AN EPIDEMIOLOGICAL STUDY OF SELECTED RISK FACTORS ASSOCIATED WITH LOW BACK PAIN AMONGST REFUSE TRUCK DRIVERS IN THE eTHEKWINI MUNICIPALITY

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DECLARATION

I, Shaun Ramroop, do declare that this dissertation is representative of my own work and the use of work of others has been duly acknowledged in the text.

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DEDICATION

This study is dedicated to my brother Sadesh Ramroop who tragically passed away on the 6 th June 2003.

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DEFINITIONS

Epidemiology: Is the study of the distribution and determinants of health related states or events in specific populations and the application of this study to the control of health problems. Epidemiology forms the research arm of public health, providing the scientific basis upon which public health policy decisions are made (Gordis:2004).

Ergonomics: The application of human biological sciences with the engineering sciences to achieve optimum mutual adjustment of people and their work, the benefits measured in terms of human efficiency and well-being (Karwowski & Marras:1999).

Goniometer: This is an instrument, which is used to measure angles and particularly to measure the range of motion angles of a joint.

Lower back pain: Any acute or chronic pain, ache or stiffness experienced by the worker in the lower part or lumbar region of the back, lumbago or chronic recurrent discomfort in the lower back/lumbar area excluding sciatic pain radiating into the legs (Kirkaldy-Willis & Bernard:1999).

Risk factor: Characteristics (e.g. race, sex, age, obesity) or variable (e.g. smoking, occupational exposure level, vibration) associated with increased probability of a toxic or adverse health effect (Karwowski & Marras:1999).

Key words: Epidemiology, Ergonomics, Lower Back Pain. Risk Factor.

ABSTRACT

Motivation: Lower back pain (LBP) has been found to affect workers and often result in higher costs to industry than any other musculoskeletal disorder. Traditionally, the most widely investigated risk factors for LBP have been biomechanical demands of the job. By examining LBP, both its prevalence and distribution, it becomes possible to focus on contributory risk factors that bring on its onset.

Aim: To identify the selected risk factors associated with prevalence of LBP amongst refuse truck drivers in the eThekwini Municipality, and to evaluate the relationship between the selected risk factors and the prevalence of LBP.

Methods: The methodology adopted in the study has employed a cross sectional study design. In total, 120 refuse truck drivers completed the questionnaire. A one hundred percent response rate was achieved. The questionnaire used was an adapted questionnaire consisting of two parts. Part one was completed by the refuse truck drivers, and part two which dealt with the ergonomic status of the refuse truck cab was completed by the researcher. Data obtained from the questionnaires were analysed using the Statistical Package for the Social Sciences (SPSS) Version 11.5.

Results: The results of the study demonstrated an association between awkward posture, vibration, stress, and the ergonomic status of the driver controls of the refuse truck cab and the prevalence of LBP.

Conclusion: This study identified specific biomechanical and psychosocial demands of work as independent risk factors for the prevalence of LBP amongst refuse truck drivers in the eThekwini Municipality. This study therefore supports the theory of a multifactorial etiology for the prevalence of LBP amongst refuse truck drivers.

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CHAPTER ONE

INTRODUCTION

1.1. INTRODUCTION

While lower back pain (LBP) is a common ailment, there is very little agreement as to its cause or prevention according to Jones (1971) and Nachemson (1975). The study of epidemiology according to Gordis (2004:3) can assist to identify the etiology or the cause of LBP and the risk factors. By examining, the risk factors associated with LBP it becomes possible to focus on these contributory factors. A study by Burdorf and Elders (1997) showed that musculoskeletal disorders are the main source of morbidity in many industrialised countries. Musculoskeletal disorders include a group of conditions that involve the tendons, nerves, muscles and supporting structures (such as intervertebral discs). They represent a varied range of disorders, which can differ in severity from mild periodic conditions to those that are severe, debilitating and chronic in nature. Some musculoskeletal disorders are defined primarily by the location of the pain. These disorders according to Joubert (2000:2) have more variable or less clearly defined pathophysiology (like back disorders including low back pain).

According to Karwowski and Marras (1999:913) epidemiological research of LBP has been, and still is, hampered by methodical problems in definition, classification, and diagnosis. Furthermore, the above authors mention that objective evidence of existing LBP is often lacking, and people’s recall of previous episodes is normally poor. Karwowski and Marras (1999) are also of the view that the intermittent nature of LBP complicates prevalence studies. Studies of disability due to LBP are influenced by both legal and socio-economic factors (Karwowski and Marras:1999). Methodological problems also exist in the quantification of physical exposures that might be of etiologic importance in LBP studies and future research according to Elders and Burdorf (1997).

The two seemingly contrasting views of the physical world and of the universe depicted by Newtonian and quantum mechanics are important and relevant to our understanding of LBP. Many patients according to Kirkaldy-Willis and Bernard (1999:4) experience LBP syndromes in a straightforward fashion and respond in an orderly way to treatment, with a predictable Newtonian outcome. There are however, other patients whose clinical presentation is vague, and their response to treatment is unpredictable, or quantum like, in nature. Physicists now realise that some aspects of our physical world may be adequately explained by either Newtonian or quantum mechanics or by both of these in combination this interconnection between Newtonian and quantum mechanics is complex and must be considered in any investigation of LBP.

Kroemer, Kroemer and Kroemer-Elbert (2001:64) show that LBP is the result of disorders that have been with humans since ancient times. It was diagnosed among Egyptians 5,000 years ago and was discussed in 1690 by Bernadino Ramazzini. Everyone has an eighty percent chance of suffering from LBP sometime during his or her lifetime.

Kroemer *et al.* (2001) further state that LBP may stem from a large number of sources, many believe to be basically associated with changes in the spinal column and its supporting ligaments and muscles due to aging, starting in the teen years and usually increasing as one gets old. These changes result from a combination of repetitive trauma and the normal aging process. Strong activity demands such as sport may also trigger the occurrence of various LBP symptoms. These differences can be classified as mechanical LBP as opposed to LBP due to organic pathology.

However, according to Kroemer *et al*. (2001) except in cases of acute injuries, the causes of or reasons for LBP usually remain unclear at this stage. Davis and Heaney (2000) reported that the most widely investigated occupational risk factors for LBP have been biomechanical demands of a specific job. Recently psychosocial characteristics of work have been investigated as potential risk factors for LBP. Psychosocial work characteristics and biomechanical demands have provided some complex evidence about the complex relationships amongst work tasks, workplace environment, and LBP. Hence psychosocial characteristics as a risk factor associated with LBP has also gained prominence over the years according to Davis and Heaney (2000).

Each of these approaches will provide some evidence about the complex relationships among work tasks, workplace environments, and LBP. A study by Kerr *et al*. (2001) showed that identified specific physical and psychosocial demands of work are independent risk factors for LBP. According to Davis and Heaney (2000) self-reported risk factors included a physically demanding job, a poor workplace social environment, inconsistency between job and education level, better job satisfaction, and better co-worker support.

Bridger (1995:57) mentions that LBP problems have a high incidence among certain groups and or occupations. One such occupational group is truck drivers. Hence, it can be hypothesised that a common adverse health effect associated with driving a truck is LBP.

Magora (1972:504) carried out an epidemiological survey amongst truck drivers to investigate the incidence of LBP in relation to occupational requirements for sitting, standing and lifting. LBP symptoms were higher among those with uniform (sitting only or standing only) occupational requirements than those whose daily activities were more varied (who were able to alternate between standing and sitting).

According to Burdorf and Elders (1997) there is evidence for a strong association with physical risk factors such as manual handling of materials, heavy physical work, frequent bending and twisting, lifting, and forceful movements. By contrast, there is conflicting evidence for psychosocial risk factors associated with LBP. A combination of low social support, low job control, high psychological demands, and high-perceived workload may cause psychosocial job strain and increase the prevalence of LBP according to Bongers *et al.* (1993**)**.

According to Dempsey *et al*. (1997) with regard to individual variables such as age, sex, and physical fitness there is no clear consensus to what extent they are related to LBP. Hadler (1997) further mentions that previous studies of LBP have been criticised as being too narrowly focused on only one or perhaps two of the categories of individual, physical (biomechanical) and psychosocial aspects of the problem. Methods to assess the influence of independent risk factors on the presence of LBP tend to neglect the importance of interrelations between risk factors according to Dempsey *et al*. (1997).

Few epidemiological studies have investigated LBP in relation to more than one risk factor according to Burdorf and Sorock (1997). A review of recent literature revealed that a number of studies (Burdorf and Sorock (1997); Leboeuf-Yde *et al*. (1997) indicated that only one risk factor in relation to LBP has been investigated. According to Stayner (2001:15). A study by Bovenzi and Betta (1994) concluded that exposure to whole body vibration was related to the high prevalence of LBP. Only one risk factor namely, vibration was considered in the study by Flenghi (cited in Meyer *et al*. 1998) who attempted to find associations of LBP with more than one risk factor (posture, manual handling loads and vibration). This study by Flenghi (cited in Meyer *et al*., 1998) found the strongest associations to be with manual handling and vibration, but it is not possible to separate the effects of vibration from those of posture or prolonged sitting. The authors regret being unable to support any dose-response relationships. However, this is not surprising as their work concentrated more on examination of the subjects than on the risk factors, which is common with most studies.

Porter (1999:8) mentions that the mean number of days absent from work with LBP was 22.4 days for people, who drove for more that 25,000 miles

(40232 kms) in the last twelve months, compared with only 3.3 days for low mileage car drivers. Refuse truck drivers drive well in excess of 25,000 miles per annum according to departmental records from the Cleansing and Solid Waste Department of the eThekwini Municipality (Mileage Sheets – Feb 02 to July 02:Queensburg Depot).

Refuse truck driving is an occupation likely to cause LBP. Moreover, the researcher is of the view that few people understand how damaging to the lower back region extensive driving can be in the long term. The damage to the lower back region is particularly serious if the drivers drive a truck that does not allow them to adopt an optimum posture coupled by the presence of multiple risk factors e.g. high levels of vibration and poor ergonomics of the truck cab. Hence, the purpose of this study was to investigate the selected risk factors associated with LBP among refuse truck drivers in the eThekwini Municipalities Cleansing and Solid Waste Department.

The methodology adopted in the study employed a cross sectional study design. In total, 120 refuse truck drivers completed the questionnaire. The sample population included all the refuse truck drivers of the study environment. The questionnaire used was an adapted questionnaire from the 1987 Standardised Nordic questionnaire. The questionnaire consisted of two parts. Part one dealt with the general biographical details, the issue of LBP and selected risk factors associated with LBP. Part two, which was completed by the researcher, dealt with the ergonomic status of the refuse truck cab. Part two entailed physical measurements being taken of the seat dimensions with the aid of a standard tape measure and a goniometer. The sampling design consisted of inclusion and exclusion criteria. The researcher and an assistant via prior arrangements with the various supervisors administered the questionnaires.

The study environment was the Cleansing and Solid Waste Departments of the eThekwini Municipality. Specific inclusion and exclusion criteria ensured that only the full-time drivers were surveyed. Part time drivers for example were excluded from the study. Data obtained from the questionnaires were analysed using the Statistical Package for the Social Sciences (SPSS) Version 11.5. The services of a professional statistician was utilised for the analysis of the raw data. Descriptive and inferential statistics was used during the analysis.

1.2. RATIONALE FOR THE STUDY

According to Gilad and Kirschenbaum (1987) by examining LBP, both its incidence and distribution, it becomes possible to focus on contributing factors, which bring on its onset. Distinguishing between reported chronic and sporadic episodes of LBP demonstrates that rates of LBP incidence differ by the type of worker, arrangements of the workplace, and task requirements. This particular study is essential, as it will add to the existing scant body of knowledge on the selected risk factors associated with LBP amongst refuse truck drivers in a Local Government setting. Furthermore, the occupational status of refuse truck driving as a lower status occupation and its association with LBP will be investigated.

Recent developments on both Constitutional and Legislative levels have effected profound changes in the system of occupational health and safety regulation in the workplace in South Africa according to Mischke and Garbers (1994). In terms of the new Bill of Rights (1996), which forms an integral part of the new South African Constitution, every person has a right to a safe and healthy environment. This right is assumed by the researcher to encompass the workplace, and the health and safety of the workplace fall within the ambit of this Constitutional provision.

The Occupational Health and Safety Act, 1993 (Act 85 of 1993) (OHSA) is an Act of Parliament that enhances this basic right. In terms of OHSA it is a general duty of an employer to their employees, “to provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees”. There is a lack of specific legislation in South Africa that can offer the same protection for occupational/professional drivers as provided for other occupational groups as covered by the various regulations framed under the Occupational Health and Safety Act, Act 85 of 1993 according to Joubert (2000:5). Currently, no legislation, regulations or standards (SABS) exist for the field of ergonomics in South Africa.

Due to the absence of legislation and proper policy, manufacturers in respect of seat design adhere to arbitrary manufacturing and production rules and regulations. Worker health and ergonomic principles are seldom considered at the design stage. There is also very little incentive on the part of employers, to conduct ergonomic risk analysis and to implement appropriate programmes, to address this growing problem responsible for crippling the labour force with the high incidences of LBP. The position of the Health and Safety Inspectors, Department of Labour in Durban, is that additional research and scientific evidence is needed in South Africa before any new regulations would be promulgated. (Telephonic communication: Department of Labour Inspectors, Durban, 30th January 2002). Thus, it appears that timely research could greatly benefit employees with LBP by helping to prompt policy makers in the direction of promulgation of the appropriate regulations and or guidance notes.

According to Karwowski and Marras (1999:182) lower back disorders (LBDs) have been labelled as one of the most common and significant musculoskeletal problems in the United States of America that contributes to substantial amounts of morbidity, disability, and economic loss. Next to the common cold, LBDs are the most common reason for workers to miss work. The total cost of LBP to the United States economy is ninety billion dollars per annum and LBP accounts for twenty percent of all work related injuries according to Karwowski and Marras (1999). The prevalence of LBDs has also been observed to increase by 2700% since 1980 according to Pope (1993). In light of the above, the situation in South Africa is presently unknown. This study will attempt to provide information in assessing the prevalence and severity of LBP among refuse truck drivers in the eThekwini Municipality.

The study will further provide important information for refuse truck drivers in the eThekwini Municipality, thereby contributing to the body of knowledge on LBP and refuse truck driving in a Municipal setting. Refuse trucks are considered by the researcher as more hazardous than an ordinary truck for the following reasons:

- All refuse trucks have a compactor installed at the rear of the truck. The compactor is an additional mechanical mechanism used to compact the garbage. When in operation the compactor introduces new stresses such as added vibration, noise and weight to the refuse truck.

- The driver of the refuse truck has the highest dose of the various risk factors due to the longest exposure time during an eight-hour work shift.

- The introduction of the additional feature on the refuse truck, namely the compactor also introduced new ergonomic challenges in respect of driver health and safety. More controls are introduced in the truck cab and the driver is forced to twist and turn more frequently during the loading of refuse and the operation of the refuse truck.

The relationship between occupational risk factors and LBP is difficult to determine because exposure is usually difficult and sometimes impossible to quantify. The seven most frequently discussed risk factors according to Karwowski and Marras (1999:923), are heavy physical work, static work postures, frequent bending and twisting, lifting, pushing and pulling, repetitive work, vibrations, and psychosocial factors. These risk factors need to be adequately quantified for refuse truck drivers.

Although there is extensive literature supporting a positive relationship between LBP and workplace risk factors, recent research according to Karwowski and Marras (1999:927) have claimed that psychosocial factors are much more important. However, an exhaustive literature survey (Journals, Internet and Research Reports) revealed that no recorded studies have explored psychosocial risk factors and its association with LBP amongst refuse truck drivers in a Municipal setting in South Africa. This study will therefore also investigate this important risk factor specific to refuse truck drivers.

The results of the study will assist Management at the eThekwini Municipality in formulating improved strategies thereby addressing health and safety issues for the refuse truck drivers and other truck drivers in general. The indirect spin off from the study will no doubt be reduced accident rates, decreased absenteeism, greater job satisfaction and greater wellness amongst the drivers. This will translate to increased financial benefits to the organisation in the form of reduced fixed and variable costs.

1.3. LIMITATIONS OF THE STUDY

This study was conducted at a period when the eThekwini Municipality was undergoing fundamental organisational, reengineering and transformation. According to Wright (1996:6) organisations surveyed recognised that change and reengineering has the potential to impact on occupational health and safety management (OHSM) issues. These impacts could be both positive and negative according to Wright (1996). On the positive side, employees would participate in research and development issues pertaining to OHSM. On the side of negativity, employees will display apathy towards research and development pertaining to OHSM. Hence conducting this study during the present time in the eThekwini Municipality was considered a limitation.

There are also various methodological issues that may contribute to inconsistent results when a relationship between risk factors and LBP is investigated. These methodological issues according to Heaney (1999) include: uncontrolled confounders, timing of the measurement of exposure and outcome, and the reliability and validity of study variables (exposure and outcome). These methodological issues are considered as a limitation to the study.

This study did not take into account that some refuse truck drivers could have been suffering from LBP due to organic pathology, infection of the vertebral column or spinal tumours. Hence past history was not considered in this study design.

1.4. ASSUMPTIONS OF THE STUDY

It was assumed that the drivers from the Cleansing and Solid Waste Sections of the eThekwini Municipality would be willing to participate in the study by honestly filling in the questionnaires. This assumption was concluded against the backdrop of the approval letter from the Head: Cleansing and Solid Waste of the eThekwini Municpality (Appendix 1).

1.5. AIM OF THE STUDY

To identify the selected risk factors associated with LBP amongst refuse truck drivers in the eThekwini Municipality, and to evaluate the relationship between the selected risk factors and LBP.

1.6. OBJECTIVES OF THE STUDY

The following objectives were considered:

- To determine whether selected demographic data of refuse truck drivers are associated with LBP.

- To determine whether selected biomechanical risk factors are associated with LBP amongst refuse truck drivers.

- To determine whether selected psychosocial risk factors are associated with LBP amongst refuse truck drivers.

- To determine the prevalence and severity of LBP amongst refuse truck drivers.

- To determine whether the ergonomic findings of the refuse truck cab is associated with LBP amongst refuse truck drivers.

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1.7. HYPOTHESES OF THE STUDY

Hypothesis one: There is a significant relationship between the age of refuse truck drivers and the prevalence of LBP.

Hypothesis two: There is a significant relationship between the height of the refuse truck drivers and the prevalence of LBP.

Hypothesis three: There is a significant relationship between the weight of the refuse truck drivers and the prevalence of LBP.

Hypothesis four: There is a significant relationship between the number of years of driving a refuse truck and the prevalence of LBP.

Hypothesis five: There is a significant relationship between the speed of driving a refuse truck and the prevalence of LBP.

Hypothesis six: There is a significant relationship between the kilometres travelled by a refuse truck driver and the prevalence of LBP.

Hypothesis seven: There is a significant relationship between the posture of refuse truck drivers whilst driving a refuse truck and the prevalence of LBP.

Hypothesis eight: There is a significant relationship between the rating of vibration level caused by the refuse trucks and their attachments and the prevalence of LBP.

Hypothesis nine: There is a significant relationship between the monotony of driving a refuse truck and the prevalence of LBP.

Hypothesis ten: There is a significant relationship between physical stress of refuse truck drivers and the prevalence of LBP.

Hypothesis eleven: There is a significant relationship between the participation in physical activities by the refuse truck drivers and the prevalence of LBP.

Hypothesis twelve: There is a significant relationship between the ergonomic assessment of the refuse truck driver's seat and the prevalence of LBP.

Hypothesis thirteen: There is a significant relationship between the make and model of the refuse truck and the prevalence of LBP.

Hypothesis fourteen: There is a significant relationship between the ergonomic status of the driver controls of the refuse truck cab and the prevalence of LBP.

1.8. THE STUDY SETTING

The study was conducted in the eThekwini Municipality, more specifically the Cluster: Procurement and Infrastructure, Cleansing and Solid Waste Section.

The researcher approached the Head: Cleansing and Solid Waste Section in January 2002, and requested permission to conduct the study. The Head:

Cleansing and Solid Waste granted permission to conduct the study in the Council (Appendix 1).

CHAPTER TWO

THE RELATIONSHIP BETWEEN SELECTED RISK FACTORS AND LOW BACK PAIN

2.1. INTRODUCTION

According to Andersson (1981) work - related musculoskeletal disorders commonly involve the back, cervical spine, and upper extremities. Understanding of these problems has developed rapidly. Low back pain (LBP) is one of the oldest occupational health problems in history according to Levy and Wegman (2000:503). In 1713, Bernardino Ramazzini, the “founder” of occupational medicine, referred to “certain violent and irregular motions and unnatural postures of the body by which the internal structure” is impaired. Ramazzini as cited by Levy and Wegman (2000) examined the harmful effects of unusual physical activity on the spine, such as sciatica caused by constantly turning the potter’s wheel, lumbago by sitting, and hernias among porters and bearers of heavy loads. Levy and Wegman (2000) further mention that in addition to being one of the oldest occupational health problems, LBP is also one of the most common.

In any understanding of the magnitude of LPB as a health problem, it is important that LBP be measured by prevalence and incidence. In a study according to Karwowski and Marras (1999:913) the prevalence of LBP and other important variables is determined at one point in time (point prevalence) or during one period of time (period prevalence) for each member of the population studied or for a representative sample. Incidence may be also according to the abovementioned authors be defined as the number of people who develop LBP over a specified time period, such as their lifetimes (lifetime incidence, which is synonymous with lifetime prevalence) or in a single year (annual incidence). Hence, prevalence of

LBP means all cases of LBP, whereas incidence of LBP means all new cases of LBP.

A study by Guild *et al*. (2001:324) showed that the relationship between occupational factors and LBP is often difficult to determine as objective evidence of LBP is often lacking and exact exposure is usually difficult and sometimes impossible to quantify. Further complicating the situation is the fact that exposure to several occupational risk factors often occurs in the same job simultaneously. According to the above researchers, a truck driver may have to load and unload his truck (lifting), sit for many hours in an unchanged posture (static loading), and be exposed to whole-body vibration.

The most frequently mentioned task risk factors for LBP include heavy physical work, static work posture, frequent bending and twisting, lifting, pushing and pulling and whole body vibration. Risk factors which are also known, based on epidemiological evidence, to be associated with the development or aggravation of musculoskeletal disorders include personal characteristics (e.g. gender, age, body mass, physical limitation) and psychosocial aspects. These risk factors are known as individual risk factors.

Traditionally, the most widely investigated occupational risk factors for LBP have been biomechanical demands of the job according to Chaffin and Park (1973). However according to Bongers, de Winter, Kompier, and Wildebrandt (1993), psychosocial characteristics of work have also been investigated as potential risk factors for LBP. Due to these simultaneous approaches, some evidence about the complex relationship amongst work tasks, workplace environment, and LBP needs to be investigated.

2.2. LOWER BACK PAIN

Pain in the lumbosacral spine can result from inflammation, degenerative, neoplastic, gynaecologic, traumatic, metabolic, or other types of disorder according to Levy and Wegman (2000). However, the great majority of LBP is non-specific and of unknown cause. Many theories regarding the origin of non-specific LBP have been proposed, but so far no one has been able to prove how and where the pain arises (Levy and Wegman 2000:504). Mechanical low back pain is the most common of LBP (Borenstein *et al.* 1995:183). It may be defined as LBP of a musculoskeletal orgin, either due to overuse of a normal anatomical structure (for example a muscle strain) or due to injury or deformity of a normal anatomical structure (for example a herniated intervertebral disc) (Borenstein *et al*. 1995:183).

With regard to the incidence and prevalence of LBP, in South Africa, van der Meulen (1997:99) found the lifetime incidence of LBP in a formal Black township to be 57.6%. Docrat (1999:156) studied the epidemiology of LBP in the Indian and Coloured communities of South Africa, and found the lifetime prevalence to be 78.2% in the Indian community and 76.6% in the Coloured community. The prevalence of LBP at the time of the respective studies was 53.1% in the Black community (van der Meulen 1997:99), 45% in the Indian community and 32.6% in the Coloured community (Docrat 1999:157). Docrat (1999:157) believed that the differences recorded between his study and that of van der Meulen could have been due to differences recorded in the definitions they used for the prevalence as well as the fact that the different race groups may have had different occupational and social activities. Other reasons for the differences may include psychosocial factors (Burton *et al*. 1995:727), economic differences or the level of education of the individuals. A literature review on the statistics on LBP for the occupational group of refuse truck drivers in South Africa revealed that no statistics presently exists.

2.2.1. THE SPINAL COLUMN

The spine is a complex structure consisting of usually 24 movable vertebrae (seven cervical, 12 thoracic, and five lumbar), together with the sacrum and the coccyx, which are fused group of rudimentary bones (Kroemer *et al.* 2001:59). The authors explain that these sections are held together in cartilaginous joints of two different kinds. First, there are fibro-cartilage discs between the main bodies of the vertebrae. Second, each vertebra has two protuberances extending posterior-superiorly- the superior articulation processes – which end in rounded surfaces fitting into cavities on the underside of the next vertebra. These synovial facet joints are covered with pain sensitive tissue, whereas the discs between the main bodies of the vertebra have no pain sensors especially the inner two thirds. (Kroemer *et al*. 2001).

The spinal column according to Kroemer *et al*. (2001:62) is often the location of injury, pain, and discomfort, because it must continuously transmit substantial internal and external strains. Thus, the spinal column must absorb and dissipate much energy, be it transmitted to the body from the outside or generated inside by muscles for the exertion of work to the outside.

For any appreciation of the causes and prevention of LBP it is important to have a thorough understanding of the pathology and pathogenesis of LBP. Attaining some understanding of lumbar spine dysfunction is almost certainly the most important step in elucidating the ways in which the process of degeneration starts according to Kirkaldy-Willis and Bernard (1999:65). The understanding of the degeneration process will also contribute in assisting in the roles that the risk factors associated with LBP play.

2.2.2. PATHOPHYSIOLOGY

The pathophysiology of LBP includes emotional factors, changes in muscle, and changes in the facet joints and intervertebral disc according to Kirkaldy-Willis and Bernard (1999). The authors mention that the most common emotional disturbances pertaining to LBP are tension, stress, anxiety, fear, resentment, and depression. Furthermore, a review of case histories according to Kirkaldy-Willis and Bernard (1999) show that patients who later develop LBP often have been under stress before experiencing pain and that the episode of trauma causing pain is often minor.

In spite of the above reviews, it is important to consider injury to a muscle or facet joint or both as a possible initiating cause of LBP. Kirkaldy-Willis and Bernard (1999:67) cite that muscles activating an intervertebral joint or the joint itself may be responsible for the patient's symptoms often both are involved. The authors explain that it is unknown whether a strain to the joint comes first, followed by a contraction of muscle to protect the joint, or whether the initiating factor is abnormal muscle function, which leads to a joint strain.

Kirkaldy-Willis and Bernard (1999:67) postulate that emotional disturbance acts through the autonomic nervous system to produce local areas of vasoconstriction in muscle. This results in impaired local circulation, thus supporting the theory that vasoconstriction occurs in trigger point zones in muscles.

The combination of restriction of movement causes further emotional changes, depression becoming dominant in many patients. This according to Kirkaldy-Willis and Bernard (1999:69) is often called the chronic pain syndrome. It must however be noted that much of the pathophysiology of LBP is speculative at present.

2.2.3. THE MECHANISM OF INJURY

According to Kirkaldy-Willis and Bernard (1999:70) two different mechanisms are involved, rotational strains and compressive forces in flexion. Rotational strains affect mainly the L4-5 joint. Compressive forces such as falls onto the buttocks, most commonly affect the L5-S1 joint because it is often protected and because the disc is wedge shaped. Rotational stresses lead mainly to changes in the facet joints. Compression in flexion is a common cause of disc herniation.

The level of risk to LBP is important in understanding the mechanism of injury. The earliest changes are seen in the L4-5 joint in approximately two thirds of patients and in the L5-S1 joint in the remaining third according to Kirkaldy-Willis and Bernard (1999).

The spectrum of degenerative change in an inter-vertebral joint can be divided into three phases known as the three phases of the degenerative process according to Kirkaldy-Willis and Bernard (1999:70). In Phase I known as the dysfunction phase, normal function of the three-part complex is interrupted as the result of injury. Examination of the patient reveals that on one or the other side of the spine at either L4-5 or L5-S1 the segmental posterior muscles are in a state of hypertonic contraction or spasm. Normal movement is restricted in one or the other direction because of the injury (Kirkaldy-Willis and Bernard (1999:70).

In Phase 2, known as the unstable phase according to Kirkaldy-Willis and Bernard (1999:70), examination of the patient demonstrates the presence of abnormal, increased movement of the involved area of the spine. Laxity of the posterior joint capsule and of the annulus fibrosus is seen in autopsy specimens. As degenerative changes become advanced (Phase 3), the unstable segment regains its stability because fibrosis is present and osteophytes form around the posterior joints, within, and around the disc (Kirkaldy-Willis and Bernard 1999:70).

Sometimes the changes seen in Phase I pass directly into those of Phase 3 without the intermediate changes of Phase 2. On other occasions, Phase I changes pass to Phase 2, and these pass later to those of Phase 3. The occurrence of the above mention phenomena is still unknown according to Kirkaldy-Willis and Bernard (1999:70).

In understanding the importance of LBP, both emotional and physical factors contribute to the development of LBP problems. It is however almost impossible to determine which of these factors plays the greater role. This state of affairs according to Kirkaldy-Willis and Bernard (1999:86) may be due to delay in obtaining treatment, inadequate or incorrect treatment, or co-existence of usually complicated and persistent emotional problems.

Three studies reviewed (Bigos and Battie 1992, Bigos and Battie 1997 and Battie and Bigos 1989) have attempted to identify risk factors, in the workplace or related to the individual that is associated with LBP and found heavy physical work; static work postures; frequent bending and twisting; lifting pushing and pulling; repetitive work; vibrations and psychological and psychosocial risk factors as signficant.

Other risk factors associated with LBP according to Kirkaldy-Willis (1999:361) relates to the employee which include a history of prior low back pain, poor physical condition, obesity, smoking and increased age.

2.3. RISK FACTORS

There are many risk factors associated with developing LBP in individuals. Davis and Heaney (2000:389-406) developed a conceptual model of the potential relationships among psychosocial work characteristics, biomechanical work demands, and LBP. This conceptual model will be utilised as the reference point in the literature review. The model is presented as Figure 2.3. on page 21.

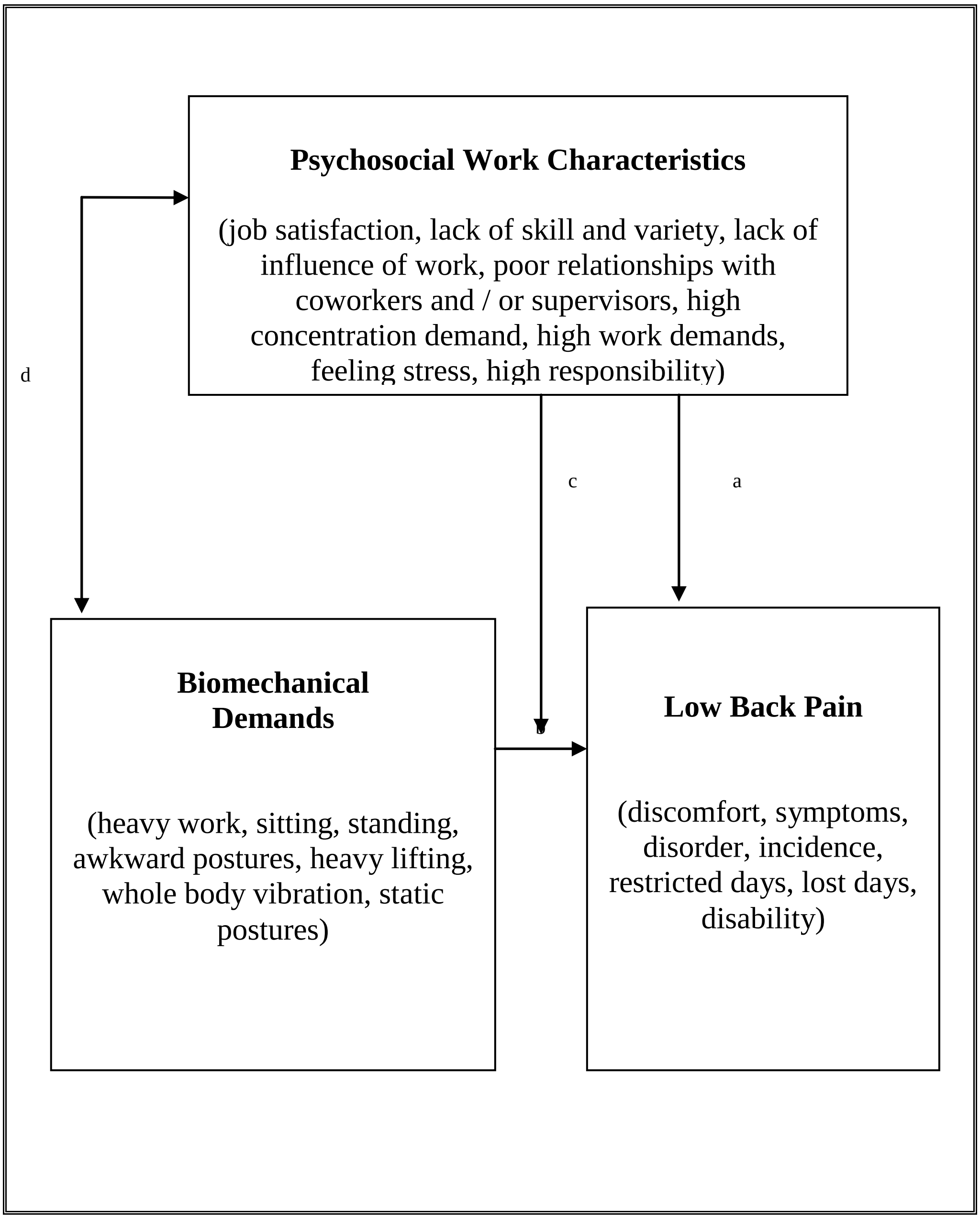

Fig. 2.1. Conceptual model of the relationship between psychosocial and biomechanical risk factors and LBP.

Adapted from Davis and Heaney. 2000. The relationship between psychosocial work characteristics and low back pain: underlying methodological issues. *Clinical Biomechanics*, (15):389-406.

In terms of this model psychosocial factors (see pathway a) and biomechanical factors (see pathway b) may independently contribute to the etiology and progression of LBP. Psychosocial factors may also influence the relationship between biomechanical factors and LBP (see pathway c), such that biomechanical demands have a greater effect on LBP under poor psychosocial work conditions. Additionally, poor psychosocial characteristics and high biomechanical demands may covary (e.g. tend to concentrate in similar jobs and occupations such as refuse truck driving).

This covariation (see pathway d) raises the possibility of confounding if both types of risk factors are not accounted for in risk models. According to Davis and Heaney (2000), biomechanical demands and psychosocial work characteristics were rarely investigated as risk factors for LBP within the same study.

The biomechanical approach has been based on the premise that physical aspects of the job contribute to LBP. Biomechanical factors have been hypothesised by Davis and Heaney (2000:389-406) to cause LBP through two mechanisms: excessive load and repetitive loading on the spinal structure. Caffin and Barker (1990:16-27) mention that excessive loads can result from lifting heavy loads, awkward postures, prolonged sitting such as refuse truck driving and high trunk velocities. Andersson (1981:53-60) had earlier established that that biomechanical factors such as awkward postures, static postures, repetitive trunk motions, whole body vibration, and lifting heavy loads have been found to be risk factors for LBP. Loads on the spine that accompany the above mentioned risk factors have also been found to be moderately associated with LBP according to Herrin *et al.* (1986:322-30). These loads can be due to excess weight carried by the individual or due to the carrying of heavy loads by the individual.

Davis and Heaney (2000:389-406) mention that the psychosocial approach is based on the premise that social aspects of the work environment and psychological demands of work contribute to LBP. This approach according to Holt (1993:419-44) has its intellectual roots in the occupational stress literature, which has established the effects of exposure to psychosocial stressors on numerous health outcomes. Psychosocial stressors are conditions that are likely to be perceived as harmful, threatening, or bothersome or that place a demand on employees that results in a physiological adaptation response according to Selye (1993).

Examples of psychosocial stressors include work overload, role ambiguity, and interpersonal conflict, having responsibility for the well-being of others, lack of opportunity for advancement, and having little say in decisions that affects one's work (Caplan *et al*. 1975). Models of occupational stress also contend that characteristics of the social environment (e.g, the extent to which social support is available from co-workers and supervisors) influence employees health, well-being, and ability to cope with stressors according to Israel *et al*. (1996: 261-86).

Miyamoto *et al*. (2000) investigated the risk factors involved in occupational LBP occurring in professional truck drivers who work in a large chemical industry corporation. In their study, it was found that the prevalence of LBP in one month of the survey was 50.3%. Correlating among data of personal factors and LBP, the prevalence of LBP was significantly higher in the professional drivers sampled (Odd's ratio of 2.7) who answered "yes" to the item "shortage of spending time with family" than in the drivers who did not answer "yes". The occupational factors, working load and working environment showed no correlation with the prevalence of LBP. In contrast, 3 items of the working format related significantly to the prevalence of LBP: "irregular duty time" (Odd's ratio of 3.0), "short resting time" (Odd's ratio of 2.4), and "long driving time in a day" (Odd's ratio of 2.0). Eighty-one of the 153 drivers (53%) in the Miyamoto *et al.* (2000) study pointed out the relationship between LBP and work especially work which involves vibration or road shock.

2.4 BIOMECHANICAL RISK FACTORS

2.4.1. STATIC WORK POSTURE

Working predominantly in one posture, such as prolonged sitting (e.g. refuse truck driving), seems to carry an increased risk for LBP. However, there is considerable disagreement with this view. While many studies indicate an increased risk of LBP in subjects with predominantly sitting work postures (Hult 1954, Kroemer & Robinette 1969, Lawrence 1955, Magora, 1972, Partidge and Anderson 1969), other researchers do not (Bergquist-Ullman (1977); Braun 1969). However, Kelsey and Hardy (1975) found that men who spend more than half of their workday in a car have threefold increased risk of disc herniation.

This could be due to the combined effect of sitting and vehicle vibration. Magora (1972) further established that those who either sat or stood during most of the workday had an increased risk of LBP. Frequent changes in posture were also found to increase the risk of back pain. Refuse truck drivers frequently change their posture, whilst driving. The drivers will often stand up from the seats for various reasons.

2.4.2. AWKWARD WORK POSTURE

The association between LBP symptoms and frequent bending and twisting is difficult to evaluate as a separate activity because lifting is also involved. However, in refuse truck driving frequent bending and twisting was considered an important risk factor. The driver frequently bends and twists while driving. This occurs whilst reversing as the driver is constantly turning the head in order to negotiate the narrow spaces. Whilst the refuse truck is moving forward, the driver has to also constantly check on the pickers that are if they are still running behind the truck. This activity also causes the driver to frequently bend and twist. A few studies report an association between these movements and LBP (Bergquist-Ullman & Larsson, 1977; Brown, 1975; and Troup, 1984).

Magora (1973) established a connection between both excessive bending and occasional bending on the one hand and LBP on the other, and a similar finding was made by Chaffin and Park (1973). Devereux *et al.* (2004) established that continuously working with the head/neck bent or twisted excessively was classified as a major risk factor associated with LBP. Hence, it is hypothesised that awkward postures as a biomechanical risk factor is associated with LBP amongst refuse truck drivers in the eThekwini Municipality.

2.4.3. VIBRATION

There are several studies suggesting an increasing risk of LBP in drivers of tractors (Seidel and Heide 1986) of trucks (Gruber 1976; Kelsey and Hardy 1975) of buses (Gruber and Ziperman 1974; Kelsey and Hardy 1975) and of pilots of aeroplanes (Fitzgerald and Crotty 1972; Schulte-Wintrop and Knoche 1978). These studies also suggest that LBP occurs at an earlier age in subjects exposed to vibration. Bongers and Boshuizen (1990), present some of the possible mechanisms why this occurs at an earlier stage of exposure. Changes induced by vibration exposure could render the spine more susceptible to spinal loading. Damage to one spinal level could increase the load and risk of degenerative changes at other levels, as all spinal motions are coupled. Vibration also increases the muscular activity of the back, which may lead to muscular fatigue and pain, increasing the load on the vertebrae and other structures (Bongers and Boshuizen 1990).

According to Kelsey and Hardy (1975) truck driving increased the risk of disc herniation by a factor of four, while tractor driving and car commuting increased the risk by a factor of two. A later follow up study by the Kelsey and Hardy (1975) also found an association that was related to the type of vehicle, indicating significant differences between different brands of cars. The Durban Solid Waste has approximately six main models of refuse trucks. This study attempted to investigate the association between the different types of refuse trucks and LBP. Hence, it is hypothesised in this study that there is a significant relationship between the make of refuse trucks and the incidence of LBP.

Hulshof and Van Zanten (1987) have reviewed the epidemiologic data supporting a relationship between whole body vibration and LBP. They concluded that vibration was a probable risk factor in helicopter pilots, tractor drivers, construction machine operators, and transportation workers. They were critical of the data, concluding that none of the many studies reviewed was adequate in terms of the quality of exposure data, effect data, study design, and methodology. Most studies did not control for confounding variables i.e. other than vibration, and only a few had control populations. However, the studies by Hulshof and Van Zanten (1987) established that vibration is a risk factor associated with LBP.

Dupuis and Zerlett (1986), in a 10-year prospective study (1961 to 1971), describe an increased incidence of backache reports from 47% to 58% amongst tractor drivers. Gruber and Zipermann (1974) compared 1448 male interstate bus drivers to three sets of control groups. The control groups were people who were not in a driving occupation. The interstate bus drivers had a higher prevalence of spinal disorders than the three control groups. A significant correlation (+1) was obtained between prevalence rates and exposure level. In a later study, Gruber (1976) found significantly higher back pain prevalence rates among 3205 interstate truck drivers compared to 1137 air traffic controllers. These studies suggest that truck drivers are at a greater risk than other drivers to exposure to vibration.

Behrens *et al*. (1994) found the highest prevalence (70%) estimates for LBP among U.S. occupational groups to occur among truck drivers. In a Danish study, 2045 full-time male bus drivers in the three largest cities in Denmark were compared to 195 motormen (Netterstrom and Juel 1989). The prevalence of LBP was 57% verses 40%. Burdof and Zondervan (1990) found an odds ratio of 3.6 for LBP among crane operators compared to controls. In all of these occupational groups, vibration was the common variable. Hence, it is suggested that due to the prevalence of vibration as a risk factor, high prevalence of LBP has been found in these studies.

Buckle *et al*. (1980); Frymoyer, (1980); Backman, (1983); Damkot *et al*., (1984); and Biering-Sorenson and Thompsen (1986) all reported to have established an association between automobile use and LBP. Hence, it is hypothesised that vibration, as a biomechanical risk factor is associated with LBP amongst refuse truck drivers in the eThekwini Municipality.

Experimental data collected over the years, for defining limits of vibration exposure to human beings, have resulted in a set of vibration criteria specifically in the ISO standard 2631 (ISO 2631/1:1985). The standards and guidelines concerning whole-body vibration are designed to reduce vibration to a level where most workers can perform job tasks without discomfort.

The early versions of the ISO guidelines, gave three different types of exposure limits, namely:

- a reduced comfort boundary;
- the fatigue-decreased proficiency boundary;and
- an exposure limit.

The reduced-comfort boundary was for the comfort of people travelling in aeroplanes, boats and trains, and exceeding these exposure limits would make it difficult for passengers to eat, read or write when travelling. This did not relate to occupational exposure situations where work was being conducted.

The fatigue-decreased proficiency boundary was a limit set for time dependant effects that impair performance. For example fatigue impairs performance when operating a vehicle.

The third limit, the exposure limit was used to assess the maximum possible exposure allowed for whole-body vibration. A separate set of “severe discomfort boundaries” was also given for 8-hour, 2-hour, and 30 minute exposures to whole-body vibration in the 0.1 Hz to 0.63 Hz ranges. These exposure limits were given as acceleration for one third octave band frequencies and the three directions of exposure; ie: X, Y, Z. The exposure limit was lowest for frequencies between 4 and 8 Hz as the human body is thought to be most sensitive to whole body vibration and resonance at these frequencies.

The new revised IOS-2631 (1997) guideline document has various changes that incorporate new experience and research results. The frequency ranges in the revised version have been extended below 1 Hz, and the evaluation is based on frequency weighting of the RMS acceleration rather than the rating method used before. Different frequency weighting are given for the evaluation of different effects.

5. PSYCHOSOCIAL RISK FACTORS

2.5.1. MONOTONY

Studies by Astrand (1987), Battie (1989), Cunningham and Kelsey (1984) showed that several psychosocial work factors, including monotony at work, work dissatisfaction, and poor relationship to co-workers have been found to increase the risk of complaining of LBP and reported workers compensation claims. Monotony as a psychosocial risk factor had a direct relationship to LBP in the study by Svensson and Andersson (1983). Bergquist-Ullman and Larsson (1977) found that workers with monotonous jobs, requiring less concentration, had a longer sickness absence following LBP than the others. Monotonous jobs are considered as jobs of a repetitive nature i.e. doing the same tasks day in and day out.

Diminished work satisfaction amongst workers has also been found to be related to an increased risk of LBP by Westrin (1970), Magora (1973), and Svensson (1983). Bergenudd and Nilsson (1988) found that middle-aged workers had an increased prevalence of back pain if they had physically heavy jobs and that the association increased further when the workers were dissatisfied with their work. The risk factor of age and its association with LBP can be attributed to why middle-aged workers had an increased prevalence of LBP.

Kelsey and Golden (1988) point out that since most of the studies are retrospective it is difficult to determining whether psychosocial factors are antecedents or consequences of pain. Bigos's (1986) and Battie's (1992) prospective studies concluded, that psychosocial work factors were more important than physical work factors as risk indicators of LBP. The possible reason for the change of importance could be that ergonomic interventions over the years have been successful in addressing biomechanical risk factors (Bigos's 1986 and Battie's 1992). However, the ranking of the selected risk factors associated with LBP amongst refuse truck drivers is not considered in any hierarchical sequence in this study.

2.5.1. STRESS

A recent study by Devereux *et al.* (2004) showed that work related stress and musculoskeletal disorders was the leading occupational health problem in the European Union. In the UK, these disorders are the two leading causes of work absence and turnover. The study showed that in the last 12 months of the survey 5.7 million working days were lost from back injuries.

The psychosocial work factors, extrinsic effort, intrinsic effort, role conflict and verbal abuse or confrontations with members of the public were not only associated with high perceived job stress but also predicted the onset of LBP. According to the above researchers, high exposure to both physical and psychosocial work risk factors produced the greatest likelihood of reporting high-perceived job stress compared to other combinations of exposure to these sets of workplace risk factors. There was a potential interaction effect between high exposure to physical and psychosocial work risk factors that increased the likelihood of reporting high-perceived job stress. The increase in the likelihood of reporting the onset of high-perceived job stress was mainly from high exposure to a number of psychosocial workplace risk factors. The abovementioned researchers concluded that stress as a risk factor was found to increase the risk of complaining of LBP.

The most common emotional disturbances pertaining to LBP is stress according to Kirkaldy-Willis and Bernard (1999). Review of case histories according to these authors shows that patients who later develop LBP often have been under stress before experiencing pain and that the episode of trauma causing pain is minor.

Kirkaldy-Willis and Bernard (1999:115) mention that the vulnerable person who harbours a somatization diathesis, given sufficient stress, is likely to somatize. Somatization diathesis is a vulnerability to somatize under sufficient stress, harboured by those persons who in one way or another have been deprived, abandoned, abused, or otherwise emotionally shortchanged during their formative years Kirkaldy-Willis and Bernard (1999). These persons can be identified readily if attention is directed to the history of psychosocial events and circumstances paralleling in time the onset and course of their LBP and associated symptoms. However according to Kirkaldy-Willis and Bernard (1999:115) this parallel history must be viewed against the backdrop of the formative years to discover the likelihood of a somatization diathesis.

2.6. BIOGRAPHICAL RISK FACTORS

2.6.1. LOWER BACK PAIN AND AGE

Stature changes also occur with age, after about 30 years of age, the intervertebral disks degenerate, developing micro tears and scar tissue, fluid is lost more readily, the disk space narrows permanently, and the spinal motion segments lose stability (Bridger 1995:47). Therefore it is not surprising that most occupationally induced LBP occurs in middle aged people. In the elderly according to Bridger (1995) disk degeneration reaches a stage where, together with other degenerative processes, the spine is stabilised but with a corresponding loss of mobility.

There is evidence that 12% to 26% of children and adolescents experience LBP although most cases of LBP occur in persons between the ages of 25 and 60 years, peaking at about 40 years (Plowman 1992:221-242). Jayson (1996) however mentions that most patients with LBP report that onset usually occurs between ages 35 and 45 thereby supporting Bridger’s (1995) theory.

Gilad and Kirschenbaum (1988) in their research found that rates of LBP increases as age increases, but not consistently. These researchers established that young workers had about a 25% lower incident rate of LBP than pre - retirement workers. However, people in their primary working ages (35-44) had rates nearly as high as the oldest age cohort group. Thus, the study by Gilad and Kirschenbaum (1988) concluded that aging appeared to be a factor in increasing the risk of LBP, but not a completely decisive one.

2.6.2. LOWER BACK PAIN AND HEIGHT

Jayson (1996) has established that individuals having above average height (using average European anthropometric data – 1.74m) have greater incidence of LBP that those of shorter stature. Thus according to Jayson (1996) LBP is primarily caused by the tendency to stoop to appear shorter. Height also increases the weight and consequently the force the lower spine must support with movement.

2.6.3. LOWER BACK PAIN AND WEIGHT

People who are overweight or obese and suffer from LBP may not be aware that their excess weight is actually contributing to their LBP (Jayson 1996).While it has not been thoroughly studied exactly how excess weight can cause or contribute to LBP, it is known according to Jayson (1996) that people who are overweight often are at greater risk for LBP, joint pain and muscle strain than those that are not obese. According to the American Obesity Association patients who carry more weight around their midsection are at greater risk for obesity related health problems, such as LBP.

2.6.4. LOWER BACK PAIN AND SEX OF THE INDIVIDUAL

The impact of the sex of the individual on the incidence of LBP has not been established as well as the roles of other risk factors. However Gilad and Kirschenbaum (1988) established in their research that when probing the differential impact of the work environment on the incidence and frequency of LBP, differences appear by age and sex. Table 2.1. illustrates the rates of LBP by age and sex and frequency of occurrence and severity ratio as found in the Gilad and Kirschenbaum (1988) study.

	N	**OVERALL RATE**	**CHRONIC RATES OF INCIDENCE**	**SPORADIC RATES OF INCIDENCE**	**SEVERITY RATIO**
Sex					
Male	156	593	133	460	3.5
Female	100	580	80	500	6.3

	N	**OVERALL RATE**	**CHRONIC RATES OF INCIDENCE**	**SPORADIC RATES OF INCIDENCE**	**SEVERITY RATIO**
Age					
< 25	6	538	76	461	6.1
25-34	85	544	68	476	7.0
35-44	79	635	173	461	2.7
45-54	35	576	121	455	3.8
55-64	43	686	171	514	3.0
65+	8	1000	-	1000	-
Total	259	588	112	476	4.3

Table 2.1. Rates of back pain incidence by age and sex and frequency of occurrence and severity ratio

Adapted from Gilard and Kirschenbaum. 1988. Rates of Back Pain Incidence Associated With Job Attitudes and Worker Characteristics. *International Journal of Industrial Ergonomics*. 2:267-272.

2.7. POTENTIAL CASUAL MECHANISMS LINKING PSYCHOSOCIAL WORK CHARACTERISTICS AND LOW BACK PAIN

The mechanisms through which psychosocial work characteristics might contribute to LBP are not clearly understood. Davis and Heaney (2000) have hypothesised several different mechanisms. Because these mechanisms represent quite different points of view and have different implications for intervention, a brief summary of the leading hypotheses as provided by Davis and Heaney (2000) is discussed.

First, it has been hypothesised that psychosocial factors are directly related to LBP by influencing the loading on the spine via changes in trunk kinematics, the forces exerted, or muscle activity. Support for this premise can be provided by studies that use physiological measures of LBP. For example, Bergenudd and Johnell (1991) found that symptomatic individuals with physical signs of LBP as determined by a physical examination (tenderness under palpation and loss of range of motion) were more likely to have higher job stress and lower job decision latitude than individuals without these physical symptoms. Other researchers like Backus and Dudley (1974) had earlier found increased muscle tension (estimated by electromyography) to be associated with high psychosocial demands (e.g. high concentration demands) and employee responses to a demanding job (e.g. high-perceived stress levels, low job satisfaction). This increase in muscle tension could directly increase loading on the structures of the spine or increase loading through changes in trunk motion. Either way, the increased loading on the spine may contribute to LBP by increasing loads on the disc, devascularisation of the nerve roots and other tissues, inflammation and degeneration of the zygapophysial joint and ligaments (Hickey and Hukins, 1980).

Another possible mechanism is based on psychosocial factors influencing various chemical reactions in the body that take place during the performance of job tasks. Backus and Dudley (1974) hypothesised that the increased muscle tension found with poor psychosocial factors may reduce blood flow resulting in the accumulation of metabolites that, in turn, result in muscle pain. According to Frankenhaeuser and Johansson (1986) long-term exposure to a poor psychosocial environment may result in the depletion of the oxygen supply to the spinal tissues and an accumulation of metabolites through another mechanism e.g., the degeneration of the blood vessels.

Theorell *et al.* (1993) hypothesised that long-term elevated cortisol levels may make muscles vulnerable to mechanical loads. While none of these chemicals have been directly related to LBP, it does raise the possibility that other chemicals in the muscles and nerves may be either insufficient or in excess, ultimately leading to pain. Refuse truck drivers are exposed to a cocktail of chemicals, due to the nature of their work. These chemicals are emitted from the contents of the refuse bags, the compacting process at the rear of the truck and from the landfill sites. These chemicals emanate from the loads they carry, the landfill site and generally the external road environment. At the present time, little research has investigated how psychosocial factors influence metabolic processes in the muscles, discs, nerves and other structures in the lower back.

A third potential mechanism entails psychosocial factors influencing the reporting of an injury by altering tolerance to pain. In other words, psychosocial factors may reduce the pain threshold of the individual, thus increasing the likelihood of reporting LBP. According to Burton (1997) through this mechanism, an employee in a stressful psychosocial environment might be more sensitive to pain and more likely to report an injury than an employee in a non-stressful environment, all else being equal. Theorell *et al.* (1993) found that individuals with low decision latitude had lower pain thresholds than individuals with high decision latitude. In the Theorell study, an algometer was used to measure pain pressure thresholds for females and males that had different levels of job demands and decision latitude. According to Theorell *et al.* (1993) males had a higher pain threshold than females.

The reporting of LBP may also be influenced by psychosocial factors in another way according to Nachemson (1992). Individuals who have a poor psychosocial work environment may be more likely to report LBP or call in sick, even when LBP is not severe, in order to avoid stressors at work. Frank *et.al*. (1995) suggested that LBP is “a modern day consequence” of poor job satisfaction and easily available worker’s compensation.

2.8. METHODOLOGICAL ISSUES

Several methodological issues may be contributing to the inconsistent results presented in the above literature review and it is important that these issues be reviewed. These issues can also be considered as limitations to this study, in identifying the selected risk factors associated with LBP amongst refuse truck drivers in this study. According to Davis and Heaney (1999) these include: uncontrolled confounders, timing of the measurement of exposure and outcome, and the reliability and validity of study variables (exposure and outcome). These items are briefly discussed below.

2.8.1. CONTROLLING FOR POTENTIAL CONFOUNDERS

While there appears to be some evidence that psychosocial variables are related to LBP, the interpretation of the results may depend upon whether other potential confounding variables were controlled for in the analyses. Two types of variables are important to take into account when evaluating the association between psychosocial factors and LBP. Firstly, according to Hilderbrandt (1995), demographic variables such as age, gender, and occupation have been associated with both LBP and with exposure to psychosocial work characteristics. Thus, it is important to include demographic variables in multivariate models when assessing the relationship between psychosocial work characteristics and LBP. Some of the studies reviewed included demographics in multivariate analyses (statistics involving two or more variable quantities). In general, there were only small or no differences in the results when comparing unadjusted models and models adjusted for demographic variables. Hence, it is suggested that when multivariate analysis is conducted it is important to include demographic variables. In this study, age, height and weight of the refuse truck driver were including as demographic variables.

Biomechanical factors have also been shown to be related to both psychosocial work factors and LBP. Several studies according to Johansson and Nonas (1994) have found that jobs with high biomechanical demands are likely to be associated with poor psychosocial work factors such as low job decision latitude, low levels of social support, and high workload. While some studies according to Nonas (1994) have found that the relationship between psychosocial factors and LBP is independent of biomechanical factors, there is other evidence that biomechanical demands may confound the relationship between psychosocial work factors and LBP (Johansson 1995).

As indicated in Fig. 2.1. the conceptual model of the relationship between psychosocial and biomechanical risk factors and LBP, it is also possible that biomechanical and psychosocial work characteristics have an interactive effect on LBP. This hypothesised effect has not been adequately tested. Johansson (1991) found that workers exposed to heavy physical demands as well as poor psychosocial work characteristics were twice as likely to have an episode of LBP than a worker with few physical demands and a good psychosocial work environment. However, no statistical test was provided to indicate if the magnitude of this effect was due to the main effects of the two predictors or to an interaction. Only one study conducted such a test. Barnekow-Bergvist *et al*. (1998) found that the effect of heavy lifting on LBP was stronger when employees were performing monotonous work that provided little variety in job tasks.

2.8.2. TIMING OF THE EXPOSURE AND OUTCOME VARIABLES

In order for any relationship between a risk factor and LBP to be casual, the exposure to the risk factor must precede the outcome. Cross-sectional designs, which have been widely used to evaluate the association between psychosocial work factors and LBP, have limited ability to establish a casual relationship. Often according to Davis and Heaney (2000), study participants are asked to report how they are currently experiencing their work (e.g., how stressful it is), and then are asked to report any LBP that they experienced during some previous time (e.g., over the last year). Thus, the exposure is measured after the experience of the outcome. A relationship established by such a study is just as likely to reflect an effect of symptoms on how the worker experiences the job, as it is the reverse.

At best, a cross-sectional design can measure co-occurrence of exposure and outcome (e.g., respondents report symptoms being experienced at the time of the data collection) according to Davis and Heaney (2000). All cross-sectional studies are vulnerable to a selection effect whereby workers with back pain may choose less stressful or less physically demanding jobs (Davis and Heaney,2000). Such an effect will lead to an underestimation of the effect of the exposure on the outcome. This could well be possible with refuse truck drivers. Drivers with LBP move on to other jobs within the Municipality rather than remaining as refuse truck drivers until retirement.

Cross-sectional studies that rely on self-reports of potential risk factors are also vulnerable to a bias due to workers being aware of the supposed relationship between work characteristics and LBP (Davis and Heaney 2000). Thus, when workers are experiencing LBP, they may attribute their pain to a worksite exposure for example refuse truck driving. This may increase their perception of being exposed to physical or psychosocial demands at the workplace, resulting in an overestimation of the relationship.

According to Davis and Heaney (2000), two other types of study designs have been used to investigate the relationship between work characteristics and LBP: case-control studies and prospective cohort studies. Since case-control studies are vulnerable to recall bias and the "attribution" bias described above, prospective cohort studies have typically been touted as the most practical design for providing reliable evidence of a casual relationship between work factors and LBP. However, the ability of a prospective cohort study to discern a cause and effect relationship is dependent on measuring the exposure (whether it be biomechanical or psychosocial) and the outcome with a time interval that best reflects the hypothesised underlying injury mechanism. An "initial impact" model suggests that the measurement of the exposure and the outcome need to be relatively close in time, while injuries related to chronic exposure are best predicted when there is a longer lag time between the measurements of the two. Cross-sectional studies, particularly those that measure current symptoms, could provide evidence for an additional impact or acute effect. The results of these studies, as reported above, are not supportive of the initial impact model for psychosocial characteristics on LBP.

2.8.3. RELIABILITY AND VALIDITY OF THE EXPOSURE MEASURES

According to Davis and Heaney (2000) the subjectivity of the exposure measure, or the extent to which the measure depends on one employee's perception, is likely to affect the results of a study. A person's perception of his work is likely to be a reflection of both the work itself and the person's expectations about work, and general mood and well-being. Thus, a subjective measure of a worksite exposure provides uncertain cues as to what is contributing to injury incidence, is it the demands of work or the inadequate resources of the employee or both? In addition, when the LBP outcome is also measured through employee self-report, negative effect and common method variance can artificially inflate the association between workplace exposures and LBP.

All employee self-report of work characteristics, whether biomechanical or psychosocial characteristics are vulnerable to the criticism of subjectivity. However, the amount of subjectivity involved in a given self-report measure depends on how the questions are worded. For example, questions that involve the workers making judgements or interpretations (e.g., "Is your job stressful?"Alternatively "Do you consider refuse truck driving monotonous and boring?") introduce more subjectivity than do questions that ask for more descriptive, quantifiable assessments (e.g., "How many hours do you play sport for?").

2.8.4. QUALITY OF THE BIOMECHANICAL ASSESSMENTS

Although reliable, validated tools for objective assessments of biomechanical work demands are available (e.g. goniometers, electromyography, video-based tools, loading models), most studies included in this literature review used self-reported questionnaires to assess these work demands. According to Davis and Heaney (2000) several authors have found that employee self-reports of biomechanical work demands are not particularly accurate assessments. For example, Wiktorin *et al*. (1993) found that employee responses to questions assessing trunk flexion and lifting agreed with the reports of trained observers only one-third of the time.

Viikari-Juntura *et al*. (1996) found that correlations between employees self-report and expert observations were between 0.42 and 0.55. When workers have been asked to provide estimates of the time spent lifting or flexed forward, the agreement between observations and self-reports was less than 12%. In general, the self-reported duration of trunk flexion and lifting have been over-estimated as compared with direct observations.

These biomechanical assessments may also lack adequate reliability because of the use of single item measures. Basic psychometric principles suggest that, because answers to any single question contain random error, combining the answers to multiple questions will provide a more reliable estimate of the true score. This study an epidemiological investigation of the selected risk factors associated with LBP amongst refuse truck drivers in the eThekwini Municipality used multiple item indices to measure biomechanical demands.

As stated previously, biomechanical and psychosocial work demands tend to covary. Thus, the reliability of the measures of biomechanical variables may not only affect the magnitude of the relationship between biomechanical demands and LBP, but may also influence the magnitude of the relationship found between psychosocial work characteristics and LBP (when using multivariate models that include biomechanical factors). The effects of biomechanical demands on LBP are only partially controlled for when measures of low reliability are used.

Indeed, among the studies reviewed in this survey, those that included more reliable and valid measures of biomechanical factors typically showed: (1) more consistent and stronger relationships between biomechanical demands and LBP, and (2) less consistent relationships between psychosocial factors and LBP. Among the studies that provided no information about or no assessment of biomechanical demands, 30% found associations between poor psychosocial work characteristics and LBP, while 59% found no association (Davis & Heaney 2000). When single item self-reported biomechanical assessments were entered into multivariate models, studies were more likely to yield mixed results (Davis & Heaney 2000). The percentage of studies finding the hypothesised association between poor psychosocial characteristics and LBP decreases even further (18%) when multiple item biomechanical assessments were entered into the models (Davis & Heaney 2000).

According to Marras (1995) where trunk kinematics were directly measured using a goniometer, job dissatisfaction was a significant predictor of LBP in bivariate models, but not in multivariate models that controlled for biomechanical demands. In summary, the ability to accurately assess the biomechanical demands of the study participant’s jobs significantly affected the magnitude of the relationships found between biomechanical demands and LBP as well as the relationships between psychosocial factors and LBP was the main reasons for the findings.

2.8.5. QUALITY OF PSYCHOSOCIAL ASSESSMENTS

There are very few validated, non-self-report measures of psychosocial work characteristics (Davis & Heaney 2000). Quantitative workload has been measured through direct observation of discreet events (such as number of calls handled by a police dispatcher or number of parts assembled by an autoworker), and some observational protocols exist for measuring other stressors. However, psychosocial characteristics of work such as concentration demands or responsibility for others are inherently subjective to some degree. Measures that explicitly measure employee attitudes (e.g., monotony and perceived stress) rather than environmental exposures will, by their very nature, be the most subjective.

As with biomechanical assessments, self-report measures of psychosocial work characteristics have been found to be only moderately correlated with other types of measures. For example, Melamed *et al*. (1995) investigated the level of agreement between monotony on the job as measured through self-administered questionnaire and monotony as measured through observation of repetitions of tasks in work with short, medium and long cycle times. For all of these types of jobs, the self-report and observational measures were only moderately associated at best (r = 0.09-0.42).

The limitations of the measurement of the psychosocial work characteristics are likely to contribute to the inconsistency of the results in the literature. More specifically, the use of unreliable measures may increase the likelihood of getting null results due to measurement error masking true underlying relationships.

2.8.6. QUALITY OF THE LBP ASSESSMENTS

According to (Davis & Heaney 2000) the majority of studies (n = 59) used a self-administered questionnaire to measure LBP, while only 10 studies included physical examinations. According to Davis and Heaney (2000) the ability to discern a relationship between psychosocial work characteristics and LBP is affected by the reliability of the outcome measure. The reliability of self reported LBP is determined, in part, by the length of the recall period and by the nature of the questions asked. The longer the recall period the less reliable the response is.

Other types of LBP measures also suffer from threats to their reliability. Physical examination measures introduce subjectivity of the physician or other health professional that is performing the examination. While there is no “gold standard” according to Davis and Heaney (2000) for the assessment of LBP, the appropriateness of the outcome measure depends on the research question being investigated.

2.9. CONCLUSION

The literature review critically evaluated the current epidemiological evidence linking biomechanical and psychosocial risk factors with LBP. The review also attempted to identify and address methodological issues in the literature which can be considered as limitations when evaluating the relationship between biomechanical and psychosocial risk characteristics and LBP.

The review adequately presented evidence that biographical data are associated with LBP. Furthermore, evidence was provided that biomechanical and psychosocial risk factors are associated with LBP. Truck driving as a job was also found to be associated with LBP. The review also established that the prevalence and severity of LBP was also significantly high amongst truck drivers.

CHAPTER THREE

RESEARCH AND STATISTICAL METHODOLOGY

3.1. INTRODUCTION

In chapter two, a theoretical discussion of the selected risk factors associated with LBP and truck driving was provided. In this chapter the methods and instruments used to conduct the empirical research for the study, as well as the statistical methodology used, will be discussed. The topics to be addressed include the study environment, study design, sampling design, the research method and statistical methodology employed in the study.

3.2. OBJECTIVES OF THE STUDY

The following objectives were considered:

- To determine whether selected demographic data of refuse truck drivers are associated with LBP.

- To determine whether selected biomechanical risk factors are associated with LBP amongst refuse truck drivers.

- To determine whether selected psychosocial risk factors are associated with LBP amongst refuse truck drivers.

- To determine the prevalence and severity of LBP amongst refuse truck drivers.

- To determine whether the ergonomic findings of the refuse truck cab is associated with LBP amongst refuse truck drivers.

3.3. THE STUDY ENVIRONMENT: DURBAN SOLID WASTE (DSW)

This study was conducted in the Solid Waste Department of the Ethekwini Municipality, in response to the number of complaints received over the years from refuse truck drivers, regarding lower back pain. Excessive sick leave related to LBP has also been the trend, resulting in excessive man-hours lost. One hundred and twenty refuse truck drivers from Durban Solid Waste were sampled.

The researcher approached the management of the Solid Waste Department in January 2002, and requested permission to conduct the study. Permission was granted by the Head: Solid Waste and Cleansing to conduct the study in the Council (Appendix 1).

3.4. THE STUDY DESIGN

In this study a cross-sectional study design was chosen. According to Cooper and Schindler (2001:136) the cross sectional option is categorised as a time dimension study. A cross sectional study is one where a sample of the population is selected and information is obtained simultaneously on exposure and outcome to determine whether persons with a particular exposure characteristic are more likely to have the outcome (disease or condition) being investigated (Lilienfeld & Stolley 1994:198).

3.5. SAMPLING DESIGN

As mentioned in Chapter One, it was decided to conduct this study in the Solid Waste Department of the Ethekwini Municipality and the refuse truck drivers were requested to complete the questionnaires.

The first step in this sampling process involved obtaining a list of all refuse truck drivers at the Ethekwini Municipality. A driver was accepted onto the study based on the following criteria:

Inclusion Criteria:

- Full time refuse compactor drivers.
- Drivers must have been driving for twelve months prior to the study.
- The drivers must be willing to participate in the study.
- The drivers must be literate in order to understand and fill the questionnaire. All drivers must be able to read and write English.

Exclusion Criteria:

- Temporary and or part-time drivers of refuse compact vehicles.
- Drivers during their probation period of employment.
- The drivers not willing to participate in the study.

Table 3.1. provides a breakdown of the groupings of the drivers, the population and sample size as well as the response rate.

Male	120
Population:	120
Black:	50
White:	1
Coloured:	5
Indian:	64
Questionnaires administered	120
Questionnaires returned	120
Response rate	100%

Table 3.1. Driver groupings from which the sample was drawn and the response rate

According to Welman and Kruger (1999:64) it is not necessary to use a sample size bigger than 500 unit of analysis, no matter what the size of the population may be. A sample size of 120 refuse truck drivers was hence considered adequate.

3.5.1. QUESTIONNAIRES ADMINISTERED

As indicated in Table 3.1, 120 questionnaires were administered to the refuse truck drivers. All drivers were notified in advance of the place and time where the questionnaires will be administered.

Table 3.2. provides a schematic representation of which depot the questionnaires were administered; the number of drivers sampled and the date they were sampled.

NAME OF DEPOT	NUMBER OF DRIVERS SAMPLED	NUMBER OF DRIVERS PER HUMAN RESOURCE LIST	DATE
Shallcross	7	7	21 May 2004
Kloof	4	4	27 May 2004
Phoenix North	10	10	01 June 2004
Tongaat	9	9	26 May 2004
Newlands	12	12	28 May 2004
Amanzimtoti	21	21	02 June 2004
New Germany	22	22	03 June 2004
Ottawa	13	13	04 June 2004
Collingswood	8	8	03 June 2004
Springfield	9	9	08 June 2004
Kingsburg/Umkomaas	5	5	09 June 2004
Total Sample	**120**	**120**	

Table 3.2. Questionnaire administration details

Wiseman and Kruger (1999:66) regard a response rate of 33 percent as being representative of the population. Hence, the response rate of 100% in this study is considered excellent, and is hence regarded as being representative of the population.

3.6. THE RESEARCH METHOD

Different methods for the collection of primary data such as surveys, experiments, or observations are available for research purposes (Diamantopoulos & Schlegelmilch 1997:5). The type of data required for a study will largely determine the most appropriate method to be used. The questionnaire method of data collection was used in this study. Sekaran (2000:233) defines a questionnaire as being a preformulated written set of questions to which respondents record their answers. De Vos (2001:89) further enhances on the definition by stating that a questionnaire is an instrument with open or closed questions or statements to which a respondent must react. The questionnaire according to Sekaran (2000) is an efficient data collection mechanism when the researcher knows exactly what is required and how to measure the variables of interest.

3.6.1. THE QUESTIONNAIRE

A questionnaire is a document comprising a set of questions, and is sent, and or administered to a large number of respondents with a view to obtaining their input and opinions on the subject of the study. Researchers can use either structured or unstructured questionnaires. A structured questionnaire provides different options to each question, and the respondent is simply required to select and mark the applicable answer (Babbie 1998:257). Unstructured questionnaires require far more co-operation on the part of the respondents since they are required to answer the questions in their own words. The use of unstructured questionnaires in a mail survey significantly reduces cooperation without providing much helpful information (Sudman & Blair 1998:289). Since mail surveys tend to have the lowest response rates of all survey methods (Welman & Kruger 1999:152), and since according to Aaker, Kumar and Day (1995:378), it is not uncommon for mail surveys to have a non response rate of ninety percent, it is imperative to choose questionnaires with great care. In this study a structured questionnaire was used.

3.6.1.1. REQUIREMENTS OF A QUESTIONNAIRE

If a researcher succeeds in designing a good questionnaire, many of the shortcomings of a questionnaire can be overcome. A good questionnaire must, however meet certain requirements. There are a number of requirements that must be considered in the design of a good questionnaire. Sudman and Blair (1998:293-299) have listed a number of requirements for the design of a good questionnaire. The researcher prudently followed the requirements for the design of a good questionnaire as provided by Sudman and Blair (1998:293-299):

- **Use a booklet format:** A booklet format is desirable because (1) it prevents pages from being lost, (2) it makes it easier to handle, (3) a double-page format can be used, and (4) it looks more professional. The questionnaire for this study was stapled into a booklet form entailing easy use.

- **Identify the questionnaire:** Questionnaires need a date, the title of the study, and the name of the person conducting the survey. The questionnaire for this study consisted of a letter of information and instruction which consisted of the abovementioned requirements (Appendix 2).

- **Do not crowd the questions:** Self-administered questionnaires should not be crowded because crowding makes the questionnaire appear more difficult. The questions in the questionnaire were adequately spaced. A line spacing of 1.5 was used in the study questionnaire.

- **Use a large clear print:** Questionnaires can be made more user-friendly by making use of a large and clear print. In addition, small print makes the questionnaire appear more difficult and as a result discourages respondents to complete it. A 12 font Times New Roman was used in the study questionnaire.

- **Provide instructions for the completion of the questionnaire:** The ease with which a questionnaire can be completed plays a major role in a respondent's decision to complete the questionnaire. Specific instructions should appear on the questionnaire and be placed in the most useful location possible. Instructions should be easy to distinguish and therefore bold print, capital letters or italics can be used. Clear instructions were provided in the letter of instruction (Appendix 2).

- **Do not split questions across pages:** Respondents find it confusing if a question is split over two pages especially in respect of response categories for a closed question. There were no split questions in the study questionnaire.

- **Precode all closed questions:** Precoding allows the respondent to simply circle the right answer. The questionnaire should also make provision for a precolumn (column for data coding purposes), identifying the column in the data file where each response will be entered. This column must clearly indicate that it is for office use only. All questions were precoded in the study questionnaire.

- **End the questionnaire in a proper way:** Respondents should be thanked for their participation. A thank you comment was included at the end of the study questionnaire.

Although Leedy (1996:143-145) outlines general requirements for a good questionnaire, he emphasises the important role that questions play. The following summarises the requirements, which Leedy regards as the most important for a good questionnaire:

- Instructions must be clear and unambiguous.
- A cover letter must accompany the questionnaire and clearly state for what purposes the information is needed.
- Questions must be clear, understandable and objective.
- The questionnaire must be as short as possible.
- A logical flow of questions and sections must exist.
- The questionnaire must be directly related to the research problem.

3.6.1.2. THE DESIGN OF A QUESTIONNAIRE

The design of a questionnaire plays a crucial role in the success of the research. Saunders *et al*. (1997:250-263) regard the following as the most important steps in the design of a questionnaire:

- Determine information goals and identify the population.
- Decide which questions need to be asked.
- Identify the respondent's frame of reference.
- Formulate the questions.
- Pretest the questionnaire.
- Revise the questionnaire.
- Compile the final questionnaire.

The first step in the design of questionnaire involves the translation of the research objectives into information goals for the formulation of specific questions. Once the list of questions has been finalised, it should cover all information goals and research objectives.

Apart from asking the right questions, the following issues also need to be considered when formulating questions:

- **SHOULD QUESTIONS BE OPEN OR CLOSED?**

Closed questions provide response categories whereas open questions do not. Various factors such as the purpose and method of the survey and the profile of the respondents determine which type of question is the most appropriate to use. According to Sudman and Blair (1998:267), closed questions are mainly used for the following reasons:

- they encourage response by making the completion of the questionnaire easy;
- they enable respondents to complete the questionnaire in a short time;
- they simplify coding for data analysis purposes;
- they reduce the amount of probing needed;

Although closed questions require more pretesting, limit the richness of data and may become boring for respondents, they work better in situations where there is a preference for inexpensive, structured information. Welman and Kruger (1999:174) recommend that even if a questionnaire is made up exclusively of closed questions, it should conclude with an open question in case anything of importance to the respondent has been omitted. The study questionnaire consisted predominantly of closed questions.

- **DIFFICULTY OF QUESTIONS**

Questionnaires provide few opportunities for probing and therefore the different ways in which people could interpret questions should be given careful consideration. Sudman and Blair (1998:252) believe that the formulation of questions should aim specifically at addressing three issues, namely:

(1) Do all the respondents understand the words in the question?

(2) Do all the respondents interpret the question in the same way?

(3) Do the respondents interpret the question in the way it is intended?

The pretesting phase of the questionnaire administration process addressed the issue of the difficult questions as perceived by the pretest sample.

Questions must be specific
Use simple language
Use words with only one meaning
Use numbers to measure magnitudes
Ask questions one at a time

Table 3.4. Guidelines to enhance the understanding of questions in questionnaires

Adapted from Sudman and Blair. 1998. *Marketing Research: A Problem-Solving Approach*. New York: Irwin/McGran-Hill. p. 257.

- **SCALING OF QUESTIONS**

Scaling is a process of creating a continuum on which objects are located according to the amount of the measured characteristics they possess (Aaker *et al.*, 1995:255). Body part discomfort location, intensity scaling and numeric rating scaling methods were used in this study.

Question 10 of this study questionnaire used these scaling methods. This method of assessment is considered easy and quick to administer and provides a high level of sensitivity. Shachel (1969); Corlett and Bishop (1976) and Straker (1997) all utilised these scaling methods in their studies.

The subjects in this study were asked to score in the boxes surrounding the body part model on a 0-5 scale, the level of discomfort that they may have experienced in the past because of refuse truck driving. Data collection using the numeric rating scale has the advantage that they are simple to administer and the verbal scale can be used during a manual task without interference with posture (Karwowski and Marras 1999:1244). Question 11 and 12 of the questionnaire used this method.

- **ORDERING OF QUESTIONS**

Sudman and Blair (1998:285) regard the ordering of questions as important for three main reasons: Firstly, the order effects must be considered; secondly, a logical flow for the questionnaire must be developed; and lastly, a rapport must be established with the respondents.

Questions should be arranged in a sequence that minimises order effects. An order effect occurs when the answer to a particular question is influenced by the context of previous questions. In order to create the logical flow of questions, the questions must be divided into sections, each with a specific purpose in mind. To elicit a favourable response for the completion of the questionnaire, the questionnaire must start with easy, non threatening questions for which there are no wrong answers. By establishing a rapport with respondents, better cooperation can be obtained.

The researcher logically firstly divided the questionnaire into two parts. Part 1 comprised of three sections, which was to be completed by the refuse truck drivers. Part 2 comprised one section and was completed by the researcher and the research assistant. There was a natural flow in the questions, firstly dealing with biographical details, lower back pain, the selected risk factors and finally the ergonomic status of the cab. With the afore-mentioned as background, the next section will discuss the design of the questionnaire, which was used for the empirical research.

3.7. THE DESIGN AND LAYOUT OF THE QUESTIONNAIRE FOR THIS STUDY

The most important components of the research methodology used for this study will be discussed.

3.7.1. TYPE OF QUESTIONNAIRE USED

It was decided to use a structured questionnaire for this study (refer to Appendix 2, letter of information and instruction, Appendix 3 informed consent form and Appendix 4 the questionnaire). A structured questionnaire provides alternatives to each question, and the respondent simply needs to select and mark the applicable answer. According to Joubert (2000:41) most studies dealing with back disorders, and whole body vibration and other types of exposure, use some type of questionnaire to elicit the responses from study subjects. These questionnaires gathered important information regarding the actual personal characterisation of the respondents, working conditions, risk factors, exposure characterisation, as well as the incidence/prevalence and severity of pain related to musculo-skeletal symptoms and disorders.

In 1987, a Standardised Nordic Questionnaire was developed based on other standardised medical questionnaires, by Kuorinka *et al*. (1987:233-237) to allow some standardisation and a basis for adapted questionnaires to be developed to suit the different occupational settings where these types of studies were to be carried out. The Nordic Questionnaire consists of structured, forced, binary or multiple-choice variants and can be used as a self-administered questionnaire or in interviews. It appears useful both as a clinical screening tool and as a research instrument.

The Standardised Nordic Questionnaire was adapted for use in this study. Additional questions were to adapt the questionnaire to the operating environment of the Ethekwini Municipality with the help of the joint supervisor Dr. M. Govender. To increase the number of risk variables other questions were added such as involvement in sporting and other extramural activities. These questions were deemed necessary to make the questionnaire more applicable to the actual conditions and situation at the Ethekwini Municipality.

In order to characterise the ergonomic status of the cabs of the refuse trucks, specific measurements of the driver’s seat was taken by the researcher and the research assistant. The researcher and the research assistant completed 14 questions in this regard. These questions dealt specifically with the ergonomic status of the refuse cab. The measurements were taken using a standard tape measure and a 30cm standard goniometer.

The following seat measurements were taken, height of the drivers seat; height of driver’s backrest; width of driver’s seat; length of driver’s seat and the distance of the driver’s seat (from the furthest back position) to the driving leg pedals. The angle of the seat between the seat and backrest was measured with the use of a goniometer.

Questions dealing with comfort and air circulation were also included as these two factors are important ergonomic considerations in assessing the driver cab. The comfort the driver perceives is an important indicator of the ergonomic status of the refuse truck cab. Furthermore, the air circulation in the refuse cab is vital from a heat stress point of view.

3.7.2. DESIGN OF QUESTIONS

In this study, the most important reasons why the questionnaire was used as the method for collecting primary data, included the following:

- It was a relatively cheap method for the researcher.
- It was easy to administer the questionnaires by means of arranged depot visits in the Ethekwini Municipality.
- All of the respondents could read and write English. They could complete the questionnaires by themselves, without any assistance.

3.8. BIOGRAPHICAL VARIABLES

In Part 1, Section One of the questionnaire, the respondents provided their personal particulars. Not only was the purpose to start with straight forward personal questions, but the information was considered important in determining whether selected biographical data of refuse truck drivers are associated with LBP. The ages, gender, race, and weight were self reported. The height of the drivers was physically taken.

3.9. PRETESTING OF THE QUESTIONNAIRE

The purpose of pretesting is to ensure that the questionnaire meets the researcher's expectations in terms of the information that will be obtained from it. Questionnaire pretesting is one way of identifying and eliminating those questions that could pose problems. Only after all the deficiencies have been corrected, can the final questionnaire be compiled and distributed. The best way to test a questionnaire is to have qualified and knowledgeable people to examine the questionnaire. Because a pretest is a pilot run, the respondents should be reasonably representative of the sample population (Aaker *et al.,* 1995:308).

In this study, formal pretesting was done on the 28th August 2003, to assess questionnaire usability and administration methods before the baseline study was commenced. In total five (5) drivers were randomly selected from the list of refuse truck drivers. One hundred percent of these subjects returned the questionnaire fully completed. In addition to the questionnaire, subjects also completed a feedback questionnaire concerning clarity of instructions, difficulties with the questions, questionnaire length, layout and preferred method of administration of the questionnaires.

The overall feedback on the draft questionnaire was positive. The instructions were clear, questions were well laid out and the questions were interesting for 80% of the respondents. Twenty percent of the respondents believed the questionnaire was too long. The questionnaire was reduced in length by the researcher.

The questionnaire, letter of information and informed consent form took approximately 20 minutes to complete. The researcher and research assistant took a further 10 minutes in order to actually measure the seat dimensions of the refuse trucks. The measurements were taken using a standard tape measure and a 30 cm standard goniometer.

Two drivers questioned the confidentiality of the information and the process. The drivers were explained that the Head: Cleansing and Solid Waste has approved the study. They were further ensured that their participation in this study was very confidential. The respondents of the pilot study and all other respondents during the baseline study were informed not to write their names or any other detail that could identify them on the questionnaires. This requirement was strictly adhered to by all drivers and there were no spoilt questionnaires.

3.10. COMPUTERISATION AND CODING OF THE DATA

Data obtained from the questionnaires need to undergo preliminary preparation before it can be analysed. Data preparation includes (1) data editing, (2) coding, and (3) statistical adjustment of the data (Aaker *et al.* 1995:443-447).

Upon receipt of the all the questionnaires, each questionnaire was checked to identify omissions, ambiguities and errors in the responses. Illegible or missing answers were coded as "missing". This simplified the data analysis, but it did not distort any interpretations of the data.

Coding the close-ended questions was straightforward because the questionnaire made provision for response values and a column, which were used for variable identification. Once the response values were entered into a computer, a statistical software programme (SPSS Version 11.5) was used to generate diagnostic information. The services of a professional statistician were employed for the analysis of the data.

3.11. THE STATISTICAL METHODOLOGY

According to Katzenellenbogen *et al*. (1999:111), a statistic is a characteristic of a sample of the population, and is an estimate of the corresponding parameter in the population (for example, the sample mean estimates the population mean). Just as parameters are measures of properties (central tendency, variability, etc) of population distributions, a statistics are measures of the corresponding characteristics of samples (Huysamen 1987:6). Howell (1999:5) mentions that statistical procedures can be separated into roughly two overlapping areas namely descriptive and inferential statistics.

Descriptive statistics are defined as techniques used to organise, summarise and describe data. Inferential statistics on the other hand are defined as techniques applied to samples in order to make inferences about populations (Unisa 1997:3).

In this study, the researcher used the following descriptive and inferential statistics.

3.11.1. DESCRIPTIVE STATISTICS

- **FREQUENCIES AND PERCENTAGES**

People often remember pictures, symbols and graphic representations better than written words. Graphic representations are particularly useful for organising and representing numbers meaningfully (Unisa 1997:61). Bar graphs and frequency polygons were used in this study to display data.

- **MEASURES OF CENTRAL TENDENCY**

A measure of central tendency is defined as a single score value which is taken to represent the values of all the score value which is taken to represent the value of all the scores in a distribution (Huysamen 1976:41). The measures used by the researcher in this study include:

- **MEAN**

The mean of a collection of scores is the sum of the scores divided by the number of scores (Huysamen 1976:44). The researcher used the mean to determine performance around the mean and whether an occurrence is below or above the mean. The mean scores for the biographical data of the refuse truck drivers were calculated.

- **MODE**

The mode is defined as a collection of score values, which has the highest frequency of occurrences (Huysamen 1976:44). The mode scores for the biographical data of the refuse truck drivers were calculated.

- **MEDIAN**

The median is the score which falls at the exact centre of a distribution if the scores are arranged in numerical order (Huysamen 1976:44). The median scores for the biographical data of the refuse truck drivers were calculated.

3.11.2. MEASURES OF DISPERSION

The average value for a distribution (whether it be the mode, the median, or the mean) fails to give a complete story (Howell 1999:63). Using only measures of central tendency can therefore result in erroneous conclusions. The researcher used the following measures of dispersion in this study.

- **THE STANDARD DEVIATION**

The Standard Deviation is defined as the positive square root of the variance (Howell 1999:69). Standard Deviation results can be used to predict outcome. For example, management can predict what is the optimum height that a refuse truck must be. This kind of information can greatly assist with the compilation of a man-job specification data sheet for refuse truck drivers.

3.11.3. INFERENTIAL STATISTICS

Inferential statistics deals with inferring characteristics of a populations from characteristics of samples (Howell 2001:7). Sekaran (2000) further mentions that researchers are then able to establish how two or more variables are related to each other. The researcher used the following inferential statistics in the study.

- **CHI-SQUARE (PEARSON CHI- SQUARE)**

The Chi-Square Test is defined as a statistical test often used for analysing categorical data (Howell 1999:373). Hence, the Chi-Square Test helps the researcher to analyse frequency or categorical data. As both frequency and categorical data was obtained in the study the researcher as an appropriate inferential statistic test chose the Chi-Square Test.

- **t - TEST**

The t-Test is used by researchers to determine whether nominal groups of data differ from each other on a variable of interest (Sekaran 1992).

Conventionally, the 0.05 and 0.01 levels are used by most researchers as levels of significance for statistical tests performed. These levels of significance are rather severe and are used when the purpose is to limit the risk of incorrectly rejecting the null hypotheses, or concluding a significant result erroneously. Such errors are referred to as Type-I errors. In the medical sciences where an error could have severe consequences, such errors must be kept low. Often, however, for example in the human sciences, the consequences of a Type-I error is not so severe and researchers are just as concerned with missing a significant result, known as a Type-II error. Aaker *et al*. (1995:471-474) points out that when both types of errors (Type-I and Type-II errors) are equally important, levels such as 0.20 (and possibly 0.30) are more appropriate than the conventionally used 0.05 and 0.01 levels (Hays 1963:273).

There is however also another important consideration in the choice of the level of significance and that is the total number of statistical tests to be performed by the researcher. As the total number of statistical tests increases, the probability of a Type-I error also increases. One approach to counter this accumulating effect is to set the level of significance smaller for the individual statistical tests. According to the Bonferonni method, the chosen level of significance (say 0.30) is divided by the total number of tests to be performed. Suppose for example the total number of tests to be performed are 60, then the level of significance for any individual statistical test is 0.30 divided by 60 is equal to 0,005. This could however give a too conservative or strict level of significance in practice. There is no easy solution and the final choice remains subjective and to some extent arbitrary. Given the arguments above, a decision was taken to use the 0.05 level of significance in the eThekwini Study.

3.12. BIAS AND CONFOUNDING FACTORS

The biggest threat to internal validity is selection bias according to Brink (1996). The groups may not be similar at the beginning of the study. In this study, the group was similar in that all were refuse truck drivers. Another form of selection bias can occur if non-responders in a study are systematically different in their exposure or outcome distribution from responders. In this study a 100% rate was achieved, this factor was hence overcome.

Confounding exists when the variance of one or more independent variables, usually outside the focus of the research, mixes with the variance arising from the independent variables built into the research problem (Joubert 2000). Consequently, it becomes unclear whether the relationship found is between the dependent and independent variables in the research design, or between the extraneous dependent and independent variable, or both. Whenever the effects of the independent variables cannot be evaluated confounding is potentially present (Isaac and Michael 1990:81). In this study, some important confounding factors were measured and an attempt to control them was made during the logistic regression analysis. The potential confounders considered were race, model of truck, age, length of years of driving a refuse truck, driving speeds, stress and playing of sport.

3.13. VALIDITY AND RELIABILITY

According to Leedy (1993) validity is concerned with the soundness, the effectiveness of the measuring instrument, or if one is actually measuring what one thinks one is measuring. This aspect of the questionnaire was tested during the pilot study phase when various experts in ergonomics, occupational health and safety, environmental health, and solid waste were consulted (Govender 2002, Lawton 2002, Rampersad 2002 and Anthony 2002).

Measures to standardise the questionnaire aimed to ensure reliability of the instrument. The pilot testing of the questionnaire was aimed at ensuring the reliability of the questions and certain questions were changed after the feedback from the respondents.

3.1.4. ETHICS

The aspect of ethics in this study was carefully considered. No study should be conducted under circumstances in which total disclosure of the aims and purposes of the study cannot be set forth. These issues were addressed by way of an information letter and a letter of informed consent (Appendix 2 and 3). A summary of the results of the study will be drafted and submitted to the Head: Cleansing and Solid Waste.

3.1.5. CONCLUSION

In this chapter, the research and statistical methodology used in the study were discussed. The discussion focused on the population, method of sampling, the design and layout of the questionnaire, the type of questionnaire used, the design of questions, the pretesting of the questionnaire and the statistical methodology used.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.1. INTRODUCTION

The results of the questionnaire administered to the refuse truck drivers are presented in this chapter. Both descriptive and inferential statistics are used to present the data.

The aim of the study was to identify the selected risk factors associated with LBP amongst refuse truck drivers, and to evaluate the relationship between the risk factors and LBP.

The following objectives were considered:

- To determine whether selected demographic data of refuse truck drivers are associated with LBP.

- To determine whether selected biomechanical risk factors are associated with LBP amongst refuse truck drivers.

- To determine whether selected psychosocial risk factors are associated with LBP amongst refuse truck drivers.

- To determine the prevalence and severity of LBP amongst refuse truck drivers.

- To determine whether the ergonomics of the refuse truck cab is associated with LBP amongst refuse truck drivers.

The findings of the study are set out as follows:

- The study response rate.
- Biographical variables.
- Lower back pain.
- Selected risk factors.
- Ergonomic status of the refuse truck cab.

4.2. THE STUDY RESPONSE RATE

A one hundred percent response rate was achieved in this study. One hundred and twenty questionnaires were handed out, and all were duly completed and returned by the refuse truck drivers.

4.3. BIOGRAPHICAL VARIABLES

4.3.1 AGE

The various age categories of the refuse truck drivers were cross tabulated with the prevalence of LBP.

AGE	LBP YES	LBP-NO
Younger than 25	1.1%	0%
25-29	5.3%	0%
30-34	7.4%	4%
35-39	26.3%	28%
40-44	27.4%	20%
45-49	11.6%	28%
50 +	21.1%	20%

Table 4.1. Cross tabulation of age and incidence of LBP.

4.3.2. HEIGHT AND WEIGHT

The mean, median and mode values were calculated for the height and weight of the refuse truck drivers.

	N	Mean	Median	Mode	Std. Deviation
Weight (kg)	120	72.46	70.00	70	12.465
Height (m)	120	1.7	1.70000	1.700	0.100166

Table 4.2. Descriptive statistics pertaining to height and weight of refuse truck drivers.

4.3.3. HYPOTHESIS ONE

There is a significant relationship between the age of the refuse truck drivers and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q1 Age	Younger than 25	Count	0	1	1
		Column %	0.0%	1.1%	0.8%
	25-29 Years	Count	0	5	5
		Column %	0.0%	5.3%	4.2%
	30-34 Years	Count	1	7	8
		Column %	4.0%	7.4%	6.7%
	35-39 Years	Count	7	25	32
		Column %	28.0%	26.3%	26.7%
	40-44 Years	Count	5	26	31
		Column %	20.0%	27.4%	25.8%
	45-49 Years	Count	7	11	18
		Column %	28.0%	11.6%	15.0%
	50 years and older	Count	5	20	25
		Column %	20.0%	21.1%	20.8%
Total		Count	25	95	120
		Column %	100.0%	100.0%	100.0%

Table 4.3. Cross tabulation results pertaining to age and LBP during the last 12 months.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.921(a)	6	0.432

a 6 cells (42.9%) have expected count less than 5. The minimum expected count is .21.

Table 4.4. Chi-Square Test results pertaining to age and the prevalence of LBP.

Based on table 4.4. hypothesis one is rejected ($p > 0.05$). There is no significant relationship between the age of the refuse truck drivers and the prevalence of LBP at the 5% level of significance.

4.3.4. HYPOTHESIS TWO

There is a significant relationship between the height of the refuse truck drivers and the prevalence of LBP.

	N	Mean	Median	Mode	Std. Deviation
Height (m)	120	1.69308	1.70000	1.700	0.100166

Table 4.5. Group Statistics pertaining to the height of the refuse truck drivers and the prevalence of LBP.

VARIABLE	t	df	p
Height (m)	-0.470	116	0.639

Table 4.6. Independent Sample Test results pertaining to the height of the refuse truck drivers and the prevalence of LBP.

Based on table 4.6. hypothesis two is rejected ($p > 0.05$). There is no significant relationship between the height of the refuse truck drivers and the prevalence of LBP at the 5% level of significance.

4.3.5. HYPOTHESIS THREE

There is a significant relationship between the weight of the refuse truck drivers and the prevalence of LBP.

VARIABLE	Q7 BACK PAIN	N	MEAN	STD. DEVIATION
Weight (kg)	Yes	95	72.53	12.904
	No	25	72.16	10.94

Table 4.7. Group Statistics pertaining to the weight of the refuse truck drivers and the prevalence of LBP.

VARIABLE	t	df	p
Weight (kg)	0.133	116	0.895

Table 4.8. Independent Sample Test results pertaining to weight of the refuse truck drivers and the prevalence of LBP.

Based on table 4.8. hypothesis three is rejected ($p > 0.05$). There is no significant relationship between the weight of the refuse truck drivers and the incidence of LBP at the 5% level of significance.

4.4. LOWER BACK PAIN (LBP)

4.4.1. PREVALENCE OF LBP (12 MONTHS)

A significant majority, 79% of the subjects reported to have experienced LBP during the last twelve (12) months, whilst driving a refuse truck for the eThekwini Municipality.

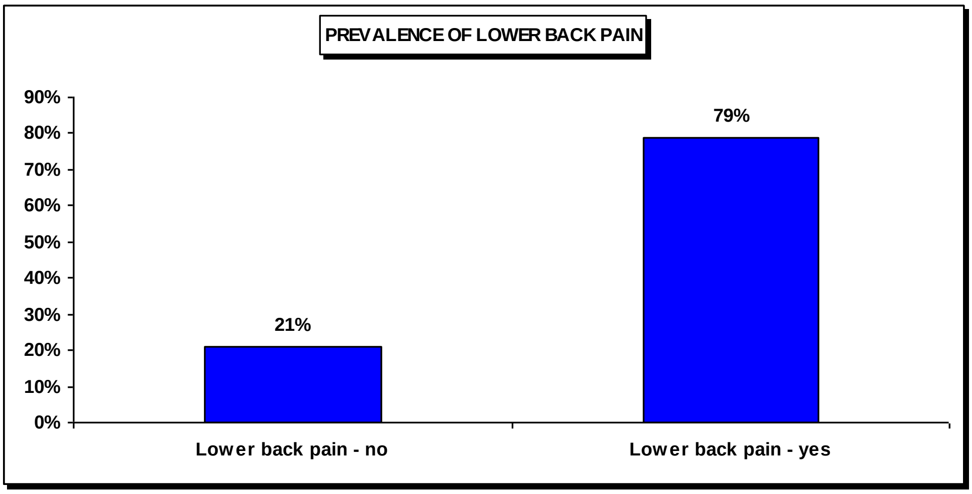

Figure 4.1. Prevalence of lower back pain amongst refuse truck drivers.

4.4.2. POINT PREVALENCE OF LBP

The point prevalence of LBP was established by questions 7.3. and 8 of the study questionnaire. Sixty four percent (64%) of the subjects indicated that they had experienced LBP during the past week of the administration of the study questionnaire. Fifty one percent (51%) of the subjects indicated that they were experiencing LBP at the time the study questionnaires were being administered. A further 69% of the subjects indicated that they experienced LBP during or shortly after driving their refuse trucks.

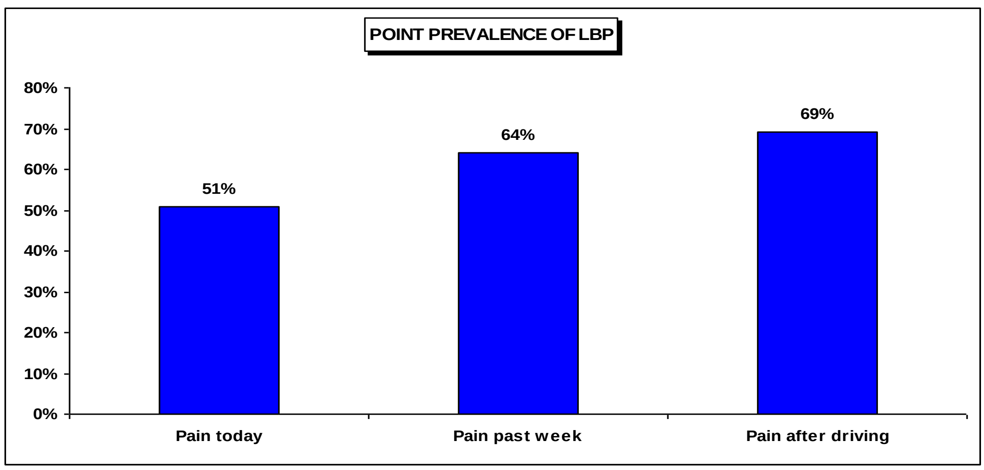

Figure 4.2. Point prevalence of LBP amongst refuse truck driver.

4.4.3. RADIATION OF LBP TO OTHER AREAS

Of the 79% of the subjects who reported to have experienced LBP during the last 12 months, 58% indicated that the pain always spread to their legs to below their knees. A further 53% indicated that they had trouble in putting on their socks due to the spread of the pain to their legs.

4.4.4. LOCATION OF PAIN

The refuse truck drivers were required to score their rating of discomfort (pain) on a body diagram using a numerical rating scale.

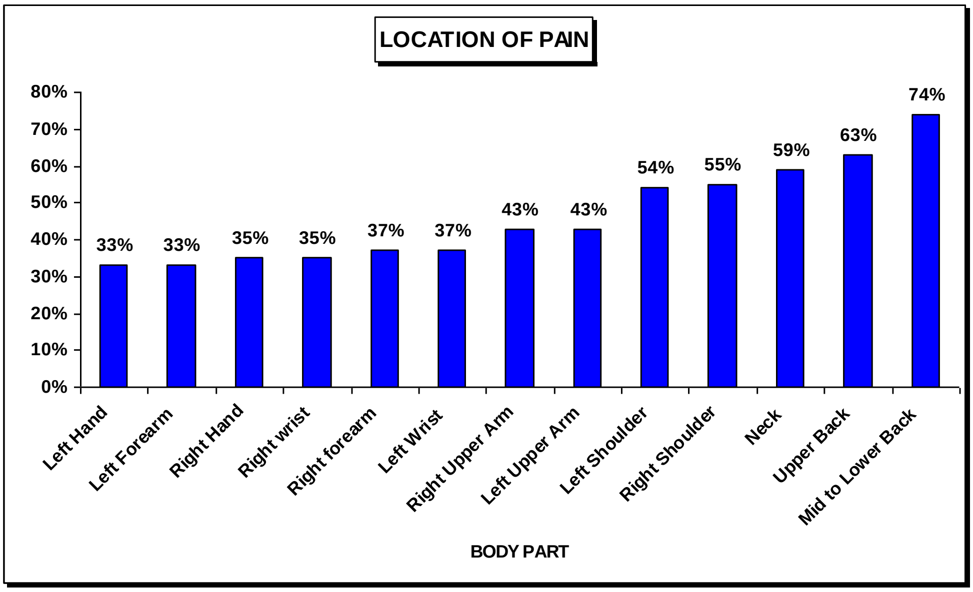

Figure 4.3. Location of pain

4.4.5. NUMERIC RATING OF THE SEVERITY OF LBP

The refuse truck drivers rated their discomfort intensity levels by marking a number from 0 to 100 on a numeric scale index. A zero (0) meant "no pain at all" and a hundred (100) meant "pain as bad as it be". The severity level as recorded when LBP was at its worst was 70%.

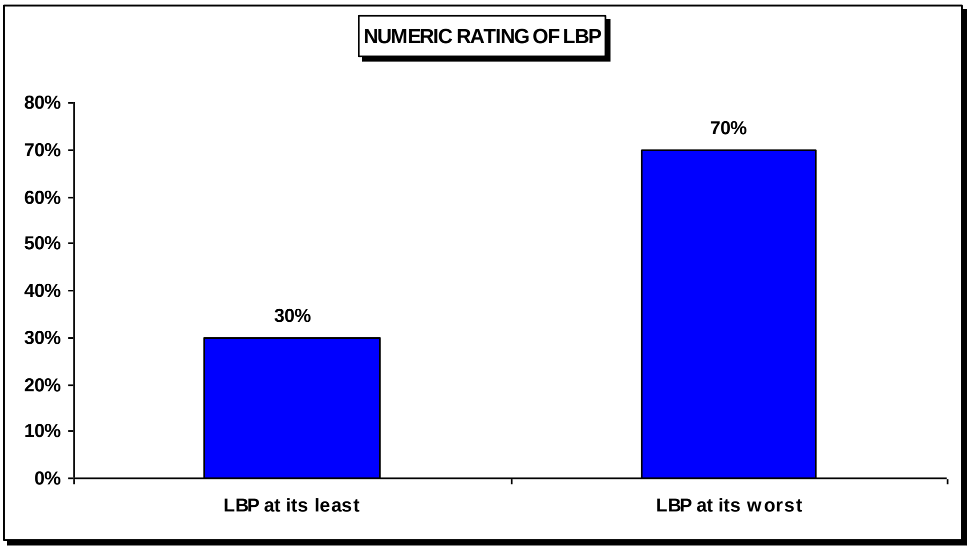

Figure 4.4. Numeric rating of LBP.

4.5. SELECTED RISK FACTORS

The following selected risk factors were specifically statistically tested in order to establish any association with the variable and the occurrence of LBP amongst the refuse truck drivers. They were the number of years of driving a refuse truck, the speed at which the refuse trucks are driven, the average kilometres travelled by the drivers on their trucks, the posture of the drivers whilst driving, the vibration levels produced by the refuse trucks, psychosocial risk factors and ergonomic risk factors pertaining to the refuse trucks.

The number of years of refuse truck driving was cross tabulated with the incidences of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q6 No. years driving	Less than 1 Year	Count	2	6	8
		column %	8.0%	6.3%	6.7%
	1 Year	Count	0	2	2
		column %	0.0%	2.1%	1.7%
	2 Years'	Count	0	1	1
		column %	0.0%	1.1%	0.8%
	3 Years	Count	2	5	7
		column %	8.0%	5.3%	5.8%
	4 Years	Count	4	8	12
		column %	16.0%	8.4%	10.0%
	5 Years	Count	0	5	5
		column %	0.0%	5.3%	4.2%
	More than 5 years	Count	17	68	85
		column %	68.0%	71.6%	70.8%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.9. Number of years of driving a refuse truck cross tabulated with the prevalence of LBP.

4.5.1. HYPOTHESIS FOUR

There is a significant relationship between the number of years of driving a refuse truck and the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.616(a)	6	0.728

a 9 cells (64.3%) have expected count less than 5. The minimum expected count is 0.21.

Table 4.10. Chi-Square Test results pertaining to the number of years of driving a refuse truck and the prevalence of LBP.

Based on table 4.10. hypothesis four is rejected ($p > 0.05$). There is no significant relationship between the number of years of driving a refuse truck and the prevalence of LBP amongst refuse truck drivers at the 5% level of significance.

4.5.2. HYPOTHESIS FIVE

There is a significant relationship between the speed of driving a refuse truck and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q13 What is the average speed that you drive your refuse truck at?	0-40 kph	Count	1	5	6
		column %	4.0%	5.3%	5.0%
	41-60 kph	Count	12	44	56
		column %	48.0%	46.3%	46.7%
	61-80 kph	Count	12	44	56
		column %	48.0%	46.3%	46.7%
	> 80 kph	Count	0	2	2
		column %	0.0%	2.1%	1.7%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.11. Average speed of driving a refuse truck cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.614(a)	3	0.893

a 4 cells (50.0%) have expected count less than 5. The minimum expected count is 0.42.

Table 4.12. Chi-Square Test results pertaining to the speed of driving a refuse truck and the prevalence of LBP.

Based on table 4.12. hypothesis five is rejected ($p > 0.05$). There is no significant relationship between the speed of driving a refuse truck and the prevalence of LBP at the 5% level of significance.

4.5.3. HYPOTHESIS SIX

There is a significant relationship between the kilometres (km) travelled by a refuse truck driver and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q14 What are the average kilometres you drive a refuse truck for daily?	0-100 km	Count	14	53	67
		column %	56.0%	55.8%	55.8%
	101-300 km	Count	10	42	52
		column %	40.0%	44.2%	43.3%
	+ 300 km	Count	1	0	1
		column %	4.0%	0.0%	0.8%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.13. Average kilometres travelled by a refuse truck driver cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.881(a)	2	0.144

a 2 cells (33.3%) have expected count less than 5. The minimum expected count is 0.21.

Table 4.14. Chi-Square Test results pertaining to the average kilometres travelled by a refuse truck driver and the prevalence of LBP.

Based on table 4.14. hypothesis six is rejected ($p > 0.05$). There is no significant relationship between the average kilometres travelled by a refuse truck driver and the prevalence of LBP at the 5% level of significance.

4.5.4. HYPOTHESIS SEVEN

There is a significant relationship between the posture of refuse truck drivers whilst driving a refuse truck and the prevalence of LBP.

		Q7 Back pain during last 12 months?		Total
		No	Yes	
Q17 Do you consider yourself to be in an awkward position while driving? Yes	Count	7	47	54
	column %	28.0%	49.5%	45.0%
No	Count	18	48	66
	column %	72.0%	50.5%	55.0%
Total	Count	25	95	120
	column %	100.0%	100.0%	100.0%

Table 4.15. Awkward posture of a refuse truck driver cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.687(b)	1	0.05		

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.25.

Table 4.16. Chi-Square Test results pertaining to posture of refuse truck drivers and the prevalence of LBP.

Based on table 4.16. hypothesis seven is accepted ($p \leq 0.05$). There is a significant relationship between the postures of the refuse truck drivers and the prevalence of LBP at the 5% level of significance.

4.5.5. HYPOTHESIS EIGHT

There is a significant relationship between the rating of vibration level caused by refuse trucks and their attachments and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q18 Category of levels of vibration produced by the	Very high	Count	2	24	26
		column %	8.0%	25.3%	21.7%
	High	Count	10	21	31

refuse truck you drive?		column %	40.0%	22.1%	25.8%
	Medium	Count	5	34	39
		column %	20.0%	35.8%	32.5%
	Low	Count	8	16	24
		column %	32.0%	16.8%	20.0%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.17. Rating of vibration caused by the refuse trucks cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.967(a)	3	0.030

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.00.

Table 4.18. Chi-Square Test results pertaining to the rating of vibration caused by the refuse trucks and the prevalence of LBP.

Based on table 4.18. hypothesis eight is accepted ($p < 0.05$). There is a significant relationship between the vibration caused by the refuse trucks and their attachments and the prevalence of LBP at the 5% level of significance.

4.5.6. HYPOTHESIS NINE

There is a significant relationship between the monotony of driving a refuse truck and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q20 Do you consider refuse truck driving as a monotonous and boring job?	Yes	Count	8	35	43
		column %	32.0%	36.8%	35.8%
	No	Count	17	60	77
		column %	68.0%	63.2%	64.2%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.19. Monotony of refuse truck driving cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.202(b)	1	0.653		

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.96.

Table 4.20. Chi-Square Test results pertaining to the monotony of refuse truck driving and the prevalence of LBP.

Based on table 4.20. hypothesis nine is rejected (p>0.05). There is no significant relationship between monotony and LBP at the 5% level of significance. The majority of drivers view refuse truck driving as not monotonous irrespective of whether they have LBP or not.

4.5.7. HYPOTHESIS TEN

There is a significant relationship between the stress of driving a refuse truck and the prevalence of LPB. No distinction was made between physical stress and emotional stress.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q22 Do you consider refuse truck driving as a stressful job?	No	Count	17	28	45
		column %	68.0%	29.5%	37.5%
	Yes	Count	8	67	75
		column %	32.0%	70.5%	62.5%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.21. Stress of refuse truck driving cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.534(b)	1	0.000		

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.38.

Table 4.22. **Chi-Square Test results pertaining to the stress of refuse truck driving and the prevalence of LBP.**

Based on table 4.22. hypothesis nine is accepted ($p<0.05$). There is a significant relationship between the stress of refuse truck driving and the prevalence of LBP at the 5% level of significance.

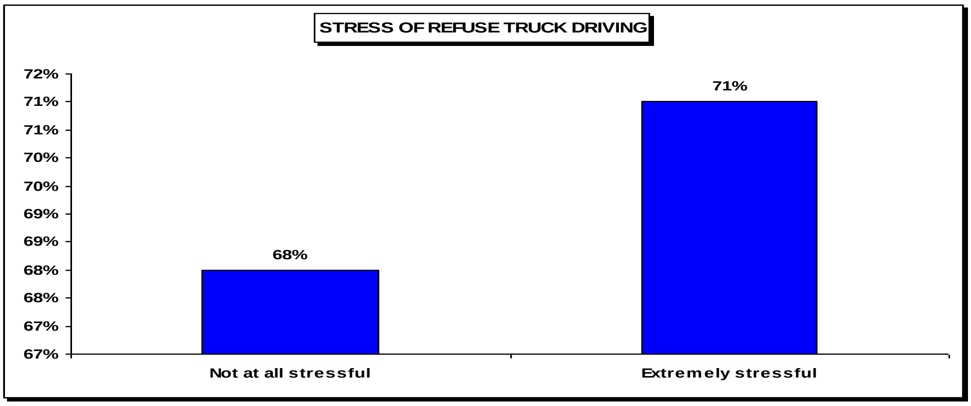

Figure 4.5. The proportion of refuse truck drivers who consider their jobs as stressful.

Figure 4.7. illustrates the proportion of refuse truck drivers who consider refuse truck driving as a stressful job. Of those with LBP, 71% consider their jobs as stressful. Of those drivers without LBP, 68% consider their job as not stressful.

4.5.8. HYPOTHESIS ELEVEN

There is a significant relationship between the participation in physical activities by the refuse truck drivers and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q24 Do you play sport or participate in any other physical exercise?	No	Count	9	24	33
		column %	36.0%	25.5%	27.7%
	Yes	Count	16	70	86
		column %	64.0%	74.5%	72.3%
Total		Count	25	94	119
		column %	100.0%	100.0%	100.0%

Table 4.23. Physical activity cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.080(b)	1	.299		

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.93.

Table 4.24. Chi-Square Test results pertaining to the participation in physical activity and the prevalence of LBP amongst refuse truck drivers.

Based on table 4.24. hypothesis nine is rejected. ($p>0.05$). There is no significant relationship between the participation in physical activities and the prevalence of LBP at the 5% level of significance. This may indicate that LBP is present whether sport is played or not.

4.5.9. MAIN PHYSICAL ACTIVITIES OF REFUSE TRUCK DRIVERS

The four most common physical activities that the refuse truck drivers participate in are illustrated in figure 4.8.

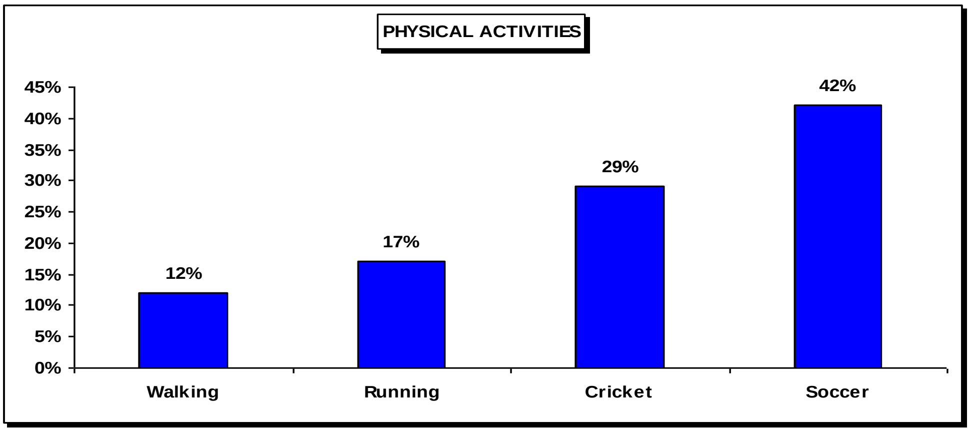

Figure 4.6. Four main sporting activities of refuse truck drivers.

Eight one percent of the drivers that play sport have LBP. Seventy three percent of drivers that do not play also have LBP

4.6. ERGONOMIC EVALUATION OF THE REFUSE TRUCK CABS

4.6.1. TRUCK SEATS

The drivers were requested to indicate the status of their refuse trucks seats. Part two of the questionnaire, which was completed by the researcher, elicited responses from the drivers on the following aspects of their truck seats:

They were “can the seat adjust for height” (Q7); “can the seat backrest adjust for height”. (Q8); “can the seat backrest alter for inclination” (Q9);

"can the entire seat be moved" (Q10); and "do they consider their seats in the trucks to be well padded" (Q11).

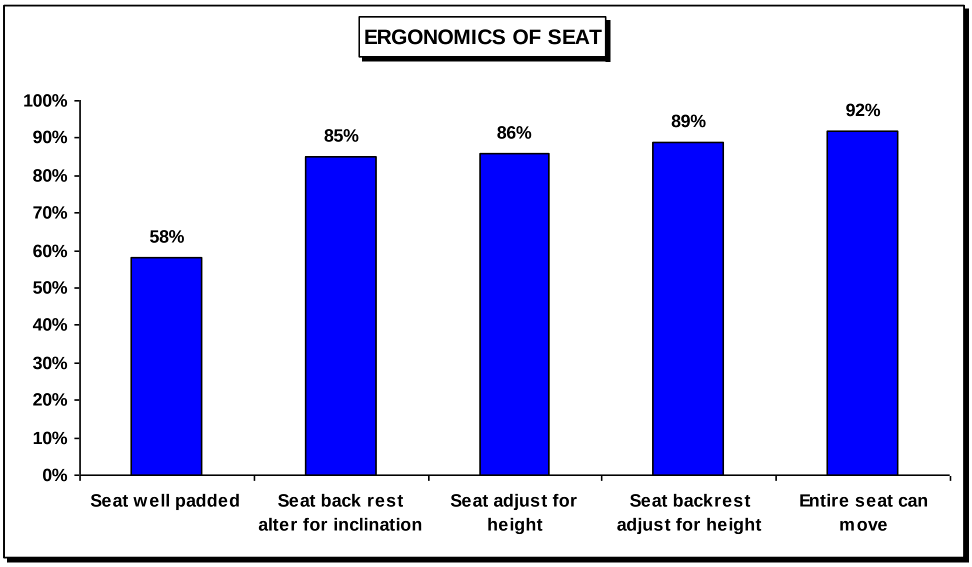

Figure 4.7. Ergonomic evaluation of the refuse truck seats.

4.6.2. HYPOTHESIS TWELVE

There is a significant relationship between the ergonomic assessments of the refuse truck driver's seat and the prevalence of LBP.

	Q7 Back pain during last 12 months?	N	Mean	Std. Deviation
Q4.1 What is the height of the driver's seat in mm?	No	25	909.20	191.940
	Yes	95	952.84	133.478
Q4.2 What is the height of the driver's backrest in mm?	No	25	638.80	142.487
	Yes	95	680.00	113.316
Q4.3 What is the width the driver's seat in mm?	No	25	554.00	128.776
	Yes	95	516.42	60.246
Q4.4 What is the length of the driver's seat in mm?	No	25	478.80	41.565
	Yes	95	473.26	29.226
Q4.5 Distance of the driver's seat to the driving leg pedals in mm?	No	25	934.80	62.258
	Yes	95	925.89	63.388
Q4.6 What is the angle of the seat between the seat and backrest?	No	25	105.76	11.956
	Yes	95	107.16	16.458

Table 4.25. Group statistics results pertaining to the basic measurements of the refuse truck seats and the prevalence of LBP.

		t	df	p
Q4.1 What is the height of the driver's seat in mm?	Equal variances not assumed	-1.071	30.372	.293
Q4.2 What is the height of the driver's backrest in mm?	Equal variances not assumed	-1.339	32.424	.190
Q4.3 What is the width the driver's seat in mm?	Equal variances not assumed	1.419	26.822	.167
Q4.4 What is the length of the driver's seat in mm?	Equal variances assumed	.767	118	.445
Q4.5 Distance of the driver's seat to the driving leg pedals in mm?	Equal variances assumed	.627	118	.532
Q4.6 What is the angle of the seat between the seat and backrest?	Equal variances assumed	-.397	118	.692

Table 4.26. Independent Sample Test results of the basic measurements of the refuse truck driver's seat and the prevalence of LBP.

Based on table 4.25. hypothesis twelve is rejected. ($p>0.05$). There is no significant relationship between the ergonomic assessment of a refuse truck seats and the prevalence of LBP at the 5% level of significance.

4.6.3. MODEL OF REFUSE TRUCKS

There were many different models of refuse trucks used in the eThekwini Municipalities Cleansing and Solid Waste Department.

Figure 4.10. illustrates the six common models of refuse trucks that are used in the eThekwini Municipality Cleansing and Solid Waste Department.

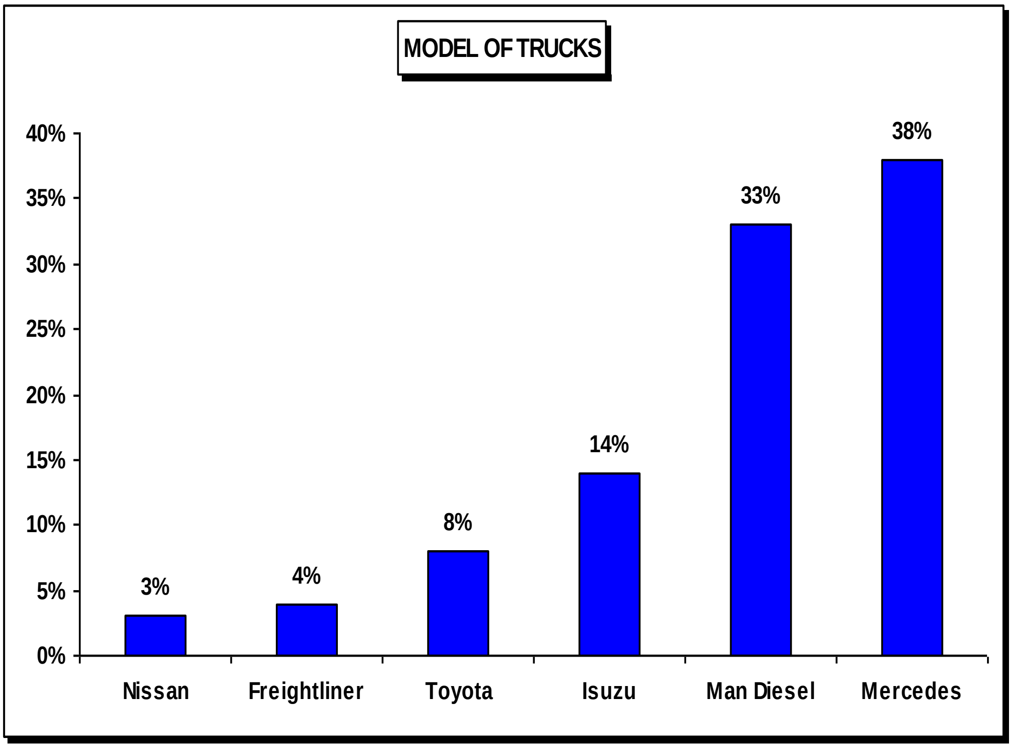

Figure 4.8. Models of trucks.

4.6.4. HYPOTHESIS THIRTEEN

There is a significant relationship between the model of the refuse truck and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Model of truck	Freight	Count	1	4	5
		column %	4.0%	4.2%	4.2%
	Isuzu	Count	1	16	17
		column %	4.0%	16.8%	14.2%
	Man	Count	5	34	39
		column %	20.0%	35.8%	32.5%
	Mercedes	Count	16	30	46
		column %	64.0%	31.6%	38.3%
	Nissan	Count	0	4	4
		column %	.0%	4.2%	3.3%
	Toyota	Count	2	7	9
		column %	8.0%	7.4%	7.5%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.27. Model of refuse truck cross tabulated with the prevalence of LBP.

	VALUE	DF	ASYMP. SIG. (2-SIDED)
Pearson Chi-Square	10.315(a)	5	.067

a 6 cells (50.0%) have expected count less than 5. The minimum expected count is .83.

Table 4.28. Chi-Square Test results pertaining to the model of refuse trucks and the incidence of LBP amongst refuse truck drivers.

Based on table 4.27. hypothesis thirteen is not accepted. ($p>0.05$). There is no significant relationship between the model of refuse trucks and the prevalence of LBP at the 5% level of significance.

6.4.5. TEMPERATURE AND CAB CONTROLS

The study findings indicated that a high percent of the drivers (74%) indicated that their refuse trucks had some sort of temperature controls in them. Controls consisted of manufactures features to self installed features such as mini dashboard fans.

Almost all drivers (98%) indicated that all driver controls in the refuse truck cab are within easy reach for them.

6.4.6. HYPOTHESIS FOURTEEN

There is a significant relationship between the ergonomic status of the driver controls of the refuse truck cab and the prevalence of LBP.

			Q7 Back pain during last 12 months?		Total
			No	Yes	
Q4.14 Are all driver controls in the cab within easy reach of the driver?	No	Count	2	0	2
		column %	8.0%	.0%	1.7%
	Yes	Count	23	95	118
		column %	92.0%	100.0%	98.3%
Total		Count	25	95	120
		column %	100.0%	100.0%	100.0%

Table 4.29. Positioning of driver controls cross tabulated with the prevalence of LBP.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.729(b)	1	.005		

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .42.

Table 4.30. Chi-Square Test results pertaining to the ergonomic status of the driver controls and the prevalence of LBP.

Based on table 4.28. hypothesis fourteen is accepted. ($p \leq 0.05$). There is a significant relationship between the ergonomic status of the driver controls and the prevalence of LBP at the 5% level of significance. Hence, 95% of the time this result can be expected.

4.6.7. A TYPICAL REFUSE TRUCK

Figure 4.9. A typical refuse truck.
***Permission granted (Appendix 1).**

The additional mechanical feature namely the compactor is at the rear of the truck. Whilst the compactor is in operation the rating of vibration levels is increased.

4.6.8. A TYPICAL REFUSE TRUCK CAB

Figure 4.10. A typical refuse truck cab.
*** Permission granted (Appendix 1)**

The various driver controls are clearly illustrated. The driver pedals are within reasonable reach for the drivers. The steering wheel, indicators and gear controls are also within easy reach for the driver. A handle next to the drivers seat is used for entry and exit into the truck cab.

4.6.9. A TYPICAL REFUSE TRUCK DRIVERS SEAT

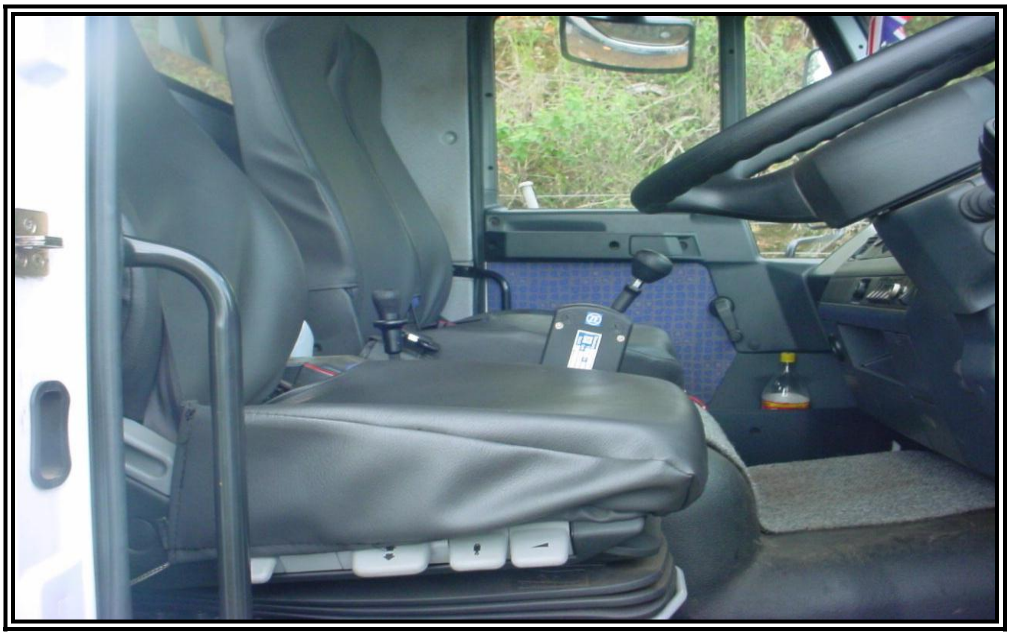

Figure 4.11. A typical refuse truck driver's seat.
*** Permission granted (Appendix 1).**

The seats are well padded. There are leavers on the side of the seat, which are used to adjust the seat. The height and backrest of the seat can be adjusted. The seat can also be moved forward.

4.7. MULTIVARIATE LOGISTIC MODELLING

Multivariate logistic modelling was used to identify significant predictors of LBP amongst the refuse truck drivers. The following independent variables were entered into the model:

- Race.
- Model of refuse trucks.
- Age.
- Length of driving.
- Cab conditions.
- Driving speeds.

- Stress.
- Sport.

		Chi-square	df	Sig.
Step 1	Step	51.080	13	0.000
	Block	51.080	13	0.000
	Model	51.080	13	0.000

Table 4.31. Omnibus Tests of Model Coefficients.

Step	Chi-square	df	Sig.
1	8.364	8	0.399

Table 4.32. Hosmer and Lemeshow Test.

			Back pain during last 12 months?		
			No	Yes	Percentage Correct
Step 1	Back pain during last 12 months?	No	12	13	48.0
		Yes	2	93	97.9
	Overall Percentage				87.5

a The cut value is .500

Table 4.33. Classification Table(a).

		B	S.E.	Wald	df	p	Exp(B)
Step 1(a)	BLACK	-1.666	0.669	6.201	1	**0.013**	0.189
	WHITE	20.379	40192.970	0.000	1	1.000	709079798.741
	COLOURED	21.741	17254.577	0.000	1	0.999	2767261431.820
	FREIGHT	-2.081	1.923	1.172	1	0.279	0.125
	ISUZU	1.833	1.741	1.108	1	0.292	6.254
	MAN	0.245	1.465	0.028	1	0.867	1.278
	MERCEDES	-.793	1.438	0.304	1	0.581	0.453
	NISSAN	18.424	19636.765	0.000	1	0.999	100369590.287
	Q1.1	-4.108	43740.088	0.000	1	1.000	0.016
	Q6.1	0.191	0.982	0.038	1	0.846	1.211
	Q19.2	1.619	0.634	6.514	1	**0.011**	5.049
	Q22	2.555	0.712	12.868	1	**0.000**	12.876
	Q4.14	21.709	28169.544	0.000	1	0.999	2679336500.996
	Constant	-21.712	28169.544	0.000	1	0.999	0.000

a Variable(s) entered on step 1: BLACK, WHITE, COLOURED, FREIGHT, ISUZU, MAN, MERCEDES, NISSAN, Q1.1, Q6.1, Q19.2, Q22, Q4.14.

Table 4.34. Variables in the Equation (Logistic Regression).

The dependent variable which measures back pain was coded 1 for Yes, 0 for No. The model chisquare showed that the model is significant (Sig/$p<0.05$). The results of the Hosmer and Lemeshow Test indicates that the model's estimates fit the data at an acceptable level ($p>0.05$). From the classification table, the overall percentage is 88.8%. This gives the overall percent of cases that are correctly predicted by the model.

As indicated from the variables in equation table 4.34, driving at reduced speeds and stress impact most on LBP (highlighted p values).

4.8. CONCLUSION

The quantitative results of this study have been presented.

The demographic variables of the refuse truck drivers assessed indicated no statistical significance with the prevalence of LBP.

The prevalence of LBP amongst refuse truck drivers was significantly high at 79%. Mid to lower back was the area with the highest percentage (74%) of perceived discomfort.

There was a significant relationship between the prevalence of LBP and three selected risk factors:awkward posture, the rating of the vibration levels and stress. It must be noted that no distinction was made between physical stress and emotional stress. A significant relationship was also found between the ergonomic evaluation of the driver controls of the refuse trucks and the prevalence of LBP.

LBP was found to be an occupational hazard amongst refuse truck drivers. Three risk factors namely awkward posture, the rating of vibration levels and stress were the main contributors to LBP amongst the refuse truck drivers.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1. INTRODUCTION

Previous studies of LBP have been criticised as being too narrowly focused on only one or perhaps two of the categories of individual, physical (biomechanical), and psychosocial risk factors (Kerr *et al.* 2001). This study was specifically designed to be comprehensive by incorporating as many selected risk factors that were considered associated with LBP amongst refuse truck drivers in the eThekwini Municipality.

The findings of the study are discussed in conjunction with the literature review, which encompassed both local and international papers. The empirical findings of the study presented in the Chapter Four will form the basis of this discussion chapter. The discussions are presented under two sub - headings, namely LBP and selected risk factors.

In keeping with previous studies, driver posture, vibration, stress, and ergonomic status of the driver controls were found to be risk factors that were associated with the prevalence of LBP amongst refuse truck drivers in the eThekwini Municipality.

5.2. RESPONSE RATE

In this study, the response rate was excellent (100%). According to Saunders *et al*. (2001:156) the 100% response rate was considered a perfect representative sample in that it represented the population from which it was taken from. Similar studies involving professional drivers yielded response rates ranging from 71% to 79% (Bongers and Boshuizen 1990). The study by Joubert (2000) also yielded high response rates in the two areas in his research, Point (100%) and Maydon Wharf (96%).

The excellent response rate obtained in this study is attributed to the fact that, the questionnaires were administered in group interview sessions. The studies as quoted by Bongers and Boshuizen (1990) consisted mainly of mailed or self-administered questionnaires; hence, the lower response rates in the Bongers and Boshuizen (1990) studies.

5.3. LOWER BACK PAIN

The dependent variable included in this study was LBP amongst refuse truck drivers.

The lifetime prevalence was not measured in this study. The researcher considered lifetime prevalence responses to be less reliable because lifetime prevalence relied on long term memory of pain and would be considered to be less accurate than other shorter recall periods such as “last 12 months” or “pain today”.

5.3.1. PREVALENCE OF LBP (12 MONTHS)

The 12 month prevalence of LBP amongst the refuse truck drivers in this study was recorded at 79%. The results of this study were lower than studies by Joubert (2000) (86%), Riihimaki (1989) (90%). The present findings were similar to only the study by Brendstrup (1987).

From the results of this study, it can be concluded that refuse truck driving can be considered as a major contributor in the development of LBP. A 79% prevalence of LBP is considered a high prevalence of an occupational hazard.

5.3.2. POINT PREVALENCE OF LBP

The point prevalence of LBP was recorded on three levels in the study questionnaire. The truck drivers reported on LBP as they experienced LBP on the day that the questionnaire was administered, LBP as experienced during the past week and LBP as experienced after the driving of their refuse trucks.

The overall point prevalence of LBP (51%, 64% and 69%) was much lower than the prevalence of LBP over a 12 month period (79%). The researcher did not expect this finding. In theory, the subjects should have a clearer and more accurate account of their prevalence of LBP over a shorter time.

A number of confounding factors could have influenced the point prevalence results. For example, some questionnaires were administered during the mornings, before any driving activities. The drivers would therefore not have experienced any LBP on that specific day, due to no driving activities. However the point prevalence percentages recorded for the three areas i.e. pain today 51%; pain during the past week 64% and pain after driving 69% was higher than that recorder by Joubert (2000) (45.5%).

For these reasons, the data for point prevalence were not regarded as accurate in assessing the prevalence of LBP amongst the refuse truck drivers in the eThekwini Municipality. Therefore no results pertaining to point prevalence are relevant.

5.3.3. RADIATION OF LBP TO OTHER AREAS

The spread of LBP is closely related to the severity of LBP. Fifty eight percent of the drivers reported that the LBP experienced did in fact spread to the other parts of their bodies especially their legs. This spreading of the pain could be attributed to other confounding risk factors such as the vibration produced by the refuse trucks and psychosocial factors.

The findings of this study is supported by Kirkaldy-Willis and Bernard’s (1999:299) theory that the traditional biomedical view is reductionistic, assuming that every report of pain originates from a specific physical cause. A particular conundrum is the fact that pain may be reported even in the absence of an identified physical pathology. For example, in this study 58% of the drivers reported that pain in their lower back spreads to their legs.

If pain spreading to the legs occurs in the absence of or is disproportionate to, an objective physical pathology as the case in this study, Kirkaldy-Willis and Bernard’s ((1999:300) view is that the pain must have a psychological etiology. Biomedical factors, in the majority of cases, appear to instigate the initial report of pain. Over time, however, psychological and behavioural factors may serve to maintain and exacerbate the level of pain and influence adjustment and disability. Following from this view in terms of Kirkaldy-Willis and Bernard’s (1999:301) theory, LBP that spreads to other parts of the body and persists over time should not be viewed as solely physical or solely psychosocial. Rather, the experience of LBP is maintained by an interdependent set of biomedical, psychosocial and behavioural factors (Turk:1996). Other possible causes of LBP and the leg pain could be disc degeneration and herniation, lateral canal stenoisis, facet/sacroiliac syndome and vascular incompetency of the lower limb (Shaik 2005).

5.3.4. LOCATION OF PAIN

The refuse truck drivers recorded their location of pain on a body diagram in question 10 of the study questionnaire. The body diagram focused on three areas namely: the lower back, middle back and shoulder area. In this study, the majority of the refuse truck drivers (79%) reported to have experienced pain in the lower back area. This finding is in keeping with the study conducted by Joubert (2000) who also found that the majority of drivers in his study (79%) reported pain in the lower back region.

The next most common area of pain was the upper back (63%); the neck (59%) and the right shoulder (55%). This finding was expected as it is in keeping with the literature review, which states the back pain is one of the most common sources of work related discomfort (Bridger 1995:56).

5.4. SELECTED RISK FACTORS

5.4.1. AGE

Mainly drivers in the age bracket of 35 yrs to 50 yrs reported that they suffered from LBP. This consisted of 86% of the drivers. The mean age of the drivers overall was between 40 and 44 years. This could be attributed to the low driver staff turnover in the Cleansing and Solid Waste Section of the eThekwini Municipality.

This study found no significant relationship between the age of the refuse truck drivers and the prevalence of LBP. The findings of this study were consistent with the study findings of Devereux *et al.* (2004) where age showed no statistical significance in relation to the prevalence of LBP.

However, the findings of this study were not in keeping with the literature review. Kroemer *et al.* (2001) found that LBP was a problem arising due to old age. Rossignol *et al.* (1988) in their study used a logistic regression model to calculate, risk factors associated with absences of 6 months or more because of LBP. An increase in age of 23 years doubled the odds of accumulating at least 6 months of absence and lumbar symptoms were 2.86 times more likely than thoracic symptoms to become chronic. The risk of chronicity of LBP hence increases with advancing age according to the study by Rossignol *et al.* (1988).

Height and weight of the refuse truck drivers was not significantly related to the prevalence of LBP. It must be noted that taller persons do complain of LBP, predominantly because of the incorrect postures they tend to adopt.

Similarly, weight especially in the abdominal region places more stress on the lower back region, which tends to increase the risk of LBP. The findings of this study were not in keeping with the study by Rossignol, Suissa and Abenhaim (1988) which clearly indicated statistical significant relationships between height and weight and the prevalence of LBP.

5.4.2. LENGTH OF REFUSE TRUCK DRIVING

The mean length of driving a refuse truck in this study was 7 years. The findings was the same to Brendstrup (1987) which also obtained a mean length of driving of 7 years. However the result of this study was much lower than that found by Joubert (2000) (13.4 years). The findings by Joubert (2000) (13.4 years) was more in keeping with other studies Bongers and Boshuizen (1990) (15 years), and Riichmaki (1989) (15 years).

The lower mean age pertaining to the length of driving obtained in this study can be attributed to two reasons. The high prevalence of LBP amongst the refuse truck drivers could be one reason. Secondly the present method of medical boarding in the Municipality is most likely a major contributing factor. The process of medical boarding is relatively simple and does not take a long time to finalise.

Studies by Brendstrup (1987), Joubert (2000), Riichmaki (1989), Bongers, and Boshuizen (1990) found statistical significances between the length of driving and the prevalence of LBP. In light of the abovementioned studies, it was expected that the length of driving a refuse truck would be a risk factor for the development and prevalence of LBP amongst the refuse truck drivers in the eThekwini Municipality. However, this study did not find any statistical significance between the number of years of driving a refuse truck and the prevalence of LBP. This finding was not in keeping with the literature review were length of driving was found to be statistically significant to the prevalence of LBP amongst long distance truck drivers (Porter 1999).

5.4.3. DRIVING SPEEDS

The average speed that the drivers drove their refuse trucks was in the between 61-80 kph. The exact driving speeds were not empirically recorded. Of those with LBP 46% reported driving between 41-60kpm and of those without LBP 48% drove between 61-80 kpm. All refuse trucks were governed for speed, as this was the policy of the Municipality.

This study did not find any statistical significance between the speed that the refuse truck was driven and the prevalence of LBP. However, the logistic regression analysis showed that driving at reduced speeds impacted most on the LBP. The odds ratio indicated that LBP would occur 4.28 times more if drivers drive their refuse trucks at reduced speeds.

This finding could be attributed to the dose response relationship. Whist driving at reduced speeds the driver will remain longer in their trucks. Exposure to the various stress and confounding risk factors will be increased.

Driving speed does contribute to other risk factors such as vibration levels produced by the refuse trucks. Vibration levels tend to increase with increased driving speeds and decrease with lower driving speeds. Malchaire *et al*. (1996), found that on average the driving speeds were reduced by approximately 1.7 km/hr when forklifts was loaded and this resulted in a reduction in the vibration levels experienced, by as much as 0.15ms^{-2}..

5.4.4. KILOMETERS TRAVELLED

The reported average kilometres travelled by the refuse, truck driver was between 101 and 300 kms a day. Of those with LBP, 56% averaged 100 kms a day and of those without LBP, 44% averaged 300 kms a day. However when statistically evaluated, there was no significant relationship between the average kilometres travelled by the refuse truck drivers and the prevalence of LBP.

The annual mileage should have been correlated with days absent from work due to LBP, as a study by Porter (1999:9) indicated that the mean number of days absent from work with LBP was 22.4 days for high mileage car drivers, as compared with 3.3 days for low mileage drivers. The annual mileages were not correlated with days absent in this study. Refuse truck drivers are considered high mileage drivers, due to the nature of the job. Hence, the findings of this study were not in keeping with the study by Porter (1999) which clearly indicated a relationship between high mileage drivers and the incidence of LBP.

5.4.5. AWKWARD POSTURE

In this study, a significant relationship between awkward posture and the prevalence of LBP was established. The findings were in keeping with the results found by Devereux *et al.* (2004). Continuously working with the head/neck bent or twisted excessively was classified as high exposure. Occasionally working or not working with the head/neck bent or twisted excessively was classified as low exposure and was used as the reference in the Devereux *et al.* (2004) study.

The findings of this study is in keeping with that reported by Bridger (1995:57) who reports that more LBP was found in groups who worked in unusual body positions or with the trunk flexed laterally or forward in standing or sitting. Pain prevalence according to Bridger (1995) increases substantially if a nonneutral posture was held for more than 10 % of the work cycle, suggesting that such postures be designed out of the work cycle or minimised.

Due to the nature of the job, the refuse truck drivers frequently turn their heads sidewards. The drivers must constantly check for the pickers at the back of the truck. Furthermore, due to the size of the truck, reversing becomes hazardous. The driver must constantly check his side mirrors and turn their head in order to negotiate the narrow spaces in which the truck must reverse into.

According to Zenz (1998:971) work postures should make it possible to retain the joints in mainly neutral positions, i.e. neither heavily flexed nor extended. Work postures in which the trunk is bent and twisted or in which the joints are forced to operate at their extreme positions often give rise to musculoskeletal complaints. Continuously working with the head/neck bent or twisted excessively was classified as high exposure in terms of a risk by Zenz (1998).

5.4.6. VIBRATION

The European Union Machinery Directive poses a threshold level for vibration, i.e.: the exposure value below which no adverse effect on health and safety is expected at an 8-hour exposure of < 0.25 ms^{-2}. The action level (i.e.: the value above which technical, administrative, and medical provisions must be undertaken) is 0.5ms^{-2}, the exposure limit (i.e.: the exposure value above which an unprotected worker is exposed to unacceptable risks) is set at 0.7ms^{-2}.

The seat effective transmissibility values (SEAT%) indicates to what extent the seat of a vehicle will offer protection of the driver against vibration exposure, by attenuation and reduction of the vibration transmitted from the chassis of the vehicle into the body of the driver through the seat (Joubert 2000). The SEAT values of the refuse trucks in this study were not measured due to the cost factor. However only 58% of the drivers considered their seats to be well padded. Seats that are not well padded, results in poor attenuation, hence vibration levels are increased. The seats not being well padded, was a confounding risk factor for the development of LBP on a refuse truck driver.

The reported perceptions of vibration produced by the refuse trucks were categorised by the drivers. 80% of the drivers categorised the levels of vibration experienced to range from medium to very high. Hence, vibration exposure as an important risk factor was quantified. Therefore, the reporting of LBP, was not merely because of any arbitrary reason, but was directly related to the perceived levels of vibration produced by the refuse trucks. It is important to mention in this discussion the standards applicable to vibration levels both locally and internationally.

According to Dorevitch and Marder (2001:260-265) WBV among bus, farm equipment and truck drivers has been associated with back pain, degenerative vertebral changes, and a variety of gastrointestinal and neurological symptoms. Although their exposure to WBV has not been studied, Municipal Solid Waste workers may be at risk as well, because they spend much of their time on operating trucks. This study established that there was a significant relationship pertaining to the levels of vibration produced by refuse trucks and the prevalence of LBP.

5.4.7. MONOTONY

Battie (1989) cited monotony at work to be a significant risk factor associated with the complaints of LBP. There was no significant relationship between monotony and LBP in this study. The majority of the drivers indicated that the job of refuse truck driving was not boring irrespective of whether they experience LBP or not. In this study, only 36% of the refuse truck drivers considered refuse truck driving as a monotonous and boring job.

This low response could be attributed to the task system employed in the Cleansing and Solid Waste Sections. After the refuse truck driver has finished his route for the day, the entire crew including the driver is allowed to go home. On some days, this could be as early as 10h00 in the morning. Hence, this could be one of the main reasons the drivers did not consider their jobs as monotonous and boring. This study therefore established that monotony was not a significant risk factor associated with LBP amongst refuse truck driver in the eThekwini Municipality.

5.4.8. STRESS

The single item measure of perceived job stress was used as the outcome. Seventy one percent of the refuse truck drivers considered refuse truck driving as a stressful job. Hence high-perceived job stress was considered as an important risk factor associated with the prevalence of LBP.

Question 22 of the study questionnaire required the drivers to provide the reasons as to why they considered refuse truck driving as a stressful job. The main reasons cited by the drivers as to why their jobs were stressful was:

- The high risk of road accidents.
- The abuse from members of the public.
- The traffic volume (peak hour traffic).
- The size of the refuse trucks.

Therefore the factors associated with the reporting of high levels of perceived job stress that also preceded and increased the likelihood of onset of high levels of perceived job stress would satisfy the criteria of association and time order indicating possible involvement in the causation of work related stress, that is refuse truck driving. However, it must be recognised that the stress is partly dependant on the individual's ability to cope and on the way in which the drivers cope with the experienced stressor.

The study found a significant relationship between stress and the prevalence of LBP. Of those drivers who reported to have suffered from LBP, 71% consider their jobs as stressful. Of those drivers whom did not report to have suffered from LBP, 68% consider their jobs as not being stressful. The logistic regression analysis also found stress to be a significant risk factor.

The odds ratio indicated that LBP is 9.7 times more likely to occur if refuse truck drivers are stressed.

The findings of this study is consistent with the study findings by Devereux *et al.* (2004) where high perceived job stress was an immediate risk factor between high exposure to both physical and psychological work risk factors and self reported LBP. According to the study by Devereux *et al.* (2004) psychosomatic symptoms, depression and perceived life stress may act independently to increase the likelihood of developing LBP.

According to Devereux *et al.* (2004) stress has been implicated in the pathway between physical and psychosocial workplace risk factors and LBP. In the stress process, an individual's cognition and subjective appraisal of a potential risk factor is considered crucially important. Sustained stress responses may result in increased muscle coactivation and thus increase loading on the musculoskeletal system. In addition, perceived job stress may reduce the ability for the musculoskeletal system to recover during or after work. In addition central nervous system responses to perceived job stress may increase sensitisation to pain stimuli (Rydstedt 2003).

Most of the epidemiological literature investing the relationship between mental stress reactions (symptoms of stress, perceived stress and depression) and LBP has been cross sectional in design making it difficult to determine whether mental stress reactions were involved in the development of LBP according to Devereux *et al.* (2004). Nonetheless, cross sectional studies have shown a positive association between stress and LBP according to Davis and Heaney (2000) and Bongers *et al.* (2002).

5.4.9. PHYSICAL ACTIVITY

A high percentage (72%) of refuse truck drivers participated in sport or in any other physical exercise. Concerning the types of physical activity undertaken by the refuse truck drivers, four common physical activities were identified amongst the refuse truck drivers in this study. They were walking (12%), running (17%), cricket (29%) and soccer (42%). The 72% recorded in this study is significantly higher that that reported in the study by Bovenzi (1998), which was only 26%.

The high percent of sport played by the drivers could be attributed to the fact that South Africans love their sport. Another contributing factor is the large amounts of spare time that the drivers have during the course of the day due to the task system employed by the Cleansing and Solid Waste Section. This system allows for a driver to go home once his route for the day is complete.

Seventy five percent of the refuse truck drivers who reported to have experienced LBP play some sort of sport. Sixty four percent of refuse truck drivers who have not reported to experience LBP do not play any sport.

Playing sport like soccer and cricket is noted for its high accident/injury rates (Joubert 2000). These injuries could be brought into the work environment and translated as an occupational injury. However, being sedentary and not doing enough exercise to allow the back to be strengthened and protected against some muscular skeletal injuries, is also a recognised risk factor for LBP according to Kirkaldy-Willis and Bernard (1999).

This study did not find any statistical association between the prevalence of LBP and sporting activities amongst the refuse truck drivers. Sporting activities could however contribute to new LBP injuries and or exacerbate existing LBP problems amongst the refuse truck drivers.

5.4.10. ERGONOMICS OF REFUSE TRUCK CAB

The refuse truck cab is regarded as the office for the drivers. The drivers need to start out in the morning with a truck that is going to allow them to complete their assigned mission in a safe, efficient and comfortable manner. Primarily, they want to be comfortable while they work. However, in this study when the safety and comfort of the cab was assessed the following was found.

From the five most common models of refuse trucks, the drivers of the Mercedes and Man Diesel trucks were more likely to complain of LBP (Mercedes 32% and Man Diesel 39%).

The age of the refuse trucks was also found to be associated with the prevalence of LBP. Drivers of the older Nissan trucks indicated a 100% prevalence rate of suffering with LBP. Drivers of the other old model, namely the Isuzu also indicated a 94% prevalence rate of suffering with LBP. This study however did not find any statistical significant relationship between the model of the refuse truck and the prevalence of LBP. This finding was expected as the newer trucks were more superior designed due to technological advancements.

Since the drivers will be in their vehicles for extended periods, adequate seats are necessary. The study found that the driver's seats were adequate, except for the padding of the seats. Only 58% of the drivers considered that their refuse truck seats were well padded.

Another area that is very important to drivers is the heating and cooling systems in the truck cabs. The heating and cooling units must be adequately sized to accommodate the temperatures extremes in which the vehicle operates. This study found that in the majority of the refuse trucks (74%) there was some sort of temperature control.

Design of driver controls should be designed to be operable in low stress postures and without static loading of body parts. Control dimensions should be determined using appropriate hand and foot, anthropometry and knowledge of the mechanical advantage needed to enable the user to actuate the control easily (Bridger 1995:369).

In this study, all driver controls in the refuse truck's cab were within easy reach of the driver. The findings of this study were consistent with Bridger's theory (1995) which requires all system designers to investigate the human machine interaction in the design for the man- machine environment. Ninety eight percent of the drivers indicated that all driver controls in the cab are within easy reach. This study therefore found a significant relationship between the ergonomic status of the driver controls of the refuse truck cab and the prevalence of LBP.

5.5. CONCLUSION

By examining the prevalence of LBP, it becomes possible to focus on confounding risk factors bringing on its onset. Analysing the selected risk factors in this study demonstrated a link between awkward posture, vibration, stress, and the ergonomic status of the driver controls and the prevalence of LBP.

This study therefore supports the concept of a multifactor etiology relating to the prevalence of LBP amongst refuse truck drivers in the eThekwini Municipality.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. INTRODUCTION

LBP is a serious occupational disease (Miyamato *et al.* 2000). According to this study findings it is time for a change in attitude to well-being, that is recognising the importance of postural comfort, in not only the home and office, but in the vehicles that are driven by the refuse truck drivers in the eThekwini Municipality.

This study concluded that the occupation of refuse truck driving was, and possibly still is associated with an elevated risk of “lumbar syndrome”. The study also showed the relationship between selected psychosocial and biomechanical risk factors and the prevalence of LBP. Significant strengths of association for work related psychosocial and biomechanical variables, suggest that workplace efforts directed towards the primary prevention of LBP will be most effective if they focus on both risk factors i.e. psychological and biomechanical.

6.2. LEGAL RESPONSIBILITIES

Under the Occupational Health and Safety Act (OHSA), 85 of 1993, every employer has the following responsibilities:

“To provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith”.

This study identified risk factors that are directly associated with the prevalence of LBP amongst the refuse truck drivers. Management at the Cleansing and Solid Waste Department must manage these risk factors, in order to ensure compliance with OHSA, which is a statutory requirement.

Furthermore, the Department of Labour must consider formulating specific regulations, in order to deal with the identified risk factors in this study namely, vibration and stress. Good ergonomic practices must be seen as a solution in addressing LBP in the workplace.

When formulating these specific regulations a collaborative approach must be adopted. The majority of employers view hazards and risks as relating to safety, noise, chemicals, heat and dust, and they do not often identify the hazards caused by poor layout, design, and risk factors, which can lead to injuries and musculo-skeletal problems like LBP (Bridger 1995).

OHSA legally requires for the identification of ergonomic risks, which include biomechanical, psychosocial, and protect their employees from injury due to poor ergonomic conditions.

In terms of the Compensation for Occupational Injuries and Diseases Act, of 1993 (COIDA), employees could claim under the various classifications of disablement, should it be proven that a back or shoulder injury was caused by poorly designed work processes or badly positioned machinery, which includes refuse trucks. The refuse truck cab is considered as the workplace for the refuse truck drivers.

Employers must therefore be aware that poor workplace practices pose a risk, which could actually cause occupational injuries, which are compensatable under the COID Act (1993) such as LBP.

6.3. OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

Ergonomic related work solutions can only be effectively managed if it is integrated into the general arrangements for managing Occupational Health and Safety at work. The current Occupational Health and Safety systems at the Cleansing and Solid Waste Section of the Ethekwini Municipality must be reviewed in order to ascertain whether they adequately cover the selected risk factors identified in this study. The following main areas of the programme must be addressed namely, policy, responsibility, organisation, systems and monitoring.

According to Karwowski and Marras (1999), The Occupational Health and Safety Authority (OSHA) in the United States suggest that a successful ergonomic programme should encompass the following:

- Management leadership – assign responsibility for ergonomics to designated managers, who must communicate policies and practices to employees;
- Employee participation – ensure that employees are aware of ergonomics requirements and have ways to report musculoskeletal disorder (MSD) symptoms and hazards;
- MSD management – talk to employees carrying out tasks suspected of causing MSDs, and observe employees performing those tasks, to uncover risk factors;
- Job-hazard reduction measures – if a task is found to cause MSDs, employers must control or reduce the risk.

The OSHA approach is recommended for use in South Africa by the researcher, cognisance taken of the findings of this study. Furthermore the OHSA approach is all encompassing an is in keeping with universal ergonomic principles.

6.4. EVALUATING THE RISK

It is recommended that the Management at the Cleansing and Solid Waste Section consider the following aspects, when evaluating the risks pertaining to the refuse trucks and the drivers.

- The Refuse Truck Driver
  - Competency
  - Training
  - Fitness and Health

- The Refuse Truck
  - Suitability
  - Condition
  - Safety Equipment
  - Safety Critical Information
  - Ergonomic Considerations

- The Daily Journey
  - Routes
  - Scheduling
  - Time
  - Distance
  - Weather Conditions

These aspects must be incorporated into recruitment, procurement and operational plans and policies. This will ensure that the aspects related to ergonomics will be addressed at all important levels in an organisation. By evaluating the risk in the abovementioned manner, the man-machine environment postulated by ergonomic principles, will be also addressed. Adopting this approach will most certainly address the problem of LBP amongst refuse truck drivers in the eThekwini Municipality.

6.5. BACK PAIN MANAGEMENT PROGRAMME

Brown *et al*. (2002:40) developed a comprehensive back injury management package for the "real world". This package is recommended for use by the management in the Cleansing and Solid Waste Section. The elements of the back injury management package is presented in Table 6.1.

ELEMENTS	AIM
Plan-do-check act	To improve awareness of the risks involved with refuse truck driving and to identify and provide remedies for the task
Behavioral measurement and feedback	To maintain awareness of the risks involved with refuse truck driving, to improve behaviour and to identify and remove barriers to healthy and safe behaviour
Back school	To give the knowledge and understanding needed to address back care twenty four hours a day
Fast track physiotherapy	To ensure swift access to rehabilitation services

Table 6.1. Back injury management package

Adapted from Brown, S., Budworth, N. and Roger, H. 2002. Participative Quality Techniques for Back Pain Management. *Journal of the Institution of Occupational Safety and Health*. 6(1):39:56.

6.6. AREAS FOR FUTURE RESEARCH

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

Intervention studies relating to the selected risk factors and the association with LBP are needed to offer intervention. These studies are important if adequate control measures are to be instituted in order to assist with the LBP problem in a specific work setting.

This study showed that the assessment of selected risk factors might contribute to identifying and recognising LBP. Additional studies with quantitative assessments are required in a continuous effort to clarify interrelations between risk factors and LBP as a dynamic entity.

Future studies are needed to utilise high quality measures of occupational exposures (biomechanical and psychosocial) and LBP.

Future studies should perform in depth analysis that evaluate the potential mechanisms through which psychosocial stressors may be linked to LBP.

6.7. CONCLUSION

This chapter concludes the study report. From this study, it can be concluded that:

The biographical variables of age, height and weight of refuse truck drivers in the eThekwini Municipality were found not to be statistically significant risk factors associated with the prevalence of LBP.

In contrast, four risk factors of the working format related significantly to the prevalence of LBP amongst refuse truck drivers. They were awkward posture, vibration, stress, and the ergonomic status of the driver controls of the refuse truck cab.

While the body of literature and the findings of this study suggest that employee’s reactions to the selected biomechanical and psychosocial risks factors in this study may play a role in the development and prevalence of LBP, evidence that is more conclusive is needed.

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APPENDIX 1

APPROVAL LETTER

<u>TO WHOM IT MAY CONCERN</u>

<u>M. TECH DEGREE: ENVIRONMENTAL HEALTH: SHAUN RAMROOP</u>

Shaun Ramroop (9572020) has registered at the Durban Institute of Technology Steve Biko Campus for his Magister Technology (M.Tech) Degree in Environmental Health.

He has chosen an area of research of strategic importance to Council in which, to date, no research has been undertaken in South Africa.

His topic on ergonomics – "whole body vibration (WVB) – occupational exposures and their health effects among eThekwini Municipality refuse truck drivers – an epidemiological survey," will be of enormous benefit to the Council.

As Head: Cleansing and Solid Waste, I strongly believe that research of this nature in the new local government will have only positive impacts on both productivity and worker health and safety.

Mr. S. Ramroop will be assured of all the assistance and professional support from the Department during the period of his research.

He has permission to conduct his research in the Cleansing and Solid Waste Departments.

Yours faithfully

R.I. Rampersad

....

Mr. R.I. Rampersad

APPENDIX 2

LETTER OF INFORMATION AND INSTRUCTION EXPLAINING THE RESEARCH PROJECT

Title: An epidemiological study of the selected risk factors associated with low back pain (LBP) amongst refuse truck drivers in the eThekwini Municipality

Dear subject

You are invited to participate in a research study to assess the risk factors associated to low back pain (LBP) among the refuse truck drivers of the eThekwini Municipality. Pain in the lower regions of the back is one of the most common sources of work related discomfort.

The research is being done firstly to recommend intervention strategies to management, as there are no specific treatments for the effects of LBP. This will go a long way in improving the health and safety of the drivers of refuse trucks. The second reason is the study will contribute towards me obtaining the Magister Technology (M. Tech) Degree in Environmental Health.

As a participant in the research total confidentiality is ensured. **At no time will your identity be revealed. You must not write your name on the questionnaire.**

Your Head: Cleansing and Solid Waste, Mr RI Rampersad has given me permission in writing to conduct this research.

The research process is very simple and will only take approximately 15 minutes minutes of your time. There is no charge for the participation in this study. You only need to complete the informed consent form and questionnaire. Answer all questions in the questionnaire. Simply tick the correct answer.

The results of the study will be sent to those who are interested.

Thank you for your interest and support.

Dr Shaun Ramroop
Researcher

APPENDIX 3

INFORMED CONSENT FORM

Date:…………………….
Title of research project:
An epidemiological study of the selected risk factors associated with LBP among refuse truck drivers in the eThekwini Municipality.
Name of Supervisor: Dr J Shaik
Tel:(031) 2042588
Name of co-supervisor: Dr M Govender
Tel: (031) 2604381
Name of research student: Shaun Ramroop
Tel:(031) 7621224

PLEASE CIRCLE THE APPROPRIATE ANSWER:

1. Have you read the research information sheet? YES/NO
2. Have you had the 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 withdraw from this study? YES/NO

(a) at any time YES/NO
(b) without having to give a reason for withdrawing? YES/NO
(c) without effecting your future health care? YES/NO

8. Do you agree to voluntarily participate in this study? YES/NO

If you have answered no to any of the above, please obtain the necessary information before signing; or contact my supervisor.

Please print in block letters

Subject: Name:…………………… Signature: ……………………….

Witness: Name:…………………. Signature: ……………………………

Research Student: Name:…………………. Signature: ……………………

APPENDIX 4

QUESTIONNAIRE (PART ONE)

SECTION ONE

BIOGRAPHICAL DETAILS

1. Age

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

2. Gender

Male		1
Female		2

3. Race (Purely for study purposes)

Black		1
White		2
Coloured		3
Indian		4

4. What is your height?

------------------------m

5. What is your weight?

-------------------------kg

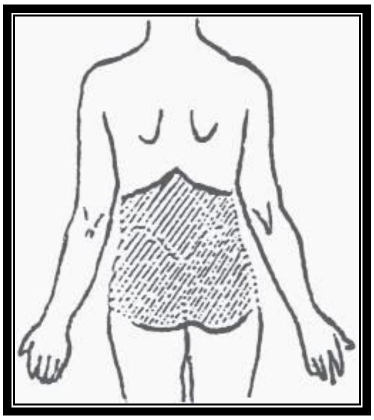
6. Indicate the number of years that you are driving a refuse truck for?

Less than 1 Year		1
1 Year		2
2 Years		3
3 Years		4
4 Years		5
5 Years		6
More than 5 years		7

SECTION TWO

LOWER BACK PAIN (LBP)

7. During the **PAST 12 MONTHS**, have you had back pain in the area shown in the diagram (shaded area), which lasted for more than a day? (Do not include pain occurring only during pregnancy, during menstrual periods, or during the course of a feverish illness such as flu).



Yes		1
No		2

7.1 If you indicated yes to the above question, did the pain spread down your legs to below your knees?

Yes		1
No		2

7.2 Did it make it difficult or impossible to put on socks, stockings or tights?

No difficulty		1
Difficult but not impossible		2
Impossible		3

7.3 Did you have any pain during the **past week**?

Yes		1
No		2

8. Do you have lower back pain today?

Yes		1
No		2

9. Do you experience lower back pain during or shortly after driving your refuse truck?

Yes		1
No		2

10. Please score in the boxes surrounding the model on a **0 – 5** scale, the level of discomfort you may have experienced in the past because of refuse truck driving.

0 – No discomfort or pain experienced

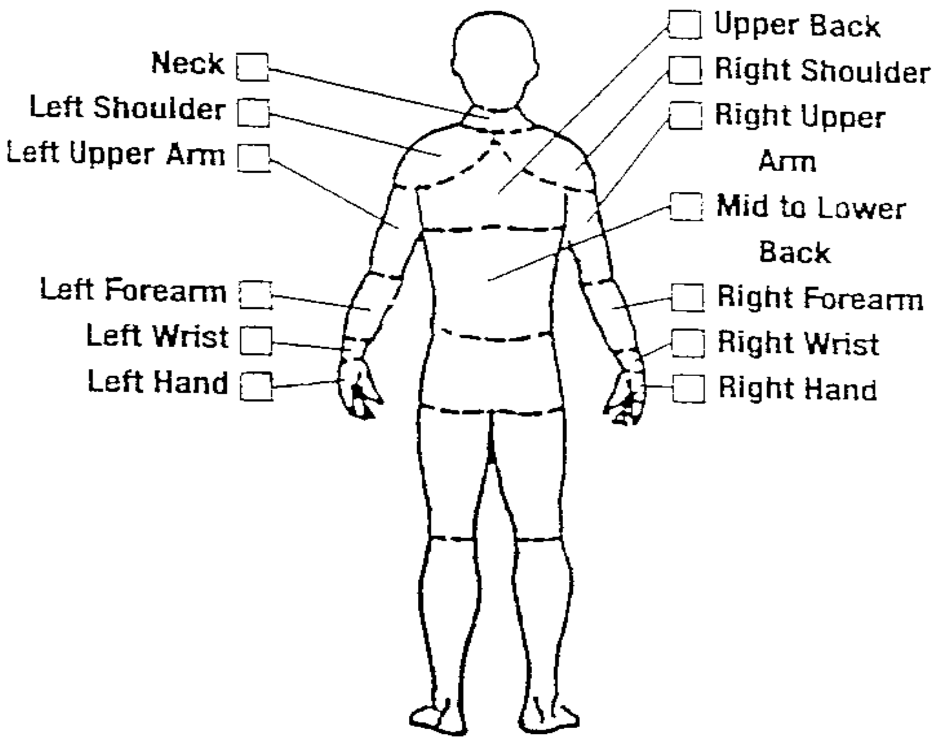
1 - Mild levels of discomfort or pain experienced

2 - Moderate levels of discomfort or pain experienced

3 - Significant levels of discomfort or pain experienced

4 – Severe levels of discomfort or pain experienced

5.- Extreme levels of discomfort or pain experienced



11. Please indicate on the line below the number between 0 and 100 that best describes the pain in your back when it is at its worst. A zero (0) would mean “no pain at all” and a hundred (100) would mean “pain as bad as it could be”. Please write only one number!

0………………25……………..50…………..75……………….100

12. Please indicate on the line below the number between 0 and 100 that best describes the pain in your back when it is at its least. A zero (0) would mean “no pain at all” and a hundred (100) would mean “pain as bad as it could be”. Please write only one number!

0………………25…………….50……………75……………….100

SECTION THREE

SELECTED RISK FACTORS

Driving conditions

13. What is the average speed that you drive your refuse truck at?

0-40 kph		1
41-60 kph		2
61-80 kph		3
> 80 kph		4

14. What are the average kilometres you drive a refuse truck for daily?

0-100 kms		1
101-300 kms		2
+ 300 kms		3

Cab conditions

15. Please indicate on the line below the number between 0 and 100 that best describes the seating comfort / discomfort intensity levels in your truck cab. A zero (0) would mean, “Relaxed” and a hundred (100) would mean “painful”. Please write only one number!

0………………25……………..50……………75……………….100

Posture

16. What is the longest period that you remain seated for and drive your refuse truck in a day?

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

17. Do you consider yourself to be in an awkward position while driving?

Yes		1
No		2

Vibration

18. How would you categorise the levels of vibration produced by the refuse truck you drive?

Very high		1
High		2
Medium		3
Low		4

19. Do you do the following to reduce the levels of vibration produced by the truck you drive?

19.1 Use a cushion for back support and or comfort?

Yes		1
No		2

19.2 Drive at reduced speeds?

Yes		1
No		2

19.3 Use a back/kidney belt?

Yes		1
No		2

Psychosocial factors

20. Do you consider refuse truck driving as a monotonous and boring job?

Yes		1
No		2

If yes, state briefly why?

…………………………………………………………………………………..
…………………………………………………………………………………..
…………………………………………………………………………………..
…………………………………………………………………………………..

21. If you have a problem at work do you have a social support system that can assist you.

Yes		1
No		2

If you indicated yes to the above question, please tick the relevant social support system.

Family		1
Friend		2
Religious organisation		3
Wife/husband		4
Other		5

22. Do you consider refuse truck driving as a stressful job?

Yes		1
No		2

If yes, state briefly why?
…………………………………………………………………………………..
…………………………………………………………………………………..
…………………………………………………………………………………..

23. Are you dissatisfied with your job as a refuse truck driver?

Yes		1
No		2

If yes to question 23, state briefly why?

……………………………………………………………………………..
……………………………………………………………………………..
……………………………………………………………………………..
……………………………………………………………………………..

Other factors

24. Do you play sport or participate in any other physical exercise?

Yes		1
No		2

24.1 If yes, what sport and or/physical activity do you participate in?
…………………………………………………………………………………
…………………………………………………………………………………
…………………………………………………………………………………
…………………………………………………………………………………
………………………………………………………………………………….

24.2 If yes, for how many hours per week?

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

25. Do you perform any other part time work involving driving a truck?

Yes		1
No		2

26. Do you have any suggestions in reducing the incidences of low back pain amongst refuse truck drivers?

…………………………………………………………………………………
…………………………………………………………………………………

You have completed
Thank you

TO BE COMPLETED BY THE RESEARCHER

QUESTIONNAIRE (PART TWO)

SECTION FOUR

ERGONOMIC STATUS OF CAB

Make of truck: ……………………………………..

Model: ……………………………………………..

1. What is the height of the driver's seat in mm?

2. What is the height of the driver's backrest in mm?

3. What is the width the driver's seat in mm?

4. What is the length of the driver's seat in mm?

5. What is the distance of the driver's seat (from the furthest back position) to the driving leg pedals in mm?

6. What is the angle of the seat between the seat and backrest?

7. Can the driver's seat adjust for height?

Yes		1
No		2

8. Can the driver's seat backrest adjust for height?

Yes		1
No		2

9. Can the driver's seat backrest alter for inclination?

Yes		1
No		2

10. Can the entire driver's seat be moved in order to change its position?

Yes		1
No		2

11. Is the driver's seat well padded?

Yes		1
No		2

12. Is the front edge of the driver's seat well padded?

Yes		1
No		2

13. Can the temperature in the truck cab be regulated?

Yes		1
No		2

14. Are all driver controls in the cab within easy reach of the driver?

Yes		1
No		2

END OF QUESTIONNAIRE