a table indicating the most likely causes of pain as a result of damage to particular structures. This concurs with Leach (2004) and Cramer and Darby (2005) who indicate that damage to the integrity of the anatomical structures within a vertebral motion segment results in a process of inflammation which is the principle source of pain (as a result of nociceptive stimulation).

Table 2.3: The originators of pain in the low back (Adapted from Vlok, 2005)

Anatomical part of the spine	Cause of the deviation from the normal posture	Resultant change in the normal anatomy	Causes for the development of LBP
Disc	Rotation / twisting and flexion movements with compression	Annulus tearing	Inflammation, Long term disc protrusion or herniation's
Facets	Rotation / twisting and extension movements	Capsular tears leading to posterior joint capsule synovitis and impaction of the facet joints limiting normal movement	Inflammation, Joint movement restriction (subluxation). Degeneration or fibrosis may follow at a later stage
Muscles	Overuse, fatigue, inability to splint	Muscle spasm due to joint changes, restricted movement	Ischemia, metabolite build up, aggravation of pain and sustained hypertonic contraction.

The pain, once present is then responsible for a variety of other clinical signs and symptoms in the low back (Haldeman, 2005; Leach, 2004; Redwood and Cleveland, 2003), which include, but may not be limited to, decreased range of motion (Bergmann and Peterson, 2011), muscle splinting (muscle spasms / myofascial trigger points) (Travel and Simons, 1999), muscle dysfunction (arthrogenic muscle inhibition or core muscle dysfunction) (Hopkins and Ingersoll, 2000), pathophysiology (e.g. oedema / scar formation) (Redwood and Cleveland, 2003; Leach, 2004), perceived local (referred pain) or distal (radicular pain) symptoms (Redwood and Cleveland, 2003; Morris, 2006) as well as increased muscular or bony prominence tenderness (Magee, 2002). These signs and symptoms may be prolonged due to chronic inflammatory processes (Morris, 2006) or as a result of either of the controversial “neurogenic inflammation” (Redwood and Cleveland, 2003). These latter processes are thought to be the reason why LBP is a recurrent phenomenon in the general population (Morris, 2006; Redwood and Cleveland, 2003). In both contexts of acute or chronic non-specific LBP, it is a well documented that acute and long-term disability respectively are present mainly in economically active populations (Pope, Goh and Magnusson, 2002; Anderson 1999), with a lifetime prevalence of 70% to 85% noted in these populations specifically (Roffey *et al.*, 2010a; Roffey *et al*., 2010b; Roffey *et al.*, 2010c; Roffey *et al.*, 2010d; Roffey *et al*., 2010e; Wai *et al.*, 2010a; Wai *et al.,* 2010b; Costa, 2007; Silva, 2004; Loney and Stratford 1999; Anderson, 1999).

2.4 Epidemiology of LBP

2.4.1 Prevalence and incidence of LBP

According to Dagenais and Haldeman, (2012); Bronfort *et al.*, (2010); Dagenais e*t al., (*2008); Haldeman, (2005) the incidence and prevalence of LBP is high and therefore of increasing international concern. Their research has found that 60% to 80% of the population will suffer from LBP at some time in their lives and that 20% to 30% suffer from it at any given time (Burton*,* 1997).

To this end, Hoy *et al*., (2005), noted that the ***annual incidence (new cases)*** was at an average of 9.73%, indicating that there is an annual increase of new cases of almost 10%. This, therefore, supports the lifetime average percentage for incidence of LBP at 29,85% and concurs with the much earlier work of Hillman *et al.,* (1996), who indicated that during 1996 in the United Kingdom, the average an annual incidence for LBP was 47/1000 (with a range of 38-58/1000).

In contrast, the ***lifetime prevalence (ever having had LBP)*** of LBP was noted to range from 26,4% - 79,2% in the USA (Deyo *et al*., 2006) and Australia (Walker *et al*., 2004). These figures concur with and allow for the inclusion of prevalence figures obtained in the French population (Rossignol *et al*., 2009) and in the Chinese population (Jin *et al*., 2004) where LBP is reported to have a lifetime prevalence of 50%.

The above also concurs with Cassidy *et al.,* (1988) results who reported a 29% point prevalence, 69% 6-month prevalence, and 84% lifetime prevalence and Biering-Sorensen *et al.,* (1989), who indicated a point prevalence of 14%, 1-year prevalence of 45%, and lifetime prevalence of 62%; as well as Hillman *et al.,* (1996) who revealed a point prevalence of 19%, 1-year prevalence of 39%, and lifetime prevalence of 59%. Furthermore, in the context of the lifetime prevalence of LBP, Loney and Stratford (1999), who critically evaluated 18 studies, indicated that lifetime prevalence seemed to range from 59% to 84%. These latter authors also considered point prevalence in their summary, which concurred with Cassidy *et al.,* (1988), Biering-Sorensen *et al.,* (1989) and Hillman *et al.,* (1996). The statistics, however, are limited to the developing world.

Therefore, it is important to consider Galukande *et al*., (2005), who reported that the LBP lifetime prevalence in Uganda was reported to be 62% (point and period prevalence's not being reported). Similarly, in terms of the South African context, it is noted that Docrat (1999), reported on a comparison between the Coloured and Indian communites of South Africa indicating that lifetime prevelance was 76.6% in Coloureds and 78.2% in Indians. These reported lifetime prevelances are higher than the lifetime prevalence of LBP in the Black population of Chesterville which was noted at 57,6% (Van der Meulen,1997).

The above figures on annual incidence and lifetime, period and point prevalences seem to support and confirm the findings of Louw *et al.,* (2007), who indicated the prevalence of LBP in Africa is high and increasing. This has been suggested to be as a result of greater predisposing factors for LBP being present in Africa (Woolf and Pfleger, 2010). This, therefore, may support a predominance of LBP in manual labour and related activity implying that these factrors are not protective of LBP (Woolf and Pfleger, 2010). This however, is in contrast to Coole *et al.,* (2010); Woolf and Pfleger, (2010); Dagenais *et al.*, (2008); Woodwell and Cherry, (2004); and Guo *et al*., (1999), who indicated that developing countries would financially benefit from a reduced prevalence of LBP because of the costs involved (loss of workforce, absenteeism, medical costs) in treating patients with LBP, because it places an increased burden on the economy (Wasiak *et al.*, 2006; Ekman *et al.*, 2001; Manga *et al.,* 1992).

Therefore, it is essential to understand the predisposing factors to LBP in the developing countries and particularly the contribution that occupation, manual labour and related activities contribute to the incidence, prevalence and severity of LBP in these communities (Roffey *et al.*, 2010a; Roffey *et al*., 2010b; Roffey *et al.*, 2010c; Roffey *et al.*, 2010d; Roffey *et al*., 2010e; Wai *et al.*, 2010a; Wai *et al.,* 2010b; Dempsey *et al.,* 1997).

To better understand what is known about the predisposing factors and how these affect the various communities and working populations, the following section outlines these predisposing factors, indicating what the possible outcome may be if particular characteristics where to be present in different groups of people sharing a similar working environment.

2.4.2. Predisposing factors of LBP

Prior to determining predisposing factors to LBP, possible aetiological factors should be identified (Bell and Burnett, 2009). In the workplace, the physical work environment (e.g. physical demands, mechanical loading, place of work, ergonomics), organizational factors (e.g. support, lack of control), social contexts (e.g. physical activities) and individual factors may all play a role in the first episode and recurrence of LBP (Redwood and Cleveland, 2003). In addition, psychosocial factors (outside of the workplace) have also been identified as important in the progression of LBP, although their specific role in the cause, and recurrence, of LBP at work is still unclear (Bell and Burnett, 2009).

In terms of all factors related to LBP, those most directly related to occupational LBP, according to the literature are: mechanical factors, postural factors, traumatic factors and factors related to tobacco use / smoking, body weight and physical activity / exercise (Roffey *et al.*, 2010a; Roffey *et al.*, 2010b; Redwood and Cleveland, 2003), in addition to the presence of physical / psychological comorbidities as well as genetic factors (Helfenstein-Junior *et al.,* 2010; Dagenais and Haldeman, 2008). In order to understand these individual factors, each will now be addressed as follows:

2.4.2.1 Sociodemographic factors

2.4.2.1.1 Age

Aging is an evolutionary and dynamic process that results in degenerative changes (Morris, 2006), not only in the intervertebral discs, but also in ligaments and bones, accounting for most diseases and disorders, impairment and disability of the aging spine (Cramer and Darby, 2005). The pathogenesis of degenerative changes in the aging spine, entailing three phases, begins with dysfunction and progressing to unstable and stabilizing phases (Morris, 2006; Kirkaldy-Willis and Burton, 1999). In the context of a three-joint complex / motion segment (Cassidy and Burton, 1988), it therefore stands to reason that there is an increased likelihood of clinical symptomatology with regards to patients presenting with LBP as the population in this study ages (Bernick, 1991). This can be seen in Table 2.4, where the literature indicates increased prevalence percentages as one moves from point to period and then to lifetime prevalence's (viz. there is no decrease in the percentages obtained, but rather an increase, which indicates and increased likelihood of LBP as a person ages).

Table 2.4. INTERNATIONAL PREVALENCE OF LBP (adapted from Dyer, 2012)				Point %	One year %	Life %
AUTHOR	**DATE**	**COUNTRY**	**TYPE OF STUDY**			
Hillman *et al.,*	1996	United Kingdom – Bradford	National	19	39	59
Jin *et al.,*	2004	Shanghai	National	-	40-74	50-79
Galukande *et al.,*	2005	Africa – Uganda	National	20	-	62.3
Van Vuuren *et al.,*	2006	-	Steel industry	36	56	64
Van Vuuren *et al.,*	2006	-	Manganese industry	37.6	69.8	71.6
Dagenais and Haldeman	2012	-	International	25	50	85

In addition the likelihood for increased severity and the possibility for complications of LBP increasing with age (Morris, 2006; Bernick, 1991). It has therefore been noted that LBP is a major cause of suffering, disability and increasing social costs, in people younger than 45 years of age (Thomas, 2007). Thus, in this study it is anticipated that if the study sample population represents a younger population then the extent, degree and likelihood of LBP would be lower. However, the converse would be true if the population in this study represented an older age group. This may be compounded in the comparison between manual and sedentary employees in this particular study, as it is anticipated that with advancement / progression of work over an employee's lifetime, it is possible that an artificial result as a consequence of aging may be present in the sedentary group as compared to a younger manual employee group resulting in ambivalent results.

2.4.2.1.2 Height / weight / BMI:

In terms of these anthropometric measures, it has been shown that there is an association between body weight and LBP. Lean (1998), in a cross-sectional study of approximately 13,000 (6,000 men and 7,000 women), aged 20 to 59 years, reported that chronic LBP of more than 12-weeks per year was found in 14% in men with a normal waist circumference, compared to 20% and 21% with moderately and significantly larger waist circumference. Similarly, Han (1997) evaluated the prevalence of LBP and its associations with body fat, fat distribution, and height by evaluating 5,887 men and 7,018 women aged 20 to 60 years. This study reported that women, who are overweight or had a large waist circumference compared to their height, had a significantly increased prevalence of LBP.

It was also concluded that both genders over the age of 40 had a larger chance of decreased daily activities due to LBP (Kostova, 2001). It is, therefore, anticipated that if the employees in this study are found to have an above average BMI or an abnormal waist-height ratio, then it is likely that they would have LBP.

It, therefore, stands to reason that the sedentary population would fall into this category to a greater extent as their likelihood of having a higher BMI is greater than those people involved in manual activities (Mirtz and Greene, 2005). Therefore, it is anticipated that the sedentary employee group in this study would have a greater likelihood and increased severity of LBP as compared to the manual employee group.

The correlation, however, may not be as simple or uncomplicated as above, as confounding factors are known to obscure this relationship. For example, obesity (or increased BMI) has also been correlated with increased likelihood of coronary heart disease and diabetes mellitus (Haslett, 2002; Edwards, 1995).

This according to Buckwalter, Goldberg and Woo (1993), the aging process, comorbid conditions and obesity alter the pathophysiology of ligaments and tendons, therefore increasingly facilitating the likelihood of LBP (O'Neill, 1999; Lean, 1998). O'Neill (1999) further added that on increased BMI, was associated with more frequent osteophytes at both the dorsal and lumbar spine. Similarly, further confounding factors include psychosocial factors (Kostova, 2001), who investigated how musculoskeletal conditions were related to LBP in men over 40, found a correlation between obesity and smoking. Thus, it would seem that increased BMI, in addition to other lifestyle factors, may be among the predisposing precursors for LBP (Heneweer *et al.,* 2010).

Therefore, it stands to reason, if high BMI is linked to LBP (Heneweer *et al.,* 2010) and LBP is linked to decreased activity (Roffey *et al.,* 2010b), that BMI and decreased activity are linked (Roffey *et al.,* 2010b). This would imply that there is a greater likelihood for the sedentary individuals in this current study to have low back pain, as their activity levels are expected to be lower than the manual employees. If, however, the converse is found in this study, one would need to consider the degree to which activity (and related injury) (Woolf and Pfleger, 2010) overshadow the protective mechanism (Dagenais and Haldeman, 2012; Morris, 2006; Haldeman, 2005) that activity has been identified as the catalyst for decreasing the likelihood of LBP.

2.4.2.1.3 Gender : Male

From Table 2.5, it would seem to suggest that the lifetime prevalence of LBP in males in developing countries (India, China and South Africa) is consistently lower than for developed countries, which supports the assertion that manual work seems to decrease the likelihood of LBP in the male population group (Dagenais and Haldeman, 2012; Morris, 2006; Haldeman, 2005). This, is however, in contradiction to the work of Woolf and Pfleger (2010), who seem to suggest that manual work predisposes to an increased risk of LBP (Bildt Thorbjornsson *et al.,* 2000; Vingard and Nacehmson, 2000). It is, therefore, likely that in this study, the results would show the protective nature of manual work (unless there is an unqualified increase in the amount of trauma sustained by the manual employees in the automotive industry). If the converse is found, then it would agree with the current assertions of Woolf and Pfleger (2010) and counter the argument that the literature currently seems to portray (Table 2.5).

Table 2.5: The prevalence of LBP in the male gender.

STUDY	YEAR	TYPE OF STUDY	COUNTRY AND/ OR TOWN	LIFETIME %	POINT %	PERIOD %	SAMPLE SIZE	AGE (YEARS)
Hult *et al.,*	1954	General population	UK	60	-	-	1193	25-59
Gyntelberg *et al.,*	1974	General population	Copenhagen	-	-	25	-	40-59
Valkenburg *et al.,*	1982	General population	Netherlands	51.4	22.2	-	3091	>20
Frymoyer *et al.,*	1983	General population	UK	69.9	-	-	1221	28-55
Svensson *et al.,*	1983	General population	Sweden	61	-	31	716	40-47
Biering-Sorensen *et al.,*	1989	General population	Denmark	62.6	12	-	449	30-60
Mendes de Leon *et al.,*	1995	General population	USA	32.2	-	-	2576	65-80+
Papageorgiou *et al.,*	1995	General population	UK	59	-	35	1884	>18
Hillman *et al.,*	1996	General population	UK	40.5	-	-	1437	25-64
Han *et al.,*	1997	General population	Netherlands	46	-	-	5887	20-60
van Der Meulen	1997	Black population	SA – Chesterville	51.8	-	-	-	-
Picavet *et al.,*	1999	General population	Netherlands	50	-	45.1	6317	20-59
Docrat	1999	Indian population	SA – Durban	45.4	-	-	227	-
Picavet *et al.,*	2002	General population	Netherlands	50.4	-	-	-	25-65
Jin *et al.,*	2004	General population	China - Shanghai	45	-	-	169	20-50
Bingefors *et al.,*	2004	General population	Sweden	20.9	-	-	-	-
Vindigni *et al.,*	2005	General population	Australia	46	-	-	87	15-56+
Cesar *et al.,*	2008	General population	Canada – Saskatchewan	58.6	-	-	-	-
Koley *et al.,*	2008	General population	India – Punjab	48.32	-	-	149	40-65
Freburger *et al.,*	2009	General population	USA - North Carolina	2.9	-	-	-	-

2.4.2.1.4 Gender : Female

Table 2.6 suggests that women in the developing and developed world are affected to similar degrees, in terms of the prevalence of LBP. This is in contrast to the male prevalence which implies that they have less LBP in the developing world. It is possible that the prevalence percentages of LBP in women are affected by women being generally responsible in the family unit and associated daily manual tasks. This exposes all females to similar levels of manual work / activity irrespective of their daily routines at work. Therefore, it is possible that their LBP prevalences are more similar when compared to men irrespective of their location in developed and developing countries. To support this and specific to gender, the average annual incidence for LBP is noted as 40.5 (range: 29-55/1000) for men and 54 (range: 40-41/1000 for women (Hillman *et al.*, 1996).

Table 2.6: The prevalence of LBP in the female gender.

STUDY	YEAR	TYPE OF STUDY	COUNTRY AND/ OR TOWN	LIFETIME %	POINT%	PERIOD %	SAMPLE SIZE	AGE (YEARS)
Hirsch *et al.,*	1969	General Population	Sweden	48.8	-	-	692	15-72
Valkenburg *et al.,*	1982	General population	Netherlands	57.8	30.2	-	3493	>20
Svensson *et al.,*	1982	General population	Sweden	67	-	35	1640	38-64
Biering-Sorensen *et al.,*	1989	General population	Denmark	61.4	15.2	-	479	30-60
Papageorgiou *et al.,*	1995	General population	UK	59	-	42	2617	>18
Mendes de Leon *et al.,*	1995	General population	USA	48.6	-	-	4246	65-80+
Hillman *et al.,*	1996	General population	UK	54	-	-	1747	25-64
Picavet *et al.,*	1999	General population	Netherlands	50	50	51.6	7505	20-59
Docrat	1999	Indian population	SA	54.6	-	-	273	-
Picavet *et al.,*	2002	General population	Netherlands	49.6	-	-	-	25-65
Jin *et al.,*	2004	General population	China – Shanghai	54.2	-	-	214	20-50
Bingefors *et al.,*	2004	General population	Sweden	24.3	-	-	-	-
Vindigni *et al.,*	2005	General population	Australia	53	-	-	102	15-56+
Koley *et al.,*	2008	General population	India – Punjab	53.64	-	-	151	40-65
Ferreira *et al.,*	2010	General population	Brazil	57	-	-	-	20-69

This means that women are more likely to suffer from LBP (Vingard *et al.,* 2000), unless men are exposed to traumatic events as opposed to repetitive strain injuries (Bildt Thorbjornsson *et al.,* 2000; Vingard *et al.,* 2000). Therefore, if the sedentary or manual employee groups have a greater tendency to a female predominance, then it is likely that they would have a higher likelihood of LBP as compared to a group with a higher number of males.

2.4.2.1.5 Marital status

In terms of analyzing marital status, various statistical data has determined that there is a higher prevelence of LBP in unmarried persons as compared to married persons (Biering-Sörensen *et al.,* 1986; Reisbord *et al.,* 1985). Thus, it is evdent that single / unmarried persons suffer from a higher prevelence of LBP and we can assume that companionship aids in the outcome of a decreased pain cycle (Cats-Baril and Frymoyer, 1991).

This, therefore, suggests that LBP is more likely in females that are unmarried and older, than males in the same catergory (given the gender predominance). By contrast, younger, unmarried females would be potentially similar to younger unmarried males (as age would not support a difference). Therefore, in the context of marital staus, both age and gender are important modifiers (Morris, 2006; Vingard *et al.,* 2000).

2.4.2.1.6 Activity / exercise

Individuals that live a sedentary lifestyle, with little or no physical activity have an increased predisposition to LBP (Heistaro *et al.,* 1998; Leino-Arjas, 1998; Harreby *et al.,* 1996; Salminen *et al.,* 1994; Cady *et al.,* 1985). This is in contrast to people who exercise regularly, who report a good state of health generally and appear to be conscious of their diet and weight. This seems to result in a happy psychosocial individual with less stress and more energy to fulfill the daily job requirements.

This concurs with the research that has shown exercise to result in an individual having a lesser risk of LBP and a more rapid recovery after an episode of acute back pain (Dagenais and Haldeman, 2012; Morris, 2006; Haldeman, 2005).

Power *et al.,* (2001); Mortimer *et al.,* (2001); Holmstrom *et al.,* (1992); Magnusson *et al.,* (1992); Riihimaki *et al.,* (1989); Battie *et al.,* (1989) and Troup *et al.,* (1981) showed that although, contrary to the stated evidence, some authors seem to disagree, stating that there is no association between exercise and LBP and / or that exercise is predisposed of LBP. This might be borne out in the statistics in later chapters that show that a sedentary lifestyle accompanied by the sedentary work may result in no LBP; or conversely that a manual employee is likely to have high or no LBP. Evidence seems to be contradictory (Heneweer *et al.,* 2010; Hoogendoorn *et al.,* 2000).

2.4.2.1.7 Education / Income

In terms of education, Dionne *et al.,* (1997); Viikari-Juntura *et al.,* (1991); Bergenudd and Nilsson (1988); Heliövaara (1989); Deyo *et al.,* (1987) and Biering-Sörensen (1983) stated that poor education increased the risk of LBP. This increased risk of LBP is indicated to be accompanied by disabiling pain (Hurwitz and Morgenstern, 1997; Deyo *et al.,* 1987).

Contrary to the above, Power *et al.,* (2001); Riihimaki *et al.,* (1989) and Bigos *et al.,* (1991) indicated that there is no considered link between education levels and the increased or decreased incidence of LBP. However, there has been a link showing umemployment and LBP are related (Hurwitz and Morgenstern, 1997; Cheadle *et al.,* 1994; Volinn *et al.,* 1988)

In terms of this study then, it is expected that the manual employees may have a greater predisposition to LBP, as there is a relationship between increased umemployment / blue collar worker (manual employee) and an increased likelihood of LBP (Hurwitz and Morgenstern, 1997; Cheadle *et al.,* 1994; Volinn *et al.,* 1988). In contrast, however, Volinn, 1997 indicates that LBP is also common among high income country populations as compared to low income country populations and urban versus rural areas, suggesting that the presence of LBP in white collar workers (sedentary employee) could be as high or higher than the blue collar workers (Volinn, 1988).

It must, however, be noted with regards to the white collar worker that the little research that has been done on the prevalence and incidence of LBP, explores all the population groups within the same countries (mostly high income) without looking at the contributing popualtions (viz employed versus unemployed or blue collar versus white collar workers) (Dagenais and Haldeman, 2012; Volinn, 1988).

Therefore the expected outcomes in this study are ambivalent with reagrds to education and therefore related income.

2.4.2.1.8 Absenteeism

There are numerous consequences of LBP, with the associated increased absence from work, lost productivity and the corresponding increase in economic costs. LBP results in significant levels of disability, producing restrictions on usual activity and participation in demands of living (e.g. an inability to work) (Ghaffari, 2006). To this end, Anderson (1999) estimated that LBP was the largest single cause of absence from work in 1988-89 in the United Kingdom, and was responsible for 12,5% of all sick days recorded in that time period. Similarly, in United States of America it has been reported that 149 million working days are lost per year as a result of LBP (Guo *et al.,* 1999). This impact of LBP and related health care (Bildt Thorbjornsson *et al*., 2000), can be seen in the Netherlands (Hutubessy *et al.,* 1999) where musculoskeletal conditions were rated as the most expensive disease in work absenteeism amounting to a cost of US$3.1 billion and a disablement cost of US$1.5 billion. It was further noted that the entire workforce cost the Netherlands government US$4.6 billion (Hutubessy *et al.,* 1999). This is in agreement with Hart *et al.,* (1995) who noted LBP as the third most commonly reported symptom, the second most frequent cause of employee absenteeism (Guo *et al*., 1999) and the most costly ailment of working age adults in the United States of America.

In another study conducted by Hoogendoorn *et al.,* (2000), it was revealed that an increase in absenteeism was associated with (viz. specific occupational injuries). For example: lifting of heavy objects and bending at the waist, which has been shown to increase the prevalence of LBP (Smith *et al.,* 2005; Chiou *et al*., 1994)

Although the research, dated in the reviewed literature shows a trend that LBP is a risk factor for absenteeism, in this research, it would be anticipated that the manual employees would be at a higher risk of participating in activities that would predispose them to LBP and, therefore, it would be expected that they would also report the highest impact of LBP on their presence / absence from work.

Further factors that often impinge on absenteeism are related to psychological and psychosocial factors, the most important of which are outlined in Table 2.7 (Hoffman *et al.,* 2007).

Table 2.7: Job factors related to absenteeism as a result of LBP	
Airaksinen *et al.,* 2006; Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; Accident Compensation Corporation, 1997	Compensation factors:
Airaksinen *et al.,* 2006; Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002; Accident Compensation Corporation, 1997	Job disatisfaction:

2.4.2.1.9 Ethnicity

Green *et al*., (2002) and Portenoy *et al.,* (2004), have indicated in their studies that ethnicities have different cultural influencers that impact on the outcome of LBP. One such example is the perception of pain, which is different between cultures and would, therefore, impact on the reporting of LBP and its impact on the working environment.

The reported lifetime prevalence of LBP in Black South Africans (57.6%) (Van der Meulen, 1997), Coloured South Africans (76.6%) and Indian South Africans (78.2%) (Docrat, 1999) validate that there may be a differences compared to the White population as studied (48%) (Dyer, 2012). Therefore, Black South African and White South Africans presented with a lower lifetime prevalence of LBP as compared to Coloured and Indian South Afircans. This may, therefore, suggest that the composition of the sedentary and manual employee groups in this study may affect the outcomes of the groups reporting their experince of LBP. This would concur with Hurwitz and Morgenstern (1997) study, that indicated that ethnicity does play a role in the presentation and reporting of LBP.

2.4.2.2 General health and physical factors

2.4.2.2.1 Smoking

Smoking of tobacco is considered as the most preventable cause of disease (particularly LBP) in the USA (Klesges *et al.,* 1998). Even though the negative health consequences associated with smoking are well established, about 26% of all adults in the USA continue to smoke. Recent estimates suggest that prevalence is increasing in youth (Leatherdale *et al.,* 2006).

Various theories have been stipulated which associates smoking to increased LBP, these include:

- Smoking results in poor blood circulation with its degenerative sequelae (Palmer *et al.,* 2003; Gardner, 2000; Leino-Arjas, 1998; Pascarelli and Quilter, 1994; Boshuizen *et al.,* 1993; Silverstein, 1992).
- Smoking causes pathological change in bone, resulting in osteoporosis with its sequelae (Campion and Maricic, 2003; Palmer *et al.,* 2003; Haslett *et al.,* 2002; Boshuizen *et al*., 1993; Gatterman, 1995).
- As a consequence of lung pathology, smoking produces a chronic cough, giving rise to increased intra- abdominal and intra-discal pressure, putting increased mechanical stress on the lumbar discs (Kirkaldy-Willis and Burton, 1992).
- Smoking has also been linked with anxiety and depression, which are found to exacerbate LBP as a result of the changes in the perception of LBP (Portenoy *et al*., 2004; Green *et al*., 2002; Boshuizen *et al.,* 1993).

Thus, Palmer *et al.,* (2003) and Leino-Arjas (1998) suggest that smokers and ex-smokers, tend to report more LBP than non-smokers. This may also be compounded by the fact that smokers are generally less physically active and, therefore, have a lower level of physical fitness than non-smokers (Gardner, 2000).

In terms of this study then, it is important to investigate how many sedentary or manual employees report that they smoke, as this would impact on the outcome of the study in terms of the possible confounding factors associated with LBP.

2.4.2.2.2 Psychological / stress:

Heneweer *et al.,* (2010); Portenoy *et al.,* (2004); Green *et al*., (2002); Linton and Ryberg, (2000); Hoogendoorn *et al.,* (2000); Bongers *et al.,* (1993) and Boshuizen *et al.,* (1993) have all suggested that psychological factors (such as stress and depression) are related to current and future episodes of LBP. These suggestions have been supported in the work reported by Dagenais and Haldeman (2012), as outlined in Table 2.8 / Table 2.9 (psychological factors and psychosocial factors respectively) and supported by further references therein.

Table 2.8 Psychological factors that impact on LBP	
Airaksinen *et al.,* 2006; Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002; Accident Compensation Corporation, 1997	Unrealistic treatment expectations
Airaksinen *et al.,* 2006; Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002; Accident Compensation Corporation, 1997	Inappropriate beliefs – religion factors
Airaksinen *et al.,* 2006; Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002; Accident Compensation Corporation, 1997	Fear avoidance behaviour factors
Airaksinen *et al.,* 2006; Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002; Accident Compensation Corporation, 1997	Emotional factors

Table 2.9 Psychosocial factors that impact on LBP	
Nielens *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; Accident Compensation Corporation, 1997	Family factors
Nielens *et al.,* 2006; Accident Compensation Corporation, 1997	Previous occurances of LBP
Nielens *et al.,* 2006; The Norwegian Back Pain Network, 2002	Neurological involvement

It is, therefore important, particularly in the workplace to identify factors both psychological and psychosocial that may impact on the sedentary and the manual employees of the automotive company under study, in order to decrease the impact of these factors on the presentation of LBP and its severity. The latter will assist the automotive company in being able to decrease the likelihood of these factors on their productivity and, therefore, income.

2.4.2.3 Occupational factors

Lastly, and most importantly are the direct occupation risk factor to LBP, which result from people normally working a minimum five days in a given seven day week, the nature of their occupation and the tasks that are required in that occupation (Roffey *et al.*, 2010a; Roffey *et al*., 2010b; Roffey *et al.*, 2010c; Roffey *et al.*, 2010d; Roffey *et al*., 2010e; Wai *et al.*, 2010a; Wai *et al.,* 2010b; Redwood and Cleveland, 2003).

The nature of, as well as the tasks required by the occupation, that an individual pursues is most likely one of the commonest precursors to LBP. This can be seen from the literature where,

- bending and twisting (Wai *et al.,* 2010b),
- carrying and pushing (Roffey *et al.,* 2010a; Pope *et al.,* 2002; Ayoub and McDaniel, 1974),
- periods of driving (vibration has been linked to an increased likelihood of LBP over time) (Heneweer *et al.,* 2010; Okunribido *et al*., 2008; Lis, Black and Korn, 2007; Ramroop *et al.,* 2006; Krauser *et al.,* 2004; Hoogendoorn *et al.,* 2000; Vingard *et al.,* 2000),
- lifting and manual handling of physical loads (Plouvier *et al.,* 2011; Heneweer *et al.,* 2010; Roffey *et al.,* 2010d; Jansen *et al.,* 2004; West and Gardner, 2001; Hoogendoorn *et al.,* 2000),
- repetitive loading / tasks assoaicted with increased frequency of lifting (Heneweer *et al.,* 2010; Cromie, Robertson and Best, 2000; Hoogendoorn *et al.,* 2000),
- static work postures (Roffey *et al.,* 2010a; Roffey *et al.,* 2010b; Lis, Black and Korn, 2007; Glover *et al*., 2005; Pope *et al.,* 2002; Davis and Heaney, 2000) and
- repetitive positions (Plouvier *et al.,* 2011; Roffey *et al.,* 2010c; Rupert and Ebete, 2004).

This high load, high repetition of work is greater in manual employees (Table 2.10) whereas the static postures are greater in the sedentary workforce (Table 2.11) (Roffey *et al.,* 2010b). Both of these increase the liklehood of increasing the reported prevalences and indicence of LBP, whereas moderate load and occupations which require a varied number of tasks (applicable to either employee group) would lower the prevalences and incidence of LBP (Bildt Thorbjornsson *et al.,* 2000; Vingard *et al.,* 2000).

2.4.2.3.1 Physical versus sedentary occupational activities

In view of the occupational factors that may or may not cause LBP, Table 2.10 outlines that type of occupation that was studied by the noted authors in the noted years and presents the aggravating factors that they found to be associated with the particular occupations under study. The outcomes of these studies go to supporting the outline presented in Section 2.4.2.3 and will allow for the comparison of the results of this study to the literature as presented here.

The studies that most closely resemble the automotive industry in terms of the type of activities that are required in the workplace have been previously compiled by Bernard *et al*., (2011); Van Vuuren *et al*., (2006) and Latza *et al.,* (1999).

Table 2.10: Physical manual occupation activities related to LBP

AUTHOR	YEAR	COUNTRY	OCCUPATION TYPE	SAMPLE SIZE	PREVELANCE OF LBP %	AGGRAVATING FACTORS
Latza *et al.,*	1999	Germany	Construction workers	571	50.1	Carrying heavy loads, lifting, bending over
Omokhodion *et al.,*	2000	Nigeria	Hospital staff	80	69	Heavy physical activities, poor posture and prolonged sitting and standing
Teitz *et al.,*	2001	USA	Intercollegiate rowers	1632	32	Changes in training, rowers physique, equipment used
Rugelj *et al.,*	2003	Slovenia	Physiotherapist	133	73.7	Lifting and handling patients
Smith *et al.,*	2005	Korea	Nurses	330	72.4	Bending, twisting or stretching
Holmberg *et al.,*	2005	Sweden	Farmers	1013	64	Manual handling, whole body vibration
Van Vuuren *et al.,*	2006	RSA	Plant workers	109	71.6	Long hours, hard manual work
Lui *et al.,*	2008	USA	Farmers	2045	38.4	Manual handling, whole body vibration, mechanical shock
Mattila *et al.,*	2009	Finland	Finnish military	391,241	30	Carrying heavy loads
Secer *et al.,*	2011	Turkey	Novice soldiers	871	74	Carrying heavy loads
Bernard *et al.,*	2011	France	Vineyard workers	3974	40%	Traditional blade sharpening, manual pruning

In these contexts, several investigators (Secer *et al*., 2011; Van Vuuren *et al.,* 2006; Smith *et al.,* 2005; Rugelj *et al.,* 2003) were also able to link an increase in absences from work (sick days) due to LBP and particular activities in workers performing consistent physical and / or heavy work. As an example, it is seen from Table 2.8 that lifting is associated with a prevalence range (LBP) from 50.1% - 73.7%. This was further associated with an increased

occurrence of LBP in men (Latza *et al*., 1999). Therefore, sudden unexpected maximum efforts, as well as lifting in combination with lateral bending and twisting, which represents a combination of factors make it even more likely that an individual will suffer from LBP. This was previously documented by Chaffin and Park (1973), who reported an eight times higher incidence of LBP in workers involved in heavy manual lifting and carrying between manual and sedentary employees.

This is perhaps also true of sedentary employees, but their reasons for the development of their LBP are not related to the extremes of physical activity but the absence of physical activity. This is supported by the references as outlined in Table 2.10. In addition, it was also reported that individuals with sitting or standing occupations have an increased risk of developing LBP (Brown, 1975). The literature suggests that the reason for the increase in their LBP, in contrast to the manual employees, is related to the lack of protective effect of moderate exercise (Dagenais and Haldeman, 2012; Morris, 2006; Haldeman, 2005) that these occupations curtail. From the foregoing discussions, on factors that have been linked to LBP, for one reason or another, it becomes evident that LBP may have many aetiologies and combinations of aetiologies that predispose to the presence of LBP. Therefore, it is more likely that during a person's lifetime they will have at least one episode of LBP (Morris, 2006).

Table 2.11: Sedentary occupation activities related to LBP

AUTHOR	YEAR	COUNTRY	OCCUPATION TYPE	REPONDENTS SAMPLE SIZE	PREVELANCE OF LBP %	AGGRAVATING FACTORS
Bovenzi	1996	Italy	Bus drivers	234	83.8	Shock jerking movements
			Tractor driver	1155	30.6%	Shock jerking movements
Hoy *et al.,*	2004	UK	Forklift truck drivers	46	65.2	Lifting tasks
Chen *et al.,*	2005	Taiwan	Taxi drivers	1242	51	Bending and twisting, job dissatisfaction, job stress
Okunribido *et al.,*	2007	Scotland	Bus drivers	80	59	Shock jerking movements
Wynne-Jones *et al.,*	2007	UK	Primary care consultants	935	37	-
Spyropoulos *et al.,*	2007	Greece	Public office workers	771	61.6	Ergonomics
Pargali *et al.,*	2010	Iran	Dentists	90	33 - 55	Prolonged, static muscle contractions, muscle ischemia

Therefore, it is also important to understand the impact of LBP in terms of its cost implications with regards to both diagnosis and treatment, as these factors are in addition to costs that although may not directly be related to the company it still may impact on its contributions to third party payors, these include Health Management organizations, medical aid schemes or other medical insurance providers as well as tax implications (as these proceeds are utilized to provide medical facilities, should the country of origin provide state aided benefits to its employees and / or through public hospital sector care as provided for by a government) (Dagenais and Haldeman, 2012; Burnett and Bell, 2009; Dagenais *et al.,* 2008; Ghaffari, 2006; Pai and Sundaram, 2004; Maetzel and Li, 2002; Maniadakis and Gray, 2000; Moffett *et al.,* 1999; Manga *et al.,* 1992).

2.5 Diagnosis in relation to treatment and costs:

Based on the complex anatomical nature of the spine (as discussed in Section 2.2), and the many intrinsic and extrinsic causative agents (as dsicussed in Section 2.4) that may contribute to LBP (Dagenais and Haldeman, 2012), it is necesary to consider evaluating / isolating the causative agents in each individual presentation of LBP.

This implies that each case of LBP is required to be evluated on its own merits, which makes the evalaution and treatment of LBP potentially costly to all concerned. Therefore, to reduce these costs it is critical that the practioner be effective and efficient when evaluating a LBP so to achieve a genuine diagnosis (Helfenstein-Junior *et al.,* 2010; Haldeman, 2005; Haslett *et al.,* 1999).

If the appropraite assessments are not done effectively, inappropraite outcomes can result, which in turn will lead to a delayed diagnosis and / or mismanagement of the patient (Dagenais and Haldeman, 2012; Morris, 2006). This has an indirect effect on increased sick leave, increased medical costs (for inappropriate care), increased costs associacited with unecessary tests or special investigations, in addition to indirect costs borne by the patient / company and the state in terms of lost income / productivity / sales of the company respectively (Dagenais and Haldeman, 2012; Burnett and Bell, 2009; Dagenais *et al.,* 2008; Ghaffari, 2006; Pai and Sundaram, 2004; Maetzel and Li, 2002; Maniadakis and Gray, 2000; Moffett *et al.,* 1999; Manga *et al.,* 1992).

This also increases the likelihood of future expenditure on health care, due to unresolved, unrehabilitated or inappropraitely treated LBP (Dagenais and Haldeman, 2012; Crook *et al.*, 2002; Dempsey *et al.,* 1997).

In general, the special investigations in terms of the evalaution of LBP (outside of the clinical assessment of the patient in the practitioners rooms) include the use of:

- Blood tests and other laboratory tests (Dagenais and Haldeman, 2012; Ferri, 2004; Haslett *et al.,* 2002;):
    - Blood tests (e.g. full blood count, arthritide screens, tumour screens, inflammation screens),
    - Blood cultures and
    - Other laboratory testing which may be called for (e.g. biopsy).

- Diagnostic injections (Morris, 2006; Haldeman, 2005):
    - Diagnostic nerve blocks,
    - Epidural steroid injections,
    - Facet joint / sacro-iliac joint injections and
    - Nerve root blocks.

- Imaging examinations (Helfenstein-Junior *et al.,* 2010; Haldemann, 2005; Marchiori, 1999). These inlcude, but are not limited to (in alphabetical order):
    - Bone densitometry (Yochum and Rowe, 2005; Taylor and Resnick, 2000),
    - Computed tomography (CT) (Dagenais and Haldeman, 2012; Yochum and Rowe, 2005; Taylor and Resnick, 2000),
    - CT-myelography (Dagenais and Haldeman, 2012; Yochum and Rowe, 2005; Taylor and Resnick, 2000),
    - Discography (Haldeman, 2005),
    - Dynamic MRI (Dagenais and Haldeman, 2012; Yochum and Rowe, 2005; Taylor and Resnick ,2000),
    - Magentic resonance imaging (MRI) (Dagenais and Haldeman, 2012; Yochum and Rowe, 2005; Taylor and Resnick, 2000),
    - Nuclear imaging (Yochum and Rowe, 2005; Taylor and Resnick, 2000),
    - Standard radiographic imaging (Dagenais and Haldeman, 2012; Yochum and Rowe, 2005; Taylor and Resnick, 2000),

- Ultrasound studies (Morris, 2006),
- Videofluoroscopy (Dagenais and Haldeman, 2012; Yochum and Rowe, 2005; Taylor and Resnick, 2000).

Muscle testing :

- Electromyography (Morris, 2006)
  - Static /
  - Dynamic / ambulatory,
  - Needle verusus surface and

- Nerve testing : (Morris, 2006; Haldeman, 2005)
  - Nerve conduction studies and ,
  - Quantitative sensory testing.

These tests all require a clinical indication for their use, as their expense or collective expenses can be significant for the patient or their medical insurer. Furthermore, it must also be considered that some of these tests require in hospital application (therefore, costs related to hospital admission), consumable use, absenteeism from the office / from work as well as the delay in obtaining the results of these various tests (Ferri, 2004; Haslett *et al.,* 2002). However, the judicious use of these tests as applicable to the pateint, are important in that they dictate the prognosis of treatment, rehabilitation and management, which in and of itself also implies and carries a cost (Manga *et al.,* 1992).

2.6 Management and treatment of LBP

Management and treatment of LBP, in part is reflective of an accurate diagnosis (in the acute case presenting to practice). Thereafter treatment and management usually centers on preventative care in order to reduce the re-occurrence and to reduce the likelihood of LBP becoming a chronic problem (Dagenais and Haldeman, 2012; Valat *et al.,* 2001). In order to achieve this, management is centered on addressing aetiologies of previous occurrences of LBP and related disability (Crook *et al.*, 2002). Therefore, in order to decrease the prevalence of LBP, the perpetuating factors need to be determined (Dempsey *et al.,* 1997).

2.6.1 Primary care interventions

These interventions include patient education allowing for modifications to be made at the workplace, medications (ethier homeopathic or over the counter or prescription based), manual therapy and physical modalities (Dagenais and Haldeman, 2012; Haldeman, 2005).

In terms of eliminating or minimizing the risks to LBP, it is the practitioner's role to explain the benefits modifying certain risk factors, to the individual. These include: smoking (Section 2.4.2.2.1), obesity (Section 2.4.2.1.2), psychological / psychosocial issues (Section 2.4.2.2.2), level of physical fitness / activity and exercise (Section 2.4.2.1.6).

Workplace education and ergonomic programmes (including stress management, lifting strategies and adaptation of vehicles or office structures) may also need to be addressed by the practitioner (Cherkin, 2002; Coulter *et al*., 2002; Picavet, 1999; Hurwitz *et al*., 1998, Hurwitz, 1994; Gilad and Kirschenbaum, 1987) and / or company (Rupert and Ebete, 2004; Nyland and Grimmer, 2003) and employee and/ or (Cherkin, 2002; Coulter *et al*., 2002; Picavet, 1999; Hurwitz *et al*., 1998, Hurwitz, 1994; Gilad and Kirschenbaum, 1987) to ensure that these identified occupational risk factors (Section 2.4.2.3) are reduced.

2.6.2 Secondary care interventions

Preventing acute LBP from becoming chronic LBP requires that a more detailed and thorough assessment of the patient's circumstances and the company's policies and practices be examined with particular reference to (Griffith *et al.*, 2007):

- Disabling claims procedures (Manga *et al.,* 1992),
- Disabling medical boarding procedures (Manga *et al.,* 1992),
- Enabling appropriate leave and absence policies (Manga *et al.,* 1992),
- Enabling employee empowerment with regards to behavioural modification through in back schools/talks and intensive rehabilitation (Wynne-Jones *et al.,* 2007; Negrini *et al.,* 2006; The Norwegian Back Pain Network, 2002) and
- Enabling overt company policy that highlights employees health and enables this (Dagenais, and Haldeman, 2010; Skillgate *et al.,* 2007; Chou *et al.,* 2007; Negrini *et al.,* 2006; van Tulder *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002).

In essence therefore, the company needs to focus employee activity and thought on exercise and activity as this seems to be the most highly recommended intervention for the management of LBP (in particular acute LBP) and stopping acute LBP to becoming chronic LBP (Dagenais, and Haldeman, 2010; van Tulder *et al.,* 2006; Negrini *et al.,* 2006; Australian Acute Musculoskeletal Pain Guidelines Group, 2003; The Norwegian Back Pain Network, 2002; Manga *et al.,* 1992).

2.6.3 Tertiary care interventions

Should employees however develop chronic LBP, tertiary care is then required, including but not limited to comprehensive rehabilitation with the aim to restore to optimum function and accommodating residual disabilities, multi-disciplinary pain management programmes, and behavioural modification in talks (Dagenais and Haldeman, 2012; Morris, 2006).

2.7 Conclusion

Therefore, in conclusion, all these interventions and combinations of interventions only serve one function and that is to identify, qualify and limit the development, extent and progression of LBP within the working populace as embodied in each and every patient that conforms to the diagnosis of LBP. This outcome, is however, only possible when the context in which LBP occurs is studied, understood and applied within a multi-factorial (Cherkin *et al.,* 2002; Coulter *et al.,* 2002; Hurwitz *et al.,* 1998; Hurwitz, 1994), multi-disciplinary setting (Gilkey *et al.*, 2007) in which good communication exists between the practitioner, employee and employer (Coole *et al*., 2010). In this way, the effects of LBP as an important clinical, social, economic, and public health problem affecting the population indiscriminately can be more specifically and effectively addressed (Kim *et al.,* 2010; Dagenais *et al.,* 2008; Cherkin, 2002; Coulter *et al.*, 2002; Karwowski and Marras, 1999; Hurwitz *et al.,* 1998; Angus and Swan, 1993).

Therefore the aim of this study was to determine the prevalence and associated risk factors of LBP for employees of an automotive production company.

Chapter Three:

3.1 Introduction:

This chapter focuses on the methods and instruments used to conduct the research as well as the statistical methodology employed. The topics to be addressed include the study design, sampling method, the research tool, ethical considerations and statistical methodology employed in this study.

3.2 Design:

The study was a quantitative, epidemiological, cross sectional survey, which was in the form of a self-administered questionnaire (Hicks, 2004; Salant and Dillman, 1994). In this context, questionnaire based research, is a way of collecting information from a large dispersed group of people allowing descriptive and analytical statistical information (Hicks, 2004; Dyer, 1997). In addition, a structured questionnaire ensured researcher bias was kept to a minimum, which allowed for minimum misinterpretation of the results (Mouton, 2002; Mouton, 1996). Therefore, a focus group and pilot study were required to validate the questionnaire that was used to collect the appropriate data for this study.

The research topic was approved for the Faculty of Health Science by the Institutional Research and Ethics Committee (Appendix M), noting this study's compliance with the Declaration of Helsinki, 1975 (Johnson, 2005).

3.3 Advertising and permission:

- No advertising was necessary.

Permission was sought from an automotive company in order to be able to access their employees (Appendix A: Letter of Information to the managing directors requesting permission). Appendix B (only available on request and with permission from the company), is a formal reply letter providing provisional approval from the managing directors indicating that their management is in agreement with this proposal. This approval was on provision, that the research, as outlined in this document, is approved by the Faculty of Health Sciences Research and Ethics Committee.

3.4 Sampling:

3.4.1 Sample method and size:

3.4.1.1 Participant sampling:

The study requested participation from manual and sedentary employees (see inclusion criteria), employed by an automotive company selected with a total population of 1200. With the exclusion of the management who were involved in approving this study, and those assisting with the research, a total of 1150 potential participants remained of which, N_1 = 200 (manual employees) and N_2 = 200 (sedentary employees) were minimally required (Esterhuizen, 2011). The sample size was based on the need for a sample that would be sufficiently large enough in order to detect trends through regression analysis, but also sufficiently small enough to ensure that the groups that were compared to one another would be of a manageable size.

A self selection process (Mouton, 2002; Mouton, 1996) utilized in this study, which was based on participation on the participant's willingness to read and complete a Letter of Information and Informed Consent form (Appendix L) and fill in the final questionnaire (Appendix K), which reflected their willingness to participate in the study.

3.4.2 Sample characteristics

3.4.2.1 Inclusion criteria:

- Employees were required to be 18 years of age and older.
- Employees who were employed by the company and agreed to participate in this research at the time that data collection was done.
- Employees were required to read and sign the Letter of Information and Informed Consent form.
- To be sedentary the employee was required to work at a desk for the majority of their working day (>4 hours), whether they were office bound or linked to the production lines (Yip, 2004; Harkness 2003; Vingard *et al.,* 2000).
- To be manual the employee was required to work at a desk for the minority of their working day (<4 hours), whether they were office bound or linked to the production lines (Yip, 2004; Harkness 2003; Vingard *et al.,* 2000).

3.4.2.2 Exclusion criteria:

- The employees who were not willing to participate in the study (those that were not prepared to read and sign the Letter of Information and Informed Consent form).
- Any employees that met the industry definition of a labour broker.
- Members of the focus group and pilot study were excluded from the study.
- Persons younger than 18 years of age were excluded from the study. It is unlikely that such employees existed due to the company policy of only employing persons over the age of 18 years.

3.5 Procedure:

- Once approval was gained from the Faculty of Health Sciences Research and Ethics Committee, an appointment was made with the managing directors of the automotive company.

- This meeting was held with the managing directors, outlining the final approved research protocol and its processes, the outcomes (aims and objectives) of the study and allowed for any concerns to be raised and addressed in terms of logistical implementation of the study.

- Then a date and time were set with the appropriate / appointed personnel health manager in order to organize the logistic procedures, including:
    - Placement of information sheets on company notice boards (electronic and hard copy); in order inform the employees that the research was approved, what the research was about and when the researcher would be at a specific area of the company's plant production.
    - Identification of appropriate times to access the employees. The employees were principally contacted during the Health and Safety talks as mandated by the Occupational Health and Safety Act, 1993 (Act 85 of 1993) (OHSA). However the company also appointed additional times for different types of sectors / plants as they found appropriate.
    - Security passes were applied for and granted (as necessary for the researcher to access different areas of the plant) or company personnel (a nurse)

accompanied the researcher (in access regions where the company required this).

- Once logistics arrangements were met, the employees were approached to request their participation in the study.
- Willing employees were presented with a Letter of Information and Informed Consent form (Appendix M) by the researcher, detailing the nature of the study and the process involved.
- The researcher then answered any questions that the employee might have had, with regards to the research and ensured that the participant understood the context of the research study and what was expected of them.
- The researcher then requested that the employee sign the Letter of Information and Informed Consent form. The signed document was dropped into a sealed collection box/ envelope (Dyer, 1997) for Letters of Information and Informed Consent form.
- Employee's names were written on a separate register, that the employee had completed and signed the Letters of Information and Informed Consent form.
- The questionnaire was then handed to the employee, with the instructions that they should not place any information (name or staff number) on the questionnaire so that the questionnaire information remained ***anonymous*** (Mouton, 2002; Mouton, 1996).
- The employee was given about 15 minutes to complete the questionnaire before returning it to the researcher as outlined below. The time allocated for completion of the questionnaire, was determined from the pilot study and also considered the agreeable time period given by management, for employees to not fulfill their operational duties.
- The employee was asked to drop the questionnaire into the sealed collection box / envelope (Dyer, 1997) marked for questionnaires and their name was entered onto a register tracking the completed questionnaires.

- The use of separate collection boxes / envelope for the:
- Letters of Information and Informed Consent forms and
- The questionnaires,

Ensured that the letters and the questionnaires could not be associated with one another, which ensured ***anonymity***. The sealed boxes were only opened on completion of the required minimum of 200 questionnaires per sector (i.e. the researcher had 4 collection boxes / envelopes – 2 each for the manual and sedentary employee groups and 2 each for

the questionnaires and informed consent forms (See Table 3.1). This ensured that the data was kept ***confidential*** throughout the process, as no one had access to the completed questionnaires until the researcher had collected all questionnaires and was ready to capture the data.

Table 3.1: Collection boxes required		
	Informed consent – Box A	Questionnaire – Box B
Sedentary employees	1	1
Manual employees	1	1

Once the collection boxes were opened, the questionnaires were captured on excel spreadsheet in preparation for data analysis as outlined in the data analysis section of this proposal (Section 3.6.5). All questionnaires were kept in a locked cabinet during this process. All questionnaires and all materials related to this research will be handed to the Chiropractic Programme for storage for fifteen years before the data will be shredded.

3.6 Measurement tool

3.6.1 Questionnaire development

The questionnaire method of data collection was used in this study. A questionnaire is a research tool with questions or statements allowing the sample participants to respond accordingly (De Vos, 2001). A questionnaire can be either structured or unstructured. A structured questionnaire provides options to each question and the participant is required to mark the applicable answer while an unstructured questionnaire requires the participant to answer in their own words (Babbie, 1998).

For this study, a combined structured and unstructured questionnaire was designed by the researcher, based on data gathered in the literature (Babbie, 1998). The literature from which the questionnaire was compiled included reviews of the following publications (both published and unpublished):

Table 3.2: References utilized to compile the questionnaire for this focus group

Published	Unpublished / dissertations
Roffey *et al.*, 2010a; Roffey *et al*., 2010b; Roffey *et al.*, 2010c; Roffey *et al.*, 2010d; Roffey *et al*., 2010e; Wai *et al.*, 2010a; Wai *et al.,* 2010b; Bell and Burnett, 2009; Wynne-Jones *et al.,* 2007; Griffith *et al.,* 2007; Gilkey *et al.,* 2007; Smith *et al.*, 2006; Ramroop *et al*., 2006; Ginanneschi *et al*., 2006; Bongers *et al.,* 2006; Vieira, Kumar and Narayan, 2005; Manek and MacGregor, 2005; Glover *et al.,* 2005; Cedraschi, 2005; Rupert and Ebete, 2004; Sjolie, 2004; Van den Heuvel *et al*., 2004; Hartvigsen *et al.,* 2003; Kovacs *et al*., 2003; West and Gardner, 2001; Cromie, Robertson and Best 2000; Holder *et al*., 1999; Tim, 1996; Bork *et al*., 1996; Bovenzi, 1996; Pope *et al*., 1991.	Prangley, 2010; Albert, 2009; Pereira, 2007; Dasappa, 2007; Fyfe, 2006; Vlok, 2005; Docrat, 1999; van der Meulen, 1997.

The data from all the literature sources was then converted into possible questions and the questionnaire was designed around the areas related to occupational LBP as suggested by Cedraschi, (2005). Thereafter the questionnaire was submitted to a focus group process.

3.6.2 Focus Group (FG)

The reason for having had a FG was to stimulate the group members thinking and encourage them to develop ideas about the topic(s) surrounding the research question (Salant and Dillman, 1994). This enabled members of the FG to critically assess the relevance of questions presented in the questionnaire (Appendix C: pre focus group questionnaire), in the context of the research question and aims and objectives of this study. This allowed the FG members to add to, delete from or modify for clarity, the questions presented by the researcher (Bernard, 2000). The FG was, thus, also able to contextualize the questionnaire (Salant and Dillman, 1994) so as to enhance its face validity (Bernard, 2000). Validity constructs such as face validity (Morgan, 1998a; Morgan 1998b; Morgan 1998c; Mouton, 1996) and construct validity (Morgan, 1998a; Mouton, 1996;) were achieved by ensuring that the FG members were representative of the specific areas of expertise related to the research to be conducted as well as the process in which the FG was conducted (Bernard, 2000; Mouton, 1996;).

The FG followed the guidelines as outlined by Salant and Dillman, (1994), Silverman, (2001), Streiner and Norman, (1995), Morgan (1998a) and Morgan (1998b).

Therefore the FG in this study consisted of the following members:

- The researcher, who acted as moderator of the FG session.
- The research supervisor, who had guided the researcher through the research process / recorded the proceedings and who is a chiropractor.
- Three chiropractors, with more than five years clinical experience (two local and one international).
- An occupational health care worker, who specializes in industrial ergonomic settings and is also a qualified chiropractor.
- Two members of / representatives from the automotive industry in Durban, one with management experience and one with floor experience.
- Three research students who had completed or were completing questionnaire studies.
- A statistician.

Before commencing with the FG proceedings, each participant was required to read the Letter of Information (Appendix D: Letter of information for Focus Group) and sign the Confidentiality Statement (Appendix E), Code of Conduct Statement (Appendix F) and Informed Consent Form (Appendix G). During this process the participants had a chance to ask any questions and make sure that they understood what was required of them.

The questionnaire (Appendix C: Pre Focus Group questionnaire) was distributed to respondents and each question in the questionnaire was then sequentially discussed by the members of the FG. All discussions required that any changes (omissions, additions and / or alterations) were a unanimous decision among the group, unless the group left a task for the researcher to complete (e.g. wording of a particular questionnaire or structure of a particular part of the questionnaire).

The changes were then implemented to form the post FG, pre pilot study group (Appendix I).

3.6.3 Pilot study (PS)

After the FG was held, the changes suggested to the questionnaire were implemented and thereafter the questionnaire was compiled into a post FG / pre pilot questionnaire. In this context, the pilot study was a “trial run” of the larger study that is conducted in preparation for that study to determine the feasibility of a research tool (Trochim, 2000). The aim of the pilot study was to determine if the sample could relate to the questionnaire and if any further errors / inconsistencies were brought to light as per the guidelines set by Fink and Kosecoff (1985). This was completed with the assistance of five automotive company employees from a local automotive company, who completed the questionnaire in order to determine if there were any problems in completing the questionnaire (with respect to time, language and instructions given) as well as to allow the researcher to identify problems in the process envisioned for this research study.

The purpose of the PS was thus to ensure that the following questions could be answered efficiently and effectively (Fink and Kosecoff, 1985):

- Are certain questions in the questionnaire redundant or misleading?
- Are the questions appropriate for the individuals who participated in the survey?
- Did the information that the researcher collect enable him/her to use the survey forms properly?
- Are the procedures standardized?
- How consistent was the information obtained by the survey?
- How accurate was the information obtained by the survey?
- How long did it take to complete the questionnaire?

3.6.4 Final Questionnaire

As a result of the above FG and PS processes the final questionnaire was developed, which consisted of three sections, Section A, B and C (Cedraschi, 2005).

Section A	The demographics
Section B	The risk factors and psychosocial components that contribute to LBP
Section C	The LBP, including the LBP history, pain characteristics, outcome and how it influences the employees productivity

3.6.5 **Measurement and statistical analysis** (Esterhuizen, 2011)**:**

The questionnaire will be administered once to all participants and all sections - A, B and C – of the questionnaire were used for statistical analysis.

SPSS (IBM) version 19 was used to analyze the data. A p value <0.05 was considered as statistically significant.

Demographics of the employees were described using summary statistics such as mean, standard deviation and range for quantitative variables. Demographic and characteristics of back pain were compared between sedentary and manual groups using chi square tests in the case of categorical variables, and independent samples t-tests in the case of normally distributed continuous variables.

Prevalence and characteristics of low back pain was described using relative frequency and percentages, with 95% confidence intervals. Associations between risk factors and LBP were identified with log linear regression analysis and tested using Pearson's chi square test in the case of categorical variables and t-tests in the case of continuous variables. For the comparison of risk factors between groups, data were stratified on group (sedentary versus manual) and chi square tests or t-tests were used to assess the association between risk factor and presence of current LBP. Strength of association between risk factor and outcome was compared descriptively between the groups. Non-parametric Mann-Whitney test was used to compare median number of days absent from work between the groups in those who had taken leave from work due to LBP.

All data that is incomplete in the questionnaires will be noted as "missing" or "unknown" for the purposes of data analysis.

Chapter Four

4.1 Introduction:

This chapter presents the results of this study.

4.2 Aims and Objectives:

Objectives of study were to determine and then compare the following between the sedentary and manual employees:

- The demographics,
- The prevalence and characteristics of LBP,
- The psychosocial risk factors of low back,
- The rate of absenteeism in relation to and LBP.

The null hypotheses of this study were:

There are no differences between the sedentary and manual employees in terms of:

- The demographics,
- The prevalence and characteristics of LBP,
- The psychosocial risk factors of low back,
- The rate of absenteeism in relation to and LBP.

4.3 Data:

4.3.1 Primary Data

Data was collected by virtue of questionnaire and its subsections (Table 4.1).

Table 4.0: Questionnaire Subsections

Section A	The demographics
Section B	The risk factors and psychosocial components that contribute to LBP
Section C	The LBP, including the LBP history, pain characteristics, outcome and how it influences the employees productivity

4.3.2. Secondary Data

The literature was extracted from medical journals, articles, books, textbooks, dissertations and internet online journals and articles.

4.4 Abbreviations:

- "*p"* refers to the p-value, which indicates the data statistical significance (Hinton, 2001; Campbell and Machin, 1999; Wright, 1997; Swinscow, 1996; Bland, 1996).
- "n" refers to the to the sample size. Sample in this case is defined as *"A subset of a population"* (Tropper, 1998).
- "%"refers to percentage.
- "<" refers to a figure "less than" the figure reported.
- ">" refers to a figure "more than" the figure reported.
- "=" implies "equals to"
- Std. Deviation: The standard deviation is a numerical value used to indicate how widely individuals in a group vary. If individual observations vary greatly from the group mean, the standard deviation is extensive; and vice versa (http://stattrek.com/statistics/dictionary.aspx?definition=standard_deviation, 2012) or
- Standard deviation (SD): *n* a computed measure of the dispersion or variability of a distribution of scores around a given point or line. It measures the way an individual score deviates from the most representative score (mean). A small SD indicates little individual deviation or a homogeneous group, and a large SD indicates extensive individual deviation or a heterogeneous group. (http://medical-dictionary.thefreedictionary.com/standard+error+of+the+mean, 2012)

- Std. Error Mean**:** *n* an estimate of the amount that an obtained mean may be expected to differ by chance from the true mean. (http://medical-dictionary.thefreedictionary.com/standard+error+of+the+mean, 2012)

4.5 Response Rate

In terms of the response rate (Figure 4.1).

With respect to the response rates it must be noted that prior to data collection in the study; the questionnaire development necessitated the use of a focus group and pilot study. Once the focus group and pilot study had been completed, changes to the questionnaire were required and processed for ethical clearance. Approval from the IREC was gained and necessary changes to the document were completed. This process, however, resulted in the need to include automotive company employees within the ethical clearance process. This, therefore, resulted in these members being excluded from the total sample of employees working at the automotive company and reduced the total sample size from 1200 to 1150 for the purposes of this study.

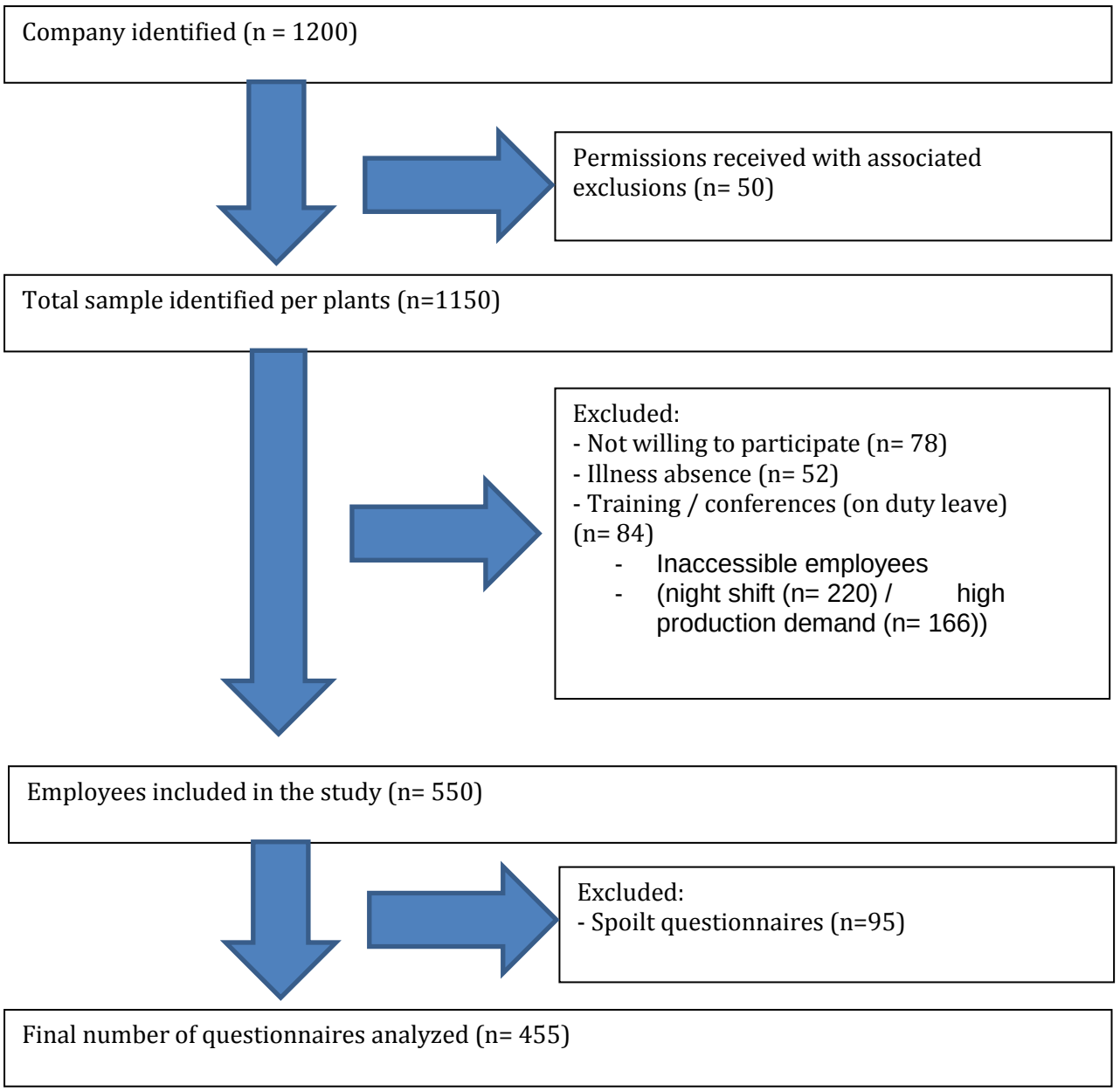
The numbers within the sample for this study were further reduced by the exclusion criteria, which resulted in the following numbers of potential participants being lost:

- Those that were not prepared to read and sign the Letter of Information and Informed Consent form (n= 78).
- Those employees that did meet the industry definition of a labour broker (n = 0).
- Those employees that were absent from the automotive plant due to illness (n= 52), at the time of the study.
- Those employees that were absent from automotive company due to training/ conferences (on duty leave n=84).
- Those employees that were inaccessible during the time of the study (e.g. night shift workers) (n= 220).
- Those employees that were working in high production demand plants or centres that were unable to take time out to complete the questionnaire (n= 166).

Thus the final number of employees that participated in the study was 550. Of these completed questionnaires, 95 were noted as spoilt (pages missing) or grossly incomplete questionnaires (greater than 50%), which were excluded at the data capturing process.

This left 455 questionnaires for data analysis which was 14% above the required and ethics approved number of 400.

Figure 4.1 Flow diagram adapted from Moher, Schulz and Altman, (2001).



4.6 Results:

4.6.1 Demographics:

4.6.1.1 Age and Height:

There was a highly significant difference between sedentary and manual employees with regards to age (p<0.001) (Table 4.1). The manual employees were on average younger than the sedentary employees. There was no difference with regard to height.

Table 4.1 : Comparison of Age and Height between employee groups

	Group	N	Mean	Std. Deviation	Std. Error Mean	*p* value
Age	Manual	216	37.24	8.420	.573	**<0.001**
	Sedentary	229	40.38	10.331	.683	
Height	Manual	214	1.710	.1069	.0073	0.191
	Sedentary	209	1.696	.1105	.0076	

4.6.1.2 Gender, Ethnicity, Marital Status and Education:

Table 4.2 shows that there were highly significant differences between the two groups in terms of gender (higher proportion of females in the sedentary employee group), and education (higher education levels in sedentary employee group). There was also a higher proportion of Whites and married people in the sedentary employee group but this could not be verified statistically as the numbers in some categories was low, invalidating the chi square test.

However, it can be concluded that there were demographic differences between the two groups.

Table 4.2: Demographics comparison between the groups

		Group						*p* value
		Manual		Sedentary		Total		
		Count	%	Count	%	Count	%	
Gender	Female	16	7.3%	89	38.4%	105	23.2%	**<0.001**
	Male	204	92.7%	143	61.6%	347	76.8%	
Ethnicity	African	1	.5%	0	.0%	1	.2%	**<0.001***
	Black	108	49.1%	28	12.1%	136	30.2%	
	Coloured	94	42.7%	94	40.7%	188	41.7%	
	Indian	1	.5%	14	6.1%	15	3.3%	
	Other	1	.5%	2	.9%	3	.7%	
	White	15	6.8%	93	40.3%	108	23.9%	
Marital	Divorced	12	5.5%	18	7.9%	30	6.7%	**<0.001***
	Married	117	53.7%	164	71.6%	281	62.9%	
	Other	4	1.8%	0	.0%	4	.9%	
	Single	85	39.0%	46	20.1%	131	29.3%	
	Widow	0	.0%	1	.4%	1	.2%	
Education	Primary school	5	2.3%	1	.4%	6	1.3%	**<0.001**
	High School	32	14.7%	11	4.8%	43	9.6%	
	Matriculated	119	54.6%	42	18.3%	161	36.0%	
	Tertiary	21	9.6%	128	55.9%	149	33.3%	
	Other	41	18.8%	47	20.5%	88	19.7%	

* Interpret with caution, chi square test not valid.

4.6.1.3 Medical Aid and Work Status:

The groups also differed with regards to medical aid (p=0.015, higher in the manual employee group) and, as expected, they differed regarding their work being sedentary or manual (p<0.001), (Table 4.3).

Table 4.3: Medical Aid and Work status

		Group						*p* value
		Manual		Sedentary		Total		
		Count	%	Count	%	Count	%	
Do you have a medical aid?	No	0	.0%	7	3.0%	7	1.5%	**0.015**
	Yes	220	100.0%	227	97.0%	447	98.5%	
Work status	Full time	217	98.6%	231	98.7%	448	98.7%	0.547
	Part time	3	1.4%	2	.9%	5	1.1%	
	Unknown	0	.0%	1	.4%	1	.2%	
Activity	Desk	2	.9%	230	99.1%	232	51.4%	**<0.001**
	Physical	217	99.1%	2	.9%	219	48.6%	

4.6.2 Low Back Pain (LBP)

4.6.2.1 Prevalence of Low Back Pain

The prevalence of current LBP overall was 53.8%, and in the manual employee group it was 61.5% compared to the sedentary employees at 46.6%. The prevalence of LBP over the last 12-months was 56% collectively and it was 57.5% in the manual employee group compared to 54.7% in the sedentary employee group (Table 4.4). There was a significant difference in prevalence between the groups for current back pain (p=0.001, it was higher in the manual employee group) and LBP previously suffered (p=0.553), as compared to previous LBP which is not statistically significantly linked.

Table 4.4: Prevalence of Low Back Pain

LBP								*p* value
		Manual		Sedentary		Total		
		Count	%	Count	%	Count	%	
LBP Current	No	85	38.5%	125	53.4%	210	46.2%	**<0.001**
	Yes	136	61.5%	109	46.6%	245	53.8%	
LBP Past	No	94	42.5%	106	45.3%	200	44.0%	0.553
	Yes	127	57.5%	128	54.7%	255	56.0%	

4.6.2.2 Characteristics of Low Back Pain - Pain Score

There was no difference in pain score for those who reported having back pain between the two groups either for current back pain or past back pain (Table 4.5).

Table 4.5 :Comparison of mean pain score between groups for current and past pain

	Group	N	Mean	Std. Deviation	Std. Error Mean	*p* value
Pain score	Manual	136	4.94	2.114	.181	0.133
	Sedentary	109	4.54	2.002	.192	
Pain (past back pain)	Manual	127	5.84	2.140	.190	0.530
	Sedentary	128	5.67	2.196	.194	

4.6.2.2.1 Pain Type – Current Pain

Table 4.6 indicated that most of the types of pain differed significantly between the two groups when current pain was considered. Only stiffness and other pain were not different between the groups.

Table 4.6 : Pain Type – Current Pain

Type of Pain Current Group Cross tabulation						*p* value
			Group		Total	
			Manual	Sedentary		
Type of Pain Current	Sharp	Count	35	17	52	**0.047**
		% within group	26.3%	15.7%		
	Shooting	Count	16	4	20	**0.020**
		% within group	12.0%	3.7%		
	Dull ache	Count	24	53	77	**<0.001**
		% within group	18.0%	49.1%		
	Stabbing	Count	26	3	29	**<0.001**
		% within group	19.5%	2.8%		
	Stiffness	Count	46	48	94	0.122
		% within group	34.6%	44.4%		
	Catching	Count	25	5	30	**0.001**
		% within group	18.8%	4.6%		
	Other type	Count	14	8	22	0.401
		% within group	10.5%	7.4%		
Total		Count	133	108	241	

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

4.6.2.2.2 Pain Type – Past Low Back Pain

The type of pain did not differ significantly between the two groups, according to Table 4.7, for pain experienced in the past except in the case of catching pain which was more common in the manual employee group.

Table 4.7 : Pain Type – Low Back Pain experienced in the past

Type of Pain Past Group Cross tabulation						*p* value
			Group		Total	
			Manual	Sedentary		
Type of pain past	Sharp	Count	40	43	83	0.788
		% within group	32.3%	33.9%		
	Shooting	Count	11	6	17	0.191
		% within group	8.9%	4.7%		
	Dull ache	Count	28	41	69	0.085
		% within group	22.6%	32.3%		
	Stabbing	Count	22	14	36	0.129
		% within group	17.7%	11.0%		
	Stiffness	Count	41	45	86	0.693
		% within group	33.1%	35.4%		
	Catching	Count	15	6	21	**0.035**
		% within group	12.1%	4.7%		
	Other	Count	13	7	20	0.146
		% within group	10.5%	5.5%		
Total		Count	124	127	251	

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

4.6.2.2.3 Location of Pain – Current and Past Low Back Pain

There was a significant difference between the side of the back pain and group in both current and low back pain experienced in the past (p<0.001), in the context of Table 4.8.

Table 4.8 Location of Pain – Current and Past Low Back Pain

		Group						*p* value
		Manual		Sedentary		Total		
		Count	%	Count	%	Count	%	
Where – Current LBP	Both sides of the Low Back region	98	72.6%	75	72.1%	173	72.4%	**<0.001**
	Left side of the back	2	1.5%	14	13.5%	16	6.7%	
	Right side of the back	9	6.7%	15	14.4%	24	10.0%	
	No Low Back pain	26	19.3%	0	.0%	26	10.9%	
Where- Past LBP	Both sides of the Low Back region	100	81.3%	98	79.0%	198	80.2%	**<0.001**
	Left side of the back	7	5.7%	0	.0%	7	2.8%	
	Right side of the back	5	4.1%	0	.0%	5	2.0%	
	No Low Back Pain	11	8.9%	26	21.0%	37	15.0%	

4.6.2.2.4 Associated features of Current Low Back Pain

According to Table 4.9 and Table 4.10, some of the features of both current and past back pain differed significantly between the manual and sedentary employees.

Table: 4.9 : Features of Current Back Pain by Group

		Group						*p* value
		Manual		Sedentary		Total		
		Count	%	Count	%	Count	%	
Do you ever get the feeling of pins and needles in your legs when the low back pain presents?	No	69	51.9%	76	69.7%	145	59.9%	**0.005**
	Yes	64	48.1%	33	30.3%	97	40.1%	
If indicated yes to the above question, did the pain spread down your legs to below your knees?	No	74	56.1%	81	74.3%	155	64.3%	**0.003**
	Yes	58	43.9%	28	25.7%	86	35.7%	
Do you ever get a numb feeling in your legs and feet when the low back pain presents?	No	71	53.8%	80	73.4%	151	62.7%	**0.002**
	Yes	61	46.2%	29	26.6%	90	37.3%	
Did the low back pain make it difficult to tie your shoe laces or put your socks on?	No	66	48.9%	50	47.2%	116	48.1%	0.791
	Yes	69	51.1%	56	52.8%	125	51.9%	
Did the low back pain affect your daily activities?	No	52	38.8%	47	44.8%	99	41.4%	0.354
	Yes	82	61.2%	58	55.2%	140	58.6%	
Have you ever needed bed – rest for your low back pain?	No	42	31.1%	51	49.5%	93	39.1%	**0.004**
	Yes	93	68.9%	52	50.5%	145	60.9%	
Have you ever been absent from work due to your low back pain?	No	15	11.1%	42	40.8%	57	23.9%	<0.001
	Yes	120	88.9%	61	59.2%	181	76.1%	
Do you have low back pain only at work?	No	89	66.4%	85	83.3%	174	73.7%	**0.006**
	Yes	45	33.6%	17	16.7%	62	26.3%	
Do you have low back pain only at home?	No	98	72.6%	83	80.6%	181	76.1%	0.152
	Yes	37	27.4%	20	19.4%	57	23.9%	
Does the low back pain get better over weekends?	No	63	46.7%	62	60.2%	125	52.5%	**0.038**
	Yes	72	53.3%	41	39.8%	113	47.5%	
Do you think your low back pain is related to your work?	No	19	14.1%	39	37.9%	58	24.4%	**<0.001**
	Yes	116	85.9%	64	62.1%	180	75.6%	
Have you ever lost your job due to low back pain?	No	132	97.8%	103	100.0 %	235	98.7%	0.128
	Yes	3	2.2%	0	.0%	3	1.3%	

4.6.2.5 Features of Past Back Pain

Table 4.10 : Features of Low Back Pain experienced in the past

		Group						*p* value
		Manual		Sedentary		Total		
		Count	%	Count	%	Count	%	
Do you ever get the feeling of pins and needles in your legs when the low back pain presents?	No	73	59.3%	93	75.0%	166	67.2%	**0.009**
	Yes	50	40.7%	31	25.0%	81	32.8%	
If indicated yes to the above question, did the pain spread down your legs to below your knees?	No	77	64.2%	95	76.6%	172	70.5%	**0.033**
	Yes	43	35.8%	29	23.4%	72	29.5%	
Do you ever get a numb feeling in your legs and feet when the low back pain presents?	No	77	63.1%	96	77.4%	173	70.3%	**0.014**
	Yes	45	36.9%	28	22.6%	73	29.7%	
Did the low back pain make it difficult to tie your shoe laces or put your socks on?	No	51	41.1%	48	38.4%	99	39.8%	0.660
	Yes	73	58.9%	77	61.6%	150	60.2%	
Did the low back pain affect your daily activities?	No	41	33.1%	55	44.0%	96	38.6%	0.076
	Yes	83	66.9%	70	56.0%	153	61.4%	
Did the low back pain last more than a day?	No	14	11.6%	14	11.6%	28	11.6%	1.000
	Yes	107	88.4%	107	88.4%	214	88.4%	
Have you ever needed bed – rest for your low back pain?	No	38	31.1%	58	47.2%	96	39.2%	**0.010**
	Yes	84	68.9%	65	52.8%	149	60.8%	
Have you ever been absent from work due to your low back pain?	No	32	26.2%	59	48.8%	91	37.4%	**<0.001**
	Yes	90	73.8%	62	51.2%	152	62.6%	
Do you have low back pain only at work?	No	74	61.2%	107	88.4%	181	74.8%	**<0.001**
	Yes	47	38.8%	14	11.6%	61	25.2%	
Do you have low back pain only at home?	No	90	73.8%	101	84.2%	191	78.9%	0.104
	Yes	32	26.2%	19	15.8%	51	21.1%	
Does the low back pain get better over weekends?	No	53	43.1%	85	69.7%	138	56.3%	**<0.001**
	Yes	70	56.9%	37	30.3%	107	43.7%	
Do you think your low back pain is related to your work?	No	22	18.0%	68	55.7%	90	36.9%	**<0.001**
	Yes	100	82.0%	54	44.3%	154	63.1%	
Have you ever lost your job due to low back pain?	No	121	98.4%	121	100.0%	242	99.2%	0.159
	Yes	2	1.6%	0	.0%	2	.8%	

4.6.3. Psychosocial risk factors of low back pain

Although the manual employee group had generally higher levels of domestic, financial and overall stress than the sedentary employee group, there was no association between any of these stresses and current LBP in either of the groups (Table 4.11). Therefore, there were no differences between the groups in terms of the psychosocial risk factors of LBP.

Table: 4.11: Association between psychosocial risk factors and Current Low Back Pain.

Psychosocial risk factors and associated scores:		Group									
		Manual					Sedentary				
		No LBP		LBP		P value	No LBP		LBP		*p* value
		Count	Row %	Count	Row %		Count	Row %	Count	Row %	
Stress	Low	23	31.5%	50	68.5%	0.185	23	54.8%	19	45.2%	0.952
	Moderate	50	43.5%	65	56.5%		77	53.1%	68	46.9%	
	High	9	31.0%	20	69.0%		25	55.6%	20	44.4%	
Domestic stress	No	57	38.0%	93	62.0%	0.716	92	54.4%	77	45.6%	0.614
	Yes	23	35.4%	42	64.6%		33	50.8%	32	49.2%	
Financial stress	No	42	34.1%	81	65.9%	0.242	89	56.3%	69	43.7%	0.199
	Yes	39	41.9%	54	58.1%		35	47.3%	39	52.7%	

4.6.4. The Rate of Absenteeism in relation to and Low Back Pain

Of those with current LBP (Table 4.12), 89% of the manual employee group and 60% of the sedentary employee group had been absent from work due to back pain. This difference was highly statistically significant (p<0.001)

Table 4.12: Absence due to low back pain by group

			Group		Total
			Manual	Sedentary	
Absent	No	Count	15	42	57
		% within Group	11.0%	40.4%	23.8%
	Yes	Count	121	62	183
		% within Group	89.0%	59.6%	76.3%
Total		Count	136	104	240
		% within Group	100.0%	100.0%	100.0%

Pearson's chi square = 28.04, p<0.001

A non-parametric Mann-Whitney test, according to Table 4.13, showed a highly significant difference in median days absent between the two groups (p<0.001) where the median days absent was higher in the sedentary employee group. Therefore, although the manual employee group was more likely to be absent from work due to low back pain, the number of days taken by the sedentary employee group was higher.

Table 4.13: Comparison of median days absent from work between groups

No. Days				*p* value
Group	Median	Minimum	Maximum	
Manual	5.00	1	365	**<0.001**
Sedentary	14.00	2	365	
Total	7.00	1	365	

4.7 Conclusion

With the conclusion of the results as presented in this chapter, the following chapter provides an insight into the significance of these results in the context of the literature. This will enable an effective comparison with regards to the prevalence and characteristics between the literature and this study, highlighting particularly the differences between manual and sedentary employees within an automotive company.

Chapter Five:

5.1 Introduction

This chapter contextualizes the results of this study in terms of the current literature.

5.2 Response rates

According to Lindorff-Larsen *et al*., (2007), the generalizability of a questionnaire becomes questionable when the return rates fall below 30%. This is because the data may have inherent biases as a result of the manner of data collection and the particular characteristics of the subgroup that respond (purporting to represent the group as a whole). This is supported by Louw and Myburgh (2007); Mearns and Reader (2007); Suter, Vanderheyden, Trojan, Verhoef and Armitage (2007) and Symon, McStea and Murphy-Black (2006).

A more suitable minimum return rate is one that is over 30% and starts to approximate the total sample size or total population size. This is because studies that have a better response rate tend to be more representative and therefore generalizable to the population under study and other similar populations (Copp *et al.,* 2007).

To this end, there are a number of factors that have been found to affect response rates, which include, but may not be limited, to the following factors that have ben identified in the literature:

- Advance incentives (Delnevo *et al*., 2004; Leung *et al.,* 2004),
- Advance notices have also been noted to increase the response rate for questionnaire studies (Russell *et al.* 2004),
- Delivery methods or methods by which the questionnaire is administered, as personal contact by the researcher tends to increase the response rate (Louw, 2005; Van As, 2005; Hunter, 2004; Reubens, 1996),
- Facilitate incentives (Halpern *et al.*, 2002; Asch *et al.*, 1998),
- Follow-up methods indicate that an increased number of contacts with the population sample increase the likelihood for return of questionnaires (Russell *et al.,* 2004; Sheth and Roscoe, 1975),
- Geographical location (Sheth and Roscoe, 1975),
- Multiple forms of data collection (Kasprzyk *et al.,* 2001),

- Number of reminders (Barclay, Todda, Finlay, Grande and Wyatt, 2002; Etzel and Walker, 1974),
- Perceived importance of the questionnaire at the time that the population is requested to complete the questionnaire (Rattan, 2007),
- Time that the respondents have to complete the questionnaire (Labuschagne, 2009; Asch, Jedrziewski and Christakis, 1997),
- Questionnaire colour and design (LaGarce and Kuhn, 1995),
- Questionnaire length (Sheth and Roscoe, 1975; Dyer, 1997) and
- Timing of reminders is important (Barclay, Todda, Finlay, Grande and Wyatt, 2002; Etzel and Walker, 1974).

In terms of this research, the questionnaires were delivered in person to the employees of the automotive company, after the company had informed its employees that the research would be taking place. In addition, the questionnaire was kept as short as possible and presented in a manner that was easy to read and understand. In addition, the company support also increased the possibility that employees would return the questionnaire promptly if they were on the premises.

As a result, the following response rate outlines were achieved:

- Total sample 1150
    - Excluded 600 (52.2%) (Section 4.5)
    - Spoilt questionnaires 95 (8.3%)
    - Included 455 (39.5%)

Therefore, it is possible to suggest that the outcomes of this study would be generalizable to the entire population from which the sample was drawn. In addition, it is also possible to indicate that this study can draw comparisons with the literature as the generalizability is possible between this and other studies (Lapane *et al.,* 2007).

5.3 Demographic factors related to the employees

The demographics have revealed that the sedentary employees are older White female employees who are married with tertiary education, and are not part of a medical scheme. By contrast, the manual employees of the automotive company are young Black and Coloured males who are unmarried with no tertiary education and who are currently part of medical scheme (Table 5.1 as drawn from Tables 4.1, 4.2 and 4.3, it was noted that sedentary versus manual work was excluded from this extraction as it denoted the relative numbers as a result of the inclusion and exclusion requirements of the study).

Table 5.1: Demographics

Demographics	Sedentary Employees	Statistics	Manual Employees
Age	Older	Significant difference	Younger
Gender	Female	Significant difference	Male
Ethnicity	White	Significant difference	Black- Coloured
Marital Status	Married	Significant difference	Single
Education	Tertiary	Significant difference	Matriculated
Medical Aid	No medical Aid	Significant difference	Medical Aid

When looking at the individual factors, Morris (2006), Thomas (2005) and Bernick (1991) describe that there is an increased likelihood of LBP with increased age. This would agree with this study if the sedentary employees reported an increased rate and level of LBP as compared to their manual employee counterparts (as a resultant of the significant difference between the employee groups).

From the literature it is suggested that the lifetime prevalence for males (Table 2.5) is generally lower in developing counties (because there are more manual employees) as opposed to developed countries (usually more sedentary employees) (Picavet *et al.,* 2002; Docrat, 1999; van der Meulen 1997; Biering-Sorensen *et al.,* 1989; Frymoyer *et al.,* 1983). Therefore, a decreased rate and level of LBP is expected in the manual employees as compared to the sedentary employees (Ferreira *et al*., 2010; Koley *et al.,* 2008; Vindigni *et al.,* 2005). It would, however, be surprising if this was upheld in the reporting of the LBP, as there is a marked difference in number between the males in the sedentary employee group and the manual employee group. It would be anticipated that the increased female numbers in the sedentary employee group would decrease the chance of a significnat difference between the groups in terms of LBP reporting.

The results from this research show a significant difference in the ethnic groups, as the sedentary employees are mainly of White ethnic origin compared to the manual employees who are mainly of Black and Coloured ethnicity. According to Van der Meulen, (1997), there was a 57.6% lifetime prevalence LBP in Black South Africans and according to Docrat (1999) a 78.2% and 76.6% lifetime prevalence amongst Indian South Africans and the Coloured South African ethnic groups respectively, with Dyer (2012) indicating a 48.0% lifetime prevalence amongst White South Africans. This would imply that the sedentary employee groups should present with lesser reported findings of LBP as compared to the manual employee group. This is further supported by the work of Hurwitz and Morgenstern (1997).

The literature suggests that marriage decreases pain, due to the companionship and indirect shared stresses (Biering-Sörensen *et al.,* 1986; Reisbord *et al.,* 1985). Thus, it would be expcted that the sedentary employee groups reports less LBP as compared to the manual employee group.

In terms of education and employment, Biering-Sörensen (1983); Deyo *et al.,* (1987); Heliövaara (1989); Bergenudd and Nilsson (1988); Viikari-Juntura *et al.,* (1991); Dionne *et al.,* (1997) and Hurwitz and Morgenstern, (1997) stated that poor education increased the risk of LBP and severity of LBP. Contrary to the above, however, Riihimaki *et al.,* (1989); Bigos *et al.,* (1991) and Power *et al.,* (2001) indicated that there is no considered link between education levels and the increased or decreased incidence of LBP. However, there has been a link showing umemployment (inferring lower levels of education) and LBP are related (Volinn *et al.,* 1988; Cheadle *et al.,* 1994; Hurwitz and Morgenstern, 1997). Therefore, in this study, it would be expected that the manual employee group would have reported a higher level of LBP with an increased severity.

In conclusion then, the literature would suggest that the sedentary employees would report a lesser incidence and prevalence of LBP because they are White South African females, who are married and are educated as compared to the manual employee groups who are predominantly Black and Coloured South African males, who are single and have a lesser degree of education. In both groups, there are however, two factors that may counter this assertion and this includes the facts that the sedentary employee group is older (and therefore more prone to LBP) and also has no medical aid (which makes them more prone to chronic LBP due to decreased access to care (Dagenais and Haldeman, 2012)).

5.4 Characteristics of LBP history

Table 5.2 :Characteristics of Low Back Pain History (extracted from Table 4.4)

Prevalence of Low Back Pain		**Sedentary Employees**	**Statistics**	**Manual employees**
Current Low Back Pain	Point Prevalence	Decreased Low Back Pain	Significant difference	Increased Low Back Pain
Past Low Back Pain (previous 12months)	Period Prevalence		Not Significant difference	

The sedentary employees revealed lower reports of LBP as compared to the manual employees who showed higher reports of LBP in both point and period prevalence (although it was noted that period prevalence was not significantly different), with point prevalence being significantly different between the groups. This suggests that more manual employees present with LBP at any time point than the sedentary employees, however as time increases (as denoted by period prevalence), there is a lesser chance that the groups remain significantly different from one another (viz. the likelihood of the two groups reporting LBP over a period in time becomes greater and therefore the differences between the groups becomes less).

In terms of the ***point prevalence*** in the sedentary employee group, it is noted that the prevalence of LBP compares favourably with that reported in other studies that focus on predominantly sedentary employees (seen in Table 5.3 below); faring well below the average reported in the literature.

Table 5.3 Sedentary type of occupational tasks - showing the Point Prevalence of LBP

AUTHOR	**YEAR**	**OCCUPATION TYPE**	**REPONDENTS**	**PREVELANCE OF LBP % (Point)**
Bovenzi	1996	Bus drivers	234	83.8
		Tractor driver	1155	30.6
Hoy *et al.,*	2004	Forklift truck drivers	46	65.2
Chen *et al.,*	2005	Taxi drivers	1242	51
Okunribido *et al.,*	2007	Bus drivers	80	59
Wynne-Jones *et al.,*	2007	Primary care consultants	935	37
Spyropoulos *et al.,*	2007	Public office employees	771	61.6
Pargali *et al.,*	2010	Dentists	90	33 - 55
Current study	***2012***	***Automotive industry***	***234***	***46.6***

Table 5.4: Physical type of occupational tasks - showing the Point Prevalence of LBP

AUTHOR	YEAR	OCCUPATION TYPE	SAMPLE SIZE	PREVELANCE OF LBP % (Point)
Latza *et al.,*	1999	Construction workers	571	50.1
Omokhodion *et al.,*	2000	Hospital staff	80	69
Teitz *et al.,*	2002	Intercollegiate rowers	1632	32
Rugelj *et al.,*	2003	Physiotherapists	133	73.7
Smith *et al.,*	2005	Nurses	330	72.4
Holmberg *et al.,*	2005	Farmers	1013	64
Van Vuuren *et al.,*	2006	Plant workers	109	71.6
Lui *et al.,*	2008	Farmers	2045	38.4
Mattila *et al.,*	2009	Finnish military males	391,241	30
Secer *et al.,*	2011	Novice soldiers	871	74
Bernard *et al.,*	2011	Vineyard workers	3974	40
Current study	***2012***	***Automotive industry***	**221**	**61.5**

By contrast and in terms of the ***point prevalence*** in the manual employee group, it is noted that the prevalence of LBP compares favourably with that reported in other studies that focus on predominantly sedentary employees (seen in Table 5.4 below), appearing to be well above average and contending with the higher reported point prevalences in the literature.

These results concur with the discussion of the demographic profiles obtained for the two employee groups in this study and the impact that these were anticipated to have on the prevalence of LBP (see Section 5.2) and validates that the point prevalence of the manual employee group (61.5%) is higher than that obtained by the sedentary employee group (46.6%).

With regard to ***period prevalence*** it was noted that there was no significant difference between the two employee groups, which notes that as time passes both groups have similar levels of reporting in terms of having had at least one episode of LBP in their lives (Table 4.4) and in the context of the general literature, the outcomes of this study seem to situate themselves within the mid to upper ranges of the reported period prevalence ranges that have been noted by the authors over the years from the mid 1990's through to the Helfenstein-Junior *et al.,* (2010) study (see Table 5.5).

Table 5.5 : Review of epidemiology (Adapted from Dyer, 2012)

Authors	Study type	Lifetime prevalence
Frank *et al.,* (1996)	Epidemiological study	50% - 80%
Bovenzi, (1996)	Intervention study	66.4% - 83.8%
Cassidy *et al.,* (1998)	Epidemiological study	84%
Loney and Stratford, (1999)	Review of literature	59% - 84%
Waddell, (2004)	Epidemiological study	50% - 80%
Dagenais *et al.*, (2008)	Review of literature	5% - 65%
Bell and Burnett, (2009)	Review of literature	60% - 90%
Helfenstein-Junior *et al.,* (2010)	Review of current knowledge of LBP	50% - 80%
Current study (2012)		54.7% - 57.5 %

5.5 Low Back Pain and its Characteristics

Table 5.6 : Characteristics of Low Back Pain

	Sedentary employees	**Statistics**	**Manual employees**
Pain Scores	-	No Significant difference	-

In this study no significant difference was shown in the pain score characteristics of LBP when comparing the sedentary employees comparing to manual employees. This indicates that although one might expect that the manual employees would have a greater likelihood of more severe LBP; this is not found in this study. This may be as a consequence to the fact that the pathogenesis of LBP (irrespective of origin) affects similar anatomical structures within the low back (refer to Table 2.3) and thereby affecting nerves and pain conduction pathways in the sane or similar ways (Freiwald, Reuter and Engelhardt, 1999). Therefore little difference would be expected in the severity of the pain reported.

In addition the above results seem to suggest that there is very little difference between the employee groups in terms of the reported pain, even though there was a significant difference between the ethnic groups that constituted the majority within each of these groups (Table 4.2 and Table 5.1). This would therefore not agree with the suggestions by Green *et al.,* (2002) and Portenoy *et al.,* (2004) with regards to ethnic influencers resulting in significant differences in the perceived severity of pain.

5.6 Type of Low Back Pain experienced by the employees

In analyzing the current type of LBP (as taken from Table 4.6); the results showed that current pain in sedentary employees were significantly different compared to the manual employees with the exception stiffness and other type of pain.

Table 5.7 Type of Low Back Pain – Current Low Back Pain

Description of Low Back Pain	Sedentary employees	*p* value outcome	Manual employees
Sharp		Significant difference	Higher
Shooting		Significant difference	Higher
Dull ache		Significant difference	Higher
Stabbing		Significant difference	Higher
Stiffness	No significant difference		
Catching		Significant difference	Higher
Other type	No significant difference		

In contrast when analyzing the past type of LBP (as taken from Table 4.7); the results showed that past pain in sedentary employees were non-significantly different compared to the manual employees with the exception of catching pain.

Table 5.8 Type of Low Back Pain – Past Low Back Pain

Description of Low Back Pain	Sedentary employees	*p* value outcome	Manual employees
Sharp	No Significant difference		
Shooting	No Significant difference		
Dull ache	No Significant difference		
Stabbing	No Significant difference		
Stiffness	No Significant difference		
Catching		Significant difference	Higher
Other type	No Significant difference		

It is of interest to note that the types of pain change from current to past – particularly in the manual employee group. It seems to emphasize that current pain experienced in the manual employee group seems is of a more traumatic origin (viz. not related to a dull aching pain or stiffness) as compared to that which might be as a result of prolonged immobility (Morris, 2006). This seems to be further supported by the fact that past pain is noted as catching by the manual employees and seems to suggest that their LBP stems from or is exacerbated by instability as compared to the sedentary group which has a higher degree of stiffness and “other pain” (Tables 5.7 and 5.8).

5.7 Location of the reported Low Back Pain

Table 5.9 : Location of Low Back Pain

Low Back Pain	Sedentary employees	Statistics	Manual employees
Current	Sidedness	Significant difference	Bilateral
Past	No pain	Significant difference	-

From the above results, it would seem to suggest that in terms of their current pain that sedentary employees tend to have pain localized on one or another side whereas manual employees complained of bilateral pain or central pain. This significant difference seems to suggest that sedentary employees have pain related directly to prolonged and incorrect seated posture, whereas the manual employees have pain from musculoskeletal failure because of repetitive activity. This would, therefore, concur with the work of Roffey *et al.*, (2010a); Roffey *et al*., (2010b); Roffey *et al.*, (2010c); Roffey *et al.*, (2010d); Roffey *et al*., (2010e); Wai *et al.*, (2010a); Wai *et al.,* (2010b) and Redwood and Cleveland (2003) who indicate that particular work requirements predispose workers to LBP for particular reasons. It is, therefore, suggested that future studies within the automotive industry try to establish what the particular work related factors are that link with LBP sidedness, in both the manual and sedentary employee groups. This suggestion stems from the fact that this study did not find any significant correlations between sidedness of the current LBP and the activities (as noted in the questionnaire (Appendix K) questions related to occupational activities). This was as a result of the small numbers of employees that were allocated to each of the subgroups when analyzing these relationships, therefore making the analysis insignificant and thus impossible to note any effect. Thus, a larger sample size would make this more feasible.

Table 5.10: Features of Current Low Back Pain		**Responses with regards to these symptoms noted by "x" indicate that the symptom response number is higher in the denoted group**	
		Sedentary employees	**Manual employees**
Do you ever get the feeling of pins and needles in your legs when the low back pain presents?	Significant difference		X
If indicated yes to the above question, did the pain spread down your legs to below your knees?	Significant difference		X
Do you ever get a numb feeling in your legs and feet when the low back pain presents?	Significant difference		X
Did the low back pain make it difficult to tie your shoe laces or put your socks on?	No significant difference	-	-
Did the low back pain affect your daily activities?	No significant difference	-	-
Have you ever needed bed – rest for your low back pain?	Significant difference		X
Have you ever been absent from work due to your low back pain?	Significant difference		X
Do you have low back pain only at work?	Significant difference		X
Do you have low back pain only at home?	No significant difference	-	-
Does the low back pain get better over weekends?	Significant difference		X
Do you think your low back pain is related to your work?	Significant difference		X
Have you ever lost your job due to low back pain?	No significant difference	-	-

Table 5.11; Features of Past Low Back Pain		**Responses with regards to these symptoms noted by "x" indicate that the symptom response number is higher in the denoted group**	
		Sedentary employees	**Manual employees**
Do you ever get the feeling of pins and needles in your legs when the low back pain presents?	Significant difference		X
If indicated yes to the above question, did the pain spread down your legs to below your knees?	Significant difference		X
Do you ever get a numb feeling in your legs and feet when the low back pain presents?	Significant difference		X
Did the low back pain make it difficult to tie your shoe laces or put your socks on?	No significant difference	-	-
Did the low back pain affect your daily activities?	No significant difference	-	-
Have you ever needed bed – rest for your low back pain?	Significant difference		X
Have you ever been absent from work due to your low back pain?	Significant difference		X
Do you have low back pain only at work?	Significant difference		X
Do you have low back pain only at home?	No significant difference	-	-
Does the low back pain get better over weekends?	Significant difference		X
Do you think your low back pain is related to your work?	Significant difference		X
Have you ever lost your job due to low back pain	No significant difference	-	-

5.8 Features of the reported Low Back Pain

Tables 5.10 and 5.11 where extracted from Tables 4.9 and 4.10 in order to highlight the differences between the manual and sedentary employees.

The results of this section support that which was outlined in Section 5.5, in which it was indicated that the manual employees would present with a greater chance of traumatic injury and, therefore, a wider range of signs and symptoms (pins and needles, pain to the knees and / or numbness or a combination of one or more of these) than the sedentary employee group.

From the remaining results it can be seen that the LBP seemed to affect the manual employees at work (or manual employees perceived that the LBP is related to work) and over the weekends (when they are likely to participate in recreational activities), as opposed to at home relaxing as there was no significant difference between the employee groups. This would also perhaps lead the manual employees to spend greater periods being absent and to be more sedentary over the weekends (best rest). Limited literature with respect to the manual employees. Future research is required to determine whether these assertions are indeed valid.

This may imply that the manual employee has greater problems at home and at work in that he is unable to function in these environments to his / her full ability because of LBP, creating psychosocial and psychological stress. There is, however, no difference as noted in Section 5.7 below.

5.9 Psychosocial factors related to Low Back Pain

There is no significant difference in the data, comparing the psychosocial factors between the sedentary employees versus the manual employees.

Table 5.12: Psychosocial Factors

	Sedentary employees	Manual employees
Stress	No significant differences noted for any of the measured parameters.	
Domestic Stress		
Financial Stress		

There are various different studies suggesting that psychological factors (such as stress and depression) are related to current or future episodes of LBP (Heneweer *et al.,* 2010; Linton and Ryberg, 2000; Hoogendoorn *et al.,* 2000; Bongers *et al.,* 1993). It is evident when evaluating the relevant literature that psychosocial stress is influential in LBP (Linton and Ryberg, 2000; Hoogendoorn *et al.,* 2000; Bongers *et al.,* 1993). However, the results of this current study seem to suggest that stress is not a factor (irrespective of the category (Table 5.12)). This may be at odds with the literature because of the sample size, which reflected insignificant factors between the sedentary and manual employee groups.

5.10 Absenteeism

Table 5.13 : Absenteeism of Current Low Back Pain

	Sedentary	Statistics	Manual Employees
Absenteeism	59,6%	Significant difference	89%

One of the consequences of LBP is its association with increased absence from work, lost productivity and corresponding increase in economic costs. These costs are because LBP results in significant levels of disability, producing significant inability to work (Ghaffari, 2006; Bildt Thorbjornsson *et al*., 2000; Anderson, 1999; Guo *et al.,* 1999; Hutubessy *et al.,* 1999).

In terms of this study, the absenteeism rate shows a significant difference when comparing the sedentary and manual employees (Table 5.13 extracted from Table 4.12), revealing that the manual employees have a higher rate of absence in a year.

It is, however, noted that the manual employees take less sick days than the sedentary employees (Table 4.13). This may be related to company policy where the number of days of leave granted for sickness are limited per absence period for manual employees and if this is exceeded, then there are consequences for the manual employee in terms of their work requirements. This means that the manual employee never has the time to have their LBP dealt with effectively and thus the likelihood of recurrence is greater. This contrasts with the sedentary employees, where the rate of reported LBP is less, but they take more time for each absence (not limited by company policy), which allows them to deal with the LBP more effectively and hence the likelihood that the rate of LBP is less (as recorded in Table 5.11).

It is nonetheless significant that the rate of LBP reported amongst both the sedentary (59.6%) and the manual (89%) are still relatively high, implying that the costs to the company are relatively high. It is, therefore, suggested that the company looks at a variety of strategies to reduce the burden of LBP in their employees.

5.11 Review of the aims and objectives of the study

The aim was to determine the prevalence and associated risk factors of low back pain in an automotive production company.

Objectives of study were to determine and then compare the following between the sedentary and manual employees with respect to their:

- demographics,
- prevalence and characteristics of LBP,
- psychosocial risk factors of low back,
- rate of absenteeism in relation to LBP.

The null hypotheses of this study were:
There will be no difference between the sedentary and manual employees in terms of:

- The demographics,
    - This was rejected for
        - Age,
        - Gender,
        - Ethnicity,
        - Marital status,
        - Education and
        - Medical aid.
    - This was accepted for all other factors (as noted in the questionnaire (Appendix K).

- The prevalence and characteristics of LBP,
    - This was rejected for
        - Point prevalence,
        - Current LBP: sharp, shooting, dull aching, stabbing and catching pain descriptions.
        - Past LBP: catching pain description.
        - Sidedness/ location of pain.
        - Associated features of the current LBP: pins and needles, pain to the knees, numbness, bed rest, absence from work, pain at work, pain on weekends.

        - Associated features of past LBP: pins and needles, pain to the knees, numbness, bed rest, absence from work, pain at work, pain on weekends.

    - This was accepted for
        - Period prevalence,
        - Pain scores.
        - For present LBP: Stiffness and “other pain”.
        - For past LBP: sharp, shooting, dull aching, stabbing, stiff and catching pain descriptions.
        - Associated features of the current LBP: tying laces, affecting daily activities, pain at home.
        - Associated features of past LBP: tying laces, affecting daily activities, pain at home.

- The psychosocial risk factors of low back pain,
    - The hypotheses as applied to all factors were accepted.

- The rate of absenteeism in relation to LBP.
    - This was rejected as there was a significant difference between the manual and sedentary employees.

5.12 Conclusion

From the above it can be seen that there are some significant differences between the sedentary and manual employees at the automotive company that was studied. However, irrespective of the differences between the groups, it is still noted that there are high reported rates of LBP in both groups, which leads one to understand that there must be a significant cost attached to this for the company. It is, therefore, suggested that the company looks at some form of intervention strategies in order to reduce this burden. .

Chapter Six

6.1 Conclusions

In terms of the study, it was proposed that there was no difference between manual and sedentary employees at a particular automotive company with respect to their:

- demographics,
- prevalence and characteristics of LBP,
- psychosocial risk factors of low back,
- rate of absenteeism in relation to and LBP.

It was found that there were indeed some significant differences between these groups that both agree and disagreed with the prevailing literature. However, and more importantly, it was noted that there were high reported rates of LBP in both groups. This implies that there must be a significant cost attached to the company. As a result, it is suggested that with these high reported rates, that the company look at some form of intervention strategies in order to reduce this burden.

6.2 Recommendations

Recommendations from this study arise from three areas. These include the methods, analysis and future studies.

Methodology:

- An increased window of time may have allowed for more questionnaires to be collected (assisting with more accurate subgroup analysis).
- The questionnaire could also have been more in-depth and detailed, in terms of, questions related to the ergonomics of the sedentary employees and manual employees specifically. This could aid in developing more specific and accurate intervention strategies in order to assist in reducing the LBP burden in the company.

Analysis

- Larger sample size would have assisted in this research by allowing greater in depth analysis of sub group contributions to the overall results. However, because the samples in some cases were small and the Chi-square tests could not be calculated the significance of these factors was not able to be determined.

Future research

- It should be considered that future research look at the statistics with respect to LBP and other musculoskeletal conditions per plant or per department (if there are several what - departments per plant), as there may be specific designated job descriptions that link to higher prevalence’s of particular conditions, which would then require specific interventions.
- It was also considered that it may be beneficial to translate questionnaires into various other languages (as applicable to the region in which the company exists) to take advantage of first language understanding of employees (even though the company may have a policy requiring all employees to speak English for employment purposes). Languages to consider would include all 11 of the official languages of South Africa.

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Appendix A
Letter of Information: Managers

To whom it may concern:

I am a chiropractic master's student who is doing my research on the prevalence and associated risk factors of low back pain in the automotive industry.

Supervisor:	Dr C. Korporaal	(083 246 3562)
Research student:	Tarnia Raad	(082 784 1470)

Institution: Durban University of Technology

Title of the Research Study:
The prevalence and associated risk factors of low back pain in an automotive production company.

Brief Introduction and Purpose of the Study:
Several studies have confirmed a high prevalence of low back pain in certain occupations. This could be as a result of employees maintaining static work postures (e.g. sitting behind a desk for long periods of time). In contrast, lifting, twisting, lifting while twisting, pulling, pushing, carrying and lowering, twisted posture (particularly when dealing with heavy objects), heavy manual labour, cumulative load exposure are also risk factors for low back pain in the working situation. Both of these types employees are found in high proportion in the automotive industry and therefore the impact of low back pain would be perceived to be high. However there may be specific risk factors, especially within specific occupational activities or specific professions, which the company may consider addressing but are currently unknown.

Thus the aim of this research is therefore, to determine the prevalence and associated risk factors of low back pain, comparing the statistical data of manual production employees to sedentary desk employees.

How are you able to assist with this research study?

Your company has been selected to take part in the above study. Participation for the study in terms of the company and the employees is at all times voluntary and refusal to participate will not result in adverse consequences of any kind to either the company or the employee. The results of this study will be made available in the Durban University of Technology library in the form of a mini-dissertation, and the HR Offices of the company willing to participate.

Procedures:
Four hundred employees (200 sedentary and 200 manual production employees) from your automotive company will be chosen through a systemic random sampling procedure. The selected employees will be eligible to take part in the study. Each employee will be given a letter of information and should he/she agree to take part in the study, will complete a letter of informed consent. This will be followed by completion of the research questionnaire.

The researcher will be available for the entire duration to assist with any queries that may arise. Total time to fill out all paperwork will take approximately 15 minutes and all information will be strictly anonymous and confidential.

Confidentiality:
All information (company name as well as the individual employee's names) is confidential and the results will be used for research purposes only. Therefore the automotive company chosen to participate in the study will remain anonymous and confidential. Please do not hesitate to ask any questions on any aspect of this study.

Your company's approval for access to your employees would be of importance in allowing for this process to be completed and feedback sent to you / your company.

Risks/Discomfort and Cost:
There are no risks/discomfort or cost involved from your company or employee as a result of your collective participation in the study.

Persons to contact with problems or questions:
Should you have any questions that you may want answered by an independent source, you can contact my supervisor on the above number. If you are not satisfied with any aspect of this study, feel free to forward any concerns to the Durban University of Technology Research and Ethics Committee.

In order to move forward with this study, would you be so kind as to respond to this letter in writing indicating whether you would approve of this study taking place on your premises or not, provided that the attached proposal is approved by the Faculty of Health Sciences Research and Ethics Committee.

Thank you.

Tarnia Raad
Signature:_____Date:_____

Charmaine Korporaal (M.Tech:Chiropractic, CCFC, CCSP, ICSSD)
Signature:_____Date:_____

Appendix B – Approval letter from company

AVAILABLE ON REQUEST, IF THE AUTOMOTIVE COMPANY GIVES ACKNOWLEDGEMENT AND PERMISSION

APPENDIX: C - PREFOCUS GROUP QUESTIONNAIRE

Section: A							
Demographics							
Age:	Younger than 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50 years and older
Gender:	Male			Female			
Race:	White	Black	Indian	Coloured	Other:		
Marital Status:	Single	Married	Divorced/ Separated		Other:		
Number of children:	1	2	3	4	5 or more		
Height:							
Weight:							
Highest level of education?	1. No formal education	2. Primary School	3.High School	4. Matriculated	5. Tertiary	6. Other (Specify)	

Do you have medical aid?		Yes	No
If "yes" please answer the following	Do you have comprehensive medical aid?	Yes	No
	Do you have a hospital scheme?	Yes	No
	Do you suffer from any heart conditions?	Yes	No
	Do you suffer from Diabetes?	Yes	No
	Have you been diagnosed with any health conditions? If so please specify	Yes(specify)	No
	Have you had any surgery?	Yes	No
	Have you had any back surgery? If yes please specify	Yes(specify)	No
	Have you had any lower limb surgery? If yes please specify	Yes(specify)	No
Have you ever been pregnant?		Yes	No
If "yes" did you experience any low back pain while pregnant?		Yes	No
Have you ever had multiple births? (Twins/ triplets)		Yes	No

Occupation:					
Present work status?	Full time		Part time		
What division what you classify yourself mainly?	Sedentary (desk work)		Assembly line (physical work)		
How many years have you been in this occupation?	Under 1 year	1-3 years	4-7 years	8-10 years	More than 10 years
How long have you been working for this specific company?	Under 1 year	1-3 years	4-7 years	8-10 years	More than 10 years
Does your occupation involve any of the following for majority of the day? (may indicate many options)	1.Lifting heavy objects	2. Sitting for long periods	3.Turning your body – (twisting)	4.Working at a computer	5.Working with your arms overhead
	6.Bending	9.Prolonged standing	8. Working in an air-conditioned room		9.Other (specify)
Number of days you work per week?	1	2 3	4	5 6	7

Number of hours you do per day?	5-7hours	8-12hours	More than 12hours	
Are you satisfied at work?			Yes	No
Do you feel your job is boring and monotonous?			Yes	No

Section: B						
Social History:						
How do you rate your health?			Excellent	Good	Fair	Poor
How would you rate your stress levels generally?			High	Moderate	Low	
Are you currently taking any medication for stress or depression?					Yes	No
Smoking:	What is your smoking status?		Current smoker	Ex-smoker	Non- smoker	
If yes, for current smoker or ex-smoker how many per day?		1-5	6-10	11-15	16-20	>20
Alcohol consumption:	Do you drink alcohol?	Yes		No		
	If yes, how much of the following do you drink?	1. Litres of beer per week? 2. Litres of wine per week? 3. Tots of spirits per week?				
Exercise:	Do you exercise?			Yes	No	
	If no, do you feel it's due to your demanding/ physical job?			Yes	No	
	If yes, what exercise do you do?	1.Running				
		2.Aerobics				
		3. Soccer				
		4. Cricket				
		5. Cardio (gym)				
		6. Swimming				
		7.Golf				
		8. Pilates				
		9.Weight training				
	Do you adhere to a regular exercise routine?				Yes	No
	If yes, what is the total amount of time spent exercising each week? (hours)					
Sleeping habits:	How many hours do you sleep per night?		Less than 3hours	3-5 hours	6-8 hours	9 or more hours
	Do you have a routine sleeping pattern?				Yes	No

Section: c					
Low back pain history:	During the past 12 months, have you had back pain in the area shown in the diagram? (shaded area)	Yes		No	
	Did the low back pain last more than a day?	Yes	No		
	If indicated yes to the above question, did the pain spread down your legs to below your knees?	Yes	No		
	Approximately how many episodes of low back pain have you experienced in the past year?	Daily	1-3 days	4-6 days	6-10 days
	Did the pain make affect your daily activities?	Yes	No		
	Did the pain make it difficult to tie your shoe laces or put your socks on?	Yes	No		
	Did you have any low back pain in the last week?	Yes	No		
	Do you have any low back pain today?	Yes	No		
	How did your back pain begin?	1.Gradually over time			2.Suddenly
	How many hours does the pain last?	1hour or less		2-4hours	5-7hours
		8-10hours		More than 10hours	

Characteristics of pain:											
How would you score your back pain? (0 being no pain, 10 being the worst pain)	0 (no pain)	1	2	3	4	5	6	7	8	9	10 (Severe)
Have you ever needed bed – rest for your low back pain?	Yes			No							
Have you ever been absent from work due to your back pain?	Yes			No							
If "yes" how many days in total? (in the past 12months)	a)0-1 day			b)2-4 day			c)5-7 days				
	d)8-10 days			e)10-15 days			f) 15-20days				
	g) more than 20 days										
Do you think your low back pain is related to your work?	Yes			No							
What do you think the cause of your low back is?	1. Bending			2.Twisting			3.Lifting heavy objects				
	4. Sitting			5. Standing			6. Posture				
Have you ever injured your low back at work?	Yes			No							
Do you feel your work activities aggravate the low back pain?	Yes			No							
Have you ever received treatment for the low back pain?	Yes			No							
If "yes" to the previous question please specify what treatment.											
Are you taking and medication for the low back pain?(pain killers, muscle relaxants)	Yes			No							
Does the medication help the pain?	Yes			No							

Low back pain:	Describe the pain?	1.Sharp	2.Shooting	3. Dull ache
		4. Stabbing	5. Stiffness	6. Catching pain
		7. other:		
	Is the location of the low back pain one side or both sides?	One side- left	One side - right	Both sides
	Do you ever get pins and needles in your legs when the back pain presents?	Yes	No	
	Do you ever get a numb feeling in your legs when the pain presents?	Yes	No	
	Any other signs and symptoms you experience when you have the back pain?	(Please specify)		

APPENDIX : D

LETTER OF INFORMATION – FOCUS GROUP

Dear Participant,

I would like to welcome you into the focus group of my study.

The title of my research project is:
An investigation into the prevalence and associated risk factors of low back pain in an automotive production company.

Background to the study:
Low back pain is an important clinical, social, economic, and public health problem affecting the population indiscriminately. Low back pain can be acute or chronic, dull ache or stiffness felt which results in hindering a persons daily activities. Therefore certain occupations have a higher risk of low back pain, identifying these risk factors for (cost effective) intervention and preventative actions.

In this context, low back problems (LBP) represent a major public health problem due to the high prevalence and major consequences for the individual and the employer, including disabilities and work leave. Although the aetiology of most LBP is poorly understood, some specific physical activities are well known risk factors for LBP.

This may be seen as there is an increased risk to low back pain in patients that maintain static work postures and individuals who predominantly sit behind a desk for long periods of time (clerical, management, secretarial employees) While lifting, twisting, lifting while twisting, pulling, pushing, carrying and lowering, twisted posture – particularly when dealing with heavy objects, heavy manual labour, cumulative load exposure, working more than 40 hours a week are also identified as risk factors for LBP in the working situation for the general manual labour population. Therefore there seem to be specific risk factors, especially within specific areas or specific professions e.g. manual labour and desk work.

As a result of this, there are numerous and significant consequences of LBP, and the associated increase of absence from work, lost productivity and unsatisfactory management cause a corresponding increase in economic costs. Therefore, there is an increased likelihood that production workers may have an increased incidence of low back pain, (compared to desk workers) due to the manual labour of lifting, twisting or being in a flexed position for long occupational hours.

Objective of the study:
The data obtained by means of this questionnnaire will allow for further assessment of the prevalence and associated risk factors of low back pain amongst employees in the automotive industry. The questions are designed to determine the demographics, psychosocial risk factors and particular characteristics of low back pain. In order to establish if production workers have an increased predisposition to the development of low back pain, as compared to sedentary workers in the automotive industry.

The questionnaire will only take a few minutes to complete, as most of the questions require you to tick or circle the appropriate answer. There are only a few short written responses that are required.

Your participation in this study is much appreciated and you are assured that your comments and contributions to the discussion will be kept confidential. The results of the discussion will only be used for research purposes.

If you have any further questions please feel free to contact either my supervisor or myself.

Tarnia Raad	Dr Charmaine Korporaal
Research student	Supervisor

APPENDIX: E

IMPORTANT NOTICE:

THIS FORM IS TO BE READ AND FILLED IN BY EVERY MEMBER PARTICIPATING IN THE FOCUS GROUP, BEFORE THE FOCUS GROUP MEETING CONVENES.

CONFIDENTIALITY STATEMENT – FOCUS GROUP
DECLARATION

1. All information contained in the research documents and any information discussed during the focus group meeting will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.
2. The returned questionnaires will be coded and kept anonymous in the research process.
3. None of the information shall be communicated to any other individual or organisation outside of this specific focus group as to the decisions of this focus group.
4. The information from this focus group will be made public in terms of a journal publication, which will in no way identify any participants of this research.

Once this form has been read and agreed to, please fill in the appropriate information below and sign to acknowledge agreement.

Please complete Focus Group member:

Name:	Surname	Sign

Researcher's Name: _____ Signature:_____

Supervisor's /
Co-supervisor's Name: _____ Signature:_____

APPENDIX: F

CODE OF CONDUCT

This form needs to be completed by every member of the Focus Group prior to the commencement of the focus group meeting.

As a member of this committee I agree to abide by the following conditions:

1. All information contained in the research documents and any information discussed during the focus group meeting will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.

2. None of the information shall be communicated to any other individual or organisation outside of this specific focus group as to the decisions of this focus group.

3. The information from this focus group will be made public in terms of a journal publication, which will in no way identify any participants of this research.

Member represents	Member's Name	Signature	Contact Details

APPENDIX: G

INFORMED CONSENT/ ASSENT FORM

(TO BE COMPLETED BY THE PARTICIPANTS OF THE FOCUS GROUP)

DATE:

TITLE OF RESEARCH PROJECT:
An investigation into the prevalence and associated risk factors of low back pain in an automotive production company.

NAME OF SUPERVISOR: Dr. Korporaal

NAME OF RESEARCH STUDENT: Tarnia Raad

Please circle the appropriate answer	**YES /NO**	
1. Have you read the research information sheet?	Yes	No
2. Have you had an opportunity to ask questions regarding this study?	Yes	No
3. Have you received satisfactory answers to your questions?	Yes	No
4. Have you had an opportunity to discuss this study?	Yes	No
5. Have you received enough information about this study?	Yes	No
6. Do you understand the implications of your involvement in this study?	Yes	No
7. Do you understand that you are free to		
a) withdraw from this study at any time?	Yes	No
b) withdraw from the study at any time, without reasons given	Yes	No
c) withdraw from the study at any time without affecting your future health care or relationship with the Chiropractic day clinic at the Durban University of Technology.	Yes	No
8. Do you agree to voluntarily participate in this study	Yes	No
9. Who have you spoken to regarding this study?		

If you have answered NO to any of the above, please obtain the necessary information from the researcher and / or supervisor before signing. Thank You.

Please print in block letters:

Focus Group Member: _____ Signature: _____

Witness Name: _____ Signature:_____

Researcher's Name: _____ Signature:_____

Supervisor's Name: _____ Signature:_____

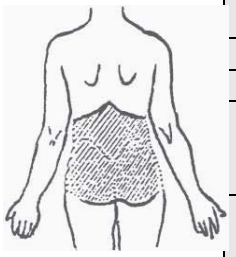
APPENDIX: H– POST FOCUS GROUP QUESTIONNAIRE

Section: A - Please indicate a cross to mark off your answer								
Demographics								
Age: (in years)								
Height: (metres)								
Weight: (kg)								
Gender:	Male				Female			
Race:	Black	Coloured		Indian	White		Other:	
Marital Status:	Single	Married		Divorced/ Separated			Other:	
Number of children:	1	2		3	4		5 or more	
Highest level of education?	1. No formal education	2. Primary School	3.High School	4. Matriculated	5. Tertiary	6.NQF	7. N2/ N3	8. Other (Specify)
Do you have medical aid?				Yes			No	
Do you have comprehensive medical aid?				Yes			No	
Do you have a hospital scheme?				Yes			No	
Do you suffer from any heart conditions?				Yes			No	
Do you suffer from Diabetes?				Yes			No	
Do you wear anything that supports your back? (back brace, tapping)				Yes (specify)			No	
Have you been diagnosed with any health conditions? If so please specify				Yes(specify)			No	
Have you had any surgery?				Yes			No	
Have you had any back surgery?				Yes			No	
Have you had any lower limb surgery? If yes please specify				Yes(specify)			No	
Have you ever been pregnant?				Yes			No	
If “yes” did you experience any low back pain while pregnant?				Yes			No	

Occupation:							
Present work status?	Full time		Part time		Unemployed		
What division would you classify yourself mainly?	Sedentary (desk work)		Assembly line (physical work)				
How many months/ years have you been in this occupation?							
How long have you been working for this specific company?							
Does your occupation involve any of the following for majority of the day? (may indicate many options)	1.Lifting heavy objects	2. Sitting for long periods	3.Turning your body – (twisting)	4.Working at a computer	5.Working with your arms overhead		
	6.Bending	9.Prolonged standing	8. Working in an air-conditioned room		9. Diving		
	10.other (specify)						
If your job involves lifting of heavy objects, how much weight (kg) on average do you lift?							
If your job involves lifting of heavy objects, what is it you are lifting?							
On average, how many times a day do you repeat the tasks required of you? (list each different object lifted if needed)							
On average how many hours do you sit behind a desk?							
Number of days you work per week?	1	2	3	4	5	6	7
Number of hours you work per day?							
Are you satisfied at work?	Yes		No				
If “no” for the previous question, why not?							

Section: B Social History										
How would you rate your health, at the moment?			Excellent		Good		Fair		Poor	
How would you rate your stress levels generally?			High		Moderate		Low			
Are you currently taking any medication for stress?			Yes				No			
Are you currently taking any medication for depression?			Yes				No			
Smoking:	What is your smoking status?		Current smoker			Ex-smoker			Non- smoker	
If yes, for current smoker or ex-smoker how many cigarettes do you/ did you smoke?										
If yes, for current smoker or ex-smoker. How many years have you, or did you smoke?										
Alcohol consumption:	Do you drink alcohol?		Yes				No			
	If yes, how much of the following do you drink? (please fill in)	1. Units f beer per week? (x1 beer= 340ml)		2. Glasses of wine per week? (x1glass= 200ml)			3. Tots of spirits per week?			
Exercise:	Do you exercise?		Yes				No			
	If no, do you feel it's due to your demanding/ physical job?		Yes				No			
	If yes, what exercise do you do? Indicate how many times per week?	1.Running		4. Cricket		7.Golf		10. Rugby		
		2.Aerobics		5. Cardio (gym)		8. Pilates		11. Other		
		3. Soccer		6. Swimming		9.Weight training				
	Do you adhere to a regular exercise routine?					Yes		No		
Sleeping habits:	On average, how many hours do you sleep per night?									
	Do you have a routine sleeping pattern?		Yes					No		
	What is your predominant sleeping position?		On your side		On your back			On your stomach		
Particular Stress:	Have you had any domestic stress in the past year? (divorce, moving house, births, deaths)		Yes			No				
	Have you had any financial stress in the past year?		Yes			No				

Section: C

Low back pain history: 	At any time during the past 12 months, have you had low back pain in the area shown in the diagram? (shaded area)	Yes	No	
	Did the low back pain last more than a day?	Yes	No	Have not had low back pain within the last year
	If indicated yes to the above question, did the pain spread down your legs to below your knees?	Yes	No	
	Approximately how many days of low back pain have you experienced in the past year?			
	Did the low back pain affect your daily activities?	Yes	No	Have not had low back pain within the last year
	Did the low back pain make it difficult to tie your shoe laces or put your socks on?	Yes	No	Have not had low back pain within the last year
	Did you have any low back pain in the last week?	Yes	No	
	Do you have any low back pain today?	Yes	No	
	How did your low back pain begin?	1.Gradually over time	2.Suddenly	3. Not sure
	How many hours does the low back pain last?			
	Do you have low back pain only at work?	Yes	No	Have no low back pain
	Do you have low back pain only at home?	Yes	No	Have no low back pain
	Does the low back pain get better over weekends?	Yes	No	Have no low back pain

Low back pain:	Describe the pain?	1.Sharp	2.Shooting	3. Dull ache	4. Stabbing	5. Stiffness	6. Catching pain
		7. Poking	8. Other			9. No low back pain	
	Is the location of the low back pain one side or both sides?	One side-left	One side -right	Both sides	No low back pain		
	Do you ever get the feeling of pins and needles in your legs when the low back pain presents?	Yes	No				
	Do you ever get a numb feeling in your legs and feet when the low back pain presents?	Yes	No				
	Any other signs and symptoms you experience when you have the low back pain? (associated changes)	(Please specify)					

Characteristics of pain																						
The following questions apply to current and/ or past low back pain.	<u>Current Low Back Pain:</u> (low back pain today)											<u>Past Low Back Pain experienced:</u> (within the last 12 months)										
	May fill in both if have low back pain today and within the past month																					
How would you score your low back pain? (0 being no pain, 10 being the worst pain)	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Have you ever needed bed – rest for your low back pain?	Yes					No						Yes					No					
Have you ever been absent from work due to your low back pain?	Yes					No						Yes					No					
If "yes" how many days in total?																						
Do you think your low back pain is related to your work?	Yes					No						Yes					No					
Have you ever lost your job due to low back pain?	Yes					No						Yes					No					
What do you think is the cause of your low back pain?	Bending		Twisting		Lifting heavy objects		Posture		Other: (Specify)			Bending		Twisting		Lifting heavy objects		Posture		Other: (Specify)		
	Sitting		Standing		Overhead movements		Driving					Sitting		Standing		Overhead movements		Driving				
Have you ever injured your low back at work?	Yes					No						Yes					No					
Do you feel your work activities aggravate the low back pain?	Yes					No						Yes					No					
Have you ever received treatment for the low back pain?	Yes					No						Yes					No					
If "yes" to the previous question please specify what treatment.	Public Hospital			Pharmacy			Traditional healer					Public Hospital			Pharmacy			Traditional Healer				
	Private Hospital			Physiotherapy			Other (Specify)					Private Hospital			Physiotherapy			Other (Specify)				
	Clinic			Chiropractic								Clinic			Chiropractic							

Are you taking any medication for the low back pain?(pain killers, muscle relaxants)	Yes			No			Yes			No		
If yes what medication are you taking?	Pain killers	Anti-inflammatory	Rubs	Patches	Traditional medicine	don't know	Pain killers	Anti-inflammatory	Rubs	Patches	Traditional medicine	don't know
Does the medication help the pain?	Yes			No			Yes			No		
How much money have you spent on treatment for your low back pain?												

APPENDIX: I

Changes made from ***pre focus group questionnaire to post focus group*** (pre pilot study) questionnaire:

The table format was altered in order to save paper and allow for the perception that the questionnaire was short. Changes from portrait to landscape page layout.

Demographical changes:

Height and weight was placed in a different order to create uniformity and order.
Have you ever had multiple births? Was removed due to the question not being relevant.

Occupational section, the following questions were added to the questionnaire to get more accurate information:

- If your job, involves lifting heavy objects, how much weight (kg) on average do you lift?
- If your job involves lifting heavy objects, what is it you are lifting?
- On average, how many times a day do you repeat the tasks required of you? (list each different object lifted)
- On average how many hours do you sit behind a desk?
- Number of hours you work per day?
- If “no” for the previous question, why not? (pertaining to are you satisfied at work?)

Section B: Social history
More options were given for exercise such as rugby and another option was given.
Added in a particular stress component asking the following:

- Have you had any domestic stress in the past year? (divorce, moving house, births, deaths)
- Have you hadany financial stress in the past year?

Low back pain history:

A “ticking/ circling” option was added, stating, have not had low back pain within the last year which was left blank in order to let the participant fill in there appropriate answer if it was not stated as one of the options).
The following questions were added:

- Do you have low back pain only at work?
- Do you have low back pain only at home?
- Does the low back pain get better over weekends?

Treatment options were given instead of a blank block for the participant to fill:
If “yes to the previous question please specify what treatment.

- Public hospital
- Private hospital
- Clinic
- Pharmacy
- Physiotherapy

- chiropractic
- traditional healer
- other (which was left blank in order to let the participant fill in there appropriate answer if it was not stated as one of the options)

If “yes” what medication are you taking? The following options were given and the resultant changes:

- Pain killiers
- Anti-inflammatory
- Rubs
- Patches
- Traditional medicine
- Don’t know

The following question was added: How much money have you spent on treatment for your low back pain?

For the characteristics of pain:
The table layout was changed, two colums were created, in order to create more accuracy as all the questions applied to a current low back pain and a column of past low bck pain experienced (within the last 12 - months). These two columns applied for all the questions in the section C (characteristics of low back pain) and the participant was able to fill in either column or both Colums (current low back pain and/ or past low back pain experienced).

It was decided in order to get accuracte statistical results, that to rather let the employee fill the answers in and not give them options. Therefore various questions which did have options in the blocks were left blank.

This applied to the following questions:

- Age?
- Number of childen?
- How many years have you been in this occupation?
- How long have you been working for this specific company?
- Smoking – if yes, for current smoker or ex – smoker how many per day?
- On average how many hours do you sleep per night?
- Approximately how many episodes of low back pain have you experienced in the past year?
- How many hours does the pain last?

Spelling and grammer was alted to allow the participant to understand the questions better.
A diagram of a shaded area of low back pain was placed in to the questionnaire to allow the participant to collelate the questions with the location of pain.

APPENDIX: J

The following is changes were made from post focus group (pre-pilot study) questionnaires to final questionnaire.

The order of the questions were altered to allow the participant to understand the questionnaire better. The following was altered: Question pertaining to weight, section B (social history) and section C (characteristics of pain).

The formatting of the questionnaire was altered to allow the questionnaire to appear shorter and not to lengthy.
Colums were created to allow for a comparison of current and past low back pain.
A have “no low back pain” option was given to various questions in section C (characteristics of low back pain) for stastistical accuracy.

Question added: Section C
In conclusion, please can you list those things that you would change in your work area in order to decrease the chances of you getting low back pain. And the option was left blank in order for the participant to fill in there appropriate answers.

APPENDIX K: Section: A - Please indicate a cross to mark off your answer FINAL QUESTIONNARE

Demographics

Age: (in years)						
Height: (metres)		Weight: (kg)				
Gender:	Male		Female			
Race:	Black	Coloured	Indian	White	Other:	
Marital Status:	Single	Married	Divorced/ Separated	Other:		
Number of children:	1	2	3	4	5 or more	
Highest level of education?	1. No formal education	2. Primary School	3.High School	4. Matriculated	5. Tertiary	6.NQF	7. N2/ N3
	8. Other (Specify)						

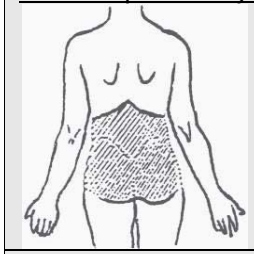
Do you have medical aid?	Yes	No
Do you have comprehensive medical aid?	Yes	No
Do you have a hospital scheme?	Yes	No
Do you suffer from any heart conditions?	Yes	No
Do you suffer from Diabetes?	Yes	No
Do you wear anything that supports your back? (back brace, tapping)	Yes (specify)	No
Have you been diagnosed with any health conditions? If so please specify	Yes(specify)	No
Have you had any surgery?	Yes	No
Have you had any back surgery?	Yes	No
Have you had any lower limb surgery?	Yes	No
Have you ever been pregnant?	Yes	No
If "yes" did you experience any low back pain while pregnant?	Yes	No

Occupation:

Present work status?	Full time	Part time	Unemployed		
What division would you classify yourself mainly?	Sedentary (desk work)	Assembly line (physical work)			
How many months/ years have you been in this occupation?					
How long have you been working for this specific company?					
Does your occupation involve any of the following for majority of the day? (may indicate many options)	1.Lifting heavy objects	2. Sitting for long periods	3.Turning your body – (twisting)	4.Working at a computer	5.Working with your arms overhead
	6.Bending	9.Prolonged standing	8. Working in an air-conditioned room		9. Diving
If your job involves lifting of heavy objects, how much weight (kg) on average do you lift?					
If your job involves lifting of heavy objects, what is it you are lifting?					
On average, how many times a day do you repeat the tasks required of you? (list each different object lifted if needed)					
On average how many hours do you sit behind a desk?					

Number of days you work per week?	1	2	3	4	5	6	7
Number of hours you work per day?							
Are you satisfied at work?	Yes	No					
If "no" for the previous question, why not?							

Section: B Social History										
How would you rate your health, at the moment?				Excellent		Good		Fair		Poor
How would you rate your stress levels generally?				High		Moderate		Low		
Are you currently taking any medication for stress?				Yes				No		
Are you currently taking any medication for depression?				Yes				No		
Smoking:	What is your smoking status?			Current smoker			Ex-smoker			Non- smoker
If yes, for current smoker or ex-smoker how many cigarettes do you/ did you smoke?										
If yes, for current smoker or ex-smoker. How many years have you, or did you smoke?										
Alcohol consumption:	Do you drink alcohol?			Yes				No		
	If yes, how much of the following do you drink? (please fill in)	1. Units f beer per week? (x1 beer= 340ml)		2. Glasses of wine per week? (x1glass= 200ml)				3. Tots of spirits per week?		
Exercise:	Do you exercise?			Yes				No		
	If no, do you feel it's due to your demanding/ physical job?			Yes				No		
	If yes, what exercise do you do? Indicate how many times per week?	1.Running		4. Cricket		7.Golf				
		2.Aerobics		5. Cardio (gym)		8. Pilates				
		3. Soccer		6. Swimming		9.Weight training				
		10. Rugby		11. Other						
	Do you adhere to a regular exercise routine?			Yes				No		
Sleeping habits:	On average, how many hours do you sleep per night?									
	Do you have a routine sleeping pattern?			Yes				No		
	What is your predominant sleeping position?			On your side			On your back			On your stomach
Particular Stress:	Have you had any domestic stress in the past year? (divorce, moving house, births, deaths)			Yes				No		
	Have you had any financial stress in the past year?			Yes				No		

Section: C - Characteristics of pain			
Low back pain history: 	Have you ever had low back pain?	Yes	No
	At any time during the past 12 months, have you had low back pain in the area shown in the diagram? (shaded area)	Yes	No
	Did you have any low back pain in the last week?	Yes	No
	Do you have any low back pain today?	Yes	No

The following questions apply to current and/ or past low back pain.	Current Low Back Pain: (low back pain today)	Past Low Back Pain experienced:
	May fill in both if have low back pain today and in the past	
How would you score your low back pain? (0 being no pain, 10 being the worst pain)	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
Describe the pain?	1.Sharp 2.Shooting 3. Dull ache 4. Stabbing 5. Stiffness 6. Catching pain 7. Poking 8. Other 9. No low back pain	1.Sharp 2.Shooting 3. Dull ache 4. Stabbing 5. Stiffness 6. Catching pain 7. Poking 8. Other 9. No low back pain
Is the location of the low back pain one side or both sides?	One side-left One side -right Both sides No low back pain	One side-left One side –right Both sides No low back pain
Do you ever get the feeling of pins and needles in your legs when the low back pain presents?	Yes / No	Yes / No
If indicated yes to the above question, did the pain spread down your legs to below your knees?	Yes / No	Yes / No
Do you ever get a numb feeling in your legs and feet when the low back pain presents?	Yes / No	Yes / No
Any other signs and symptoms you experience when you have the low back pain? (associated changes)	(Please specify)	(Please specify)

The following questions apply to current and/ or past low back pain.	Current Low Back Pain: (low back pain today)					Past Low Back Pain experienced:				
	May fill in both if have low back pain today and in the past									
Did the low back pain make it difficult to tie your shoe laces or put your socks on?	Yes		No			Yes		No		
						Have not had low back pain in the past				
Did the low back pain affect your daily activities?	Yes		No			Yes		No		
						Have not had low back pain in the past				
Approximately how many days of low back pain have you experienced in the past year?										
How many hours does the low back pain last?										
Did the low back pain last more than a day?	Yes		No			Yes		No		
						Have not had low back pain within the last year				
Have you ever needed bed – rest for your low back pain?	Yes		No			Yes		No		
Have you ever been absent from work due to your low back pain?	Yes		No			Yes		No		
If "yes" how many days in total?										
How did your low back pain begin?	1.Gradually over time		2.Suddenly			1.Gradually over time		2.Suddenly		
	3. Not sure					3. Not sure				
Do you have low back pain only at work?	Yes		No			Yes		No		
	Have no low back pain					Have no low back pain				
Do you have low back pain only at home?	Yes		No			Yes		No		
	Have no low back pain					Have no low back pain				
Does the low back pain get better over weekends?	Yes		No			Yes		No		
	Have no low back pain					Have no low back pain				
Do you think your low back pain is related to your work?	Yes		No			Yes		No		
Have you ever lost your job due to low back pain?	Yes		No			Yes		No		
What do you think is the cause of your low back pain?	Bending	Twisting	Lifting heavy objects	Posture	Other: (Specify)	Bending	Twisting	Lifting heavy objects	Posture	Other: (Specify)
	Sitting	Standing	Overhead movements	Driving		Sitting	Standing	Overhead movements	Driving	

The following questions apply to current and/ or past low back pain.	Current Low Back Pain: (low back pain today)			Past Low Back Pain experienced:		
	May fill in both if have low back pain today and in the past					
Have you ever injured your low back at work?	Yes	No		Yes	No	
Do you feel your work activities aggravate the low back pain?	Yes	No		Yes	No	
Have you ever received treatment for the low back pain?	Yes	No		Yes	No	
If "yes" to the previous question please specify what treatment.	Public Hospital	Pharmacy	Traditional healer	Public Hospital	Pharmacy	Traditional Healer
	Private Hospital	Physiotherapy	Other (Specify)	Private Hospital	Physiotherapy	Other (Specify)
	Clinic	Chiropractic		Clinic	Chiropractic	
Are you taking any medication for the low back pain?(pain killers, muscle relaxants)	Yes	No		Yes	No	
If yes what medication are you taking?	Pain killers	Anti-inflammatory	Rubs	Pain killers	Anti-inflammatory	Rubs
	Patches	Traditional medicine	Don't know	Patches	Traditional medicine	Don't know
Does the medication help the pain?	Yes	No		Yes	No	
How much money have you spent on treatment for your low back pain?						
	Current Low Back Pain: (low back pain today)			Past Low Back Pain experienced:		
In conclusion, please can you list those things that you would change in your work area in order to decrease the chances of you getting low back pain.	1 2 3 4 5			1 2 3 4 5		

APPENDIX: L

Letter of Information:

Dear Participant,

Welcome to my research study.

Title of Research Study:

The prevalence and associated risk factors of low back pain in an automotive production company.

Principle Investigator : Tarnia Raad
Supervisor : Dr C Korporaal (M.Tech:Chiropractic, CCFC, CCSP, ICSSD)

Brief Introduction and purpose of the Study:

Low back pain is very common in today's demanding lifestyle. Therefore the purpose of the study is to determine the occurrence of low back pain and if there are any risk factors that are adding to its cause, particular to the automotive industry.

Outline of the Procedures:

After having read this letter, you are requested to date and sign it as well as the attached informed consent form. Thereafter, please can you to answer the attached questionnaire. Please answer the questionnaire as honestly as possible. Your name and staff number are NOT required; as all questionnaires are to be kept anonymous. Once you have completed the questionnaire, place the questionnaire in the appropriately marked box and the informed consent form in the other appropriately marked box. This will ensure that the questionnaires are completely confidential and that your answers will not be disclosed to any third parties outside of myself (the researcher) and my supervisor. Please answer all the questions as this will enable accurate statistical results.

Risks or Discomforts to the Subject:

None

Benefits:

Your full co-operation will assist in expanding knowledge of low back pain and thus making future treatment of patients suffering from low back pain more effective.

Reason/s why the Subject May be withdrawn from the Study:

If you do not agree to sign the letter of information and informed consent form.

Remuneration / Costs of the study:

No remuneration will be given, but there will also be no costs to you - the participant.

Confidentiality:

All completed questionnaires are kept in complete confidence. The questionnaire will be administered and collected by the researcher (Collection Box Method) so as to maintain confidentiality at all times. The researcher will thereafter document the information for statistical analysis. All the information is confidential and the overall results of the study will be made available in the Durban University of Technology library in the form of a dissertation as well as be available from your HR office.

None of your individual responses will be made available to the company. The company will only receive the information regarding this study after all the data has collectively been analyzed, meaning that your individual data will not be identifiable to you.

Research-related Injury:
None

Persons to Contact in the Event of Any Problems or Queries:

The researcher:	Tarnia Raad	082 784 1470
The supervisor:	Dr C Korporaal	083 246 3562
The faculty officer	Mr Vikesh Singh	031 3732701

Statement of Agreement to participate in the Research Study:

I …….. ……subjects full name with ID no. ……., have read this document in its entirety and understand its contents. Where I have any questions or queries, these have been explained to me by the researcher (Tarnia Raad) to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Subjects Name:……

Subjects signature:……

Witness Name: .....

Witness Signature .....

Researchers Name:……

Researchers signature:……

Supervisors Name: .....

Supervisors Signature .....

APPENDIX: M
IREC CERTIFICATE APPROVAL

DURBAN UNIVERSITY of TECHNOLOGY

Faculty of Health Sciences

ETHICS CLEARANCE CERTIFICATE

Student Name	Tarnia Raad	**Student No**	20607667
Ethics Reference	FHSEC 022/11	**Date of FRC Approval**	19/9/2011
Qualification	M.Tech Chiropractic		
Research Title:	The prevalence and associated risk factors of low back pain in an automotive production company.		

In terms of the ethical considerations for the conduct of research in the Faculty of Health Sciences, Durban University of Technology, this proposal meets with Institutional requirements and confirms the following ethical obligations:

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the PG4a and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. ***The following section must be completed if the research involves human participants:***

	YES	NO	N/A
❖ Provision has been made to obtain informed consent of the participants	X		
❖ Potential psychological and physical risks have been considered and minimised	X		
❖ Provision has been made to avoid undue intrusion with regard to participants and community	X		
❖ Rights of participants will be safe-guarded in relation to:	X		
- Measures for the protection of anonymity and the maintenance of Confidentiality.	X		
- Access to research information and findings.	X		
- Termination of involvement without compromise	X		
- Misleading promises regarding benefits of the research			

[redacted]

19/9/11
DATE

19/9/11
DATE

19/09/2011
DATE

20/09/11

SIGNATURE: CHAIRPERSON OF RESEARCH ETHICS COMMITTEE