BACK PAIN AMONGST DENTISTRY STUDENTS AT THE UNIVERSITY OF WESTERN CAPE

STUDENT

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ABSTRACT

Back pain has been reported to be the most common type of discomfort in all occupational groups. Studies have shown that dentists experience more neck, shoulder and back pain than practitioners in other occupational groups. This has caused an increase of social and economic costs of healthcare and increased frequency of sickness absenteeism in Western countries. About 72% of dentists experience back pain according to studies done in Western countries thus showing a very high prevalence among dentist. This study aimed to investigate the prevalence of back pain among dentistry undergraduate students. As there have been reports of high prevalence of back pain among dentistry students in Western countries. This descriptive research study made use of a cross-sectional quantitative survey to meet the objectives of the study design. Participants were undergraduate dentistry students (1st-5th yr) registered for the 2007 academic year at the University of Western Cape in South Africa. Ethical clearance was obtained from the ethical committee at the University of Western Cape, the registrar of the institution, Dean of the Faculty of Dentistry, lecturers and participants. The study instrument incorporated the demographic data, Nordic back questionnaire, behavioral pattern of back pain, and purpose-built questions regarding educational exposure. Questions regarding educational exposure was obtained through a focus group discussion and the final data was collected by means of a questionnaire. The data was analyzed using Statistical Package for the Social Sciences (SPSS), to establish the prevalence of back pain across the

five-year levels, the risk ratio and associated putative risk factors for back pain. The findings of the study indicated that the majority of dentistry students at the University of the Western Cape suffer from musculoskeletal disorders. The overall prevalence rate was very high, especially in fourth-year. Low back pain was the most common musculoskeletal disorder experienced, followed by neck pain and then upper back pain. Low back pain and upper back pain at the University of Western Cape was shown to be the highest reported so far among dentistry students in the world. A significant year-by-year increase in students reporting UBP across year level (from first- to fifth-year level) was reported.

It can be concluded back pain is a reality for most of the dentistry students at the University of the Western Cape in South Africa. It is therefore proposed that majority of the graduates from this sample will start their career with existing MSDs. The results also suggest that early preventive strategies such as strengthening and stretching exercise, promotion of good ergonomic posture and general fitness, could be done to prevent or reduce the onset of MSD. This would clearly indicate that physiotherapy has a role to play in treatment, prevention, and health promotion amongst dentistry students.

Keywords: **Musculoskeletal disorders, back pain, dentistry students, Cross sectional study, upper back pain, low back pain, Nordic back pain questionnaire, ergonomics, and posture**

DECLARATION

I declare that "BACK PAIN AMONGST DENTISTRY STUDENTS AT THE UNIVERSITY OF WESTERN CAPE" is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

JOSEPH REEJEN PRADEEP

Signature …….. November 2008

Witnesses:

……	……
Professor José Frantz	Dr Ina Diener

DEDICATION

I dedicate this thesis to my mom for her continuous support through prayers and also understanding me throughout the good and bad times of my study, and to my dad who was prepared to make the sacrifice over the last year. May God bless everyone. In addition I would like to dedicate this to my brother (Reju) and my wife (Judith).

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

Musculoskeletal pain, particularly back pain, has been found to be a major health problem for dental practitioners (Chowanadisai, Kukiattrakoon, Yapong, Kedjarune and Leggat, 2000; Marshall, Duncombe, Robinson and Kilbreath, 1997; Milerad and Ekenvall, 1990). The appearance, persistence and aggravation of pain could be related to a number of physical factors such as repetitive motion and posture (Rising, Bradford, Hursh and Plesh, 2005). Musculoskeletal disorders (MSD) are commonly found in occupations where people have to use high apprehension forces, like during the use of instruments where small muscle groups are used frequently in awkward postures for a prolonged period of time (Finsen, Christensen and Bake, 1998). Dental professionals have been documented to have a high percentage of musculoskeletal symptoms, as the dental profession is one of the visually dependent occupations which necessitates adoption of fixed postures for a prolonged period of time (Rundcrantz, Johnsson and Moritz, 1990). Other professionals, like muscians (Marshall *et al.,* 1997) and draftsmen (Chang, Bejjani, Chyan and Bellegarde, 1987) also have a high rate of MSD as their occupations also involve high visual demands. Studies demonstrated that there is direct relationship between postures used during clinical procedures and musculoskeletal disorders (Grandjean, 1988; Westgaard and Aaras, 1984). In order to get clear access to the oral cavity within the limited space available and impaired visibility within the patients oral cavity, dentists often adopt stressful body positions, which could aggravate neck and back problems (Finsen *et al*., 1998; Marshall *et al*., 1997; Shugars, Williams, Cline and Fishburne, 1984).

Clinical dental procedures involve the application of precise motor skills which are learned largely by observation, and involve intense hand-eye coordination and concentration. Mental stress during the procedures, the length of the consultation and possible pre-existing pain conditions may also contribute to dental practitioners' musculoskeletal pain (Al Wazzan, Almas, Al Qahtani and Al Shethri, 2001; Rundcrantz, 1991).

Further more, dental procedures are usually long and require much concentration of work. Back pain has been proposed to be the most common type of discomfort in all occupational groups, although its particular causes are broad and an exact diagnosis is often difficult (Sinczuk-Walczak and Izycki, 1994). Spinal pain is often a chronic musculoskeletal pain associated with repetitive movements during routine dental procedures and has been documented among dentists, dental hygienists and dental assistants (Shugars *et al*., 1984). Studies show that dentists experience more neck, shoulder and back pain than practitioners in other occupational groups (Van Doorn, 1995). Thornwall (1977) noted that dentists had predominately pain and discomfort localized to the lower back, followed by the neck and shoulder region. In a study by Rundcrantz (1991) high back pain prevalence (72%) amongst dentists was documented. While the occasional backache or neck ache is not a cause for alarm, frequent pain from cumulative physiological damage can lead to a chronic injury or a career-ending disability. The musculoskeletal health of dental professionals has been the subject of numerous studies worldwide, and their focus has been on the pain experienced by the practitioner who demonstrated high back pain prevalence (Leggat and Smith 2006; Valachi and Valachi, 2003; Finsen *et al*., 1998; Marshall *et al*., 1997; Rundcrantz, 1991).

Prevention of back pain could be better than cure. According to a survey done in the UK by Palmer and Walsh (2000), 49% of the adult population experienced LBP in a year. Dentists are most likely part of the above-mentioned group making it is imperative to educate these professionals on ways in which back pain could be prevented or treated to prevent absenteeism from work.

It can be hypothesized that dental students perform the same type of physical work as licensed practising dentists. However, the work schedule is less intense with fewer patients treated. As the body positions used during work by dental students and dentists are similar, it is possible that dental students can experience musculoskeletal problems even during their clinical training period (Marcellos, Youssef, Luca and Roberta, 2004). In addition to physical stress, a demanding university course load can promote psychosocial stressors that often generate feelings of uncertainty, low self-esteem, and unrelenting emotional stress. The extent to which dental students cope with work-related stress influences their physical well-being (George, Whitworth, Sturdevant and Lundeen, 1987).

Although several studies regarding prevalence of back pain among dentists, as well as its predisposing factors, have been published, only a few studies have investigated when these MSD's start during a dental career (Marcellos *et al.,* 2004; Rising *et al*., 2005). Rising *et al* (2005) reported that dental students from California demonstrated significant prevalence of MSD while acquiring clinical skills and providing routine dental procedures. In the same study more than 70% of third year dental students reported some form of MSD's. The persistence, duration and frequency of pain increased from the first to third year of dental school. In addition, there was a significant year-by-year increase of a perception that dental procedures aggravate their musculoskeletal pain. Similarly, studies from Italy and Turkey

reported a high prevalence musculoskeletal pain amongst dental students (Marcellos *et al*., 2004; Adnan, Ayfer, Cankat and Raba, 2005). The results of these studies suggest that dentistry students are already predisposed to back pain during their clinical training period in dental schools.

The current study aimed at establishing the prevalence, type and pattern of back pain reported by dental students in the Western Cape, as no research studies in this regard could be found in the literature for a South African student population.

1.2 PROBLEM STATEMENT

Although there is evidence that many dentists and dentistry students experience MSD, there is no documentation of the prevalence of MSD in dental students in South Africa.

1.3 AIM OF THE STUDY

The aim of the study was to determine the prevalence, pattern and type of back pain among dentistry students at the University of Western Cape (UWC) in South Africa, and explore the possible correlation between reported back pain and perceived influencing factors.

1.4 OBJECTIVES OF THE STUDY

- To establish the life-time, 12-months and one-month prevalence of back pain among dentistry students (across the five study years)
- To determine the perceived factors influencing presence of back pain in dental students across the five study year study period
- To determine the behavioural pattern of pain (frequency, duration, and intensity) reported in this population of dental students

- To establish the possible correlation between the prevalence, influencing factors and behavioural pattern of pain among the dentistry students

1.5 SIGNIFICANCE OF THE STUDY

The determination of back pain prevalence and the pattern of back pain among dental students at UWC will provide researchers and students with relevant information necessary to investigate predisposing factors to back pain in the dentistry population in South Africa. Studies have demonstrated that chronic back pain incurs high costs to society in terms of health care and loss of productivity due to absenteeism at the workplace (Gluck and Oleinick 1998; Ingemarsson, Sivik and Nordholm 1996). It is thus important to provide a basis for preventive measures early in dentists' careers. Establishment of a high prevalence of back pain amongst dentistry students will serve as a strong motivation for an awareness program and other prevention strategies in the dental curriculum.

1.6 DEFINITION OF TERMS USED IN THE RESEARCH REPORT

Musculoskeletal disorders: According to the National Institute for Occupational Safety and Health (NIOSH), musculoskeletal disorders (MSD) is a group of conditions that involves the nerves, tendons, muscles, joints, cartilage and spinal disc (NISOH 2001, cited in Piedrahita, 2003).

Ergonomics: Ergonomics is derived from the Greek *ergon*, 'to work', and *nomos*, 'study of' and is literally the study of work, or the work system, including the worker, his or her tools, and his or her workplace. "It is an applied science concerned with people's characteristics that need to be considered in designing and arranging things

that they use in order that people and things will interact most effectively and safely" (La Dou, 1994)

Dental ergonomics: Dental ergonomics is the adaptation of the working environment and methods to the dentist and his team, with respect to these physical and psychological capacities, for a healthy, safe and comfortable functioning in their professional life. According to the European Society of Dental Ergonomics (ESDE) the term 'dental ergonomics' includes the training of the dentist/dental team to use their own capacities and the possibilities of equipment, instruments, organization, etc. (European Society of Dental Ergonomics , 2007).

Back pain: An ache, pain or discomfort in the upper or lower back area whether or not it extends from there to one leg or both legs or to the shoulders (Kuorinaka, Johsson, Kilborn, Vinterberg and Biering-Sorenson, 1987).

1.7 ABBREVIATIONS

The following abbreviations have been used in this research report:

BMI: body mass index

LBP: low back pain

MSD: musculoskeletal disorders

MSS: musculoskeletal system

NBPQ: Nordic back pain questionnaire

NIOSH: National Institute for Occupational Safety and Health

PSP: prolonged static posturing

UBP: upper back pain

UWC: University of Western Cape

WHO: World Health Organization

WRMSD: work-related musculoskeletal disorders

1.8. OUTLINE OF THE OTHER CHAPTERS IN THE RESEARCH REPORT

Chapter 2 presents a review of literature that is pertinent to the current study. It discusses the prevalence of back pain among dentist and dentistry students, behavioural pattern of the experienced pain, predisposing factors, and the impact of back pain on the quality of life of dentists. It also reviews common prevention methods practised among dentists, as well as proposals to prevent disabilities and chronicity of MSD in dentistry students. Lastly published questionnaires used in similar previous studies are reviewed.

Chapter 3 describes the methodology applied in the study, including a description of the study setting, population sample, and the sampling method. In addition, development of the data collection questionnaire and the procedure used to collect data are presented. The chapter further describes the statistical data analysis package used to analyse the data. Lastly, the ethical considerations are discussed.

Chapter 4 describes the results of the study. The results comprise of both descriptive and inferential statistics. Back pain prevalence is presented across the year levels and gender. This is followed by a report on the perceived risk factors influencing the prevalence of back pain among students, and the relationship to back pain prevalence and pattern.

Chapter 5 presents a discussion of the key findings relative to results found in the literature, and the implications that the findings may have on management of MSDs in the dentistry population.

Chapter 6 includes a summary of the key issues emerging from this study, and a conclusion related to the findings. The limitations of the research study and recommendations relative to the findings of this study are also presented in this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This literature review begins with the epidemiology of back pain in general, and the prevalence of back pain among dental professionals and dental students. This is followed by a discussion of musculoskeletal disorders (MSDs) and various types of MSD frequently found among dentists, as described in the literature. The studies on the behavioural pattern of pain experienced by dentistry students is reviewed, followed by a discussion on proposed contributing factors and possible preventive and therapeutic interventions. Finally, questionnaires to measure the prevalence and impact of occupational musculoskeletal pain are reviewed and discussed.

2.2 EPIDEMIOLOGY OF MUSCULOSKELETAL DISORDERS (INCLUDING BACK PAIN)

The World Health Organization (WHO) defines MSD as disorders of the muscles, tendons, peripheral nerves or vascular system not directly resulting from an acute or instantaneous event (e.g. slips or falls). These disorders are considered to be work-related when caused by the working environment and the performance of work.

Studies have shown that lifting heavy objects and doing repetitive task in workplace are considered to be risk factors for causing MSD's. These disorders represent one of the leading causes of occupational injury and disability in industrialized countries (Frost, Bonde, Mikkelsen, Andersen, Fallentin, Kaergaard and Thomsen, 2002; Johanning, 2000; Sobti, Cooper, Inskip, Searle and Coggon, 1997; Ekberg,

Karlsson, Axelson, Bjorkqvist, Bjerre-kiely and Malm, 1995). Back problems have been cited as the second most common reason for missing work in an industrial population in the United States (Rowe, 1969). Approximately one million people annually lose their working time in USA, due to lower back and upper extremity problems. It is proposed approximately 85% of the population will experience LBP in their lifetime, while its annual incidence rate is believed to be around 1% - 2% (Johanning, 2000). This demonstrates that lower back pain (LBP) represents one of the most common forms of occupational MSD.

2.3 MUSCULOSKELETAL DISORDERS AMONG DENTISTS

The following most common MSDs resulting from prolonged static posturing (PSP) in dentistry, are mentioned in the literature:

- Chronic lower back pain: pain in the lower back, often referring to the hip, buttock or one leg. The cause may be muscle strains or trigger points, instability due to weak postural muscles, hypomobile spinal facet joints, or degeneration or herniation of spinal disks (Valachi and Valachi, 2003);
- Tension neck syndrome: pain, stiffness and muscle spasms in the cervical musculature, often referring pain between shoulder blades or the occiput, and sometimes numbness or tingling into one arm or hand. Forward head posture may precede this syndrome, precipitating muscle imbalances, ischemia, trigger points, or cervical disk degeneration or herniation (Valachi and Valachi, 2003). Operating with the arm elevated can predispose the operator to this syndrome, which often is seen in the trapezius muscle on the side on which the dentist holds the mirror (Rundcrantz, Johnsson and Moritz, 1990);

- Rotator cuff impingement: pain in the shoulder on overhead reaching, sustained arm elevation or sleeping on the affected arm. Incorrect body mechanics and rounded shoulder posture in the working position can lead to the impingement of rotator cuff. (Valachi and Valachi, 2003).

In recent years, awareness of MSDs in the dental profession has increased due to the rise in numbers of reported MSDs. James (1998) demonstrated that the body parts which are mostly at a risk while performing regular dental procedures are the neck, back and dominant wrist. This is mainly due to these parts of the body being involved in virtually all movement carried out during dental procedures. Fish and Allen (1998) reported in their study that back pain is the second leading cause of absence from work in the general population, and that dental practitioners are possibly among those susceptible to this problem. The prevalence of back pain among dentists vary in the literature from as low as 36% (Shugars, Williams, Cline and Fishburne, 1984) to as high as 79.12% (Khalid, Khalid, Salae and Mohammed, 2001). These studies support the assumption that dental professionals are at a high risk for developing work-related MSDs. The study by Visser and Straker (1994) demonstrated that dentists experience significantly greater levels of lower back discomfort than dental assistants. Even with the best postures, dentists often assume static postures which require 50% of the body muscles to contract to hold the body motionless while resisting gravity (Valachi and Valachi, 2003). Such postures lead to overuse and localized fatigue of muscles, which is related to dental tasks (Valachi and Valachi, 2003; Yoser and Mito, 2002). Since postures outside the neutral posture can cause musculoskeletal system problems, it is vital to maintain a neutral and basic operating posture since it allows dentists to be relaxed and well-

balanced (Valachi and Valachi, 2003). As dental practice requires the dentist to move and stand in awkward postures it is necessary to analyse the possible modifiable predisposing factors which can alleviate the amount of pain a dentist experiences. Thereby the possible chronicity of back pain can be reduced or prevented.

2.4 PREVALENCE OF BACK PAIN AMONG DENTISTS AND DENTISTRY STUDENTS

Studies demonstrate that dental professionals experience more neck, shoulder and back pains than practitioners in other occupational groups (Kuorinka and Jonsson, 1987; Van Doorn, 1995). Musculoskeletal pain, particularly back pain, has been found to be a major health problem for dental practitioners. Gorter, Eijkman and Hoogstraten (2000) demonstrated that one out of ten dentists reports poor general health, and three out of ten dentists report poor physical state.

Many studies have been done in the past to establish the prevalence of MSDs among the dentistry health care group. The results of studies in different countries are listed in Tables 2.1 to 2. 3.

Table 2.1: The prevalence and type of MSD among dentists in European countries

Author, publication year and title of article	Results
Sweden Rundcrantz *et al*., (1991): Pain and discomfort in the musculoskeletal system among dentists	A prospective study was done in1987 and 1990 with the same subjects. The results of 1987 study showed that 10% of men and 24% of women had upper back pain, while 35% of men and 49% of women had lower back pain. Where as in 1990, 17% of men and 27% of women had upper back pain compared to 37% of men and 44% women with lower back pain. 1) Overall 72% of Swedish dentists reported to have musculoskeletal problems and the intensity of pain was found more in younger dentists when compared to their older counterparts. 2) More than 50% of the Swedish dentists experienced LBP in the past year, of which 74% were female dentists.
Belgium Gijbels, Jacobs, Princen, Nackaerts and Debruyne (2006): Potential occupational health problems for dentists in Flanders, Belgium	A pilot experimental study was done among Flemish dentist regarding various health related problems experienced by them. The study revealed that 54% of the dentists experienced low back pain, and majority of the LBP was stress-correlated.
South-East Turkey Polat, Başkan, Altun and Tacir (2007): Musculoskeletal symptoms of dentists from South-East Turkey	Of the respondent dentists, 84% reported having some form of musculoskeletal disorders and out of which 52.51% had either upper back or lower back pain.
Greece Alexopoulos, Stathi and Charizani (2004): Prevalence of musculoskeletal disorders among dentists	Of the respondents, 62.5% reported some form of MSD, out of which 46% reported LBP. More than 25% of all subjects reported chronic (severe) back pain. The prevalence of hand/wrist complaints followed lower back disorders and resulted in a significantly higher chronicity than any other complaint.

Among the studies done in European countries, Greek dentists had the highest MSD prevalence rate. The results of the study in Greece established that dentists had significantly more neck and back pain than dental hygienists, dental assistants, and dental technicians (Alexopoulos *et al.,* 2004). In the Swedish study it was shown that the back pain prevalence rate had increased over the years among Swedish dentists (Rundcrantz *et al*., 1991). All the above studies confirmed the fact that the prevalence of back pain among dentists is high in European countries, with more than 53% of the dentists in all the study populations reporting back pain.

Table 2.2: The prevalence and type of MSD among dentists in Middle East countries

Country of study **Author, publication year and title of article**	**Results**
Saudi Arabia Khalid, Khalid, Salae and Mohammed, (2001): Back and neck problems among dentists and dental auxiliaries	This study aimed at studying postural problems among Saudi Arabia dentists. A sample size of two hundred and four dentists and dental auxiliary was taken and results showed that 79.12% of the dentists had suffered back problems. Younger dentists and dental auxiliaries reported more back pain than their older counterparts.
Israel Ratzon, Yaros, Mizlik and Kanner (2000): Musculoskeletal symptoms among dentists in relation to work posture	Fifty-five per cent of the dentists experienced lower back pain. The most frequently reported pain and discomfort was lower back pain.

The studies done in countries in the Middle East, revealed that the prevalence was highest among South Arabian dentists. A high percentage (79.5%) of dentists suffered from back pain, while a very high percentage (90.69%) of the dentists experiencing back pain had postural faults. The prevalence rate among Israeli dentists was similar to that in the studies done in European countries.

Table 2.3: The prevalence and type of MSD among dentists in Australia

Country of study Author, publication year and title of article	Results
New South Wales (NSW): Marshall, Duncombe, Robinson and Kilbreath, (1997) Musculoskeletal symptoms in New South Wales dentists	Of the respondents, 82 % reported at least one musculoskeletal symptom in the previous month and 64 % reported backache during the previous month.
Queensland: Leggat and Smith, (2006) Musculoskeletal disorders self-reported by dentists in Queensland, Australia	53.7% of the dentists experienced lower back pain in the past 12 months. 34.4% of the dentists experienced upper back pain in the past 12 months.

Among the studies done in Australia, the prevalence for back pain was more than 53%, which was similar to the results from European countries. Lower back pain was the most prevalent symptom of MSD amongst Australian dentists.

2.4.1 Musculoskeletal problems among dentistry students internationally

Studies done in Italy, Turkey, and California (Marcellos *et al*., 2004; Adnan *et al*., 2005; Rising *et al*., 2005) found a high percentage of musculoskeletal problems among dentistry students.

Table 2.4: The prevalence and type of MSD among dentistry students

Country of study Author, publication year and title of article	Results and comments
Marcello *et al*., 2004: A comparative study between Italian and Lebanese dental students, and between Italian dental students and psychology students Upper body musculoskeletal symptoms in Sardinian dental students	The sample size for the study included Italian and Lebanese dental students. Prevalence of LBP 32.5% was 37.1% respectively and for UBP it was 21.1% and 29.2% respectively. The mean age of Italian and Lebanese students was 22.7 years and 20.7 years respectively Italian dental students reported more lower back pain than psychology students.
Rising *et al*., 2005: A study among Californian dental students Reports of body pain in a dental student population	More than 70 % of students of both sexes reported pain by their third year of dental school, with 46% - 71%reporting some sort of musculoskeletal pain. The study showed that men reported having worse pain in their mid- to lower back.
Adnan *et al*., 2005: A study among Turkish dental students Musculoskeletal disorders in both left- and right-handed Turkish dental students	Of the Turkish dental students, 86% reported one or more musculoskeletal symptoms (ache, discomfort in the neck, back, head, and shoulder region. The results also showed that left-handed students had more prevalence and severity of MSD than right-handed students

The results of Table 2.4 suggest that the prevalence of MSD is high among dental students, with 86% of Turkish students reporting to have one or more

musculoskeletal symptom. The percentage of Lebanese students reporting back pain were the highest when compared to Saudi Arabian dentists reporting that 79% (listed in table 2.2) had suffered back pain during their lifetime (Khalid *et al*., 2001). In a study done by Chowanadisai, Kukiattrakoon, Yapong, Ksedjarune and Leggat (2000), part-time Thai dentists were found to have a higher proportion of musculoskeletal problems than their full-time counterparts. The number of years since graduation was also negatively correlated with musculoskeletal pain in these Thai dentists. This suggests that musculoskeletal symptoms are more prevalent among younger dentists than older, experienced dentists. Furthermore, results from the Rising *et al*. (2005) study demonstrate that MSD prevalence increased from the first year to the third year of study, suggesting that there might be an increase in the prevalence of MSD as years go by from first to final year of study.

From the studies and results from Tables 2.1-2.4 it can be concluded that the prevalence of musculoskeletal disorders and back pain reported among students and dentists is high. Although there has been no longitudinal study done to follow up dentists right from their student period, the results suggest that back pain is experienced early in the study time, and that it can be a common feature of life for many dentistry students and graduates.

2.5. BEHAVIOURAL PATTERN OF BACK PAIN AMONG DENTISTRY STUDENTS

In the three year prospective study done by Rundcrantz *et al.* (1991) there was an increase in pain intensity among dentists. Only one study on the behavioural pattern of musculoskeletal pain experienced among dentistry students could be found. The study done in California by Rising *et al.* (2005) demonstrated interesting results. The

mean duration of pain ranged from one to three hours per day to four to eight hours per day. The mean frequency of pain ranged from more than 10% of the days to more than 25% of the days in pain. However, both frequency and duration of the most symptomatic pain were significantly higher for third year students compared to first years in dental school. The group means for pain intensity ranged from 3 to more than 5 (scale 0 - 10; 0 = almost no pain, 10 = extreme pain). Women had significantly higher pain intensity compared with men (two-way ANOVA, $p < .05$). With regard to years in dental school, third-year students reported to have significantly higher pain intensity (Bonferroni test, $p = .0015$). The study further highlighted that pain frequency and duration of pain experienced are higher in all other year levels when compared to first-years but there was no significant rise in trend.

The mean level of fatigue reported by students ranged from 2.9 to 4.8 (VAS 0-10). And the mean level of fatigue increased significantly with years in dental school, while third-year students reported the highest level of fatigue ($p = 0.01$). The students' perceptions of how much the most symptomatic body pain was aggravated by stress had a mean range of 3.0 to 5.1 (VAS 0-10) for all four classes. The students perception of their most symptomatic body pain being aggravated by the performance of dental procedures increased significantly with each year in dental school ($p = 0.001$), but it did not differ between men and women. The results of the study demonstrated significant associations between the intensity of pain and the reported levels of fatigue and stress ($r = 0.75$ and $r = 0.89$, respectively). Conversely, there was no significant association between any pain characteristics such as intensity, duration, frequency and level of regular physical exercise.

In summary, the results of the Californian study showed that the persistence, duration and frequency of pain increased from the first to the third year of dental school. In addition, the perception that dental procedure was aggravating the pain increased with each year in dental school. Although not significant, there was a trend of an increasing percentage of students reporting pain with each year in dental school.

2.6 PREDISPOSING FACTORS FOR BACK PAIN AMONG DENTISTS

The dental team is at high risk of neck and back problems due to limited work area and impaired vision associated with the oral cavity (Khalid *et al*., 2001). These occupational demands of dentists cause them to assume uncomfortable, asymmetrical positions, with high static muscle activity. Furthermore, dental procedures are usually long and require much concentration during work (Khalid *et al*., 2001). Bassett (1983) proposed that the shape of the vertebral column, aging changes, weak muscles, postural practice, movements, lifting techniques, and mechanical stress have been identified as factors that contribute to neck and back pain in general.

In order to prevent back pain among dentists it is necessary to analyse the factors which have been reported to contribute to it. Many studies have been done to find the predisposing factors. Some of the aggravating factors which would predispose dentists to incurring back pain during their career are discussed in the subsequent sections.

2.6.1 Specific clinical tasks

Valachi and Valachi (2004) proposed that MSD also often results from a prolonged forced working position of the dentist in order to allow good sight in the narrow work area of the patient's mouth. This could lead to increased disk pressure and spinal hypomobility and consequently low back pain and muscle ischemia. Dentists' tasks usually involve forcefulness and high repetitive movements. Overstrained and awkward back postures and repetitive movements of arms and hands, as often performed in dentistry, have been established as predisposing for musculoskeletal disorders such as back pain and neck and shoulder disorders (Szymanska, 2002).These repetitive movements are usually monotonous in nature (Milerad and Ekenvall, 1990). Finsen, Christensen and Bakke (1998), and Milerad, Ericson, Nisell and Kilbom (1991) state that dentists perform most of their work with their head bent forward and the arms, especially the right one, held out from the body: that is, they work in abduction or flexion of the upper arm and flexion and rotation of the neck. This working posture could lead to a considerable load on different structures in the neck. Another possible predisposing factor is the limited range of motion which leads to isometric muscle contraction as a result of the confined working area (Rundcrantz *et al*., 1990). Difficulties in direct visualization of the oral cavity and increased visual demands requires the dentists to maintain fixed postures for a prolonged period of time which loads the upper part of the trapezius muscle, causing the muscle to fatigue. Fatigue would, according to these authors, contribute to the high frequency of neck and shoulders problems (Johnson and Rugan, 1982 cited in Rundcrantz *et al*., 1990).

2.6.2 Dental office design

Szymanska (2002) proposed that Polish dentists work in conditions which generally predispose them to MSDs. The workplace design could thus also play an important role in predisposing the dentist to MSD. According to Finkbeiner (2002) and Szymanska (2002, 2001) inappropriate office size and non-ergonomically design limiting work/personal space, access, reach distances and visibility are considered to be risk factors for developing musculoskeletal symptoms among dentists. Guay (1987) was of the opinion that extended workdays, awkward postures, prolonged standing and unsupported sitting, as well as an array of other problems caused by poorly designed work stations, improper work habits, and instruments that are difficult to manipulate, are the reasons for the increased reporting of MSD among dentists.

From the above studies it can be concluded that the dentist's task involves working conditions which, under normal circumstances, can predispose them to musculoskeletal injury. The working environment plays an important role. It is thus necessary that the workstations, instruments and equipment are ergonomically friendly.

2.6.3 Posture-related risk factors

Rundcrantz *et al.* (1991) established that dentists often use body postures which are asymmetrical and uncomfortable. In the same study, it was found that low back pain correlated significantly with working posture. Various investigators have pointed out that the common postural faults among dentists and dental auxiliaries are craning and/or excessive bending and twisting of the neck, bending forward from the waist,

elevation of the shoulders, and general bending or twisting of the back and neck (Bers,1980; Willee,1967). The study by Walters (1976) highlighted that stress, postural practices (bending and twisting trying to gain better access and visibility within the oral cavity), as well as prolonged working times, lead to fatigue.

2.6.3.1 Static posture of dentists

In their study, Jonsson and Rugan, (1982 cited in Rundcrantz *et al*. 1990) found that prolonged static muscle activity is a risk factor for occupational musculoskeletal problems. Dentists frequently assume static postures, which require more than 50% of the body's muscles to contract to hold the body motionless while resisting gravity (Ratzon, Yaros, Mizlik and Kanner, 2000). Finsen *et al*. (1998) established that the static muscle activity in the neck and upper back muscle is high for dentists during work and also suggested that the risk of getting MSD would be much less if the static muscle activity were less. Valachi and Valachi (2003) proposed that spending long periods in static positions increases a worker's susceptibility to injury, especially to the lower back. This static activity is mainly caused by bending the back to allow good sight, causing sustained stretching of muscles and ligaments of the spine. The muscle and ligament fibres of the latissimus dorsi at the level of the lumbar and sacral spine are mainly overloaded by bending the thorax forward (Shugars, Miller, Williams, Fishburne and Strickland, 1987), causing lower back problems. The static forces resulting from these postures have shown to be much more taxing than dynamic (moving) forces (Ratzon *et al*., 2000).

2.6.3.2 Sitting posture

In a study by Marklin (2005), it was established that dentists were seated 78% of the time. The study by McGill, Hughson and Parks (2000) demonstrated that static prolonged contractions of the lower back extensor muscles (lumbar erector spinae), which occur while sitting, significantly decreased oxygenation levels in the muscle. This occurs a person performs as little as 2% of the maximum voluntary contraction of the muscle. In dentistry, when the dentist sits unsupported over a period of time, these muscles must maintain eccentric contractions (lengthening while under tension), which increases the susceptibility to micro-tearing of muscle tissue. Dentists spend a lot of time sitting in awkward postures while they treat patients, thus they are more prone to have lower back strain (Cailliet, 1996 cited in Valachi and Valachi, 2003). Dentists usually work in slightly forward-flexed posture. Repeated leaning toward the patient can cause strain and over-exertion in the lower back extensors, while the deep stabilizing abdominal muscle (transversus abdominus) tends to become weaker (Hodges and Richardson, 1996). Lower back strain is a common diagnosis among workers who must sit in a slightly flexed forward position (McGill, Hughson and Parks, 2000). Dentists tend to develop a muscle imbalance between the abdominal and lower back muscles due to the practice of seated posture dentistry (Valachi and Valachi, 2003). The transversus abdominus muscle is one of the muscles, which are responsible for core stabilization of the lumbar curve. The importance of the transversus abdominus muscle in preventing lower back pain was the subject of studies by Hodges and Richardson (1996) and Hides, Richardson and Jull (1996). Another study showed that only 10% of patients with a history of lower back pain could effectively contract the transversus abdominus muscle, compared with 82% of non-symptomatic subjects. In the study by Richardson, Jull

and Richardson (1995) it was found the ability to effectively contract the transversus abdominus muscle was linked closely to patients' reports of decreased pain levels and expressions that their backs felt safer and to their ability to control back pain.

From the above it can be concluded that dentists may develop a vicious cycle of events. Valachi and Valachi (2003) state that when the human body is repeatedly subjected to prolonged static postures (PSPs), a series of events can be initiated that may result, among others, in muscle imbalance, ischemia, trigger points, joint hypomobility and spinal disk degeneration. Prolonged awkward, uncomfortable, distorted, inflexible, imbalanced, compromised and stressful work postures/positions are all considered as risk factors.

2.6.4 Compromised effects on vision

A dentist's work consists of precision tasks, involving a high degree of visual and manipulative elements, sometimes in combination with exertion of force. The nature of dentistry requires extremely fine motor co-ordination of the dominant hand, and sometimes forceful grips (Rising *et al*., 2005). The non-dominant hand is mostly used as a support and for assistance to get a good view of the operating field, e.g. by using the dental mirror, which demands a static and often forceful grip. Yamalik (2007) proposes that insufficient lighting positioning, intensity and quality, and inappropriate visual adjustments lead to unbalanced positioning of the body and uncomfortable viewing due to shadowing, specular reflection and glare. These are all considered to be risk factors for developing musculoskeletal disorders. Moreover, tasks that have a high level of visual, manipulative and reach demands highly influence work postures, especially for the head, neck, arms and hands. Haslegrave

(1994) and Rising *et al.* (2005) stated that intense hand-eye co-ordination with repetitive movements, which are needed dental procedure, can also predispose to chronic MSD. It can thus be said that lighting in the clinical setup could contribute to dentists' developing MSD, as there is intense hand-eye co-ordination involved, which influences the working posture of the dentists.

2.6.5 Practice mode and workload

2.6.5.1 Practice mode

Dentists' practice mode refers to the position adopted by dentists when they work, whether they are standing or using four-handed dentistry. In order to reduce the musculoskeletal problems and fatigue experienced by the dentists sitting was adopted as their practice mode (Fox and Jones, 1967 cited in Marshall *et al*., 1997). Later in the 1960's 'four-handed dentistry' was used by the personnel working in the University of Alabama School of Dentistry (Robinson, Wuehrmann, Sinnett and McDevitt, 1968). This type of dentistry involves the dentists working alongside of dental assistants. The dental assistants help the dentists in handling instruments which are out of reach, thereby making the dentist's operation field smaller so that maximum efficiency can be achieved. Marshall *et al*. (1997) state that those who do not practise four handed dentistry or are lacking in appropriate training for practising four handed dentistry can also be predisposed to MSD.

2.6.5.2 Workload and work schedule of the dentists

In 1997 a study done by Marshall *et al.* established that maxillofacial surgeons not utilizing dental assistants or working for longer periods of work without break had significantly ($p<.05$) higher frequency of musculoskeletal problems, when compared

to those dentists who do not practise four-handed dentistry. In this study it was noted that dentists who took only one break per day had high prevalence of back pain, when compared to those dentists who took more than two breaks a day. A study done in Greece (Alexopoulos *et al*., 2004) found that the co-morbidity would be high if dentists worked for long hours without breaks, with a high physical load and lower job control. Bassett (1983) proposed that the time pressure from a fixed work schedule which is planned weeks or days in advance can also be a risk factor for low back pain. From the above discussion it can be concluded that long or irregular working hours in unnatural positions for long periods of time could predispose an individual to back pain.

2.6.6 Awareness and training

Limited awareness of ergonomic aspects of the workplace is also considered as one of the risk factors. Gijbels *et al.* (2006) recommend as a preventive step that students be trained, from the beginning of their undergraduate studies, to perform work while availing themselves of optimal postures and good habits. Special attention must be paid to work postures and movement patterns that influence head and wrist positions as well as to measures that lower the static load on the shoulder muscles. These are factors which, due to the localization of disorders found in dentists, might play the most important role for prevention of future problems. It can be concluded from the above discussion that dentists not only need dental equipment that are functionally designed, but also instructions as how to use the instruments ergonomically as applied to dentistry.

2.6.7 Psychosocial factors

Factors such as psychological stress, coping with anxious patients and stress-related health problems can contribute to the development and experience of pain and discomfort. The dental profession is often considered to be stressful, and a number of studies pay attention to psychological stress and stress-related health problems in the dental population (Morse, Michalak-Turcotte, Atwood-Sanders, Warren, Peterson, Bruneau and Cherniack, 2003). A strict time schedule, coping with anxious patients or painful treatments are frequently referred to as major stressors (Myers and Myers, 2004; Moore and Brødsgaard, 2001). In the long term the levels of stress thus experienced could lead to burnout, with typical characteristics of emotional exhaustion, depersonalisation and reduced personal accomplishment (Rada and Johnson-Leong, 2004). Rundcrantz (1991) found that there was a positive correlation of MSDs with stress.

Furthermore, dentists reporting psychological stress would have more musculoskeletal complaints (Ekberg, Bjørkqvist, Malm, Bjerre-Kiely, Karlsson and, Axelson, 1994; Lehto, Helenius and Alaranta, 1991; Rundcrantz, 1991). In the study in Belgium by Gijbels *et al*. (2006), the median score of the stress level experienced was 7 (in a scale 0-10). These researchers also emphasised that the dental profession is highly stressful. Heath, Macfarlane and Umar (1999) found that potential stressors for dentistry students are information-input overload, fear of not completing the quantity and variety of work, inadequate and conflicting feedback regarding performance, and approachability of faculty and staff. George, Whitworth, Sturdevant, and Lundeen (1987) reported in their study that students' stress levels are associated with their personalities. Health that was perceived to be bad or

moderate, ageing, and female gender were related with an increase, not only in co-morbidity, but also in co-morbidity of severe (chronic) complaints (Alexopoulos *et al*., 2004).

2.6.8 Individual risk factors

Individual risk factors include age, gender, physical fitness, cigarette smoking, and body mass index (BMI) (Bernard, 1997; National Research Council and Institute of Medicine 2001). These risk factors are thought to affect an individual's unique susceptibility to the physical and psychosocial risk factors. Studies have shown an association between musculoskeletal symptoms and back pain with demographic and workload factors, age, years of practice and gender (Rucker and Sunell, 2002; Hamann, Werner and Franzblau, 2001; Liskiewitz and Kerschbaum, 1997; Stockstill, Harn and Strickland, 1993). There are various individual factors that can influence the intensity and frequency of back pain experienced among dentists, namely age, gender, years of practice, previous episodes of back pain and weight gain.

2.6.8.1 Gender

In the studies done by Kerosuo, Kerosuo and Kanerva (2000) and Rundcrantz *et al*. (1991), it was reported that female dentists have more musculoskeletal problems than their male colleagues. Unruh (1996) reported that women are more prone to developing varying types of chronic musculoskeletal pain than men.

2.6.8.2 Period of practice and age

Many studies in the past have suggested that younger dentists have more musculoskeletal disorders than older dentists (Finsen *et al*., 1998; Marshall *et al*.,

1997). In this regard, an investigation of Thai dentists revealed that less experienced dentists were more likely to suffer from musculoskeletal pain than their more experienced counterparts. The number of years since graduation was also negatively correlated with musculoskeletal pain in these Thai dentists (Chowanadisai, Kukiattrakoon, Yapong, Kedjarune and Leggat, 2004). Possible explanations were that experienced dentists are probably better at adjusting their working position and techniques in order to avoid musculoskeletal problems compared to their less experienced counterparts, or they simply developed coping strategies to deal with the pain (Leggat and Smith, 2006). In the same study it was found that upper back pain that interfered with daily activity was significantly more likely to be reported by younger and less experienced dentists. In a study in Poland (Szymanska, 2002), however, it was found that dentists over years of work experienced an increase in the number of MSDs. Chronicity increased with age for all complaints with significant odds ratios for those of 50 years or older, varying from 2.15 to 2.69.

The results of a study done in South-East Turkey (Polat, Başkan, Altun and Tacir, 2007) demonstrate a clear association between body length, body weight and musculoskeletal symptoms. The researchers recommend that dentists pay attention to their nutrition and exercise. Rising *et al*. (2005) suggest that other factors like time constraints, unexpected procedural challenges, mental stress during the procedures and possible pre-existing pain conditions may also contribute to dental practitioners' pain. From the above studies it can be assumed that certain physical characteristics of the individual indeed play a role in development of MSD.

In conclusion, the occupational demands of dentists cause them to assume uncomfortable, asymmetrical positions, with high static muscle activity. Although the occupational demands cannot be changed, efficient working strategies or working technique can help in reducing the above-mentioned risk factors. Very few studies have been done to determine whether risk factors are same in the students who are acquiring technical skills. Results of one such study in Turkey (Adnan *et al.,* 2005) among dentistry students suggested that modification of work practices appears to be effective in decreasing the prevalence of symptoms. The best ergonomic working principles should be taught to the students, and dental schools should provide a comfortable working environment. For example, a left-handed student should learn to work on a chair that has been designed for left-handed people so that students can work from the left side of the patient.

2.7 STUDIES ON PREVENTION PROGRAMMES

Studies have shown that chronic back pain incurs high costs to society in terms of health care and loss of productivity due to absenteeism at the workplace (Gluck and Oleinick 1998; Ingemarsson, Sivik and Nordholm 1996). Prevention of occupational LBP should thus be considered as a key research concern. Feldman, Shrier, Rossignol and Abenhaim (2002), as well as Chang (2002) suggested that by modifying the known risk factors for lower back pain, it might be possible to prevent the development of lower back pain. Prevention strategies that are proposed from results of studies are ergonomic interventions, exercise intervention and health promotion (educational awareness).

2.7.1 Ergonomic intervention to prevent or reduce back pain

This applied science called ergonomics can be classified into the following categories: preventive ergonomics, geometric ergonomics, environmental ergonomics and temporal ergonomics. Preventive ergonomics is related to the design and conception of a project, correct ergonomics analyses and correcting mistakes. Geometric ergonomics mainly focuses on postures and movements and environmental ergonomics harmonizes environmental features (e.g. lighting, sound, temperature and humidity). Temporal ergonomics deals with factors related to time (e.g. breaks and working hours) (Kavo 2007, in Valachi and Valachi, 2003)

Marcellos *et al*. (2004) stated that by giving more importance to ergonomics at work place, musculoskeletal disorders could be avoided or at least reduced. Wagner (1984) proved that the effective use of ergonomic workload and the use of ergonomics in the work site could avoid recurrent episodes of pain and disability. The study thus confirmed the importance of ergonomics in workplace and the use of good ergonomic techniques to reduce the frequency of MSDs. Rundcrantz *et al*. (1991) found in their study that dentists using ergonomic techniques like using standing as their preferred position of practice, taking micro breaks during treatment of pain, changing their operating position in relation to the patient and also using a mirror to get a clear and visible access to specific area of the oral cavity and using a wedge cushion for the patients head during treatment, had fewer musculoskeletal symptoms. Kerosuo *et al*. (2000) demonstrated similar results. Various studies have been done in the past in order to reduce MSDs among dentists in the field of preventive ergonomics. A few of their results and recommendation are listed and discussed below.

2.7.1.1 Sitting posture of dentists (geometric ergonomic intervention)

In section 2.6 it was found that dentists are seated for 78% of their working time. Therefore sitting is the most frequent position in practising dentistry. In an unsupported sitting position the lumbar lordosis flattens. The bony infrastructure provides little support to the spine, which now is hanging on the muscles, ligaments and connective tissue at the back of the spine, causing tension in these structures. Ischemia can ensue, leading to lower back strain and trigger points. This flattening of the lumbar curve also causes the nucleus in the spinal disk to migrate posteriorly towards the spinal cord. Over time, the posterior wall of the disk becomes weak, and disk herniation can occur. Therefore, operators need to know about strategies they can use to maintain the essential lumbar lordosis whenever possible (Valachi and Valachi, 2003).

Maintaining the low back curve and the lumbar lordosis when sitting can reduce or prevent lower back pain (Harrison, Harrison and Croft, 1999; Hedman and Fernie, 1997). Therefore emphasis should be placed on how the operator sits on seat and how he or she adjusts the seat to achieve the greatest efficiency, thereby maintaining the lumbar lordosis. The following practices have been recommended by Valachi and Valachi (2003) to help maintain the lower back curve. Tilting the seat angle slightly forward 5 - 15 degrees will increase the low back curve (Chaffin, Andersson and Martin, 1999). This will place the operator's hips slightly higher than his/her knees and increase the hip angle to greater than 90 degrees, which may allow for closer positioning to the patient. Chairs without the tilt feature can be retrofitted with an ergonomic wedge-shaped cushion. Rundcrantz *et al*. (1991) found that dentists using wedge-shaped cushions had fewer musculoskeletal problems.

Sitting close to the patient and positioning the knees under the patient's chair if possible is beneficial. This can be facilitated by tilting the seat and using patient chairs that have thin upper backs and headrests. For some operators this positioning may cause shoulder elevation or arm abduction. In such cases a different working position should be assumed. A saddle-style operator stool that promotes the natural lower back curve by increasing the hip angle to approximately 130 degrees could be considered. Using this type of stool may allow the dentist to be closer to the patient than when the patient chairs have thick backs and headrests. Adjusting the chair, which will be discussed in detail in section 2.71.2, could also improve the situation. Regular contracting the transverse abdominal muscles will help to stabilize the lower back curve. To do this while sitting, the operator should sit tall with a slight curve in the lower back, exhale, pull his navel towards the spine without letting the curve flatten, and continue breathing while holding the contraction for one breath cycle. Another way of achieving the lumbar curve is by pivoting the hips forward. This should be done once the operator has stabilized his/her back by doing the previous exercise.

2.7.1.2 Ergonomically using the operator's chair (preventive ergonomic intervention)

Chaffin *et al*. (1999) suggested that adjusting the operator's chair properly is one of the important preventive ergonomic interventions. Operators need to know how to adjust their chairs to obtain maximal ergonomic benefits, as suggested below:

- A common mistake operators make is positioning patients first, and then adjusting their chairs to accommodate the patients. This procedure should be avoided and the operator's chair should be adjusted first.
- The buttocks should be snugly positioned against the back of the chair. The edge of the seat should not contact the backs of the knees. A seat that is too deep can encourage the operator to perch on the edge of the seat.
- The feet should be placed flat on the floor and the seat height should be adjusted up until the thighs gently slope downward while the feet remain flat on the floor. This helps the dentist to keep the low back curve straight and to use his/her lower limbs more comfortably.
- The lumbar support should rest in the natural lumbar curve of the lower back. This can be achieved by moving the backrest up or down and then angling the lumbar support forward to facilitate contact with the operator's lower back.
- Armrests, which are designed to decrease neck and shoulder fatigue and strain, should be adjusted to support the elbows in the neutral shoulder position.
- Sitting is the most frequent position in the practice of four-hand dentistry. Knowing to maintain a good lower back lumbar curve and how to adjust and use the operator's chair ergonomically will help in reducing musculoskeletal complaints.

Other methods such as the proper selection, adjustment and use of magnification systems have been associated with decreased neck and low back pain, as they allow operators to maintain healthier postures (Chang, 2002). Chang (2002) also suggested that the use of coaxial illumination headlights for treating patients and the

selection of correct surgical telescopes could prevent or reduce chronic neck and back pain.

2.7.1.3 Use of correct geometric ergonomics

In the sections below, suggestions are provided for effective measures to curtail muscle strain in practising dentists.

2.7.1.3.1 Avoid static postures

According to Lehto, Helenius and Alaranta (1991), the concept of a single correct work posture may be physiologically invalid, as the human body may be made for movement and ever-changing postures. Increasingly, the literature supports the idea that workers should shift the muscle action from one group of muscles to the other or opposite group of muscles, by constantly changing their working positions. As dentistry is a profession where there is static loading of muscle activity as discussed in section 2.6, it can be said that static posture of dentists should be avoided whenever possible. If not, effective strategies to reduce static muscle should be used. Exercises can be done during breaks to help the muscles to relax. Alternatively, exercises which will work on the opposite muscle groups can be performed, which would help in relieving the muscles from constant load.

2.7.1.3.2 Alternating between standing and sitting posture

Standing uses different muscle groups than does sitting; therefore, alternating between the two positions would allow one group of muscles to rest while the workload is shifted to another group of muscles. Callaghan and McGill (2001) suggest that alternating between standing and sitting can also be an effective tool in preventing injuries. A study by Rundcrantz (1991) showed that there were fewer

symptoms in subjects who used standing as the preferred way of treating. Ratzon *et al*. (2002) found that dentists who worked in the sitting position had more severe lower back pain than did those who alternated between sitting and standing. Another technique to reduce static muscle work is by repositioning the feet. By changing the weight bearing on the feet, work load can also be shifted from one group of muscles to another in the low back, and it can also help the overworked tissues to be replenished with nutrients. Therefore, from the above studies it can be concluded that dentists who alternate operatory position when treating patients will experience lesser musculoskeletal symptoms.

2.7.1.3.3 Avoiding twisting movements of the whole body

Operatory design plays an important part in how often dentists perform detrimental twisting movements during the workday. When possible, dentists should position instruments within easy reach. Rear delivery system encourages extensive trunk twisting and shift of vision to retrieve instruments, and side delivery systems require moderate twisting. Trans-thorax (or over-the-patient) delivery systems minimize twisting and shift of vision. If the operatory design requires the dentist to turn to retrieve instruments or handpieces, the dentist should swivel the chair to face the area squarely instead of twisting the torso. Operators should try to retrieve items with the closest hand, especially with rear delivery systems, to avoid twisting or reaching across the body. Repeated unilateral twisting in one direction may result in muscle imbalances or structural tissue damage, leading to lower back pain (Toren, 2001; Van Dieen, 1996). Dentists should therefore effectively use operatory design which will involve minimal twisting of the body.

Rundcrantz and Johnsson (1991) compared two groups of subjects: one group undergoing physiotherapy treatment and the other group ergonomic interventions. It was found that the group that had physiotherapy intervention showed immediate relief. Both of these could thus be considered to reduce MSD.

In the following paragraphs studies done on ergonomics interventions and physiotherapeutic intervention to prevent back pain will explained in detail.

2.7.1.3.4 Doing stretching exercise during micro breaks

As discussed earlier in this section static posture should be reduced as far as possible. In order to prevent injury from occurring to muscles and other tissues, the operator should allow for rest periods to replenish and nourish the stressed structures. In general, dentists tend to lose flexibility in the direction opposite to that in which they are postured statically during the day (Rundcrantz *et al*., 1991). In the study by Rundcrantz *et al*. (1990) the authors suggested that having operators take frequent breaks and reverse their positions is integral in an effective injury prevention programme. Stretches performed in the reverse direction of awkward PSPs may prevent muscle imbalances that can lead to pain and MSD (Valachi and Valachi, 2003).

Directional stretches can be performed in or out of the operatory and can be incorporated into a daily routine that facilitates balanced musculoskeletal health. Directional stretching involves a rotation, side bending or extension component that is generally in the opposite direction of that in which the operator frequently works. This strategy addresses the muscle imbalances that tend to develop. In a study on the efficacy of micro breaks during the workday, McLean, Tingley, Scott and

Rickards (2001) found that by complying with regularly scheduled micro breaks, the subjects had less discomfort and that the addition of 30-second micro breaks showed no detrimental effect on worker productivity. Theresa *et al*. (2004) recommends that between patient's breaks, dentists must move in the direction opposite to the position used to deliver clinical service by moving out of the maintained position. In this way alternate muscles take over and allow relaxation of the postural muscles which are commonly used.

We can thus conclude from the above discussion that dentists should do directional stretches, both when the operator is taking micro breaks in the operating chair and out of it. They also can benefit by taking frequent short breaks and by walking or performing other activities involving movement during longer breaks.

2.7.2 Various exercise interventions to reduce or prevent back pain

Exercise programmes that facilitate weight loss, strengthening of the trunk muscles, and stretching of soft issues, appear to be helpful in alleviating lower back pain. Theresa *et al*. (2004) and Khalid *et al*. (2001) recommended correct postural practices, relaxation exercises, aerobic exercises and weight monitoring in order to alleviate spine problems.

2.7.2.1 Aerobic exercise

One major contributing factor to MSD is decreased flow of nutrients and oxygen to muscles. Aerobic exercise increases blood flow to all of the tissues in the body and improves their ability to use oxygen. In addition, aerobic exercises improve cardiovascular and cardio-respiratory function, reduce body fat, improve stress

tolerance, and improve the circulation to the muscles (Lalumandier *et al*., 2001). In the study done by Nutter (1988) it was found that aerobic exercise improves or prevents back pain.

Exercises which strengthen low back muscles, core stabilization muscles like transverse abdominus, oblique's, and the deep back muscles should be considered. Khalid *et al*. (2001) recommended that in order for an exercise regime to be effective, that there should be a adequate warm up period of aerobic exercise followed by specific exercise to strengthen abdominal, and back muscles and then a cool down period.

2.7.2.2 Relaxation exercises

These exercises help people to reduce increased tension of muscles developed due to stress or prolonged static posturing. In section 2.6.8 we have seen that the dental profession is a profession in which much stress is experienced and that stress is one of the common factors which can have a significant impact on lower back pain. Lalumandier *et al*. (2001) found that relaxation techniques and putting the opposite groups of muscles into action during patients' breaks does indeed reduce muscle fatigue. Deep breathing exercises and progressive muscle relaxation techniques which help in progressively relaxing specific muscles, may serve to diminish this stress reaction.

In order to minimize or even prevent such ailments, preventive aerobic and relaxation exercises should be included in the weekly activities of dental personnel. Such a practice would help dental professionals avoid future physical limitations or handicaps and help them remain productive for longer periods of time during their

professional lives. This will also help in improving the quality of care they can render to their patients if they are pain free during clinical procedures.

The above-mentioned studies have shown that applying correct ergonomics and doing appropriate exercise reduces and prevents back pain among dentists.

2.7.3 Health promotion

The study by Alexopoulos *et al*. 2004 was designed to determine whether the musculoskeletal pain experienced was solely due to the dentist's job or whether there were other factors. It was found that 57% reported 'Occupational' as the only origin of the disorders and it was thus concluded that educational awareness of these disorders could perhaps play a vital role in their prevention among dentists. As professionals, dentists understand the concept of being lifelong students in order to maintain their proficiency in clinical techniques that benefit their patients. To protect their own health, dentists should seek out and receive education on musculoskeletal health, injury prevention and dental ergonomics. Ideally, this education should begin during dental school and continue through the dentist's professional life. There are no studies indicating dental practitioners have been trained in these areas, and that they have developed the skills and knowledge necessary to practise in a manner that is ergonomically correct. Mendez and Gomez-Conesa, (2001) showed in their study that programmes which involve correct practice of manoeuvres and motivational strategies to do the correct techniques demonstrated better results than just mere transmission of information. Marcellos *et al*. (2004) suggested that developing MSDs will be less if the dentists are educated about good posture during work. The same study also suggested there should be adequate information regarding appropriate arrangement of dental equipment. The previously mentioned lack of training is due in

part to the need for more research and for better teaching tools and better-informed and trained teachers. Part of the blame for the lack of training can be attributed to the magnitude of the task.

Dental operators can be taught to manage and prevent injuries effectively. They can educate themselves and their staff members by using a multifactorial approach that includes preventive education, postural and positioning strategies, proper selection and use of ergonomic equipment, and frequent breaks with stretching and strengthening techniques before painful episodes occur.

The studies by Rising *et al*. (2005) and Adnan *et al*. (2005) have highlighted the real possibility of the early onset of back pain in dental students and indicated a need for prevention. They have also pointed out that proper awareness and training should commence right at the start of their training. It is thus important for the dentistry students to practise these techniques early in their careers in order to avoid or reduce chronic MSD in future.

2.8 THE CONSEQUENCES OF BACK PAIN FOR DENTISTS

Musculoskeletal disorders are a common cause of work-related disability among workers, and have substantial financial consequences due to workers' compensation and medical expenses (Andersson, 1999). Lower back pain (LBP) is the most common and the costliest type of musculoskeletal problem, with a lifetime prevalence approaching 80% (Bernard, 1997; Heshemi *et al*., 1997; Waddell 1996; Webster and Snook, 1994). Lower back pain is a very common ailment in the western world and MSDs are the leading cause of long-term sick leave (Hestbaek L, Larsen, Weidick and Leboeuf-Yde, 2005). Back problems have been cited as the second most common reason for missing work in an industrial population in the

United States (Rowe, 1969). Chronic MSD problems play a central role in absenteeism and seeking medical care. Co-morbidity of chronic complaints is highly related to increased cost of disorders. The study by Alexopoulos *et al*. 2004 also found that dentists took sick leave because of back pain more often than for any other body pain.

Many studies have been conducted to study the impact of musculoskeletal disorders on dentists, during their clinical practice. In a study done among Queensland dentists (Leggat *et al*., 2006), 37.5% of the Australian dentists sought medical attention for musculoskeletal disorders. This statistic is similar to the 37% reported in a study of dental personnel in Saudi Arabia (Khalid *et al*., 2001). Leggat *et al*. (2006) suggest possible explanations for why older dentists experience less pain: experienced dentists are probably better at adjusting their working position and techniques in order to avoid musculoskeletal problems compared to their less experienced counterparts, or they have simply developed coping strategies to deal with the pain. Another more likely explanation, however, is that those dentists with severe musculoskeletal problems would already have ceased working, and would thus not have been captured in a cross-sectional survey. This hypothesis is partially supported by a five-year follow-up study of dentists in Sweden. Just fewer than 10% of Queensland dentists had taken sick leave, which seems to support the findings of the five-year follow-up study of Swedish dentists by Akesson, Johnsson, Rylander, Moritz and Skerfving (1999) which showed that dentists who had a higher prevalence of MSD were more likely to leave their profession. In the above-mentioned study, the mean time off for those taking sick leave was approximately two weeks, although the range varied from 1 - 72 days. It was also noted that in the

case of Queensland dentists who work in private practice, sick leave would have a considerable impact on the economics and goodwill of some dental practices.

Rundcrantz *et al.* (1990), in a study among Swedish dentists revealed that 74 out of 311 dentists (1987) and 84 out of 311 dentists (1990) were unable to work, due some form of MSDs. The main reason given for their inability to work and their ensuing absence was pain and discomfort in the neck, shoulder, lower back and thoracic region. Kajland (1974) found that dentists were absent because of reported musculoskeletal disorders to a greater extent than the control group. The groups were socioeconomically matched with respect to social background variables and professional environment. The study also showed that the reported musculoskeletal symptoms appeared to have a moderate impact on their ability to work.

Dahlen *et al*. (1985) studied the frequency of pain, discomfort and working positions among dental service staff in a nursing school in Sweden. In all the occupational groups discomfort in the neck, shoulders and lower back dominated and there was strong correlation between neck pain and the number of days of sick leave. A major study in Greece showed that chronic complaints have a central role in absenteeism and medical care seeking. Co-morbidity of chronic complaints is especially highly related to the increased cost resulting from disorders (Alexopoulos *et al*., 2004).

Based on the above-mentioned studies it can be concluded that having a musculoskeletal disorder affects the working ability of the dentists, since it prevents a high percentage of dentists from working. Furthermore, these dentists are forced to seek medical attention, which causes a substantial increase in the amount of money spent on MSD.

There is a growing body of evidence that suggest increased vulnerability within the profession to certain disorders and afflictions that can only be categorized as practice-related. The work character and number of health care workers and dentists has changed substantially. Dental professionals are subject to a wide variety of physical and psychological ailments that are induced or aggravated by the work environment. It is important to prevent back pain from affecting their careers, since such a practice would help dental professionals to avoid future physical limitations or handicaps and to extend their professional productivity. This will also contribute towards improving the quality of care dentists can render to their patients if they are pain free during clinical procedures (Khalid *et al.*, 2001).

2.9 QUESTIONNAIRES USED TO ESTABLISH THE PREVALENCE AND PATTERN OF MSD

In the past several studies have been conducted by various researchers to establish the prevalence of MSDs which is caused by working practice. Some of the relevant questionnaire surveys are discussed in the following sections.

2.9.1 Published Questionnaires used to collect prevalence data

In the study done by Marcellos *et al*. (2004) a dental student survey form regarding musculoskeletal pain (MSP) was used in an attempt to establish the prevalence of MSP in the body. It included a pain scale for rating the pain (no pain – severe pain). In the study done by Khalid *et al.* (2004), a purpose-built questionnaire was constructed that posed questions regarding demographics as well as the practising posture in the chair. It also included questions on the frequency of work. The study

by Leggat and Smith (2006) used a self-reporting MSD questionnaire. This sought information regarding the location of symptoms in the course of the preceding 12 months, and whether these symptoms affected the respondents' daily activities. It also sought information regarding medical treatment undergone, and included, amongst others, questions regarding demographic data and years of practice. Polat *et al.* (2007) used a self-administered questionnaire which gathered data regarding the dentist's mode of practice and their musculoskeletal problem experienced in the last month. Rising *et al. (*2005) administered a questionnaire to dentistry students which contained a body pain distribution chart, on which the students could mark the body parts where they were experiencing pain. This was followed by questions enquiring about the most symptomatic pain they experienced.

None of these questionnaires took account of risk factors, educational exposure, and prevalence regarding one week, one month, 12 months and lifetime. The Standardized Nordic Questionnaire which was originally developed by Kuorinka *et al*. (1987) (Appendix A), and is the most frequently used questionnaire in the literature to measure the prevalence of MSDs. The questionnaire aims to capture data regarding the prevalence of MSDs retrospectively. Its objective is to evaluate musculoskeletal problems in an ergonomic approach. Studies done by Adnan *et al*. (2005), Theresa *et al*. (2004), Ratzon *et al.* (2000), Rundcrantz *et al*. (1991) and Rundcrantz *et al*. (1990) have all used the Standardized Nordic Questionnaire.

2.9.2 Nordic Back Pain Questionnaire

In 2003 Nyland and Grimmer adapted the Nordic Back Pain Questionnaire (Holmstrom and Moritz 1991; Kuronika and Jonsson, 1987) for a study where they

used only questions regarding the back and neck problems in a group of physiotherapists. The first part of this instrument consists of questions regarding parts of the human body that relate to three anatomical areas (neck region, upper back and lower back region), marked on an illustration of the human body seen from behind. This questionnaire captures data retrospectively regarding back pain prevalence in lifetime, past 12-month, last one-month and also the last one-week. The age of onset of the musculoskeletal disorders and whether or not subjects have taken medical attention and have to take time off from work due to the problems are addressed. The questionnaire also has a set of purpose-built questions, including questions regarding the educational exposure of students. These variables were thought to be helpful in determining the impact of educational exposure on back pain. In the physiotherapy study, sitting and looking down for hours was significant for a one-month prevalence of lower back pain, and hours of treating patients for the last month was significant for one-month prevalence in males. By measuring the amount of educational exposure the student has had during the last month, and by knowing the year level of study, the length of stay at the university, the time of clinical exposure and the amount of clinical exposure, it will be possible to correlate with the prevalence of back pain. It is known that the number of educational hours (lecture or clinical hours) differs from the first year to the fifth year.

2.9.3 Shortcomings of the Nordic Back Pain Questionnaire and possible improvements from other instruments

The NBPQ (Nyland and Grimmer, 2003) does not address questions regarding educational exposures or any predisposing factors specifically for dentistry.

Moreover, it does not include questions regarding the severity of the pain experienced, which is part of objectives which needed to be measured.

In the study done by Rising *et al*. (2005), the questionnaire that was used elicited information regarding the severity of the pain experienced. The questions brought out information regarding the pain intensity, average pain, worst pain intensity, duration of pain, frequency of pain experienced and to what extent the perceived pain is aggravated by stress and by doing dental procedures. The questionnaire also contained questions regarding the level of regular physical exercise, which was rated in a four-point scale (1 = once a week, 2 = three times a week, 3 = five times a week, 4 = every day of the week).

All these questions are important to include in an outcome measure on the prevalence and pattern of back pain. As the questionnaire used by Leah *et al*. (2003) was developed to suit a physiotherapy programme (Appendix B), the same questions can be adapted to investigate the effect of educational exposure in dentistry students. The predisposing factors that aggravate pain among dentists (as discussed earlier in this chapter) should also be included in the study instrument to achieve the study objectives.

Thus from the above review of literature we can conclude that the musculoskeletal disorders common among dental professionals. Although there have been various studies done in the past to investigate the predisposing factors for back pain among dentist, there has been very few studies which has investigated the prevalence and predisposing factors of back pain among dental students.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter reports on the methods and procedures used for this study. It describes the background of the study setting, the development of a suitable survey instrument, the main study design, the selection process of the research population and the procedure used to collect the data. Finally, the data analysis is described and the issues of ethical consideration regarding the study are reported.

3.2 RESEARCH SETTING

The study was conducted in the Faculty of Dentistry of the University of the Western Cape. The University of the Western Cape is one of the five universities in South Africa offering the dentistry course. The Faculty of Dentistry offers both undergraduate and postgraduate programmes. There are currently more than 450 undergraduate dental students attending the programme (a five-year degree in dentistry). Students attend lectures at both the Tygerberg campus and the main university campus and the lecture hours differ between the different years of study.

3.3 STUDY DESIGN

This descriptive research study made use of a cross-sectional quantitative survey to meet the objectives of the study.

3.4 RESEARCH SUBJECTS

The study population included all the undergraduate dentistry students registered for the 2007 academic year at the University of the Western Cape. The total number of this population was 471 dental students who were registered for a full-time study programme at the university. The inclusion criteria for the study were that participants should be full-time dentistry students and that they would voluntarily participate. There were no exclusion criteria.

3.5 INSTRUMENTATION

A self-completed questionnaire was used to do the survey.

3.5.1 Development of a suitable survey instrument

3.5.1.1 Procedure of development of a questionnaire

Firstly, the literature was searched for suitable questionnaires to gather the data needed to meet the objectives of the study. After a suitable questionnaire was identified, a qualitative study method was used to further develop the study instrument. The chosen method of data collection for this part of the research was focus groups. According to Fontana and Frey (1994), focus group discussions have the advantage of being economical, data rich, flexible, stimulating to participants, cumulative and elaborative as opposed to the individual interview. In a focus group discussion, participants frequently share insights that may be unobtainable from individual interviews or other sources: “Focus groups are carefully planned discussions designed to obtain perceptions on a defined area of interest” (Kruger, cited in Greef, 2002: 306). Kruger (1994) suggests that one uses from six to twelve individuals in a focus group discussion.

A sample of 32 undergraduate students from UWC Faculty of Dentistry was purposefully selected to take part in the focus group discussions, depending on their availability and willingness to participate, with a minimum of five representatives from each year level. The participants were informed through representatives in each year level about the focus group discussion and were asked to contribute five problems which they thought would cause back pain in their dental curriculum. Physical communications and follow-up phone calls were made to ensure their availability to participate in the study on the pre-arranged date. Two focus group discussions were conducted in the first week of August 2007 for first- and second-year students, and in the second week of August 2007 a focus group discussion comprising of third-, fourth- and fifth-year students took place. Focus group discussions were conducted to develop and validate questions about educational exposures specific to dentistry students. Both the focus group discussions were facilitated by a neutral person who was a PhD biotechnology student (to avoid possible contamination of ideas from the researcher).The principal researcher was present in both of the focus group discussions. All the participants who attended the focus group discussions signed the consent form (Appendix D) before the commencement of the discussion. Each focus group discussion lasted approximately 90 minutes. These groups specifically had the responsibility of developing questions on educational exposures that they considered to be relevant to their training programme. In addition, the aggravating factors which could possibly predispose the student to get back pain in their training period were also discussed and listed out according to severity. The first five of the listed aggravating factors was taken into consideration. 'Educational exposure' referred to the amount of time spent by the student in the last month attending

lectures, doing private study, doing laboratory work and treating patients. The intention was to maintain the subtlety and specific nature of as many of the responses as possible. Any discrepancies were resolved via consensus. There was a minimum of five participants from each year level with an almost equal proportion of males and females. Minutes of the focus group discussion were taken down during the session and later was analysed, once the session was completed

3.5.1.2 Results of development of the questionnaire

The survey instrument developed for this study was based on the Nordic Back Pain Questionnaire (NBPQ) (Holmstrom *et al.*, 1991), which was developed from the Standardized Nordic Questionnaire (Kuorinka *et al.,* 1987). This is a standardized, validated instrument developed to analyse musculoskeletal symptoms in an ergonomic or occupational health context. Nyland and Grimmer, (2003) conducted the study among undergraduate physiotherapy students using the same questionnaire and carried out the reliability test for the NBPQ.

In the current study the NBPQ was extended with questions developed by the focus groups to gather data to answer the research question. The participating students each listed the 10 most important aggravating factors which would possibly cause back pain during their period of study. In the second and third part of the group discussion the participants were asked to rate the factors from most important to least important aggravating factors. Then the first four factors Chairs (clinic/lectures/lab), Instruments and equipment, Posture (sitting or standing) in clinics and lighting-clinics, laboratory and dental chair lighting were used in section 3 of the questionnaire, with a Likert scale to rate those factors (1 = least important

aggravating factor; 4 = most important aggravating factor). Similarly, questions regarding the amount of educational exposure were discussed and consensus was reached to ask five questions, which were included in section 1 under question 11 of the questionnaire. The students were questioned regarding the amount of time spent in the last month on sitting and looking straight ahead (i.e. sitting in lectures), on sitting and looking down most of the time (i.e. private study time), on laboratory time, and on treating patients. Both aggravating factors and amount of educational exposure hours were used as questions as a part of the final study instrument.

The newly developed questionnaire consisted of three sections (Appendix 3). Section 1 contains questions regarding demographic data and information on educational exposure. Section 2 contains questions regarding the prevalence of back pain and section 3 has questions on the behavioural pattern of the individual's pain as well as on the specific aggravating factors for back pain.

Section 1: This part of the study instrument seeks information on gender, age, height, weight, year level of study, and the current level of fitness. The level of regular physical exercise is assessed using a four-point scale (once a week, three times a week, five times a week, seven times a week). The questionnaire also has purpose-built questions on exposure to perceived workplace hazards for dentistry students. The time frame of 'the past month' for educational exposure was determined by the students who constructed the questionnaire as being relevant to their training programme. Educational exposure questions were derived directly from the student focus group deliberations (i.e. educational risks perceived by students themselves). Educational exposure is defined as the period a student is exposed to a certain educational activity.

Section 2: This section, which is based on the Nordic Back Pain Questionnaire (NBPQ), has questions relevant to back pain prevalence. These questions were directly taken from the established instrument (Holmstrom *et al.,* 1991; Kuorinka *et al.,* 1987). The NBPQ surveys the occurrence of pain and discomfort over a lifetime, 12 months, the previous month and the previous seven days.

Section 3: If a student identifies one or more body regions as being painful, an assessment is done in more detail in this section. Students are asked to identify their most symptomatic pain area (most troublesome pain) and the following questions have to be answered for the most symptomatic body pain (most troublesome pain): the duration of pain, which is scored on a five-point scale (1 = less than one hour a day, 2 = one-three hours a day, 3 = four-eight hours a day, 4 = 9-16 hours a day, 5 = 17-24 hours a day), the frequency of pain, which is scored on a five-point scale (1 = 10% of all the days, 2 = 25% of all the days, 3 = 50% of all the days, 4 = 75% of all the days, 5 = almost every day), and both the average intensity and the worst pain intensity on a visual analogue scale (VAS) (0 = no pain and 10 = extreme pain). The fatigue level which is experienced by the students at the end of the day is also measured using a visual analogue scale (VAS) (0 = very little fatigue and 10 = extreme fatigue). The perception of how much of the most symptomatic body pain is being aggravated by stress and by performing dental procedures is measured using a VAS (0 = none of the pain and 10 = most of the pain). The final question of the questionnaire rates the aggravating factors using a Likert scale (1 = least important aggravating factor and 4 = most important aggravating factor).These factors were obtained from focus group discussions.

3.5.1.3 Testing face and content validity and test-retest reliability of the new questionnaire

Validity and reliability are two of the most important criteria by which a quantitative instrument's adequacy is evaluated (Polit *et al*., 2001). Validity refers to the extent to which an instrument measures what it is supposed to be measuring (Sarantakos, 1997). The NBPQ (section 2) of the final questionnaire was validated regarding content, wording and response construction and tested for reliability (cf. Nyland and Grimmer, 2003). However questions 11 and 44 (developed from the focus groups) were not tested.

It was therefore necessary to test the final combined questionnaire for content and face validity, as well as for test-retest reliability. Content validity was firstly assessed by giving the questionnaire to experts in the field to assess the adequacy of the coverage of the content area being measured. Questions were asked as to whether the content of questionnaire was relevant to the objectives of the study and changes were made according to suggestions given. The experts who assessed the content of the questionnaire were the supervisors of the study. The final questionnaire was also tested for reliability in a test-retest study.

A pilot study was carried out prior to the main study to test the face and content validity (clarity, understanding, and time to complete) and the reliability of the instrument. The pilot study was conducted on 10 undergraduate students (equal representatives from every year level) who were selected depending on the availability and willingness, and they were excluded from the main study. They were

asked orally whether the questions were clear. The time taken to complete the questionnaire was also measured. Most of the questions were clearly understood, except for three questions which were considered to be too time-consuming. These questions were modified in order to make the questionnaire less time-consuming (it took ten minutes for each questionnaire to be completed) and clearer. These were the questions regarding the total number of days the participants had experienced pain (questions16, 24 & 32). Initially these questions were asked as a continuous variable but then changed back to an ordinal scale.

Another question that was omitted in the final questionnaire was one enquiring about the clinical posting in which they were doing clinical practice. This was done because the question had mixed responses (i.e., most students attended more than one clinical area in one month). The final questionnaire is attached as Appendix D.

The reliability of the questionnaire was assessed by using the test-retest method. This test consists of the application of the questionnaire to the same subjects, under a similar condition, in two or more situations (LoBiondo- Wood and Haber, 1998; Polit and Hungler, 1995 cited from de Barros and Alexandre, 2003). It was tested with 10 students. This approach assumes that there is no substantial change in the construct being measured between the two occasions. The amount of time allowed between measures is critical. It is known that if the same thing is measured twice, the correlation between the two observations will depend in part by how much of time elapses between the two occasions. The time interval between the two measurements was taken as two weeks (Kuorinka *et al.,* 1987).The test-retest reliability was analysed using Statistical Package for the Social Sciences (SPSS).

The Cronbach's alpha was used to test for reliability. Cronbach's alpha is a widely used psychometric measure for estimating the internal consistency of scales with multiple items (McGraw and Wong, 1996). In the social sciences, a Cronbach's alpha of >0.70 is acceptable and good at >0.80 (Gliem and Gliem, 2003).

Results of analysis for the test retest reliability were good. In the initial test (time period 1) the results were for Cronbach's ά 0.861 and during the time period 2 retest of the reliability was Cronbach's ά 0.862 which means the consistency of the questionnaire was good.

3.5.2 The quantitative cross-sectional survey

The purpose of quantitative research is to describe, explain or predict phenomena (Domholdt, 1993). In the current study the phenomena refer to the collection of the questionnaire data describing the prevalence of back pain among dentistry students in the University of Western Cape. A cross-sectional survey was used for the quantitative aspect of the study. Where the questionnaires were distributed at one time only, whoever were present at that time of study were taken as the subjects. Surveys have been defined as systems for collecting information to describe, compare, and predict attitudes, opinions, values, knowledge and behaviour (Domholdt, 2000). Another advantage of the survey approach was that it had a high degree of representativeness in proportion to the sample size (Treece and Treece, 1982).

3.6 PROCEDURE USED FOR DATA COLLECTION

Permission and ethical clearance were obtained from the UWC Research Grant and Study Leave Committee. Permission was also obtained from the UWC dentistry administration and lecturers. Informed consent was obtained from each participating student. The participation in data collection, which took place in September 2007, was voluntary and anonymous. To collect the data from the students, the principal researcher with research assistants attended nominated lectures at the Tygerberg campus as advised by the head of the Dental Research Committee in order to get a good response from the students. Permission was obtained from the lecturer concerned before the lecture and the class representatives were informed about it and were asked to give an introduction to the class about the research and the researcher. The class representative briefed the students about the consent form (Appendix F) and the form was circulated in the class and collected from the class representative at the end of the lecture. The questionnaires were given only to people who agreed to participate in the study after reading the consent form and being briefed by the principal researcher. The principal researcher and the assistant waited in the lecture hall until the students had completed the questionnaires and were available to address any questions emanating from the questionnaire. The completed questionnaires were collected before the commencement of the same lecture.

3.7 METHODS OF DATA ANALYSIS

In order to make the data analysis easier Table 3.1 (below) was created and the association between back pain prevalence and the possible exposure categories that would be measured were outlined.

Table 3.1 outlines the associations between back pain prevalence measures and the exposure variables chosen for reporting in this study. Due to the time period of data capture for exposures, not all were relevant to all back pain prevalence measures. Table 3.1 shows the general approach to analysis for back pain but in the actual results both upper and lower back pain were to be analysed in the same manner.

Table 3.1: Approach to data analysis

Recall period				
	Lifetime	**12 months**	**I month**	**1 week**
Disease information	Prevalence	Prevalence	Prevalence	Prevalence
	Age of initial onset			
	Initial incident			
Possible risk factors	Age	Age	Age	Age
	Gender	Gender	Gender	Gender
	Length of study	Length of study	Length of study	Length of study
	Length of clinical exposure	Length of clinical exposure	Length of clinical exposure	Length of clinical exposure
		Height		
		Weight		
		BMI		
		Level of fitness	Level of fitness	Level of fitness
		Level of physical exercise	Level of physical exercise	Level of physical exercise
			Educational exposures	Educational exposures

Data was captured using SPSS. Both upper and back pain prevalence data was described by year level (overall and in gender strata), using percentages, risk ratios and associated 95% confidence intervals (CI). Linear analysis for trend in proportions was calculated across the five university year levels, and was to be reported as chi-square for trend statistics and associated p values. Association between potential exposure variables and the four measures of back pain

prevalence was tested using univariate logistic regression models, reporting association as odds ratios and 95%C.I. Significance of association was detected when confidence intervals did not span 1, and where confidence intervals skimmed 1, these were noted as trends towards significance. For the analysis of behavioural patterns of pain the data was analysed using R statistical packaging where analysis of variance (ANOVA) for means was calculated and p-value was established using Bonferroni tests (Dawson and Trapp, 2004).

3.8 ETHICAL CONSIDERATIONS

Ethical clearance and approval were obtained from the UWC Research and Study Grants Committee (see Appendices G & H) before the study commenced. Written consent was obtained from the Dean of the UWC Faculty of Dentistry and the head of the Research Committee of the Faculty of Dentistry (see Appendices H & I) prior to the study. The aim of the study was explained to the relevant administrative bodies and to the dentistry students. The participants were assured that all the information would be confidential and anonymous. All the participants were informed that they had the right to withdraw from the study at any time. Participants who took part in the focus groups were asked to read and sign the consent letter (see Appendix E). The consent letters were given to the participants a few days prior to the discussion session and these were duly signed by them and returned to the researcher. For the quantitative study consent forms were given out just before filling the questionnaire in the lecture halls (see Appendix F).

3.9 SUMMARY OF THE CHAPTER

In this chapter the methodology (for the development of the questionnaire as well as for the survey) used in the study, the study design, the research setting, and the sampling, including the inclusion and exclusion criteria, were described. The data collection questionnaire and the procedure used in data collection were also described. The pilot study approach to data analysis and the data analysis were discussed and supported with references. The procedure to ensure that the study was conducted in an ethical manner was explained.

CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

In this chapter, both descriptive and inferential statistic results of the study are presented. The quantitative results of the socio-demographic characteristics of the study population are presented. This is followed by the inferential statistic results of the relationships and associations found between some of the demographic/background characteristics with the pain characteristics experienced for the most symptomatic area of pain. Lastly, back pain prevalence is presented across the year levels and gender, as well as the possible risk factors influencing the prevalence of back pain among students.

4.2 DEMOGRAPHIC CHARACTERISTICS OF THE PARTICIPANTS

4.2.1 Response rates in the prevalence study

A total of 362 questionnaires were distributed out of which 342 were returned, yielding a response rate of 94.5%.

4.2.2 Demographic data

Table 4.1 indicates the response rates in each university year level, and describes the sample by gender, mean age, weight, height and BMI.

Table 4.1: Characteristics of the sample (N=342)

	Year level					Overall
	1	2	3	4	5	
No of available subjects	67	67	78	80	70	362
Response rate (%)	n=64 (96)	n=66 (99)	n=76 (97)	n=68 (85)	n=68 (97)	N=342 (95)
Gender (%) ***-Male*** ***-Female***	n=27(42) n=37(58)	n=35(53) n=31(47)	n=32(42) n=44(58)	n=29(43) n=39(57)	n=28(41) n=40(59)	N=151(44) N=191(56)
Mean age in years(SD)	19 (1.3)	20.5 (1.8)	21.5 (3)	22.8 (3.4)	23.7 (2)	21.5 (2.9)
Mean WT (kgs)	62	65	64	63	68	64
Mean HT (cm)	168	169	167	168	169	168
Mean BMI kg/m^2	22.12	22.77	23.13	22.6	23.69	22.88

4.3 THE MOST TROUBLESOME AREA OF PAIN

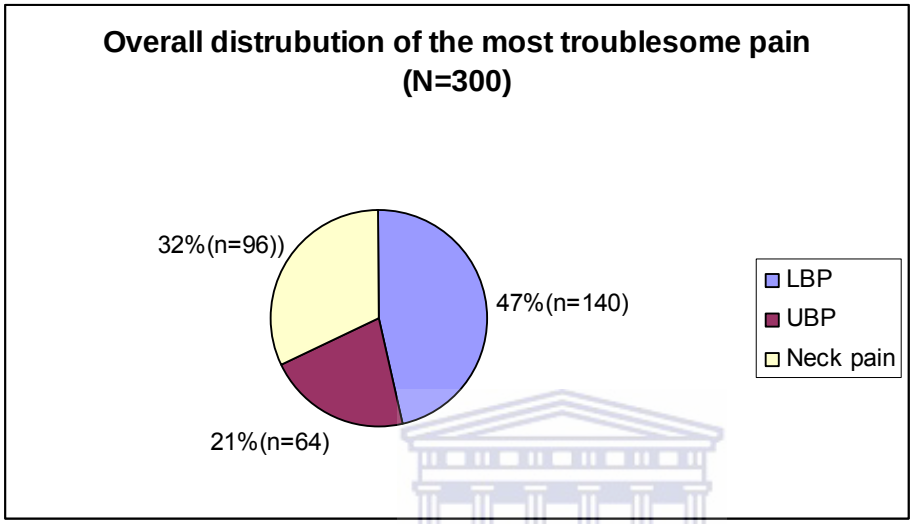
4.3.1 Distribution of the most troublesome pain experienced

Of the total study size of 342 who took part in the study, 300 (88%) of the students reported having had some form of musculoskeletal disorders (LBP/UBP/Neck pain) during their lifetime. The overall distribution of area of most troublesome pain identified by students is illustrated in Figure 4.1.

Although students often experienced more than one area of pain, Figure 4.1 illustrates that 47% (n=140) of students identified LBP as the pain that troubles them most. There was not a significant difference between male and female students in the area of pain experienced. The most troublesome area of pain experienced by the

student population with some form of MSDs (N=300) is described in Table 4.2 across the year level and in gender strata.

Figure 4.1: Overall distribution of most troublesome pain N=300



The highest percentage of students experiencing LBP as their most troublesome problem was reported amongst 2nd year students (63%). For upper back pain it was the fourth years with 35.3% and for neck pain it was fifth years reporting at 41.7%. It can be inferred that LBP was the highest of all troublesome problem reported from 1st years to 4th years followed by neck pain, except for the fourth years where upper back pain was the second highest. However the majority of the fifth years reported neck pain as their most troublesome problem experienced followed by low back pain.

Table 4.2: The most troublesome pain experienced by students (N=300)

Year level	Sex	N	Body pain distribution		
			LBP (%)	UBP (%)	Neck pain (%)
	Overall	**300**	**46.7%(n=140)**	**21.5%(n=64)**	**32.3%(n=96)**
1	Female	28	50.0	10.7	39.3
	Male	21	38.1	14.3	47.6
	Total	49	44.9	12.2	42.9
2	Female	25	52.0	12.0	36.0
	Male	29	72.4	7.7	23.1
	Total	54	63	9.8	29.4
3	Female	42	35.7	23.8	40.5
	Male	27	63.0	14.8	22.2
	Total	69	46.4	20.3	33.3
4	Female	39	46.2	33.3	20.5
	Male	29	48.3	37.9	13.8
	Total	68	47.1	35.3	17.6
5	Female	38	34.2	23.7	42.1
	Male	22	31.8	27.3	40.9
	Total	60	33.3	25	41.7

4.3.2 Features of the most troublesome pain experienced

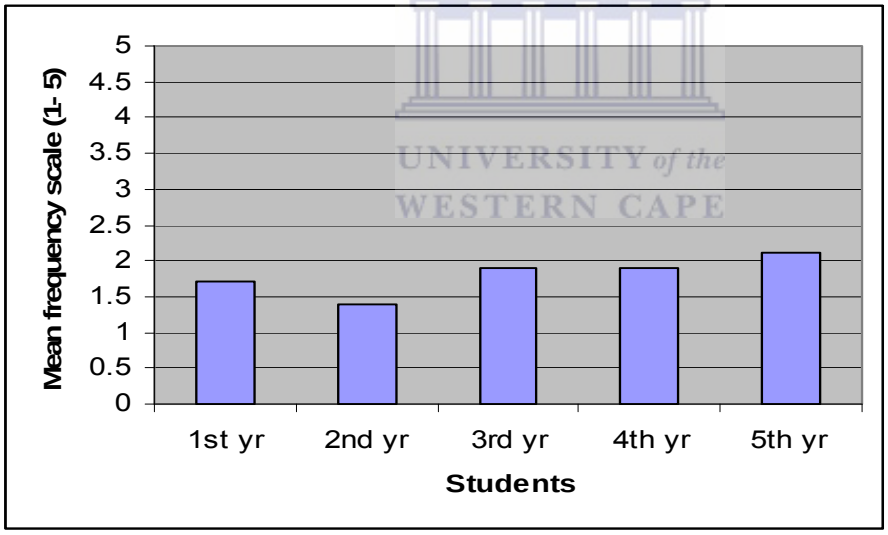
The section below describes the pain experienced according to the most troublesome area of pain. The following section was analyzed by one, two and three way ANOVA using R statistical packaging software.

4.3.2.1 Frequency and duration of the most troublesome area of pain

The mean frequency and duration of the most troublesome area of pain for men and women in five dental classes is shown in Figure 4.2 and Figure 4.3. The mean frequency of pain experienced ranged from more than 10% of the days to less than 50% of the days. There were no significant sex differences for the mean frequency for the area of most troublesome pain (two-way ANOVA). However the frequency of

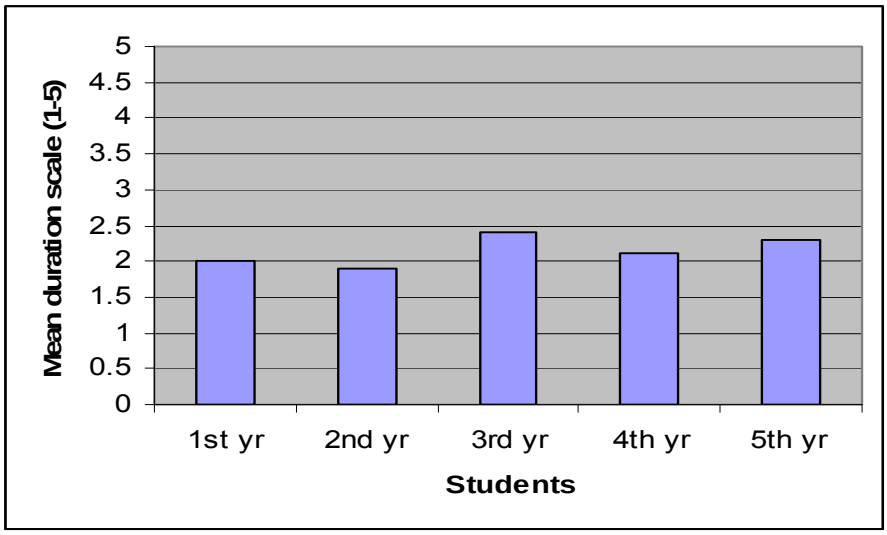
the most troublesome pain experienced was significantly higher for fifth year when compared with the year two of the dental school (Bonferroni test p =.015). The mean frequency of the most troublesome pain experienced by students who perceived their level of fitness was good, was much less when compared to those with poor level of fitness (Bonferroni test p =.0011). The overall mean duration of the pain experienced ranged from three hours per day to fours per day, and the mean duration of the most troublesome pain experienced by students who's perceived level of fitness was moderate, was much less when compared to those with students who perceived level of fitness as poor (Bonferroni test p =.008).

Figure 4.2: Mean frequency of most troublesome pain experienced.



Mean frequency scale (1 = 10 percent of all the days, 2 = 25 percent of all the days, 3 = 50 percent of all the days, 4 = 75 percent of all the days &5 = almost every day)

Figure 4.3: Mean duration of most troublesome pain experienced.

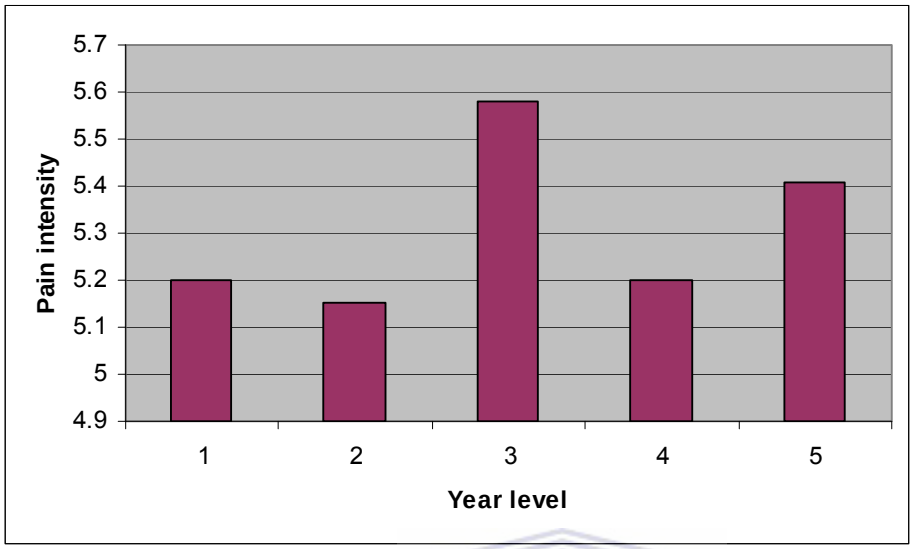


Mean duration scale (1= <1 hr a day, 2=1-3 hrs a day, 3=4-8 hrs a day, 4=9-16 hrs a day & 5=17-24 a day)

4.3.2.2 Pain intensity for the most troublesome area of pain

Pain intensity was assessed by averaging the worst pain intensity and average pain intensity reported for the most symptomatic body region and is shown in Figure 4.4. The group means for pain intensity ranged from more than five to less than six (scale0-10; 0=almost no pain, 10=extreme pain). There was no significant gender difference for the mean pain intensity for the most symptomatic pain (two-way ANOVA). There was a significant difference in the intensity of the most troublesome pain experienced between students doing physical exercise and those not doing physical exercise. The students doing physical exercise had a lesser pain intensity when compared to students who do not do physical exercise (Bonferroni test P=.028).

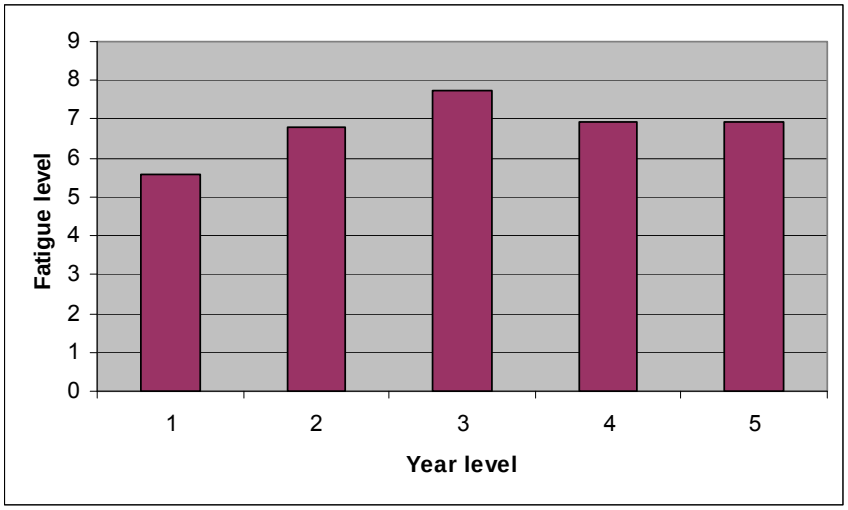
Figure 4.4: Pain intensity for the most troublesome area pain. (Visual analog scale: 0=no pain &10=maximum pain)



4.3.2.3 Fatigue level

The mean level of fatigue experienced by students ranged from 5.6-6.9 (VAS 0-10, 0= no fatigue & 10=high fatigue).the mean level of fatigue was significantly higher in third and fourth year level students when compared to first year of dental school Figure 4.5 describes the mean fatigue level experienced across year levels (Bonferroni test, p=5.2e-05, p=.049 respectively). There were also significant differences in the fatigue level experienced by students who rated their perceived level of fitness as poor and moderate. The students who reported to have moderate fitness level experienced lesser fatigue level when compared to those rated themselves to have poor fitness level (Bonferroni test, p=.011). The students doing physical exercise demonstrated significantly less fatigue level when compared to students who do not do physical exercise (Bonferroni test, p=.0038).

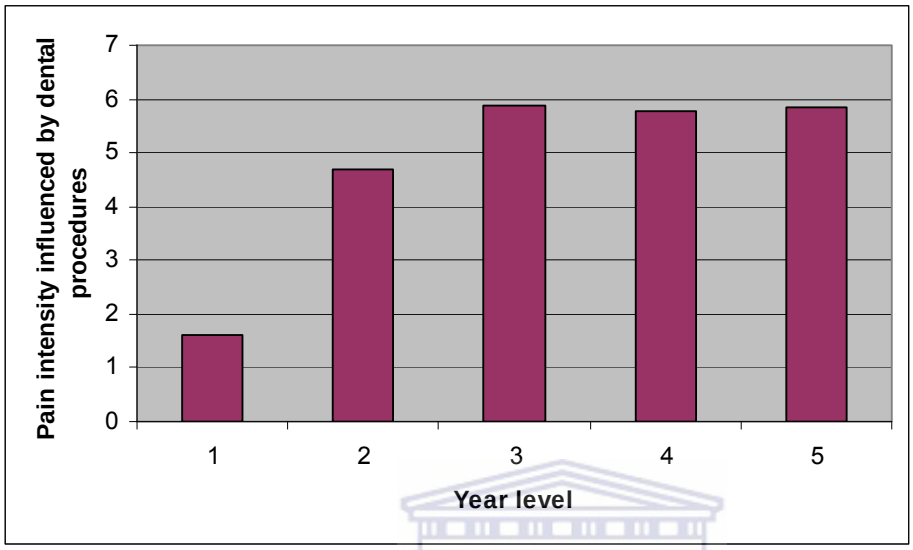
Figure 4.5: Mean level of fatigue experienced by students. (Visual analog scale: 0=no influence & 10 = maximum influence)



4.3.2.4 Influence of stress and dental procedures on pain intensity experienced

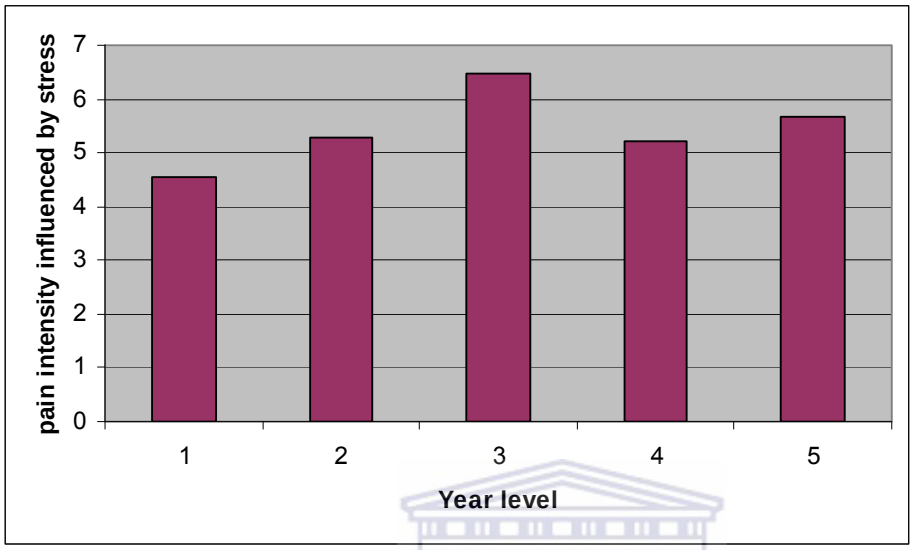
The perception of how much of the most troublesome area of pain is aggravated by doing dental procedures was significantly higher in all four year levels when compared to first year level . And third year level students reported the highest when compared to first years (Bonferroni test, p=4.6e-14). The mean level of pain intensity being influenced by doing dental procedure for the most symptomatic pain ranged from1.6-5.8 (VAS 0-10, where 0=no pain &10=extreme pain) and is shown in Figure 4.6. Woman reported to have significantly higher influence of dental procedure on their pain intensity when compared to men (two-way ANOVA, Bonferroni test, p=.0011). The perception of how much of the most troublesome body pain is aggravated by doing dental procedures was significantly lesser in students doing physical exercise when compared to those students not doing physical exercise (Bonferroni test, p=.049).

Figure 4.6: Mean perception of how much of the most troublesome area of pain is aggravated by doing dental procedures. (Visual analog scale: 0=no influence 10=maximum influence)



The perception of how much of pain intensity is influenced by stress for the most troublesome pain is significantly higher in third year dental school when compared to first year students (two way ANOVA, Bonferroni test, p=.0073). The mean level of pain intensity influenced by stress varied from4.5-6.5 (VAS 1-10) across the whole group. Figure 4.7 explains the mean level of stress influencing the pain intensity across the year levels. The perception of how much of the most symptomatic body pain is aggravated by stress was significantly lesser in students doing physical exercise when compared to those students not doing physical exercise (Bonferroni test, p=.02). Woman reported to have significantly higher influence of pain intensity by stress when compared to men (two-way ANOVA, Bonferroni test, p=9e-04).

Figure 4.7: Mean perception of how much of the most symptomatic body pain is aggravated by stress (Visual analog scale: 0=no influence &10=maximum influence).



4.3.2.5 Perceived aggravating factors of most troublesome pain

Posture (sitting/standing) was rated the most important aggravating factor with 60.9%followed by chairs used in lectures/clinics/lab (42.75), with instruments and equipments (44.7%) following it and lighting in clinics (57.1%) as the least important aggravating factor given in the following table (Table 4.3).

Table 4.3: Rating of the aggravating factors against factors expressed in overall percentages

Aggravating factors in% (n)	**Rating** 1=least important aggravating factor & 4=most important aggravating factor			
	1	***2***	***3***	***4***
Chairs(lectures /clinic/lab)	12.6(35)	19.4(54)	**42.1(117)**	25.9(72)
Instruments/ equipments	26.2(72)	**44.7(123)**	16.4(45)	12.8(35)
Posture(sitting/ standing in clinics)	6.4(18)	12.8(36)	19.9(56)	**60.9(171)**
Lighting-clinics, lab& dental chair)	**57.1(156)**	18.0(49)	16.9(46)	8.1(22)

4.4 PREVALENCE OF BACK PAIN AMONG STUDENTS

From the above table 4.3 it can be concluded that from the total sample of 300 students, back pain was reported to be the most troublesome musculoskeletal disorder (MSD). The next section thus reports on the prevalence of back pain in detail. The lifetime prevalence of LBP and UBP from the overall sample (N=342) was 61.7% (N=211) and 41.8% (N=143) respectively. The average age of initial onset of lifetime prevalence of LBP and UBP across the year level from 1st to 5th year is given in the below (Table 4.4). The average age of initial onset of LBP is 18.7 years (SD 2.9 years) and for UBP is 19.7 years (SD 2.7years).

Table 4.4: Average age of initial onset of back pain in years

	1st year	**2nd year**	**3rd year**	**4th year**	**5th year**	**Average age of onset**
LBP	16.6	17	18.5	19.9	21.3	18.7
UBP	17.3	18.2	19	21.1	21.2	19.7

4.4.1 Low back pain (LBP) prevalence's

The overall life time prevalence of LBP was the highest, followed by neck pain and then upper back pain. Table 4.5 presents the prevalence of each measure of LBP in percentage with their confidence interval (95% CI) for each year level, and in gender strata. From the total study sample of 342, 61.7% (N=211) had lifetime prevalence of LBP (i.e. these students had LBP in some time of their life), 55.3% (N=189) had LBP in the last 12 months, 39.5% (N=135) have had LBP in the last month and 25.7% (N=88) had LBP in the last week.

Table 4.5: Prevalence of LBP expressed as percentage (95%CI) overall, per year level and gender.

Key: *=.05 significance, **=.01 significance & ***=.001 significance

Year level & sex	Lifetime (%)	12-month (%)	1-month (%)	1-week (%)
Overall	**61.7(55.1-68.3) N=211**	**55.3(48.2-62.4) N=189**	**39.5(31.3-47.7) N=135**	**25.7(16.6-34.8) N=88**
1st female	62.2(42.4-82)	51.4(28.9-73.9)	40.5(15.7-65.3)	24.3(-3.7-52.3)
Male	48.1(20.9-75.3)	40.7(11.7-69.7)	29.6(-2-61.2)	18.5(-15.5-52.5)
Overall	56.3(40.1-72.5)	46.9(28.8-64.6)	35.9(16.3-55.5)	21.9(.2-43.6)
2nd female	51.6(27.1-76.1)	37.9(9.2-66.6)	31(.8-61.2)	10.3(-24.1-44.7)
Male	62.8(42.7-83.1)	55.9(33.6-78.2)	44.1(19-69.2)	29.4(1.2-57.6)
Overall	57.6(41.9-73.3)	46.7(29.7-65.5)	38.1(18.7-57.5)	20.6(-1.4-42.6)
3rd female	70.5(54.4-86.6)	68.2(51.5-84.9)	56.8(37.4-76.2)	36.4(12.8-60)
Male	68.8(49.4-88.2)	59.4(37.3-81.5)	33.3(4.1-62.5)	30(-1.4-59.9)
Overall	69.7(57.3-82.1)	64.5(51.1-77.9)	47.3(30.8-63.8)	33.8(15.3-52.3)
4th female	71.8(55.1-88.5)	69.2(51.8-86.6)	51.3(29.4-73.2)	41(16.9-65.1)
Male	58.6(35.2-82)	55.2(30.8-79.6)	34.5(5-64)	17.2(-15.9-50.3)
Overall	66.2(52.4-80)	63.2(48.8-77.6)	44.1(26.3-61.9)	30.9(11.1-50.7)
5th female	67.5(49.8-85.2)	62.5(43.5-81.5)	45(22-68)	27.5(1.1-53.9)
Male	42.9(14.9-70.9)	42.9(14.9-70.9)	17.9(-15.7-51.5)	14.3(-20-48.6)
Overall	57.4(41.9-72.9)	54.4(38.4-70.4)	33.8(14.5-53.1)	22.1(1.1-43.1)
Chi square (p values) describing the linearity of trend				
Overall	.147(.70)	2.39(.12)	.004(.95)	.34(.55)
Male	.318(.57)	.004(.949)	1.61(.204)	.812(.36)
female	.90(.34)	3.77(.052)	.99(.319)	1.96(.16)

A linear by linear analysis demonstrated no significance in linear trend for any measures of LBP. Third year level students reported the highest prevalence percentage when compared to other year levels. The percentage of females reporting LBP for all measures except for one month prevalence was highest in fourth years, and the percentage of males reporting for all measures of LBP except for one month prevalence was highest in third years. Gender as well as year level association with LBP was not found statistically significant. The variables with negative values in the C.I should be read with caution because of the low sample size of students reporting that specific type of problem in that year.

4.4.2 Upper back pain (UBP) prevalence

Table 4.6 presents the prevalence of each measure of UBP in percentage with their confidence interval (95% CI) for each year level, and in gender strata. From the total study sample of 342, 41.8 % (N=143) had lifetime prevalence of UBP (i.e these students had UBP in some time of their life), 41.5% (N=142) had UBP in the last 12 months, 26.6 % (N=91) have had UBP in the last month and 20.5% (N=70) had UBP in the last week.

Table 4.6: Prevalence of UBP (95%CI) as a percentage overall, per year level and gender.

Key: *=.05 significance, **=.01 significance & ***=.001 significance

Year level & sex	Lifetime (%)	12-month (%)	1-month (%)	1-week (%)
Overall	**41.8(33.7-49.9) N=143**	**41.5(33.4-49.6) N=142**	**26.6(17.5-35.7) N=91**	**20.5(11-30) N=70**
1st female	32.4(5.9-58.9)	32.4(5.9-58.9)	27(-.5-54.5)	21.6(-6.9-50.1)
Male	29.6(-2-61.2)	29.6(-2-61.2)	11.1(-24.4-46.6)	11.1(-24.4-46.6)
Overall	31.3(11-51.6)	31.3(11-51.6)	20.3(-1.6-42.2)	17.2(-5.1-39.5)
2nd female	45.2(19.1-71.3)	45.2(19-71.3)	19.4(-12.2-51)	9.7(-23.8-42.3)
Male	28.6(.6-56.6)	28.6(.6-56.6)	22.9(-6.2-52)	17.7(-12.8-48.2)
Overall	36.4(17.2-55.6)	36.4(33.5-73.5)	21.2(-.2-42.6)	13.6(-8.8-36)
3rd female	54.5(34.6-74.4)	53.5(34.1-74.9)	48.8(27.4-70.2)	41.9(19.1-64.7)
Male	25(-5-55)	25(-5-55)	18.8(-12.5-50.1)	9.4(-23.6-42.4)
Overall	42.1(25-59.2)	41.3(24-58.6)	36(17.9-54.1)	28(8.8-47.2)
4th female	51.3(29.4-73.2)	51.3(29.4-73.2)	28.2(1.6-54.8)	23(-4.5-50.5)
Male	48.3(22.1-74.5)	48.3(22.1-74.5)	10.3(-24.1-44.7)	10.3(-24.1-44.7)
Overall	50(33.2-66.8)	50(33.2-66.8)	20.6(-.6-41.8)	17.6(-3.9-39.1)
5th female	52.5(33.1-73.9)	52.5(31.1-73.9)	47.5(25-70)	35(10-60)
Male	42.9(14.9-70.9)	42.9(14.9-70.9)	14.3(-20-48.6)	10.7(-24.3-45.7)
Overall	48.5(31.4-65.6)	48.5(31.4-65.6)	33.8(14.5-53.1)	25(4.4-45.6)
Chi square (p values) describing the linearity of trend				
Overall	**6.27(.012)***	**6.28(.012)***	2.313(.128)	1.54(.213)
Male	2.77(.096)	2.77(.096)	.146(.702)	.212(.645)
female	3.17(.075)	3.19(.074)	3.77(.052)	2.66(.105)

A linear by linear analysis demonstrated statistical significance in linear trend for measures of UBP for lifetime and 12 month prevalence (p<.05) in all study subjects but showed no significance in linear trend for other measures of UBP and in gender strata as well. The 4th year level students reported the highest in lifetime and 12month prevalence, and the 3rd year level students reported the highest in one month and one week prevalence. This however was not found to be statistically

significant p>.05. The percentage of females reporting UBP for all measures except for one month prevalence was highest in third years. The variables with negative values in the C.I should be read with caution because of low sample size of students reporting that specific type of problem in that year.

4.4.3 Frequency of upper and low back pain reported by students in the last 12 months

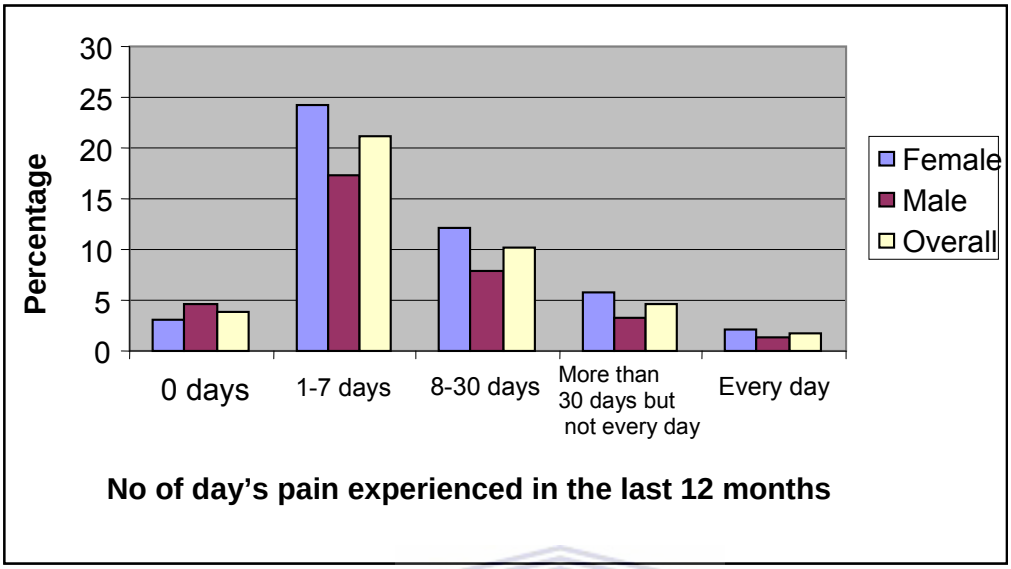
Of the 61.7% (N=211) & 41.8% (N=143) of the students who experienced lifetime prevalence of LBP & UBP frequency of back pain was reported in the context of back pain experienced in the last 12 months (overall, according to gender), in Figure 4.8 & Figure 4.9 respectively.

Only the frequency of back pain for those students who reported lifetime prevalence of back pain (LBP & UBP) was taken into account.

4.4.3.1 Frequency of low back pain reported by students in the last 12 months

Figure 4.8 presents the frequency of pain experienced by those students who have experienced LBP once or more in their lives (lifetime prevalence of LBP, 61.7% N=211) in the last 12 months. There is a gender difference in the frequency with which LBP was suffered between one and seven days, 8-30 days and more than 30 days (but not every day) in the last twelve months and females reported a higher incidence of LBP than males. Considering students responses to all categories of LBP prevalence it was found that out of the 61.7% who experienced lifetime prevalence of LBP only 5.3% of the students didn't experience LBP in the last 12 months.

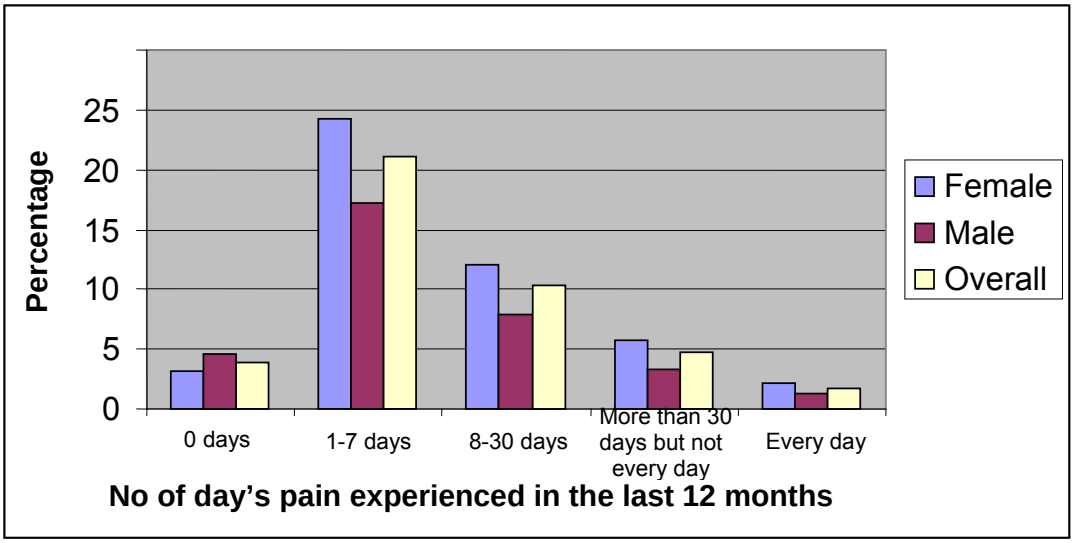
Figure 4.8: Frequency of LBP reported by students in the last 12 months



4.4.3.2 Frequency of upper back pain reported by students in the last 12 months

Figure 4.9 describes the frequency of pain experienced by those students who have experienced UBP in their life (lifetime prevalence of UBP, 41.8% N=143) in the last 12 months. From figure 4.9 it can be stated that there is a gender difference in the frequency with which UBP was suffered between one and seven days, and 8-30 days in the last twelve months, and in that females reported a higher incidence of UBP than males. Considering students responses to all categories of LBP prevalence it was found that out of the 41.8% who experienced lifetime prevalence of LBP only 3.8% of the students didn't experience UBP in the last 12 months.

Figure 4.9: Frequency of UBP reported by students in the last 12 months



4.5 RISK RATIO FOR BACK PAIN ACROSS YEAR LEVEL AND GENDER EXPOSURE

The risk ratios of LBP & UBP occurring in each year level was compared with first year students and is reported in Table 4.7 & 4.8 with 95% C.I. This method of analysis gives us data regarding relative risk of the other year level students developing LBP with reference to first year students. The first year students were taken as the reference group because of their exposure in clinics will be the least and it is hypothesized that they are less likely to have work-related back pain when compared to other year level students.

Table 4.7: Risk ratio of LBP occurring in each year level compared with the first year students (RR=1)

Key: *=.05 significance, **=.01 significance &***=.001 significance

Year level	Prevalence	Overall Risk ratio(95%CI)	Gender specific Risk ratio (95%C.I)	
			Male	Female
5th year students	Life time	1(.7-1.4)	.9(.6-1.5)	1.0(.5-2)
	12 months	1.2(.8-1.6)	1(.7-1.6)	1.3(.8-2.2)
	One month	1(.8-1.2)	.9(.6-1.2)	1.1(.7-1.6)
	One week	1(.8-1.2)	1(.8-1.2)	1.4(.8-1.4)
4th year students	Lifetime	1.2(.8-1.9)	1.3(.7-2.2)	.2(.6-2.4)
	12 months	**1.4(1-2.1)***	1.3(.8-2.2)	1.5(.9-2.8)
	One month	1.1(.9-1.5)	1.1(.7-1.5)	1.2(.8-1.9)
	One week	1.1(.9-1.4)	1(.8-1.3)	1.3(.9-1.8)
3rd year students	Lifetime	1.4(.8-2.1)	1.7(.9-3.1)	1.2(.7-2.4)
	12 months	**1.5(1-2.2)***	1.4(.9-2.4)	1.5(.9-2.6)
	One month	1.2(.9-1.6)	1(.7-1.5)	1.4(.9-2.1)
	One week	1.2(.1-1.5)	1.1(.9-1.6)	1.1(.9-1.6)
2nd year students	Lifetime	1(.8-1.8)	1.4(.8-2.5)	.7(.4-1.3)
	12 months	1(.7-1.4)	1.3(.8-2.1)	.8(.5-1.2)
	One month	1(.8-1.3)	1.3(.9-1.9)	.8(.7-1.2)
	One week	1(.7-1.5)	1.1(.8-1.5)	.8(.7-1)

From the above table it can inferred that third **[1.5(1-2.2), p<0.05]** and fourth year **[1.4(1-2.1), p<0.05]** students have a significantly higher risk of getting LBP in 12 months when compared to first year students. When considering gender-specific risk of LBP, there was no significant difference found for all measures of low back pain when compared to first years.

Table 4.8: Risk ratio of UBP occurring in each year level compared with the first year students (RR=1)

Key: *=.05 significance, **=.01 significance &***=.001 significance

Year level	Prevalence	Overall Risk ratio(95%CI)	Gender specific Risk ratios (95%C.I)	
			Male	Female
5th year students	Life time	**1.3(1-1.7)***	1.2(.8-1.8)	1.4(1.0-2.1)
	12 months	1.3(1-1.8)	1.2(.8-1.8)	1.4(1-2.1)
	One month	1.2(1-1.5)	1(.8-1.3)	1.4(1-2)
	One week	1.1(.9-1.3)	1(.8-1.2)	1.2(.9-1.6)
4th year students	Lifetime	**1.3(1.-1.8)***	1.4(.9-2)	1.4(.9-2)
	12 months	**1.3(1-1.8)***	1.4(.9-2)	1.4(.9-2)
	One month	1(.8-1.2)	1(.8-1.2)	1(.8-1.3)
	One week	1(.9-1.1)	1(.8-1.2)	1(.8-1.3)
3rd year students	Lifetime	1.2(.9-1.5)	.9(.7-1.2)	**1.5(1-2.2)***
	12 months	1.2(.9-1.5)	.9(.7-1.2)	**1.5(1-2.1)***
	One month	**1.2(1-1.5)***	1(.9-1.4)	**1.4(1-2)***
	One week	1.1(1-1.4)	1(.8-1.2)	**1.3(1-1.8)***
2nd year students	Lifetime	1.1(.8-1.4)	1(.7-1.4)	1.2(.8-1.8)
	12 months	1.1(.8-1.4)	1(.7-1.4)	1.2(.8-1.8)
	One month	1(.8-1.2)	1.1(.9-1.4)	.9(.7-1.1)
	One week	1(.8-1.1)	1(.9-1.3)	.9(.7-1.1)

From the above table it can inferred that the fifth and the fourth year students [**1.3(1-1.7) & 1.3(1.-1.8), p<0.05** respectively] have a significantly higher risk of getting UBP lifetime prevalence when compared to first year students. And the fourth years [**1.3(1-1.8), p<0.05]** also had a significantly higher risk of getting 12 month prevalence UBP compared to first years. The third year students **[1.2(1-1.5) p<0.05]** had a significantly higher risk of getting one month prevalence when compared to first years. Furthermore, with regards to gender specific risk, it was found the risk of third year female students had a significantly a higher risk of having UBP (all measures) when compared to first year female students. From the results presented

in Tables 4.7 & 4.8 it can be concluded there is a non-significant year-by year increase in risk of developing back pain after the first year of dentistry study.

4.6 POSSIBLE RISK FACTORS INFLUENCING BACK PAIN

The association between development of back pain and risk factors was calculated using regression logistic analysis, and results were presented as Odds ratio with 95% confidence interval. The variables that had a significant association were marked in bold. The associated p values were coded *=.05 significance, **=.01 significance &***=.001 significance. The possible risk factors are described below.

4.6.1 Age

The effect of **age** was tested in independent year categories relevant to the sample distribution (18 years and younger [the comparison group], 19 through to 24 years as separate categories, and 25+ years [exposure group]). Logistic regression analysis was done for all four measures of back pain comparing with the youngest students aged18 years or less (comparison group) ODDS ratio and their 95% C.I was done. The results suggest that there was no significant effect of the age on both LBP and UBP except for the students aged 21 years demonstrated significantly higher ODDS of having UBP in the last week when compared with the youngest students (18 years or younger) **3.0 ODDS ratio(95% C.I 0.9-1.96**).

A student t- test showed no significant differences between the age of students who had MSDs, LBP or UBP with those who did not have MSDs, LBP or UBP.

4.6.2 Length of study/length clinical exposure

A dichotomy variable was created for the length of time spent in the university and length of clinical exposure using the mean as the cut off point. Thus the length of time spent in the university and length of clinical exposure was divided into two categories, one below the mean (comparison group) and the other above the mean (exposure group).

- Length of time spent studying at university divided at 2 years or less was taken as the comparison group (n= 124), and greater than two years as the exposure group (n=218).

- Length of clinical exposure at the university, any student having undergone less than 21 months of clinical exposure was taken as the comparison group (n= 193) and those above who had undergone more than 21 months of clinical exposure was the exposed category (n=149). Clinical exposure refers to students exposed to clinical arena during their length of time spent in the university. Table 4.9 reports on the association between length of study (LOS) in university and length of clinical exposure (LOCE).

Table 4.9: Risk estimates of length of university study and length of clinical exposure (OR and 95% CI)

Exposure variables key*=.05 significance, **=.01 significance &***=.001 significance		**Life time**	**12 month**	**1 month**	**1 week**
LOS > 2YRS N=218	LBP	1.5(1-2.4)	**1.9(1.2-3)****	1.4(.9-2.2)	**1.7(1-3)***
	UBP	**1.7(1 -2.8)***	**1.7(1-2.7)***	**1.8(1.1-3.1)***	**2(1.1-3.6)***
LOCE>21MON N=149	LBP	1.3(.8-2)	**1.6(1-2.4)***	1.2(.7-1.8)	1(.6-1.6)
	UBP	1.2(.8-1.9)	1.2(.8-1.9)	.9(.5-1.5)	1(.6-1.7)

Key: LOS=length of university study, LOCE=length of clinical exposure

Length of university study was significantly associated with l2-month and one-week prevalence of LBP(p<.01), and for UBP(p<.05) it was significantly associated with life time prevalence, l2-month ,one month and one-week prevalence with students reporting back pain was being involved in tertiary study for significantly longer than two years. The results of table 4.9 suggest that the ODDS of a student getting l2-month and one-week prevalence of LBP and life time prevalence, l2-month ,one month and one-week prevalence of UBP was significantly higher when compared to their counterparts who have been studying in the university less than two years. When exploring this result for gender strata, it showed no significant difference between male and female students.

The second exposure variable in Table 4.9 (length of clinical exposure) was significantly associated with 12 month LBP prevalence. It can be said that the ODDS of a student exposed to clinical training for more than 21 months having 12 month prevalence was significantly higher when compared to a student exposed to clinical training for less than 21 months [**1.6(1-2.4)***]. There was no significant association found with other measures of back pain with UBP.

This result was further analysed by comparing means by student independent t test. A student t- test showed no significant differences between the length of total study and length of clinical exposure of students who had LBP or UBP with those who did not have LBP or UBP. But when the same test was done for the students experiencing any form of MSDs, it was found the mean length of study of a student having MSDs had studied an average of 2.34 years was significantly higher when compared to a student who doesn't have any MSDs who had studied an average of 1.5 years (*p*= 0.002). The importance of this finding continued in gender-specific analysis, where for females, the length of total study for students with life time

prevalence of MSDs was 2.1years compared with those without any MSDs was1.1 years (p = 0.002).

When done for clinical training it was found that the life time prevalence of a student reporting MSDs had been undergoing clinical training on average for 22 months, which was significantly longer than a student without MSDs who had undergone clinical training on a average of16 months (p= .03).

4.6.3 Exposure to educational activities

A dichotomy variable was created for all educational exposure questions using mean as the cut off point. Thus the educational exposure was divided into two categories, one below the mean (comparison group) and the other above the mean (exposure group).

Since educational exposure of the students was measured over the pervious past month only, it will be only relevant to one-month and one-week back prevalence.

- Sitting and looking straight ahead was dichotomized into two groups those who had <55 hours of exposure (comparison group, N= 188) compared to those who had >55 hours exposure (exposure group, N= 154)

- Sitting and looking down most of the time was dichotomized into two groups those who had <52 hours of exposure (comparison group, N= 191) compared to those who had >52 hours exposure (exposure group, N= 151)

- Lab time was dichotomized into two groups those who had <20 hours of exposure (comparison group, N= 234) compared to those who had >20 hours exposure (exposure group, N= 108)

- Treating patients was dichotomized into two groups those who had <39 hours of exposure (comparison group, N= 204) compared to those who had >39 hours exposure (exposure group, N= 138)

Table 4.10 explains the influence of educational activities on one month and one week prevalence of UBP and LBP

Table 4.10: Risk estimates for development of back pain when exposed to educational activity in the past month (OR and 95% CI)

Educational activities Key:*=.05 significance, **=.01 significance &***=.001 significance		**1 month prevalence**	**1 week prevalence**
Sitting and looking straight ahead>55hrs N=154	LBP	1.3(.8-2.0)	1.4(.9-2.3)
	UBP	1(.7-1.7)	**1.7(1-3)***
Sitting and looking down most of time> 52hrs N=151	LBP	.9(1.6-1.4)	1(.6-1.7)
	UBP	1.2(.7-1.9)	1.1(.7-2)
Lab time >20hrs N=108	LBP	1.5(.9-2.3)	1.7(1-2.8)
	UBP	1.1(.7-2)	**1.4(.8-2.4)***
Treating patients >39hrs N=138	LBP	.9(.6-1.4)	.9(.5-1.4)
	UBP	1.1(.7-1.9)	1.3(.8-2.2)

Exposure to the educational activity of 'sitting and looking straight ahead' for more than 55 hours in the past month was significantly associated with reports of one-week prevalence of UBP. 'Lab time' for more than 20 hours in the past month was associated with reports of one-week prevalence of UBP. When considered in gender-specific strata the values were not significantly different for men and women.

4.6.4 Demographic variables

Height, weight and BMI were all tested as independent variables. A dichotomy variable was created for the Height, weight and BMI using the mean as the cut off point. The mean was established for all the years together then dichotomized and

the comparison and exposure category was established. Thus Height, weight and BMI was divided into two categories, one below the mean (comparison group) and the other above the mean (exposure group).

Weight, height and BMI were unlikely to be related to one-month or one-week back pain prevalence because of limited potential for change in exposure, but may well be related to 12-month prevalence. On the other hand, the expected major changes to height and weight over a lifetime would reduce the usefulness of these variables as exposures for lifetime back pain prevalence.

- Height dichotomized at less than 168 cm (comparison category, N= 179) and 168 or more cm (exposure category, N= 163)

- Weight at less than 65 kgs (comparison category, N= 215) and 65 kgs or more (exposure category, N= 127)

- Body mass index at less than 22.8 kg/m^2(comparison category, N= 210) and 22.8 or more (exposure category, N= 132).

Table 4.11 illustrates the association between the demographic variables of weight, height and BMI with 12 month prevalence of back pain.

Table 4.11: Risk estimates for development of back pain with reference to demographic variables (OR and 95% CI)

Demographic variables Key: *=.05 significance, **=.01 significance &***=.001 significance		**12 month prevalence**
Weight >65	LBP	1.4(.91-2.2)
N=127	UBP	**1.57(1-2.47)***
Height >168	LBP	.75(.48- 1.15).
N=163	UBP	1.2(.79-1.8)
BMI > 22.8	LBP	1.2(.77-1.86)
N=132	UBP	**1.62(1.03-2.54)***

There was a significant association between weight and BMI with 12 month prevalence of UBP (p<.05). A student weighing more than 65kgs the odds of them getting UBP (12 month prevalence) is **1.57(1-2.47)*** when compared to those students weighing less than 65kg. And having BMI more than 22.8 kg/m^2 showed significant association between UBP and the odds of them getting UBP (12 month prevalence) is **1.62 (1.03-2.54)*** when compared to those having a BMI less than 22.8 kg/m^2. There was no significant association found between demographic variables and 12 month LBP prevalence. Furthermore these were tested in gender strata and no significant difference between male and female students was found.

4.6.5 Level of fitness and level of physical exercise

Level of physical exercise and self-reported **fitness** were tested as independent categories. These two factors were potentially relevant to 12-month, one-month and one-week prevalence measures.

- Level of self reported fitness were split into two groups those who rated their fitness to be good as the comparison group and the other two as the exposure group.

- Level of physical exercise was also split into two groups. Group doing physical exercise as the comparison group compared to those not doing exercise as the exposure group.

Table 4.12 explains the influence of level self assessed fitness and level of physical exercise on UBP and LBP

Table 4.12: **Risk estimates for development of back pain when compared to perceived fitness and reported physical exercise (OR and 95% CI)**

Exposure variables Key *=.05 significance, **=.01 significance &***=.001 significance			**12 month prevalence**	**One month prevalence**	**One week prevalence**
Level of fitness		*Good N=45*	1	1	1
Poor N=84		LBP	1.4(.66-2.9)	2.0(.96-4.33)	1.65(.71-3.82)
		UBP	1.78(.85-3.73)	1.3(.59-3.07)	2.22(.87-5.6)
Moderate N=210		LBP	.66(.34-1.28)	.89(.45-1.77)	1.0(.47-2.2)
		UBP	1.0(.56-2.09)	1.12(.53-2.3)	1.26(.53-3.03)
Physical exercise	*yes*	*N=211*	1	1	1
	No N=128	LBP	**1.7(1.1-2.6)***	**2.2(1.4-3.4)****	**2.4(1.5-3.9)****
		UBP	**1.7(1.1-2.6)***	1.1(.7-1.8)	**1.7(1-2.9)***

From the above table 4.12 it can be established that there is significance relationship between students doing no physical exercise and back pain. It can be concluded that people who don't do physical exercise are much more prone to get back pain. The odds of a student not doing physical exercise and getting a LBP (12month, one month and one week)are **1.7(1.1-2.6)*, 2.2(1.4-3.4)**, 2.4(1.5-3.9)** respectively with their CI.** This result was further investigated to determine whether frequency of doing physical exercise had any significance in the prevalence rate using univariate logistic regression analysis. It was found that doing exercise once a week or doing exercise four times does not influence the prevalence rate of LBP (12month, one month and one week).

On the other hand for UBP there was a significance for 12 month prevalence and one week prevalence only. And so it can be concluded that people who don't physical exercise are much more prone to get back pain. The odds of a student not

doing physical exercise and getting a UBP (12month& one week) were **1.7 (1.1-2.6)*, 1.7 (1-2.9)* respectively with their CI.** This result was further investigated to find whether frequency of doing physical exercise had any significance in the prevalence rate using univariate logistic regression analysis. It was found that doing exercise once a week or doing exercise four times does not influence in the prevalence rate of UBP (12month, one month and one week). And there were no significant differences between the prevalence of back pain between students who rated their self assessed fitness to be good to those students who rated their self assessed fitness to be poor or moderate.

This study attempted to determine the prevalence of MSDs among dentistry students in UWC. It was found that majority of the students presented with some form of MSD. And back pain was identified as the most troublesome pain among the students. Pain characteristics for the most troublesome pain were assessed in detail. The influence of possible risk factors on the prevalence of back pain was also assessed. The outcome may help us to identify some possible preventive measures, and thereby reduce the impact of back pain among dentistry students.

CHAPTER FIVE

DISCUSSION

5.1 INTRODUCTION

A high prevalence of back pain among both qualified dentists and dentistry students has been documented in the literature. Therefore the pattern of musculoskeletal disorders among dental students will provide researchers and students with relevant information necessary to investigate predisposing factors to back pain in the dentistry population.

5.2 RESPONSE RATES

The response to this survey was good. As this was a cross-sectional study, the number of students present during the time of giving the questionnaire was taken as the sample group (n=362), this gave the study an overall response rate of 95% (n=342). The students from fourth-year had a poor participation (85%), when compared to other year levels. Of the total 471 students for the academic year 2007, 362 students took part in the study. The missing students did not attend class on the day that data collection was done.

5.3 MUSCULOSKELETAL PAIN PREVALENCE

The results of this study demonstrate that a high percentage of dental students had experienced some type of MSD. The most prevalent types of musculoskeletal pain in this study are lower back pain, followed by neck pain and then upper back pain. The results of this study are similar to previous results among practising dentists where the most prevalent symptoms were neck/shoulder and back pain (Van Doorn, 1995;

Conrad, Conrad and Osborn, 1993; Stockstill, Harn, Strickland, Hruska, 1993; Conrad, Conrad, Osborn, 1992; Shugars, Miller, Williams, Fishburne and Strickland, 1987). It was established that the overall prevalence of musculoskeletal pain was 88%. This represents a similar prevalence when compared to Adnan *et al*. (2005) in Turkey, where 86% of the subjects reported some sort of MSDs (neck, back, head, and shoulder region). The lifetime prevalence of musculoskeletal disorders among these graduate dentists was comparable to the prevalence of student dentists in this study. The highest prevalence experienced was by graduate dentists from south-east Turkey (Polat *et al.,* 2007), where 84% of the dentists had some form of MSD.

The prevalence percentage across year levels ranged from 77.8% - 100% which is higher when compared to a Californian study (Rising *et al*., 2005) where the range was 46% - 71%. The prevalence rate increased from the first year students to the final year students, but this was not significant. It was found that every student in the fourth year of dental school had some type of musculoskeletal disorder. This represented a 100% prevalence rate, which is similar to the findings in a study by George *et al.* (1987), where the fourth-year students reported a greater frequency of health problems when compared to other year levels. The third-year students in the current study had an MSD prevalence rate of more than 90%, which is higher than the study by Rising *et al.* (2005), where the third-years had a prevalence of MSDs of more than 70%. However the Californian dental students followed a four-year dental curriculum, compared to a five year dental curriculum in UWC. Only 22.2% of first-year students experienced no pain whatsoever when compared to fourth-years where every student reported some sort of musculoskeletal pain, which indicates that there was a high prevalence rate of MSDs among the first-year students even

before they started clinical work in the university. This suggests that MSD is experienced from early in their student period and it may be continuous through out their lifetime for many dentistry students and graduates. From the above comparison it can be interpreted that MSD experienced by the students at the UWC is so far reported to be the highest among dentistry students in the world, which suggests that there needs to be in-depth investigation of the predisposing causes of MSD among UWC dentistry students.

5.4 PAIN PICTURE EXPERIENCED BY THE STUDENTS FOR MOST TROUBLESOME PAIN

In the current study the pain picture was assessed for the most troublesome pain experienced by the students. Pain frequency, duration, intensity, fatigue level and the perception of influence of stress and dental procedure on pain intensity experienced, are discussed below. Interestingly, the findings of this study showed fluctuations in the amount of pain experienced, across the year levels. There was an increase in the pain intensity as the years progressed but this was not significant. This suggests that the dental studies have an influence on the amount of pain experienced.

5.4.1 Mean frequency and duration of pain experienced

The mean frequency and duration of the most troublesome area of pain reported was the same as reported by Rising *et al.* (2005). Final-year students experienced a higher frequency and duration of pain when compared to students from all the other years, although there was no significant year by year increase. This was followed by third-year students. The second-year students reported the lowest results in mean

frequency and duration of pain when compared to students from all the other years. The dental curriculum was analysed and it was found that fifth-year students were exposed to more clinical work and they had 300% more clinical hours when compared to the first-year students. At third-year level the students were exposed to more laboratory work, lectures and pre-clinical work when compared to first- and second-year students. The frequency of the pain experienced was significantly less in students whose perceived level of fitness was good as compared to those who perceived that their level of fitness was poor. The results of a study by Alexopoulos *et al*. (2004) study demonstrated similar results where the comorbidity was high in dentists whose perceived health was bad or moderate. The duration of the pain experienced was significantly less in students whose perceived level of fitness was moderate, compared to those whose perceived level of fitness was poor, which is similar to the results of Alexopoulos *et al.* (2004). Therefore, based on the above, it can be said that the frequency and duration of pain experienced by students at UWC was similar to those of dentistry students world-wide, and that the perceived level of fitness has a significant effect on the frequency and duration of pain experienced.

5.4.2 Pain intensity and fatigue level experienced

Pain intensity experienced by the UWC students for the most troublesome area of pain (ranging between 5 and 6 VAS) was higher than the pain intensity experienced by students (ranging between 3 and 5 VAS) reported in the study by Rising *et al.* (2005). The pain intensity was highest in third-year students, followed by fifth-year students, which suggests that the third-year students are the most affected by the problem in terms of pain intensity level.

The fatigue level experienced by the UWC students for the most troublesome area of pain (ranging between 5.6 and 6.9 VAS) was higher than the fatigue level experienced by students (ranging between 2.9 and 4.8VAS) reported in the study be Rising *et al.* (2005).

Both third- and fourth-year students experienced significantly higher fatigue levels when compared to first-year students. This is similar to the fatigue level reported in the study by Rising *et al.* (2005), where the third-year students reported the highest level. From the above comparison it can be said that the pain intensity and the fatigue level experienced by students at UWC are higher than that experienced by dentistry students internationally. This suggests that the course load is high. An overview of the course suggests that the clinical work load is high when compared to the first two years of dental school. Moreover, the students were exposed to various high intensity dental procedures that they had not been exposed to before.

5.4.3 Self-perceived level of stress and performing dental procedure influencing the pain intensity experienced

The perception that dental procedures aggravate the pain intensity increased with each year in dental school, which corresponds with what was found by Rising *et al.* (2005). Third-year students reported the highest levels when compared to students in other years. Second-, third-, fourth- and fifth-year students had a significantly higher influence of dental procedures on their pain intensity when compared to the first-year students, as the first-year students do not do any dental procedures. Although not significant, there was a trend of an increasing percentage of students reporting pain with each year in dental school. Therefore it can be said that performing dental procedures indeed increased perception of pain.

The perception that stress influences the pain intensity was higher in UWC students when compared to dental students internationally. Pain intensity influenced by stress was significantly high among third-year UWC students when compared to students from other years. This was similarly reported by Rising *et al*. (2005). But these results were contradictory to those in the study done by Newton, Baghaienaini, Goodwin, Invest, Lubbock and Marou (1994), where the first- and second-year dental students were reported to have high stress levels (where they have a five-year dental curriculum, just like UWC). It was also noted in the Newton *et al.* (1994) study that women reported significantly higher levels of stress influencing the pain intensity. In the study by Sanders and Lushington, (1999) and Westerman, Grandy, Ocanto and Erskine (1993), similar results where found suggesting that gender differences do play a role among dental students. In performing the same job, women tend to be at higher risk for some hand-wrist cumulative trauma disorders (Silverstein, Fine and Armstrong, 1986; Armstrong, Fine, Goldstein, Lifshitz and Silverstein, 1987). In addition, postural strain may also develop in women who adopt different work techniques than those of the men to compensate for the misfit. Women may use different strategies and work methods than men when performing physically demanding work (Punnett and Herbert, 2000).

The results of a study done by Kelsh and Sahl, (1996) among utility workers demonstrated that the difference in training needs and training provision accounts for some of the gender differences in work-related injury and in causing musculoskeletal disorders. This needs to be investigated if it is true among dentistry students. Humphris, Blinkhorn, Freeman, Gorter, Hoad-Reddick and Murtooma, (2002) compared the stress levels experienced by dental students with the stress levels of

students at other medical schools and found that dental students were more highly stressed than other medical students. It was thus assumed that general psychological distress and course-related stress levels were associated to their course load and the study environment of the dental students. This could be applicable to the current study, and therefore it was necessary to look into the aspects of the course characteristics or the way the dental curriculum was set for the third- and fourth-years (see section 5.5.4).

5.4.4 The influence of physical exercise on the pain status

The influence of physical exercise on the intensity of pain experienced, the fatigue level, the level of stress and the level of dental procedure was significant. It was found that the students who did physical exercise had lesser pain intensity, fatigue level, and level of pain intensity being influenced by stress or dental procedure when compared to those who did not do physical exercise. It can be inferred that doing physical exercise is good and that it does help in restricting the pain intensity among dental students at the UWC. The findings on the effect of physical exercise on reducing MSDs was similar to the findings in other studies done by Sculco, Paup, Fernhall and Sculco (2001), Mälkiä and Ljunggren (1996), and Gerdle, Brulin, Elert, Eliasson and Granlund (1995). The study instrument did not include questions regarding what type of exercise the students were doing, and thus conclusions could not be drawn on whether doing aerobic exercises, strengthening or stretching or doing some form of sports activity had caused the change. It can only be said that some form of physical exercise is good for reducing the intensity of pain experienced, the fatigue level, the level of stress influencing the pain intensity and the level of dental procedure influencing the pain intensity.

5.4.5 Aggravating factors that influenced the most troublesome pain

In the current study the students rated sitting/standing postures in clinics as the most aggravating factor, with over 60% of students reporting it. This is in accordance with other studies done on qualified dentists where posture-related MSDs were commonly reported (Rundcrantz *et al*., 1991; Guay, 1987; Walters, 1976). Wegman (1983) investigated the body postures of students and found that as students assumed unnatural body postures, there was an increase in physical stress that adversely affected work performance. From the results of this study it can be concluded that dentistry students at the UWC suffer from MSDs due to their sitting/standing postures in clinics. However, specific ergonomic analysis needs to be performed to confirm such findings. Chairs used by the students in clinics, lecture halls and laboratories were reported as the second most important aggravating factor. It was found in previous studies among dentists, that the dental chair is one of the factors that predisposes for MSDs as it involves the dentist sitting in an unsupported or awkward posture for a prolonged period of time (Chaffin *et al.,* 1999).

5.5 BACK PAIN PREVALENCE

Low back and then upper back pain were reported by majority of the UWC as the most troublesome pain. Therefore the onset and prevalence of these problems are discussed in the following sections.

5.5.1 Onset of back pain

Most of the lifetime onset of lower back and upper back pain in the sample reported from the table 4.4 is commencing in late-teens, the average age was 18.7 years and 19.7 years respectively. The most common perceived cause for the onset of LBP

was related to sports injury and studying, while for UBP it was related to bad posture and clinical work. This indicates that most of the lifetime LBP prevalence onset was early, that is, when the students had just entered the university (18 to 20 years majority of them where in the first and second year of the dentistry programme). For UBP there is also an early onset, but it occurred mostly when the student had entered the second year of university. These results suggests that there could be certain activities or some sort of exposure that has predisposed the student to develop a lifetime prevalence of UBP at university. These results were similar to those in a study done by Nyland and Grimmer, (2003) among undergraduate physiotherapy students where the initial onset of lifetime prevalence of LBP was in their late-teens. This may suggest that certain factors in the university course load could expose students to acquire UBP, which needed to found out. Since the onset of LBP and UBP is early in their student period preventive strategies should be part of their curriculum from the first year of their dental curriculum.

5.5.2 LBP prevalence across year levels and overall

The lifetime prevalence of LBP for dentistry students reported in this study was 61.7%, which represents a high prevalence rate. When compared to studies done in Italy (Marcellos *et al.,* 2004) among Italian and Lebanese dentistry students, South African dentistry students showed a higher prevalence rate. Third-year students reported a high prevalence rate in all measures of LBP when compared to other year levels (not significant).

In Table 5.1 the LBP prevalence established in the current study is compared to the results of other similar studies

Table 5.1: Comparison with other studies in prevalence of LBP estimates

Authors	Subjects	Lifetime	12 month	1 month	1 week
Current study	1st years	56.3%	46.9%	35.9%	21.9%
	2nd years	57.6%	46.7%	38.1%	20.6%
Dentistry students at UWC,	3rd years	69.7%	64.5%	47.3%	33.8%
South Africa	4th years	66.2%	63.2%	44.1%	30.9%
	5th years	57.4%	55.4%	33.8%	22.1%
	Overall	61.7%	55.3%	39.5%	25.7%
Marcellos *et al*. (2004) Dentistry students	Italian	32.5%			
	Lebanese	37.1%			
Nyland and Grimmer, (2003) Physiotherapy	Students	69.2%	63.2%	44.4%	27.6%
Leggat *et al.* (2006)	Dentists		53.7%		
Marshall *et al*. (1997)	Dentists			64 %	
Rundcrantz *et al*. (1991)	Dentists		50%		
Gijbels *et al.* (2006)	Dentists	54%			
Ratzon *et al.* (2000)	Dentists	55%			
Alexopoulos *et al.* (2004)	Dentists	46%			
Shugars *et al.* (1984)	Dentists	31%			

The lifetime prevalence of LBP for dentistry students at the UWC is generally higher than that reported in other studies done among undergraduate students or among qualified dentists internationally (see Table 5.1). However a possible explanation for such differences could be related to work techniques which cause LBP among students and younger graduates. However, when compared to a study done by Nyland and Grimmer, (2003), it was found that undergraduate physiotherapy students experience more LBP (all measures) when compared to the dentistry students in the current study. The reported LBP prevalence in the last 12 months of the current study was similar to the reports of the Australian study by Leggat *et al*. (2006). On the other hand, the LBP experienced in the last month by the dentistry

students in the current study was lower when compared to the study by Marshall *et al.* (1997). It was found that the risk of third- and fourth-year students getting a 12-month prevalence of LBP was significantly high when compared to first-years (Risk ratio 1.4 (1-2.1) and 1.5 (1-2.2) respectively with p value = .05). This suggests that students in the third and fourth year are more prone to get 12-month prevalence of LBP. Interestingly, the fifth-year students showed a slight decrease in the prevalence rate for all measures of LBP when compared to third- and fourth-years.

5.5.3 UBP prevalence across year levels and overall

In Table 5.2 the UBP prevalence established in the current study is compared to the results of other similar studies

Table 5.2: Comparison with other studies in prevalence of UBP estimates

Authors	Subjects	Lifetime	12 months	1 month	1 week
Current study	1st years	31.3%	31.3%	20.3%	17.2%
	2nd years	36.4%	36.4%	21.2%	13.6%
Dentistry students at UWC, South Africa	3rd years	42.1%	41.3%	36%	28%
	4th years	50%	50%	20.6%	17.6%
	5th years	48.5%	48.5%	33.8%	25%
	Overall	41.8%	41.5%	26.6%	20.5%
Marcellos *et al.* (2004) Dentistry students	Italian	21.1%			
	Lebanese	29.2%			
Leggat *et al.* (2006)	Dentists		34.4%		
Rundcrantz *et al.* (1991)	Dentists		22%		
Shugars *et al.* (1984)	Dentists	54%			

The lifetime prevalence of UBP for dentistry students at the UWC is generally higher than that reported in other studies done among undergraduate students, but less when compared to qualified dentists (see Table 5.2). The possible explanation for such differences could be related to work techniques which cause UBP among

students and younger graduates. However, the reported prevalence of UBP in the past 12 months in the current study was the highest internationally when compared to other studies, with regard to both students and qualified dentists. This suggests that the percentage of students suffering from UBP is higher in South Africa than elsewhere in the world. The average age of initial onset of UBP was 19.7 years (2.7 years SD), suggesting that the majority of students get UBP after entering the university. There was also a significant (p = .012) linear by linear increase in the number of students reporting UBP, both lifetime and 12 months, across the year level (from first- to fifth-year level). This suggests that UBP is experienced by the dentists early in their dental carrier and it could prolong for their entire dental career, with a possibility of an increasing trend for many dentistry students and graduates. Therefore it can be said that the UBP experienced by students at the UWC increases every year. However, it would be necessary to do a longitudinal study to confirm these results. It was also found in the current study that the risk of fourth-year students developing a lifetime or 12-month prevalence was 1.3 (1.1 - 1.8) greater when compared to first-years (p = .05) and the risk of fifth-years getting a lifetime time prevalence of UBP was 1.3 (1 - 1.7) greater when compared to first-years (p = .05). In the case of a one-month prevalence, the risk of third-years getting a UBP was 1.2 (1 - 1.5) greater when compared to first-years (p = .05). In the gender strata it was found that female third-year students had a significantly high chance of getting UBP for all measures when compared to first-years (p = .05). This suggests that the female students are more prone to get UBP, especially at the third-year level.

In the prevalence rate of both UBP and LBP it was found that the percentage of females reporting back pain was higher for all measures and across all five-year

levels when compared to males. This is similar to study reports by Kerosuo, Kerosuo and Kanerva (2000) and Rundcrantz *et al*. (1991), who reported that women are more prone to developing MSDs when compared to men. In addition, Unruh (1996) reported that women are more prone to developing varying types of chronic musculoskeletal pain than men. Studies (Berkley, 1997; Fillingim, Maixner, Kincaid and Silva, 1998) proved that women have a lower threshold for pain than men, leading them to experience pain at very low intensity. Andersson (1994) found that among chronic pain sufferers, women reported significantly greater pain intensities and more pain sites than men. However, the possible explanation for women reporting more prevalence of back pain in the current study can be that they had more problems related to handling stress, managing coping strategies or clinical adaptation skills, but it cannot be conclusive, as it is necessary to analyse the specific training for gender difference in training and using techniques.

5.5.4 Third- and fourth-year course characteristics

There are several reasons why the third-year students may have demonstrated higher perceived pain levels and a higher prevalence of MSDs. One of the reasons can be the course load (both lecture and clinical load) for which their curriculum was analysed. It was found that students were taught strong clinically based subjects when compared to first- and second-year students. Most of the structured courses in the third year focus on learning and acquiring clinical skills, such as how to extract a tooth, cut and fill teeth with the drill, and clinical procedures of prosthetic laboratory work. There are more lecture hours and laboratory hours when compared to all other year levels. Conservative dentistry and oral surgery is only introduced in the third year of study. Oral surgery, a course where students mostly stand and perform their

assessment and dental extraction (in patients), is introduced for the first time in this year level. Conservative dentistry is a field that involves more precision activity and where the student is seated, often holding the mirror in one hand while the other hand holds the hand piece or any other hand instrument for tooth cavity preparation. The students were assessed according to their ability to perform specific clinical tasks with accuracy. A minimum of 50% is the prerequisite for the final examination in this area. The quota system is introduced where students have completed a specified number of procedures as a component of their assessment (UWC dental curriculum, 2007).

Students' introduction to many new dental techniques for their first time together with the increased lecture hours and assessment techniques, could be one of the possible causes why students in this year level experience such high levels of pain and prevalence rate of MSDs. This indicates that the students indeed experience initial difficulties in coping with their undergraduate training, and especially with their new clinical procedure.

5.6 FACTORS INFLUENCING THE PREVALENCE OF BACK PAIN

A number of factors can contribute to the prevalence of back pain in dentistry students. The factors that were found to be relevant to the students in the Faculty of Dentistry at the UWC are discussed in the sections below.

5.6.1 Educational exposure

A strong association exists between educational activities such as 'sitting and looking down' and 'laboratory time' with a one-week prevalence of UBP. This

suggests that a student's exposure to the above-mentioned activities in the Faculty of Dentistry at the UWC for more than 55 hours and more than 20 hours respectively UWC dental curriculum 2007 could have predisposed the student to experience a one-week prevalence of UBP when compared to those students who had fewer hours of these activities. The students who fall under the exposure category were third- and fourth-year students, because third- and fourth-year students had more than 55 hours and more than 20 hours respectively (in the last month).

5.6.2 Length of study

In the current study a dental student exposed to more than two years of university study is at a higher risk to get 12-month and one-week prevalence of LBP when compared to those students who had studied less than two years at the university. There was also a strong association between the length of study and all measures of UBP prevalence. This suggests that a dental student who is exposed to more than two years of university study is at significant risk to get all measures of UBP when compared to those students who have studied less than two years at the university. It was found that when associating the year level of study with the exposure, those students who had completed two years of study at the university would fall under the significantly high risk category (third-, fourth- and fifth-year students).

5.6.3 Length of clinical exposure

There was strong association between the lengths of clinical exposure over 21 months and the LBP experienced in the last 12-months. This suggests that a dental student exposed to more than 21 months of clinical work is at a significant risk of experiencing LBP in the last 12-month when compared to those students who have

undergone less than 21 months of clinical exposure. It therefore appears that once a dental student has completed 21 months of clinical training he/she is runs a higher risk of developing LBP. It was found that when associating the year level of study with the clinical exposure, those students who had completed 21 months of clinical work at the university would fall under the significantly high risk category (third-, fourth- and fifth-year students).

5.6.4 Level of physical exercise

It was demonstrated that students who did not do any form of physical exercise ran a high risk of experiencing LBP in the last 12-months, last one-month and last one-week, and that such students ran a considerable risk of experiencing UBP in the last 12-months and last one-week. This suggests that physical exercise has a significant effect in reducing the prevalence of back pain (UBP and LBP).This is in accordance with studies done elsewhere (Malkia and Ljunggren, 1996).

5.7 IMPLICATIONS FOR PHYSIOTHERAPY PRACTICE

Based on the foregoing discussion it can be concluded back pain is a reality for most of the dentistry students at the University of the Western Cape in South Africa. It is therefore proposed that majority of the graduates from this sample will start their career with existing MSDs. The results also suggest that early preventive strategies such as strengthening and stretching exercise, promotion of good ergonomic posture and general fitness, could be done to prevent or reduce the onset of MSD. This would clearly indicate that physiotherapy has a role to play in treatment, prevention and health promotion amongst dentistry students.

CHAPTER SIX

SUMMARY, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

In this final chapter, a brief summary of the study is provided, as well as the researcher's conclusions on the results. This is followed by the limitations of the study and some recommendations.

6.2 SUMMARY

This study aimed to determine the prevalence of MSDs and specifically back pain among dentistry students at the University of the Western Cape, Cape Town, South Africa. The study explored the prevalence of all measures of back pain experienced by students across all year levels during their lifetime, in the past 12-month, in the last one-month and in the last one-week. The questionnaire that was developed was designed to identify the predisposing factors for back pain among dentistry students and to assess the characteristics of pain reported by the dentistry students.

This was the first study to be conducted on the prevalence and pattern of reported MSDs in dentistry students in South Africa. Dentistry is a specialized field in healthcare that requires visual acuity, repetitive movement, extreme static positions, and force exertion. Other research studies have shown that dentists have a high incidence of work-related musculoskeletal disorders (WRMSDs) in the neck, shoulders, upper extremities, and lower back (Akkesson, Hansson, Balogh, Moritz and Skerfving 1997; Milerad, Ericson, Nisell and Kilbrom, 1991). Burke, Main and

Freeman (1997) found that WRMSDs were the most frequent cause of early retirement among dentists.

The results of the current study demonstrate that majority of dentistry students experience some form of MSD (neck pain, LBP or UBP), of which the largest percentage of the students reported LBP across all year levels of study. All (100%) of the fourth-year students reported MSDs (neck pain, LBP or UBP). LBP was the highest reported of all MSDs reported in the study. Third-year students reported a significantly higher risk when compared to first-year students. Numerous possible risk factors were identified that influenced the prevalence of back pain across year levels. The most significant factors were length of university stay over two years, clinical exposure over 21 months and doing physical exercise. Lecturers therefore need to enter into a partnership with students to educate them and provide relevant information about correct ergonomics, posture and ways of overcoming the identified aggravating and risk factors. Students need to be guided to do specific exercise which will help in alleviating back pain in their time as students.

6.3 CONCLUSIONS

The main aim and objectives of this study were achieved. The findings indicate that the majority of dentistry students at the University of the Western Cape indeed suffer from MSDs. The overall prevalence rate was very high, especially in fourth-year. The prevalence of MSD at the UWC is so far the highest reported among dentistry students in the world. LBP was the most common MSD experienced, followed by neck pain and then UBP. LBP and UBP at the UWC was shown to be the highest reported so far among dentistry students in the world. A significant year-by-year

increase in students reporting UBP across year level (from first- to fifth-year level) is alarming and warrants special intervention for this group of students. Special attention should be paid to recommendation of exercise programmes for these students

LBP was the most troublesome pain experienced by the dentistry students at the UWC, the pain intensity being influenced by stress and dental procedures experienced.

6.4 LIMITATIONS OF THE STUDY

The questionnaire had some shortcomings. It did not assess the level of pain intensity, frequency, duration or fatigue level during the time of initial onset, therefore it could not be concluded that it was purely the dentistry programme that had caused that specific type or intensity of pain suffered. Furthermore, a question on the specific physical exercise that the students were doing would have made the recommendation more specific. If this survey have been conducted at the end of the student year students would have been full exposed to all academic and clinical tasks for that year.

In the questionnaire students medical conditions influencing pain, affecting spine etc was not documented, as this might also have contributed to the responded pain status. Individual consent forms should have been used as this wouldn't have compromised on confidentiality of students, who took part in the study.

Further research is required to develop better measures or scales which can be used to understand the forces on the spine resulting from occupational exposures while practicing dentistry related to back pain among qualified dentists, and which

can later be used to measure impact of educational exposure, fitness level and physical exercise on dentistry students' back pain.

6.5 RECOMMENDATIONS

Based on the findings of this study, a number of recommendations are made:

1. Future studies should investigate the effects of pain on body movements and positions involved during clinical training to better understand how the presence of chronic musculoskeletal pain may influence the body mechanics involved in learning dental skills.

2. Attempts should be made to identify student awareness of body position or work habits related to performance of dental procedures, in particular, when the student is reporting some form of MSD arising from performing a dental procedure.

3. In future, studies should include longitudinal reports of body pain in student populations entering dental practice right from their first to their final year. This will assist in evaluating the fluctuation and the influence of various educational and clinical exposures on back pain and its pain characteristics.

4. The interplay between mechanical-ergonomic factors and mental stress should be investigated in men and women separately, since data support sex differences. Women were reported to have a higher stress levels and pain intensity influenced by doing dental procedures.

5. Proactive ergonomics should be implemented as a preventive approach to recognize and eliminate future problems. For example, the administration should set policies that require ergonomic consideration before purchasing dental equipment and instruments. In the current study dentist's chair usage was reported as the

second most important aggravating factor. A large percentage of students reported non-combatable dentist's chairs as their reason for their MSDs.

6. The onus of responsibility for ergonomic assessment lies with the Faculty of Dentistry. Therefore, it is suggested that the Faculty obtain appropriate training from professionals experienced in the application of biomechanics. With this level of training, faculty staff would be able to identify aspects of job tasks that predispose students to developing MSDs, recognizing the signs and symptoms of the disorders, and participating in strategies of control and prevention.

7. The Faculty should reinforce the didactic training in the clinical environment and should train faculty staff to evaluate the students' application of biomechanical principles while treating patients.

8. The Faculty should also do some form of screening procedure during the initial process of admissions, as the majority of students had an early onset of LBP even before they were admitted to the University.

9. Positioning strategies and postural awareness techniques of how to maintain the lower back curve while treating patients should be taught to the students, since the majority of the students reported the sitting /standing posture assumed in the clinics as the most aggravating factor.

10. In the current study students doing physical exercise had a significant lesser pain intensity, so the Faculty should consider introducing an aerobics or stress relaxation class as part of the curriculum, especially for third-and fourth-year students. Students should be encouraged to do physical exercise and partake in sports.

This study served to identify the possible MSDs dentistry students could experience and the potential risk factors that need to be addressed to prevent these MSDs from

occurring in their training period. The results of the study should encourage the Dentistry department, lecturers and students to increase their physical activity to restrict development of MSDs

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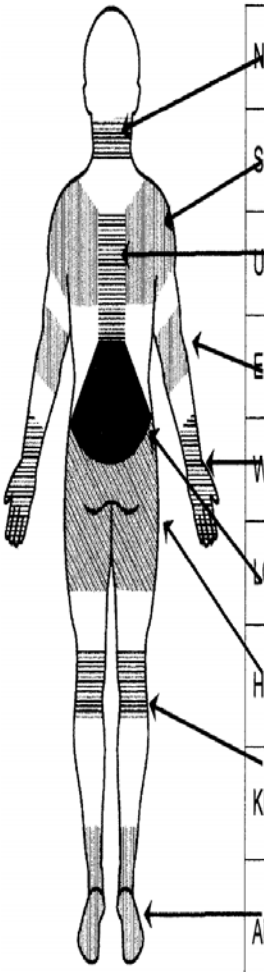
Appendix A: Standardised Nordic questionnaire

MUSCULOSKELETAL DISORDERS

Please answer by putting a cross in the appropriate box_ one cross for each question. Please answer every question even if you have never had trouble in any parts of your body. This picture shows how the body has been divided. You should decide for yourself which part (if any) is or has been affected.



	Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:	During the last 12 months have you been prevented from carrying out normal activities (e.g. job, housework, hobbies) because of this trouble in:	During the last 12 months have you seen a physician for this condition:	During the last 7 days have you had trouble in:
NECK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
SHOULDERS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
UPPER BACK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
ELBOWS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
WRISTS/ HANDS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
LOWER BACK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
HIPS/ THIGHS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
KNEES	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
ANKLES/ FEET	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

Appendix B: Nordic back pain questionnaire (questionnaire used by Nyland and Grimmer, 2005)

1. Sex: Female ☐ Male ☐

2. Age: _____years

3. Height: _____cm

4. Weight: _____kg

5. Year level: 1 ☐ 2 ☐ 3 ☐ 4 ☐

6 What year did you begin first year? _____

7. Please list your employment history to date:

Occupation (industry)	Date began	Date ceased	Hours per week
1.			
2.			
3.			
4.			
5.			
6.			

8. Please list your sporting history to date:

Sport	Date began	Date ceased	Hours per week	Social or competitive
1.				
2.				
3.				
4.				
5.				
6.				

9. How would you rate your current level of fitness?

Poor ☐ Moderate ☐ Good ☐

10. Approximately how many **hours** have you spent on the following **university** activities in the **past month**? Do not include leisure activities.

a) Sitting looking straight ahead most of the time
(Include lectures, tutorials and tutorials on clinical placement)

0	<10	11-20	21-30	31-40	41-50	>50

b) Sitting looking down most of the time (Include private study)

0	<10	11-20	21-30	31-40	41-50	>50

c) Practicing techniques on someone else

(Include practicals, tutorials and tutorials on clinic)

0	<10	11-20	21-30	31-40	41-50	>50

d) Having techniques practiced on you

(Include practicals, tutorials and tutorials on clinic)

0	<10	11-20	21-30	31-40	41-50	>50

e) Treating patients

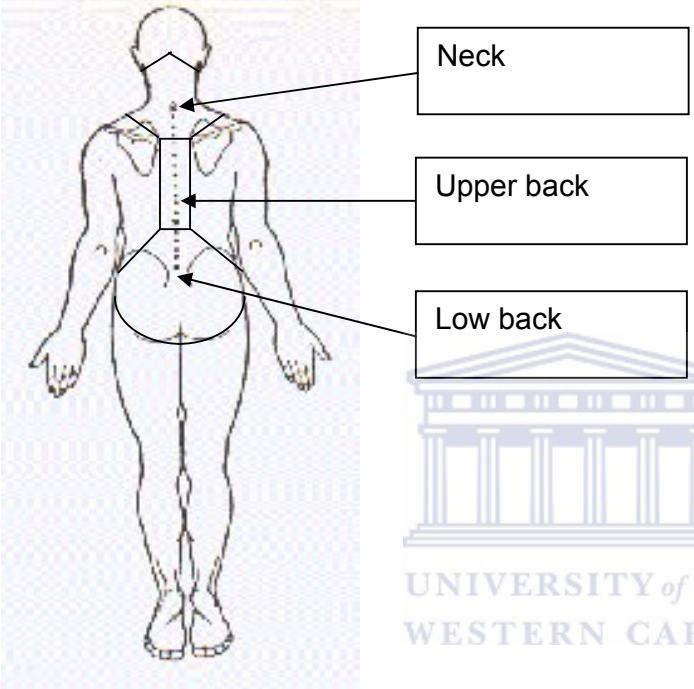
(Include clinical placement, and work as a sports trainer/physio aide*)

0	<10	11-20	21-30	31-40	41-50	>50

*Specify clinical placement:_____

The purpose of this section is to collect information on back pain that is not related to pregnancy, menstrual periods or feverish illness such as the 'flu.

For the following questions please refer to the diagram below. Please answer by putting a cross in the appropriate box – one cross for each question. You may be in doubt as to how to answer but please do your best anyway.



11. Have you ever had **low back trouble** (ache, pain or discomfort in the area specified, whether or not it extends from there to one or both legs)?

No ☐ Go to question 19.

Yes ☐ Continue with question 12.

12. At the time of the initial onset, what was your age? _____

13. Can you relate the initial onset of **low back trouble** to a specific incident?

No ☐ Yes ☐ (Specify):_____

14. Have you ever had to take time off studies or employment for **low back trouble**?

No ☐ Yes ☐

15. What is the total length of time that you have had **low back trouble** during the last 12 months?

0 days	☐
1-7 days	☐
8-30 days	☐
More than 30 days, but not every day	☐
Every day	☐

16. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **low back trouble** during the last 12 months?

    No ☐ Yes ☐

17. Have you had **low back trouble** at any time during the last month?

    No ☐ Yes ☐

    If yes, can you relate this to a specific incident?

    _____

18. Have you had **low back trouble** at any time during the last 7 days?

    No ☐ Yes ☐

---

19. Have you ever had **upper back trouble** (ache, pain or discomfort in the area described in the body diagram)?

    No ☐ Go to question 27.

    Yes. ☐ Continue with question 20.

20. At the time of the initial onset, what was your age? _____

21. Can you relate the initial onset of **upper back trouble** to a specific incident?

    No ☐ Yes ☐ (Specify):_____

22. Have you ever had to take time off from studies or employment because of **upper back trouble**?

    No ☐ Yes ☐

23. What is the total length of time that you have had **upper back trouble** during the last 12 months?

0 days	
1-7 days	
8-30 days	
More than 30 days, but not every day	
Every day	

24. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **upper back trouble** during the last 12 months?

No ☐ Yes ☐

25. Have you had **upper back trouble** at any time during the last month?

No ☐ Yes ☐

If yes, can you relate this to a specific incident?

_____

26. Have you had **upper back trouble** at any time during the last 7 days?

No ☐ Yes ☐

27. Have you ever had **neck trouble** (ache, pain or discomfort in the area described in the diagram)?

No ☐ You have finished. **Thank you.**

Yes ☐ Continue with question 28.

28. At the time of the initial onset, what was your age? _____

29. Can you relate the initial onset of **neck trouble** to a specific incident?

No ☐ Yes ☐ (Specify):_____

30. Have you had to take time of studies or employment because of **neck trouble**?

No ☐ Yes ☐

31. What is the total length of time that you have had **neck trouble** during the last 12 months?

0 days	
1-7 days	
8-30 days	
More than 30 days, but not every day	
Every day	

32. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **neck trouble** during the last 12 months?

No ☐ Yes ☐

33. Have you had **neck trouble** at any time during the last month?

No ☐ Yes ☐

If yes, can you relate this to a specific incident?

_____

34. Have you had **neck trouble** at any time during the last 7 days?

No ☐ Yes ☐

Appendix C: Questionnaire used for reliability study

Please complete the following questionnaire to the best of your ability.
Please mark only ONE block in each question

1. Sex: Female1 ☐ Male2 ☐

2. Age: _____years

5. Height: _____cm

6. Weight: _____kg

5. Year level: 1☐ 2 ☐ 3☐ 4☐ 5 ☐

6 What year did you begin first year? yyyy ☐☐☐☐

7. When did you start your clinics? ☐☐☐☐☐☐ Mm/yyyy

8. How would you rate your current level of fitness?

Poor1☐ Moderate 2 ☐ Good 3 ☐

9. Do you do physical exercise?
No 1☐ if no go to question 11

Yes2☐ if yes go to question 10

10. What is your level of regular physical exercise?

1☐ 2☐ 3☐ 4☐

(1=once a week, 2=three times a week, 3=five times a week, &4=seven times a Week)

11. Approximately how many **hours** have you spent on the following **university** activities in the **past month**? Do not include leisure activities.

a) Sitting looking straight ahead most of the time…….hrs
(Include lectures, and tutorials)

b) Sitting looking down most of the time ……hrs(include private study-projects assignment)

c) Practicing techniques ……..hrs

(Include lab time)

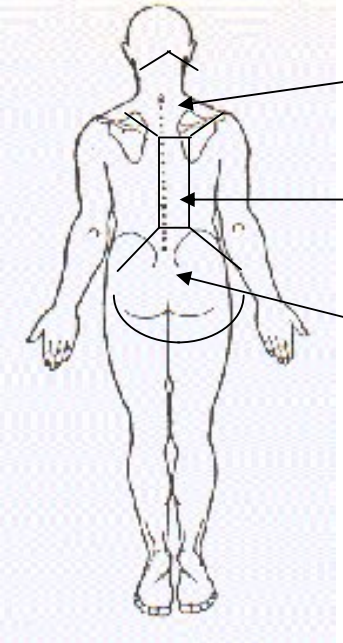
d) Treating patients (clinical area)**……..hrs**

*Specify current clinical disciple(cons,pors&etc):_____

Section 2

The purpose of this section is to collect information on back pain that is not related to pregnancy, menstrual periods or feverish illness such as the 'flu.

For the following questions please refer to the diagram below. Please answer by putting a cross in the appropriate box – one cross for each question. You may be in doubt as to how to answer but please do your best anyway.



12. Have you ever had **low back trouble** (ache, pain or discomfort in the area specified, whether or not it extends from there to one or both legs)?
    No 1 ☐ if no Go to question 20.

    Yes 2 ☐ if yes continue with question 13.

13. At the time of the initial onset, what was your age? _____

14. Can you relate the initial onset of **low back trouble** to a specific incident?
    No 1 ☐ Yes2 ☐ (Specify):_____

15. Have you ever had to take time off studies or employment for **low back trouble**?
    No 1 ☐ Yes 2 ☐

16. What is the total length of time that you have had **low back trouble** during the last 12 months? ……..days

17. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **low back trouble** during the last 12 months?

No 1 ☐ Yes 2 ☐

18. Have you had **low back trouble** at any time during the last month?

No1 ☐ Yes 2 ☐

If yes, can you relate this to a specific incident?

_____

19. Have you had **low back trouble** at any time during the last 7 days?

No 1 ☐ Yes 2 ☐

---

20. Have you ever had **upper back trouble** (ache, pain or discomfort in the area described in the body diagram)?

No 1 ☐ if no Go to question 28.

Yes. 2 ☐ Continue with question 21.

21. At the time of the initial onset, what was your age? _____

22. Can you relate the initial onset of **upper back trouble** to a specific incident?

No 1 ☐ Yes 2 ☐

(Specify):_____

23. Have you ever had to take time off from studies or employment because of **upper back trouble**?

No 1 ☐ Yes2 ☐

24. What is the total length of time that you have had **upper back trouble** during the last 12 months? ……..Days

25. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **upper back trouble** during the last 12 months?

No 1 ☐ Yes 2 ☐

26. Have you had **upper back trouble** at any time during the last month?

No 1 ☐ Yes 2 ☐

If yes, can you relate this to a specific incident?

_____

27. Have you had **upper back trouble** at any time during the last 7 days?

No 1☐ Yes 2☐

---

28. Have you ever had **neck trouble** (ache, pain or discomfort in the area described in the diagram)?

No 1☐ if no go to question 36

Yes 2 ☐ if yes continue with question 29.

29. At the time of the initial onset, what was your age? _____

30. Can you relate the initial onset of **neck trouble** to a specific incident?

No 1☐ Yes 2☐ (Specify):_____

31. Have you had to take time of studies or employment because of **neck trouble**?

No 1☐ Yes 2☐

32. What is the total length of time that you have had **neck trouble** during the last 12 months? …….. days

33. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **neck trouble** during the last 12 months?

No 1☐ Yes 2☐

34. Have you had **neck trouble** at any time during the last month?

No 1☐ Yes 2☐

If yes, can you relate this to a specific incident?

_____

35. Have you had **neck trouble** at any time during the last 7 days?

No1 ☐ Yes 2☐

Section c

If you experience pain in one or more of the above areas please continue from question 36. If no please don't fill the remaining questions and thaks for completing the questionnaire.

Mark the blocks below for your most symptomatic body pain

36. Which is the most symptomatic pain you have experienced?

1 ☐ 2 ☐ 3 ☐

(1=lower back problem, 2=upper back problem, & 3=neck problem)

37. What is the frequency of experiencing this pain?

Mark only one of the following only

1	10% of all days	
2	25% of all days	
3	50% of all days	
4	75% of all days	
5	almost every day	

38. What is the maximum duration of experiencing this pain?

Mark only one of the following only

1	<1 hr a day	
2	1-3 hrs a day	
3	4-8 hrs a day	
4	9-16 hrs a day	
5	17-24 a day	

39. What is the average pain intensity of this pain?

VAS scale 0=no pain 10=maximum pain

0	1	2	3	4	5	6	7	8	9	10

40. What is the worst intensity you have experienced with this pain?

VAS scale 0=no pain 10=maximum pain

0	1	2	3	4	5	6	7	8	9	10

41. What is the worst fatigue level you have experienced at the end of day?

VAS scale 0=no fatigue 10=maximum fatigue

0	1	2	3	4	5	6	7	8	9	10

42. How much is your pain intensity influenced by doing dental procedures?

VAS scale 0=no influence 10=maximum influence

0	1	2	3	4	5	6	7	8	9	10

43. How much is your pain intensity influenced by stress?

VAS scale 0=no influence 10=maximum influence

0	1	2	3	4	5	6	7	8	9	10

44. Please rate the following five aggravating factors in adversely affecting your pain.
From 1 = least important aggravating factor to 4 = most important aggravating factor.

Chairs(clinic /lectures/lab)	
Instruments and equipment	
Posture (sitting or standing)in clinics	
Lighting-clinics, chair& lab lighting	

Thank you for completing the questionnaire

Appendix D: The final study instrument

Please complete the following questionnaire to the best of your ability.
Please mark only ONE block in each question

1. Sex: Female1 ☐ Male2 ☐

2. Age: _____years

7. Height: _____cm

8. Weight: _____kg

5. Year level: 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

6 What year did you begin first year? yyyy ☐☐☐☐

7. When did you start your clinics? ☐☐☐☐☐☐ Mm/yyyy

8. How would you rate your current level of fitness?
   Poor1 ☐ Moderate 2 ☐ Good 3 ☐

9. Do you do physical exercise?
   No 1 ☐ if no go to question 11
   Yes2 ☐ if yes go to question 10

10. What is your level of regular physical exercise?
    1☐ 2☐ 3☐ 4☐
    (1=once a week, 2=three times a week, 3=five times a week, 4=seven times a Week)

11. Approximately how many **hours** have you spent on the following **university** activities in the **past month**? Do not include leisure activities.

    a) Sitting looking straight ahead most of the time…….hrs
    (Include lectures and tutorials)

    b) Sitting looking down most of the time ……hrs (include private study-Projects assignment)

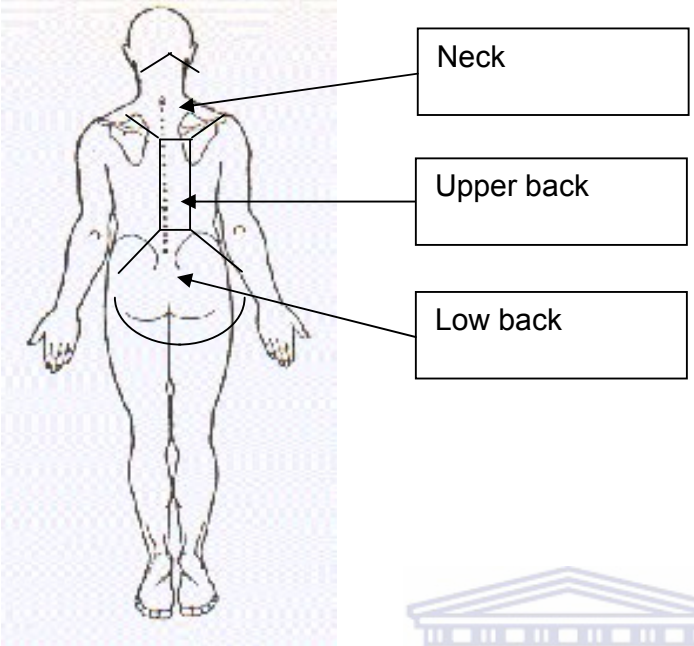
    c) Practicing techniques ……..hrs (Include lab time)

    d) Treating patients (clinical area)**……..hrs**

Section 2

The purpose of this section is to collect information on back pain that is not related to pregnancy, menstrual periods or feverish illness such as the 'flu.

For the following questions please refer to the diagram below. Please answer by putting a cross in the appropriate box – one cross for each question. You may be in doubt as to how to answer but please do your best anyway.



12. Have you ever had **low back trouble** (ache, pain or discomfort in the area specified, whether or not it extends from there to one or both legs)?

No 1 ☐ if no Go to question 20.

Yes 2 ☐ if yes continue with question 13.

13. At the time of the initial onset, what was your age? _____

14. Can you relate the initial onset of **low back trouble** to a specific incident?

No 1 ☐ Yes2 ☐ (Specify):_____

15. Have you ever had to take time off studies or employment for **low back trouble**?

No 1 ☐ Yes 2 ☐

16. What is the total length of time that you have had **low back trouble** during the last 12 months?

1	0 days	
2	1-7 days	
3	8-30 days	
4	More than 30 days, but not every day	
5	Every day	

17. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **low back trouble** during the last 12 months?

No 1 Yes 2 ☐

18. Have you had **low back trouble** at any time during the last month?

No1 ☐ Yes 2 ☐

If yes, can you relate this to a specific incident?

_____

19. Have you had **low back trouble** at any time during the last 7 days?

No 1 ☐ Yes 2 ☐

---

20. Have you ever had **upper back trouble** (ache, pain or discomfort in the area described in the body diagram)?

No 1 ☐ if no Go to question 28.

Yes. 2 ☐ Continue with question 21.

21. At the time of the initial onset, what was your age? _____

22. Can you relate the initial onset of **upper back trouble** to a specific incident?

No 1 ☐ Yes 2 ☐ (Specify):_____

23. Have you ever had to take time off from studies or employment because of **upper back trouble**?

No 1 ☐ Yes2 ☐

24. What is the total length of time that you have had **upper back trouble** during the last 12 months?

1	0 days	
2	1-7 days	
3	8-30 days	
4	More than 30 days, but not every day	
5	Every day	

25. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **upper back trouble** during the last 12 months?

No 1 ☐ Yes 2 ☐

26. Have you had **upper back trouble** at any time during the last month?

No 1 ☐ Yes 2 ☐

If yes, can you relate this to a specific incident?

_____

27. Have you had **upper back trouble** at any time during the last 7 days?

No 1 ☐ Yes 2 ☐

---

28. Have you ever had **neck trouble** (ache, pain or discomfort in the area described in the diagram)?

No 1 ☐ if no go to question 36

Yes 2 ☐ if yes continue with question 29.

29. At the time of the initial onset, what was your age? _____

30. Can you relate the initial onset of **neck trouble** to a specific incident?

No 1 ☐ Yes 2 ☐ (Specify):_____

31. Have you had to take time of studies or employment because of **neck trouble**?

No 1 ☐ Yes 2 ☐

32. What is the total length of time that you have had **neck trouble** during the last 12 months?

1	0 days	
2	1-7 days	
3	8-30 days	
4	More than 30 days, but not every day	
5	Every day	

33. Have you been seen by a health professional (doctor, physiotherapist, chiropractor or other such person) because of **neck trouble** during the last 12 months?

No 1 ☐ Yes 2 ☐

34. Have you had **neck trouble** at any time during the last month?

No 1 ☐ Yes 2 ☐

If yes, can you relate this to a specific incident?

_____

35. Have you had **neck trouble** at any time during the last 7 days?

No 1 ☐ Yes 2 ☐

Section 3
If you experience pain in one or more of the above areas please continue from question 36. If no please don't fill the remaining questions and thanks for completing the questionnaire.

Mark the blocks below for your most symptomatic body pain

36. Which is the most symptomatic pain you have experienced?

1 ☐ 2 ☐ 3 ☐
(1=lower back problem, 2=upper back problem, & 3=neck problem)

37. What is the frequency of experiencing this pain?

Mark only one of the following only

1	10% of all days	
2	25% of all days	
3	50% of all days	
4	75% of all days	
5	almost every day	

38. What is the maximum duration of experiencing this pain?
Mark only one of the following only

1	<1 hr a day	
2	1-3 hrs a day	
3	4-8 hrs a day	
4	9-16 hrs a day	
5	17-24 a day	

39. What is the average pain intensity of this pain?

VAS scale 0=no pain 10=maximum pain

0	1	2	3	4	5	6	7	8	9	10

40. What is the worst intensity you have experienced with this pain?

VAS scale 0=no pain 10=maximum pain

0	1	2	3	4	5	6	7	8	9	10

41. What is the worst fatigue level you have experienced at the end of day?

VAS scale 0=no fatigue 10=maximum fatigue

0	1	2	3	4	5	6	7	8	9	10

42. How much is your pain intensity influenced by doing dental procedures?

VAS scale 0=no influence 10=maximum influence

0	1	2	3	4	5	6	7	8	9	10

43. How much is your pain intensity influenced by stress?

VAS scale 0=no influence 10=maximum influence

0	1	2	3	4	5	6	7	8	9	10

44. Please rate the following four aggravating factors in adversely affecting your pain.

From 1 = least important aggravating factor to 4 = most important aggravating factor.

Chairs(clinic /lectures/lab)	
Instruments and equipment	
Posture (sitting or standing)in clinics	
Lighting-clinics, lab& dental chair lighting	

Appendix E: Consent form used in the focus group discussion

Dear student,

I am a postgraduate student at the University of the Western Cape in the physiotherapy department in South Africa. I am expected to conduct research as a part of the requirements for the MSc.(Physiotherapy). The title of my study is “BACK PAIN AMONGST DENTISTRY STUDENTS AT THE UNIVERSITY OF WESTERN CAPE”.

The primary aim of the study is to determine the prevalence and severity of back pain among dentistry students across all the five years at the University of the Western Cape. Data collection will be done by the researcher who is a qualified physiotherapist. The questionnaire will have data regarding demographics, back pain prevalence, behavioral pattern of pain and its predisposing factors.

This focus group is conducted as a part of procedure to develop questions regarding the predisposing factors (educational exposure) in order to develop the final questionnaire for the study.

You are assured that all the information will be confidential and anonymous. You have the right to withdraw from the study at anytime. And you will not be affected in any way in case you don’t like to participate or withdraw from the study. The research findings will be made available to you and your management with recommendations. A prevention program will be made available to the students based on the findings of the study.

Yours sincerely,

Reejen joseph

I hereby grant consent to take part in the research conducted.

Appendix F: Consent form used for the quantitative study

Dear student,

I am a postgraduate student at the University of the Western Cape in the physiotherapy department in South Africa. I am expected to conduct research as a part of the requirements for the MSc.(Physiotherapy). The title of my study is “BACK PAIN AMONGST DENTISTRY STUDENTS AT THE UNIVERSITY OF WESTERN CAPE”.

The primary aim of the study is to determine the prevalence and severity of back pain among dentistry students across all the five years at the University of the Western Cape. Data collection will be done by the researcher who is a qualified physiotherapist. The questionnaire will have data regarding demographics, back pain prevalence, behavioral pattern of pain and its predisposing factors.

You are assured that all the information will be confidential and anonymous. You have the right to withdraw from the study at anytime. And you will not be affected in any way in case you don’t like to participate or withdraw from the study. The research findings will be made available to you and your management with recommendations. A prevention program will be made available to the students based on the findings of the study.

Yours sincerely,

Reejen joseph

I hereby grant consent to take part in the research conducted.

Appendix G Approval letter from the higher degree committee

UNIVERSITY OF THE WESTERN CAPE

Private Bag X17 P **BELLVILLE** P 7535 P South Africa
□ (021) 959-3683/2746 P □ (021) 959-2755
E-mail: csjohnson@uwc.ac.za

Higher Degrees Committee **Faculty of Community and Health Sciences**

Date: 7 August 2007

Dental Faculty
University of the Western Cape
Private Bag x17
Bellville
7535

Dear ***Sir/Madam***

Research project of Mr Joseph (2701541)

This letter confirms that Mr Joseph (2701541) is a postgraduate student in the Community and Health Sciences Faculty at UWC. His proposed research entitled, ***"Back pain amongst dentistry students at the University of the Western Cape"***, has been examined by the Higher Degrees Committee and found to be of high scientific value, methodologically sound and ethical. We fully support the research and urge you to allow him access to your organisation.

Yours sincerely

P Struthers

Dr P. Struthers
Acting Chairperson Higher Degrees Committee

Appendix H Approval letter from the registrar UWC

OFFICE OF THE REGISTRAR

Private Bag X17, Bellville 7535
South Africa
Telegraph: UNIBELL
Telephone: +27 21 959-2102/2111
Fax: +27 21 959-3126
Website: www.uwc.ac.za

10 August 2007

Mr Joseph
CHS Faculty
UWC

Dear Mr Joseph

PERMISSION TO CONDUCT RESEARCH AT UWC

Thank you for complying with our requirements for obtaining permission to do research at the University of the Western Cape and for obtaining the necessary ethics clearance from our Senate research Committee.

It gives me great pleasure to grant you permission to proceed with your research project.

Yours sincerely

DR I MILLER
REGISTRAR

Appendix I Approval letter from the head of dental research committee

From: Neil Myburgh
To: Jose Frantz; Patricia Struthers; Reejen Joseph
Date: 9/12/2007 4:11:07 PM
Subject: Back pain study in UWC dental students

Hi Trish and colleagues,

I was sent this protocol for consideration and to comment on its implementation in this Faculty.

I have already seen it pass through SR/SHD and it still seems fine to me in both scientific and ethical terms so I have no problem recommending it to staff and students here.

In my experience, a good response rate is more likely if direct contact with students and or staff in each of the dental classes is established along with an arrangement to meet the whole class together just before or after a lecture. That way you can get almost everyone to complete the questionnaire and return it to you quickly.

The alternative will mean the researcher spends a lot of time chasing dental students across three campuses and several satellite clinics, which will be very difficult.

Regards,

Neil

Prof Neil Myburgh
Deputy Dean Postgraduate and Research
Director, WHO Collaborating Centre for Oral Health,
University of the Western Cape.
P/Bag X08 Mitchells Plain 7785
Cape Town, South Africa

Tel. +27-21-3704402
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CC: Yusuf Osman