# THE PREVALENCE AND FACTORS ASSOCIATED WITH OCCUPATIONAL OVERUSE SYNDROME IN THE HANDS AND WRISTS OF CHIROPRACTORS IN SOUTH AFRICA.

# THE PREVALENCE AND FACTORS ASSOCIATED WITH OCCUPATIONAL OVERUSE SYNDROME IN THE HANDS AND WRISTS OF CHIROPRACTORS IN SOUTH AFRICA.

A dissertation presented to the Faculty of health sciences, Durban Institute of Technology, in partial fulfillment of the requirements for the Masters degree in Technology: Chiropractic.

By
Michael Mathews

I, Michael Mathews, do hereby declare that the following dissertation represents my own work, both in conception and execution.

.. Date: ...17/8/6.....

Approved for final submission

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..... Date: ...17/8/6.....

# Contents

# Dedication

To my family, friends and Leanne

Thank you for all your love, encouragement and support.

# Acknowledgements

I wish to thank Dr. Andrew Jones, M.Tech Chiropractic (TN), CCFC (TN), CCSP (USA), my research supervisor, for all his help and guidance in the completion of this project. I would also like to thank my co- supervisor Dr.C Myburgh, M.Tech (TN), CCFC (TN), CCSP (USA), PhD (SSM) for his input and insight in the construction of the questionnaire. I wish to thank Dr. Charmaine Korporaal, M.Tech Chiropractic (TN), CCFC (TN), CCSP (USA), and ICSD (FICS) for her advice. Thank to Mrs. Inez Ireland for al her help in the administrative processes in this project. Thank you to all the Focus Group members and all the chiropractors who participated in this research study.

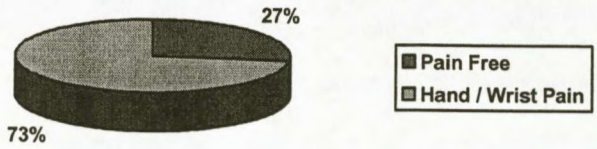
# Abstract

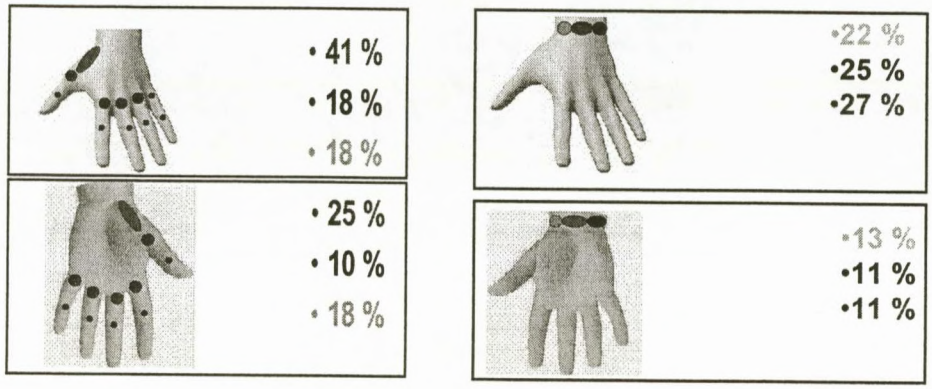
Objectives: The aim was to evaluate the prevalence of hand and wrist pain, as well as the relationships between occupational overuse syndromes in the hands and wrists of chiropractors in South Africa as a result of their daily use of manual therapy techniques while at work.

Methods: The study design was a cross sectional analysis of chiropractors in South Africa utilizing a self-administered questionnaire developed specifically for this particular research project and verified through the use of a focus group and pilot testing. The questions were based on the literature that exists with respect to repetitive strain injuries, sources of hand and wrist pain, the scope of Chiropractic practice and possible causes of hand and wrist pain within practice. The questionnaire was sent to all eligible participants via the post.

Results: Either hand or wrist pain was found in 73.15% of the sample. Forty – one subjects had both wrist and hand pain, prevalence of 37.96% . These prevalence figures where lifetime prevalence figures. Wrist pain was reported in 61 participants, with a prevalence of 56.48%. Hand pain was reported in 59 participants, prevalence of 54.63% (95% CI 44.76% - 64.24%). The most common symptom reportedly experienced by the participants was weakness in the hands and wrists (30%), There were 19 possible occupational overuse syndrome (OOS) cases (prevalence of 17.6%, 95% CI 10.94% to 26.10%). Three factors which were independently associated with possible OOS. Females were 3.87 times more likely than males to have possible OOS (95% CI 1.123 to 13.341 $p = 0.032$). With every 10 hour increase of working hours per day, the risk of possible OOS increased by 2.054. Chiropractors performing post facilitated stretching techniques were 3.745 times more likely to get possible OOS than those who did not.

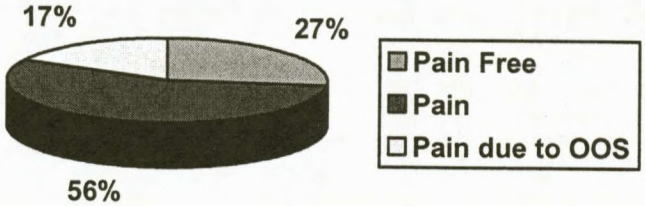
**The Prevalence of Hand / Wrist Pain in Chiropractors in South Africa**




Conclusions: Hand and wrist pain appear to have a greater prevalence amongst chiropractic practitioners than in physical therapists. The hand and wrist seem to be affected in similar proportions. Age, gender, manipulation and the use of certain non- manipulative techniques were significantly associated with hand and wrist pain while time allocation to certain activities at work did not appear to be an influential factor in the development of hand and wrist pain.

**The Prevalence of OOS in the Hands and/or Wrists of Chiropractors in Soutn Africa**



# CHAPTER 1

# Introduction

## 1.1. The problem and its setting

The world federation of chiropractic (WFC) defines chiropractic as "a health profession concerned with the diagnosis, treatment and prevention of mechanical disorders of the musculoskeletal system, and the effects of these disorders on the functions of the nervous system and general health. There is an emphasis on manual treatments including spinal adjustment and other joint and soft tissue manipulation" (www.wfc.org).

Manual therapy can be defined as any procedure by which the hands contact the body to treat the articulations or soft tissues (Gatterman, 1995). Manual therapy for the purposes of this study can be sub divided in manipulative and non-manipulative techniques. Manipulative techniques are those techniques that are specifically used in the treatment of articulations, and non-manipulative techniques those techniques used in the treatment of soft tissues.

A study conducted by Bork *et al.* (1996) determined the prevalence of work-related musculoskeletal injuries sustained by physical therapists. Hand pain (29.6%) and back pain (45%) where the leading cause of pain in physical therapists (Bork *et al., 1996.)* The prevalence and factors associated with back pain in chiropractors has previously been investigated and concluded that the prevalence of back pain was 87% (Mior and Diakow, 1987). This is considerably higher than the prevalence of back pain (45%) as reported by Bork in physical therapists.

Physiotherapy is defined as the branch of treatment that employs physical methods to promote healing, including the use of light, infrared and ultraviolet rays, heat, electric current, massage, manipulation and remedial exercise (Oxford Concise Colour Medical Dictionary, 2002). Chiropractic and physiotherapy have

many similarities including common subjects and techniques used (University of Cape Town Physiotherapy syllabus guide, 2002,; Chiropractic Handbook for Faculty of Health Sciences, Durban Institute of Technology, 2003). Chiropractic and physiotherapy are both health care professions that specialize in the treatment of disorders pertaining to the neuro-musculo-skeletal system (Hunter, 2004). Therefore, it stands to reason that chiropractors too may report a high incidence of hand and wrist pain.

An occupational injury can be defined as an injury that results from a work-related event or from a single instantaneous exposure in the work environment (Holder *et al.*, 1999). This implies that an occupational injury can be acute, sub acute or chronic in nature.

A syndrome is a combination of signs and/or symptoms that forms a distinct clinical picture indicative of a particular disorder (Oxford Concise Colour Medical Dictionary, 2002). This may include a group of injuries that have similar qualities. There are many repetitive strain injuries that occur in the hand and wrist. Occupational overuse syndrome is the name given to a range of conditions caused by poor work processes and unsuitable working conditions that involve repetitive or forceful movements or the maintenance of constrained or awkward postures. The condition is characterised by discomfort and persistent pain (http://www.nohsc.gov.au/SmallBusiness/BusinessEntryPoint/hazards/overuse/).

The aim of this research was to evaluate the prevalence of hand and wrist pain, as well as the relationships between occupational overuse syndromes in the hands and wrists of chiropractors in South Africa as a result of their daily use of manual therapy techniques while at work.

## 1.2. Aims and objectives

**The Prevalence and Factors associated with occupational overuse syndrome in the hands and wrists of Chiropractors in South Africa.**

1 The primary objective was to establish the prevalence of hand and wrist pain.

2 The secondary objective was to identify the factors associated with hand and/or wrist pain.

- Age
- Gender
- Race
- Dominant hand
- Time in practice
- Number of patients seen per day
- Hours worked per week
- Time allocation of activities while at work
- Non manipulative techniques used at work
- Manipulative techniques used at work
- Previous trauma
- Systemic conditions
- Recreational activities
- Signs and symptoms
- Anatomical location of the pain
- Anatomical structures causing pain

3 The third objective was to attempt to assess the factors associated with pain. Certain factors commonly associated with occupational overuse syndromes were correlated with individuals who reported hand or wrist pain in order to establish whether the pain origin was occupational overuse.

<u>Factors commonly associated with occupational overuse syndromes:</u>

- Pain in relation to work activity.
- Relief of pain after rest.
- Modification of non- manipulative techniques due to pain.
- Modification of manipulative techniques due to pain.
- Origin of the pain (self diagnosis).

## Hypothesis one:

The prevalence of hand and / or wrist pain will be greater than that of physical therapists (29.6%) (Bork *et al., 1996).*

## Hypothesis two:

The prevalence of wrist pain will be greater than the prevalence of hand pain.

## Hypothesis three:

The following factors may be associated with and increased prevalence of pain

- Age
- Gender
- Time allocation of activities while at work
- Non manipulative techniques used at work

### 1.3. Limitations of the study

The study utilises a self- administered questionnaire. The questionnaire was designed specifically for this research project with the aid of a focus group. All questionnaire studies do however have inherent errors as a consequence of their design. Questionnaire error includes such factors as faults in sampling, coding, tabulating, data processing, interviewer bias, researcher bias, and data misinterpretation (http://www.chalmersresearch.com/rbmg/types_bias.html). Another type of bias often found in surveys is based on the assumption that individuals who haven't responded in a survey tend to feel the same as those who have responded. However, studies have found that non-respondents generally have a more negative outlook, which may not be otherwise represented in the collected data (http://www.emich.edu/public/geo/557book/e112.survey.html.)

The cumulative effect of these inherent errors could discredit the use of the questionnaire as a valid research tool, but being aware of these errors and taking precautions to avoid them minimises their effect and bias in the interpretation of these research findings. The researcher has been aware of these possible errors and has attempted to eliminate them to the best of his ability.

Research conducted by Tartar (1969) found 65% of respondents changed their behaviour away from surveyed attitudes when confronted with actual situations requiring behavioural response (Tartar, 1969). Taking this into account, it must be noted that there may be a discrepancy between the respondents in this research questionnaires opinions about certain issues, and what their actions regarding that particular issue is.

It is also noteworthy to comment on the healthy worker effect in this particular research study as it is a cross sectional analysis of chiropractors in South Africa at a particular point in time. Therefore, Chiropractors who had experienced significant hand and wrist pain may have already left the profession and their opinions on the questionnaire cannot be accounted for and the cross sectional analysis is of a healthy working chiropractic population. It is also of particular interest that in a similar study involving physical therapists one in six physical therapists moved within or left the profession as a result of work related musculoskeletal disorders (Cromie *et al.*, 2000). It has however been shown that some of the healthy worker effect is characteristic of standardised mortality ratio (SMR) methodology and that the strength of the healthy worker effect depends on the proportion of active workers in the cohort. Furthermore, the disappearance of the healthy worker effect may be due to factors such as aging of the cohort and can be totally unrelated to the true increase in the mortality risk (Gibson *et al.*, 1983.) It is unfortunately not possible to determine the proportion of chiropractors that have left the profession due to musculo-skeletal injuries of the hand and wrist in this particular sample group, and therefore the healthy worker effect must be taken into account, as it may be an influential bias.

Another bias commonly found in survey research is the Hawthorne Effect, which states that respondents tend to respond differently simply because they have been selected for a survey. This is due to the special recognition that has been given to them; the respondents tend to answer in the way that will most please the researcher. Closely associated with the Hawthorne Effect, the "self-lifting" bias recognises that respondents want to make themselves appear in a positive light, and will respond accordingly and therefore participants' responses to this questionnaire may be biased as they may respond in a way as to appear as the

`ideal` chiropractor in regards of the time allocated to certain activities and therapeutic techniques used.
(http://www.emich.edu/public/geo/557book/e112.survey.html.)
The cross-sectional design of the study did not distinguish between factors causally related to pain and those that arose as a consequence of pain. Those participants with pain may have already modified their behaviours, thus associated factors may have been as a result of the pain and not the cause of it. This is reverse causality.

## 1.4. Rationale

This research has the potential to stimulate further research into possible preventative actions to stop chiropractors developing occupational overuse syndrome. This information will not only be of value to chiropractors but all manual therapists. This would ultimately benefit both therapists, in terms of how they can prevent injuries, as well as patients as their treatment would not be compromised by possible injuries sustained by their therapist.

## 1.5 Conclusion

Chiropractors use manual therapy techniques as part of their daily working activities. A recent survey established that there is a high prevalence of hand and wrist pain in physical therapists (Bork *et al., 1996)*. Physical therapists also use manual therapy techniques as part of their daily working activities, so it can be assumed that chiropractors too will have a high prevalence of hand and wrist pain as they utilize similar therapeutic techniques to physical therapists. Injuries sustained at work are classified as occupational injuries. Various occupational injuries occur in the hand and wrist region. Manual therapy may be a predisposing factor in the development of occupational injuries, as it requires repetitive movement and sustained awkward postures.

The research objectives were to determine the prevalence of hand and wrist pain, what factors are commonly associated with the pain, and what factors

associated with chiropractor's daily working activities are associated with an increased prevalence of hand and wrist pain.

The research utilized a self-administered questionnaire that had certain inherent errors that the researcher was aware of and attempted to eliminate to the best of his ability.

The outcomes of this research aimed to guide further research into what actions can be taken to prevent hand and wrist pain in future chiropractors and determine risk factors related to the development of hand and wrist pain in chiropractors.

# CHAPTER 2

# Literature Review

This chapter aims to clarify the meaning of occupational overuse syndrome and extract data from previous studies focused on injuries of a similar nature, in an attempt to compare and correlate the results of this study to previous studies, and thus infer meaning to these results. Risk factors associated with occupational overuse syndrome are then identified and discussed. Following this manual therapy and the identity of the chiropractic are discussed with elaboration on activities performed by chiropractors on a daily basis that may be risk factors for the development of occupational overuse syndromes.

## 2.1 Occupational overuse syndrome

Occupational Overuse Syndrome (OOS), Repetitive Strain Injury and Work-Related Upper Limb Disorder are just a few of the umbrella terms that have come to be used to describe a heterogeneous group of symptoms and disorders (Hagberg, 1995). A frequently cited problem within epidemiological research is the inadequacy of the operational definitions for OOS and the conditions that fall under the OOS umbrella (Sluiter *et al.*, 2001; Van Eerd *et al.*, 2003). Many authors have highlighted the importance of using terminology, definitions and diagnostic criteria in line with those used internationally (WHO, 1985; Buckle and Devereux, 1999; Van Eerd *et al.*, 2003). The World Health Organisation (WHO) recognises that the absence of unified diagnostic criteria, coding systems and classifications reduces the compatibility and comparability of national statistics on occupational diseases (WHO, 1985). An overuse injury often referred to as a repetitive strain injury, can be defined as pain with associated loss of function in a limb resulting from its repeated movement or sustained static loading (Oxford Concise Colour Medical Dictionary, 2002).

In contrast to terminology, there appears to be some international consensus regarding the criteria used for the classification of disorders/syndromes encompassed within OOS. The current literature review identified two main groupings: specific and non-specific conditions (HCN, 2000; Sluiter *et al.*, 2001).

Specific conditions refer to those disorders that can be medically diagnosed, whereas the non specific condition are ill-defined with symptoms such as diffuse aching, weakness and muscle tenderness (HCN, 2000; Sluiter *et al.*, 2001).

Fourteen specific conditions were identified from key consensus articles. The conditions occurring in the hand and wrist region were flexor-extensor peritendinitis or tenosynovitis of the forearm-wrist region and De Quervains disease(tendon-related disorders), Carpal tunnel syndrome and ulnar nerve compression at the wrist also known as Guyon canal syndrome (nerve-related disorders), Raynaud's phenomenon and peripheral neuropathy associated with hand arm vibration (circulatory/ vascular type disorders). Arthritis of the upper extremity (joint-related disorders), and Fibromyalgia (pain syndrome)(Harrington *et al.*, 1998; HCN, 2000; Yassi, 2000; Sluiter *et al.*, 2001; Helliwell *et al.*, 2003)

De Quervain's tenosynovitis and wrist flexor tendinitis are the most commonly found localised inflammations in the distal forearm in people involved in highly repetitive industries. Carpal tunnel syndrome is the most common form of compression syndrome. (Ranney *et al.*, 1995.) The prevalence of some of these conditions in the general population have been documented to be as follows: De Quervain's disease 0.5% among men and 1.3% among women; other tenosynovitis of the hand or wrist, 1.1% among men and 2.2% among women (Coggon *et al.*, 2006.)

Dequirvains tenosynovitus is a paretendonitis with pain located in the abductor policus longus and extensor policus brevis tendons in the thumb. Tendinitis is often described as a symptomatic degeneration of a tendon associated with vascular compromise and inflammatory repair response. In Paretendenosis there is inflammation of only the outer layer of a tendon (Magee, 2000).

Carpal tunnel syndrome is a combination of paresthesiae, numbness and pain affecting all of the hand except the little finger and half of the ring finger. There may be weakness in the thumb and wasting over the thenar eminence. It is caused by pressure on the median nerve as it passes through the carpal tunnel

in the wrist, which may result from continuous repetitive movements of the hand (Oxford Concise Colour Medical Dictionary, 2002).

Osteoarthritis is degenerative disease of joints due to wear and tear of the articular cartilage that may lead to secondary changes in the underlying bone. It can be primary or secondary due to abnormal load to the joint or damage to the articular cartilage from inflammation or trauma. The joints are painful or stiff with decreased range of motion (Oxford Concise Colour Medical Dictionary, 2002).

Guyons canal syndrome is due to the compression of the ulnar nerve as it passes through the pisohamate canal in the hand. The nerve may be compressed from trauma or chronic pressure (Magee, 2000).

Raynauds is a painful condition usually affecting the hands. The origin of the disease is unknown. The pain is due to poor circulation as a result of vasospasm. The tiny blood vessels in the hands constrict resulting in ischeamic (Oxford Concise Colour Medical Dictionary, 2002).

Fibromyalgia is a complex pain syndrome defined as a chronic pain condition occurring in a defined pattern and reproduced by pressure on specific trigger points and generally affects females more commonly than males ((9:1) (Carnes and Vizniak, 2004).

Various other conditions which are not as common or clearly defined as the aforementioned conditions fall within the group of non-specific conditions. These were acknowledged to be characterised by pain, discomfort, fatigue, limited movement and loss of muscle power (Buckle and Devereux, 1999; HCN, 2000; Sluiter *et al.*, 2001), with pain being the primary symptom present.

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (Mersky, 1979). The anatomical site, character, intensity and frequency of the pain help to make a specific diagnosis of an injury in conjunction with relevant information acquired through history taking and physical examination.

The anatomical location of the pain is a valuable diagnostic tool. Pain in the anatomic snuffbox may suggest a scaphoid fracture or Preiser's disease, whereas lunate pain may indicate Kienbock's disease. Pain in the scapholunate interval may suggest scapholunate dissociation (Forman *et al.*, 2005.) This may be indicated by pain in area 5, 7 or area 10 in Figure 1.

Pain in the distal carpal row may indicate nonunion of the hook of the hamate, which is localized in the proximal hypothenar area (1 cm distal to the flexion crease of the wrist) (Forman *et al.*, 2005.) This may be indicated by pain in area 9 in Figure 1.

The mid-carpal area is a series of joints between the proximal and distal carpal rows. Pain in this area could indicate a midcarpal strain, instability, or possible arthritis of the scaphotrapeziotrapezoid joint. This may be indicated of pain in area 4 in Figure 1.

Pain along the lateral aspect of the distal radius can indicate de Quervain's tenosynovitis. Pain along the dorsal aspect of the distal radius may indicate intersection syndrome (a bursal inflammation of the intersecting tendons of the radial wrist extensors and thumb abductor tendons) (Forman *et al.*, 2005.) This may be indicated of pain in area 7 in Figure 1.

Pain over the ulnar styloid can indicate a fracture or nonunion, whereas pain immediately distal in the hollow between the pisiform and ulnar styloid usually indicates a triangular fibrocartilaginouc complex injury (Forman *et al.*, 2005.) This may be indicated of pain in area 6 in Figure 1.
Pain located in areas 1, 2 and 3 are indicative of pain in the metacarpophalangeal joints, proximal and distal interphalangeal joints respectively.

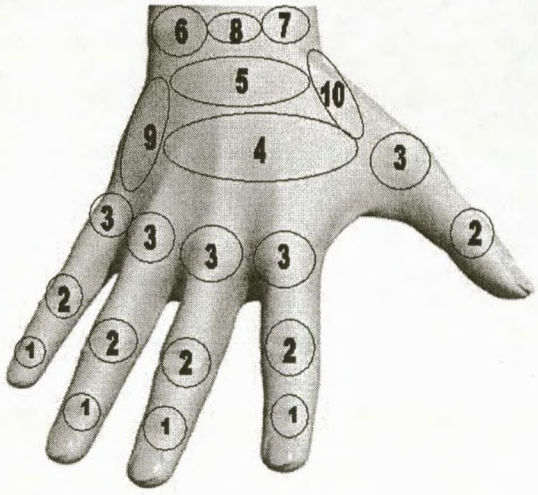



**Figure 1.**

## 2.2 Previous studies regarding occupational overuse syndrome in workers

The World Health Organization (WHO) assessed the current state of health surveillance of working populations in order to develop guidelines for the use of the ICD-10 (international statistical classification of diseases in occupational health) system. Recommendations were made regarding the ICD-10 classification of diseases of the nervous system, musculoskeletal system, connective tissues and injuries. WHO advised that a description of the causative agents should be more specific. It was noted that musculoskeletal diseases are missing from the current ICD-10 system and that many such diseases can be related to work, however only a few of them are considered to be occupational diseases by the national compensation systems. Most of these diseases are multi-factorial and the etiological fraction of work-related factors should be stated and the nature of exposure described if possible (WHO, 1998.)

Due to this deficiency in the ICD-10 system, there are very few statistics available that disclose the nature and incidence of work related neurological, musculoskeletal and connective tissue injuries. However, those statistics that do

exist suggest that `hands on` patient activities place physical therapists at risk of developing work related injuries (Lunne *et al.*, 2000).

Bork *et al.* (1996) investigated the prevalence of work-related musculoskeletal injuries sustained by physical therapists. Hand pain (29.6%) and back pain (45%) where the leading cause of pain in physical (Bork *et al., 1996.)*

Following Bork *et al.*(1996), Cromie *et al.* (2000) evaluated the prevalence, severity, risks, and responses of work related musculoskeletal disorders in physical therapists in 2000. The twelve-month prevalence of wrist and hand pain in physical therapists was 21.8% while the 12-month prevalence of thumb pain specifically was 33.6%. Of those participants reporting hand and wrist pain, 13.2% reported that the pain lasted for a period of 3 days or more while 14.9% reported that the thumb pain was present for a period exceeding 3 days (Cromie *et al.*, 2000.) The study conducted by Cromie *et al.* (2000) suggested that further research is needed to establish recommendations in practice that will help prevent the occurrence of musculo-skeletal disorders.

Holder *et al.* (1999) investigated the causes, prevalence and responses of physical therapists and physical therapists assistants to occupational musculoskeletal injuries. The most common injury type reported by physical therapist were muscle strain (69%) and ligament sprain (28%). The four activities that most commonly resulted in injury to physical therapists were transferring of patients (30%), lifting (25%), responding to unanticipated or sudden movements (24%) and manual therapy techniques (21%) (Holder *et al.*, 1999.)

Chiropractic and physiotherapy are both health care professions that specialize in the treatment of disorders pertaining to the neuro-musculo-skeletal system (Hunter, 2004). Activities routinely used by chiropractors in clinical practice include manipulation as well as various other non-manipulative techniques that include the use of therapeutic modalities.

## 2.3 Risk factors associated with occupational overuse

Factors that have previously been associated with musculoskeletal pain are higher age and female gender (de Zwart *et al.*, 2001; Wahlstedt *et al.*, 2001; Feveile *et al.*, 2002;). Physical risk factors found to be associated with neck, shoulder, or hand and wrist disorders in cross sectional studies are heavy lifting, monotonous work, static work postures, vibrations and repetitive jobs, and a high work pace (Alfredsson *et al.*, 1999). Some studies suggest that job strain increases the risk of musculoskeletal pain (Toomingas *et al.*, 1997; Wahlstedt *et al.*, 2001). It has however been found that high job strain had a greater effect on women (Bourbonnais *et al.*, 2005). Risk factors pertaining to workload are related to a higher prevalence of neck and upper-limb symptoms, and postural risk factors were related to a higher prevalence of spinal symptoms in physical therapists (Cromie *et al.*, 2000). Therefore this study has focused more on workload issues as they are more commonly related to upper limb disorders.

In previous studies it has been reported that younger therapists reported a higher prevalence of workers musculoskeletal disorders (WMSDs) in most body areas, this is in contrast to studies conducted using samples of the general working population where higher age was associated with musculoskeltal pain (Cromie *et al.*, 2000; de Zwart *et al.*, 2001; Wahlstedt *et al.*, 2001; Feveile *et al.*, 2002). The first episode of WMSD occurred for the majority of therapists in the first 5 years of practice (Cromie *et al.*, 2000).

Work related injury to the thumb has become a recognized problem for physiotherapists who perform manual techniques in the treatment of patients with musculoskeletal disorders (Reglar and James, 1999; Cromie *et al.*, 2000; West and Gardener, 2001). Thumb joints are particularly vulnerable to biomechanical overload and work related injury because forces are often transmitted directly through the thumb during the application of manual techniques (Snodgrass and Rivett, 2002). It appears that many (33%) therapists are affected bilaterally (Ranney *et al.*, 1995).

## 2.4 Manual Therapy

Chiropractic practice involves the constant performance of various forms of manipulative therapy and other manual tasks in a variety of different working postures, which subject the musculoskeletal system to potentially large repetitive

mechanical loads (Traino, 2000). Manual therapy has been found to be related to wrist and hand symptomatolgy (Cromie *et al.*, 2000).

Manual therapy can be defined as any procedures by which the hands contact the body to treat the articulations or soft tissues (Gatterman, 1995). Manual therapy is seen as a therapeutic modality used by members of various disciplines, such as osteopaths, chiropractors and physiotherapists (Lederman, 1997). The treatment of articulations is most commonly by manipulation while the treatment of soft tissues may require the use of non-manipulative techniques. Although manual therapy has previously been associated with work related musculoskeletal disorders, previous research has not identified specifically what manual therapy techniques are associated with work related musculoskeletal disorders (Cromie *et al.*, 2000).

## 2.5 Chiropractic techniques

It is estimated that there are in the region of three hundred discrete chiropractic techniques employed by the profession worldwide, these have different diagnostic techniques and employ different treatment protocols (Cooperstein and Gleberzon, 2004). The diversified techniques are the most commonly employed manipulative procedures, of which there are approximately five hundred separate and distinct manipulations used when applying a chiropractic adjustment to a specific anatomical site (Byfield, 2005).

Manipulation is defined as a manual procedure that involves a direct thrust to move a joint past the physiologic range of motion without exceeding the anatomical limit (Gatterman, 1995). More specifically, an adjustment is any chiropractic therapeutic procedure that uses controlled force, leverage, direction, amplitude, and velocity directed at specific joints or anatomical regions. Chiropractic commonly uses such procedures to influence joint and neurological function (Gatterman, 1995). These adjustments are most commonly applied to the spinal column but may also be used in the treatment of the extremities and the temporomandibular joint. The therapist may perform the adjustments with the patient in various positions.

Drover (2004) conducted a study comparing the forces applied by male and female chiropractors during thoracic spinal manipulation; he concluded that from a mechanical point of view female chiropractors provide similar manual treatments to their male colleges. He noted that during a chiropractic adjustment a thrust force of up to 1000 Newton's is applied to the target site within approximately 150 milliseconds (Drover, 2004). An investigation into the three dimensionality of direct contact forces in chiropractic spinal manipulative therapy suggests that the highest loads are at T4-5 and T8-9 levels and the lowest loads at cervical levels, with T1-2 and sacroiliac loads between both extremes (Gosselin and van Zoest, 2003). The constant lifting of patients, readjusting their body weight and positioning of tables prior to the thrust present physical risk factors for the chiropractor (Byfield, 2005). The continual mechanical stress applied to the wrist joints during thrust delivery may result in repetitive injuries to the supportive soft tissues (Byfield, 2005.) There are at least twelve areas on the hand that can be used to contact the skin surface and anatomical levers of the patient while performing a chiropractic adjustment (Grecco, 1953; States, 1968; Christensen, 1984; Schafer and Faye, 1989; Bergman, 2002). The hand may be vulnerable to unnecessary injury if incorrectly positioned or inflexible during a manipulative thrust placing additional biomechanical stress on the soft tissues and joints of the hands and fingers (Traino, 2000). This is of particular importance in the first metacarpophalangeal joint and the wrist articulations as they are particularly prone to biomechanical stresses during manipulative procedures (Byfield, 2005).

Numerous non-manipulative techniques are routinely used by chiropractors in addition to manipulation. These techniques are often referred to as mobilization techniques. Mobilization is defined as a movement applied singularly or repetitively within or at the physiological range of motion, without imparting a thrust impulse, with the goal of restoring joint mobility (Gatterman, 1995). Therefore the application of a thrust force is the differentiating feature of manipulative and non-manipulative techniques. Non- manipulative techniques may not cause as much biomechanical stress to the therapists' hand as a manipulation in a singular event, but the repetitive nature of non-manipulative techniques may have a greater cumulative effect. This phenomenon has not

previously been investigated. Potential factors contributing to the development of hand and wrist pain in physical therapists have been postulated to be forces applied during mobilizations, which supports this notion (Snodgrass and Rivett, 2002).

Neuromuscular techniques (NMT) refer to the manual application of specialized pressure and strokes, usually delivered by a finger or thumb contact, which have a diagnostic or therapeutic objective (Chiatow, 2003). The application of neuromuscular techniques requires repetitive motion and this causes stress to the hands and wrist of the therapist. No one part of the body is designed to do the same motion repeatedly for long periods without rest (Green, 2002).

With respect to the above, Chiropractors utilize a very diverse range of non-manipulative therapies including massage, which primarily consists of effleurage, petrissage, tampotment, vibrations, shaking and skin rolling.
Effleurage is the slow rhythmical gliding strokes performed by the hands in the direction of blood flow maintaining continuous contact with the skin. Petrissage is the alternating of pressure and release applied to soft tissues. Tampotment requires drumming hand movements on broad areas using fists, fingertips, the edge of the hand and flat palmar aspect of the hands. Vibrations are tremulous movements of the palms or fingertips against a body part causing it to vibrate. Skin rolling is a petrissage type movement where cutaneous and sub cutaneous tissues are grasped and lifted away from the underlying tissue and then rolled between the fingers with pressure towards the underlying structures. (Vizniak, 2005.)

Cross fibre massage, an alternative massage technique, utilises short parallel strokes of approximately one centimetre applied to underlying soft tissue at a frequency of two to three cycles per second for a period of six to twenty minutes. It aims to increase tissue circulation and inhibit collagen cross-linking and thus promote healing. (Vizniak, 2005.)

Other non manipulative techniques used by chiropractors include manual lymphatic drainage, Musculo-tendinous release, Myofascial release and

Musculo-tendinous release. Manual lymphatic drainage is a rhythmical pumping that stimulates the movement of lymph through the lypmh vessels. Musculo-tendinous release stretches and softens muscles and their attachment sites while Myofascial release is the therapeutic stretching and loosening of tight fascial layers surrounding muscles. (Vizniak, 2005.)

Trigger point therapy (includes nimmo technique and ischaemic compression is the treatment of hyperirritable spots within taut bands of muscle or muscle facia (Vizniak, 2005.) The Nimmo technique involves the application of effleurage to remove satellite trigger points. The muscle is then relaxed and pressure is applied to the trigger point within the patient's pain tolerance for a period of three to seven seconds. Trigger points are treated several times in each therapeutic session. (Vizniak, 2005.)

Ischaemic compression requires a slow progressive pressure to be applied to a trigger point within the patients pain tolerance. The maximum pressure is then maintained until tissue change is felt. The tissues are then stretched following the ischaemic compression. (Vizniak, 2005.)

Stretching (including post isometric relaxation and post facilitated techniques) techniques too are commonly used by chiropractors. Post isometric relaxation is the stretching of a muscle and then at the point of stretch the patient is asked to isometrically contact the muscle for five to seven seconds at approximately twenty percent of the muscles strength. Post-facilitated techniques require one hundred percent strength muscle contraction while the muscle is in the stretched position. The stretch is held for seven seconds and then the muscle is allowed to relax. The muscle is then rapidly stretched and the stretch is held for twelve to fifteen seconds. This procedure is repeated five times per therapeutic session. (Vizniak, 2005.)

Muscle energy techniques are resistance exercises commonly referred to as (daily adjustable progressive resistance exercises DAPRE). They require the clinician to stretch the patient into the direction of the restricted motion. The patient then gently contracts (10% effort) in the opposite direction. The

contraction is held for three to seven seconds and then the patient relaxes. This is repeated three to five times per therapeutic session. Modifications of muscle energy techniques include proprioceptive neuromuscular facilitation (PNF). This is an exercise technique based on the diagonal patterns of extremity and spine movement where the patient mildly resists certain movements. (Vizniak, 2005.)

Other modalities commonly used by chiropractors include therapeutic ultrasound, dry needling, interferrential current, hot and cold therapy and traction (Vizniak, 2005). The use of electrotherapy has been associated with an increased risk of wrist and hand symptoms in physical therapists (Cromie *et al.*, 2000). There was no reason given for this observation. Certain electrotherapies such as therapeutic ultrasound require the therapists to manually move the probe over a small surface area for specific time duration. The manual movement of the probe may cause biomechanical strain to the wrist and hand if the technique is applied for a long duration or on a frequent basis. This phenomenon has however not previously been investigated.

The use of both neuromuscular techniques as well as other therapeutic modalities requires repetitive arm movement from the therapist. Many of these therapeutic techniques require repetitive arm movements, a factor that has previously been associated with upper limb symptomatolgy and pain (Malchaire *et al.*, 2001).

# CHAPTER 3

# Materials and Methods

## Introduction

This chapter covers the study design; methodology used; sampling procedures; inclusion and exclusion criteria and methods employed.

## Study design

A cross sectional analysis of chiropractors in South Africa utilizing a self-administered questionnaire developed specifically for this particular research project (see appendix 1). The questionnaire contains unique questions developed by the researcher. It has both quantitative (the prevalence of hand and wrist pain as well as demographic data) and qualitative (the factors associated with hand and wrist pain) aspects. It has qualities of correlation research and casual comparative research.

## Methodology

The sample group contained Chiropractors registered with the Allied Health Professions Council in South Africa (385) determined from the register of Chiropractors registered with the Allied Health Professions on Friday 2 September 2005, of which approximately 385 currently have postal addresses in South Africa. Of the sample 108 (28%) chiropractors completed the questionnaire and fulfilled all the inclusion and exclusion criteria for the study.

## Inclusion and exclusion criteria

Inclusion criteria

1. Each participant's name had to be included on the AHPCSA register of chiropractors.
2. The postal address appearing on the AHPCSA register had to be in the South Africa.
3. The questionnaire had to be returned completed.

4. The informed consent form had to be returned completed.

Exclusion criteria

1. Chiropractors in South Africa who are not registered with AHPCSA.
2. Chiropractors registered with the AHPCSA who have postal addresses in a foreign country.
3. Questionnaires that were returned incomplete.
4. Any participant who was not familiar with the English language as the questionnaire was only available in English.
5. Non- responses were not included.
6. Chiropractors who participated in the Focus Group were excluded from the study.

The questionnaire was sent to all eligible participants via the post. The questionnaire was sent with a self addressed return envelope (stamped) which was addressed to the Chiropractic Day Clinic at the Durban Institute of Technology thus providing a third party that received the completed questionnaires.

Accompanying the questionnaire was the:

- letter of information (appendix 2)
- informed consent form (appendix 3)

When establishing validity, the degree to which a particular tool reflects reality is being tested (Mouton, 1996). This tool is vital to ensure that future research utilizing this particular research tool is accurate (Bernard, 2000).

Therefore the questionnaire was tested in a focus group (n=10) to give face validity to the context in which the questionnaire was used. The questionnaire was tested in a focus group held in the Chiropractic department at the Durban Institute of Technology on Thursday 9 June 2005.The focus group included 5 qualified Chiropractic practitioners, 3 senior Chiropractic students, a statistician and the researcher.

The Focus group made the following amendments to the questionnaire. The formats of various questions were modified in order for them to be suitable for statistical analysis as advised by the statistician in the focus group as well as to make the questionnaire more user- friendly, the content of these questions however remained unchanged. It was recommended that severity of the pain using the numerical pain rating scale be completed at different time intervals in order to establish point prevalence, period prevalence and the progression of the pain. A list of adjectives describing the pain sensation was omitted as the focus group felt that it would not have a significant effect on the outcomes of this research study. It was recommended that the diagram used to locate the area in which the pain was felt included both right and left hands as well as the palmer and dorsal aspects. Questions regarding the range of motion in the hands and wrists were omitted as these were regarded as clinical findings and the focus group decided that a questionnaire was not a sufficient way in order to analyze this phenomenon. Questions regarding the use of specific chiropractic techniques (diagnostic and therapeutic) were omitted as the focus group felt that many chiropractors would use not one specific technique but rather a combination of various techniques and this subject was refined rather to what adjustment techniques they utilized as seen in question 1.9 in appendix 1. Questions regarding the satisfaction with hand function were omitted as the focus group felt that these questions were more suitable for respondents who suffer specifically from arthritides, the focus group also questioned the relevance of these questions in this research study. Question 1.7 appendix 1 was formulated by the focus group in order to gain greater insight into the time allocated to specific activities during a chiropractor's typical working day. Further adjustments were made to the format of the questionnaire to make it clear and easy to understand and ensure validity in the utilization of the questionnaire as a research tool. During the focus group a letter of information (see appendix 6), informed consent form (see appendix 3), confidentiality statement (see appendix 4) and a code of conduct (see appendix 5) were completed and signed by the participants.

The questionnaire was then tested using pilot testing (see appendix 7) giving further face, content, criterion and construct validity.

The questionnaire consists of 7 Sections each containing a varied number of questions.

1. General information regarding the participant.
2. Relevant medical history pertaining to the participant.
3. Prevalence of hand and wrist pain.
4. Characteristics of hand and wrist pain.
5. Pain at work.
6. Pain related to performing Chiropractic adjustments.
7. Self Diagnosis.

The questions were based on the literature that exists with respect to repetitive strain injuries, sources of hand and wrist pain, the scope of Chiropractic practice and possible causes of hand pain within practice. The researcher did however attempt to address the major risk factors commonly associated with workers musculo-skeletal disorders in physical therapists as identified by Cromie *et al.* (2000)

1. Risk factors related to specific activities.
2. Postural risk factors.
3. Risk factors with regard to workload issues
4. Work capacity and health of the participant) (Cromie *et al.*, 2000).

The researcher formulated questions to identify similar risk factors in chiropractors.

1. The first sub category identified <u>risk factors related to specific activities</u> routinely used by the physical therapists such as manipulative techniques, soft tissue techniques and therapeutic modalities used by the therapist while treating patients.
   (See Questions 1.7, 1.8 and 1.9 appendix 1)

2. The second sub category identified postural work factors or the position of the therapist.
   (See Questions 6.1 and 6.2 appendix 1)

3. The third subcategory identified risk factors with regard to work load issues such as the frequency of specific treatments and rest time while working.
   (See Questions1.5 and 1.6 appendix 1)

4. The fourth sub category evaluated factors such as the work capacity and health of the physical therapist.
   (See Question 1.1, 1.2, 1.3, 1.4, , 2.1, 2.2, 2.3 appendix 1)

The remainder of the questions were included to further investigate the prevalence of pain in the hands and wrists in chiropractors and what factors were commonly implicated with the pain. The questionnaire took the following format

1. General information regarding the participant (Demographic data)

1.1. Age
1.2.1. Gender
1.2.2. Race Group
1.3. Dominant hand
1.4. Years in practice
1.5. Average number of patients seen per day
1.6. Average number of hours worked per day
1.7.1. Activities used in daily practice
1.7.2. Time allocated to specific activities in practice
1.8. Non- manipulative techniques used in practice
1.9. Manipulative techniques used in practice
1.10.1. Alteration of non- manipulative techniques in practice due to pain
1.10.2. Alteration of manipulative techniques used in practice due to pain

2. Relevant medical history

2.1. Trauma

2.2. Systemic disease

2.3. Recreational activities

3. Prevalence of hand pain and wrist pain at work

3.1.1. Prevalence of hand pain.

3.1.2. Initial onset of hand pain.

3.2.1. Prevalence of wrist pain.

3.2.2. Initial onset of wrist pain.

4. Characteristics of hand and wrist pain

4.1. Percentage of time that hand pain is felt

4.2. Severity of pain

4.2.1. Initially

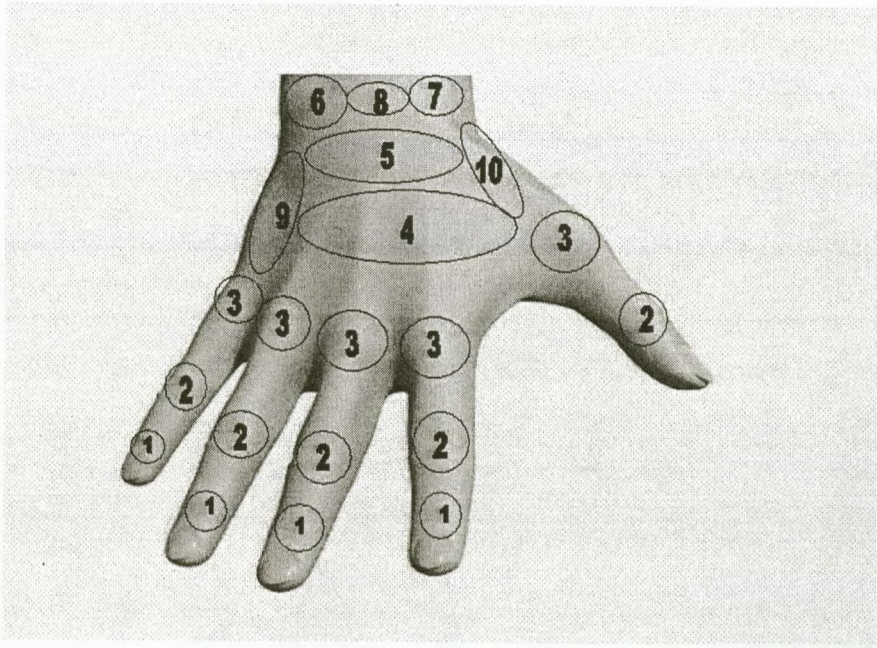
4.2.2. Presently

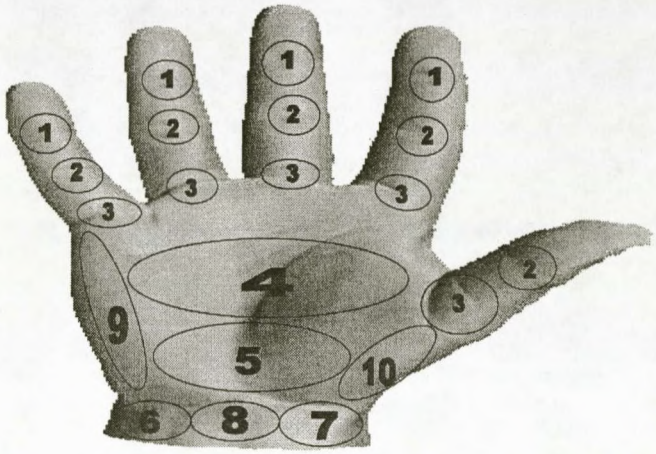
4.2.3. Worst

4.3. Associated signs and symptoms

4.4. Location of the pain (Diagram developed by the researcher)

This diagram was evaluated using the following criteria, which was interpreted by the researcher.






The participant indicated in which area/s on the hand the pain was felt. This was categorized according to the area (1-10) and whether the pain was felt on the left or right hand and on the palmer or dorsal aspect.

5. Pain at work

5.1. Pain relation to activities.

6. Pain related to performing Chiropractic adjustments

6.1. Anatomical areas are associated with hand pain.

6.2. Patient positions associated with hand pain.

7. Self diagnosis

7.1. Anatomical structures involved in the pain.

7.2. Sources of the pain.

In question 4.2.1, 4.2.2 and 4.2.3 (appendix 1) the numerical pain rating scale was used (McCaffery *et al.*, 1999). The numerical pain scale allowed the participant to describe the intensity of their discomfort in numbers ranging from 0 to 10. The scales included words or descriptions to better label their symptoms, from feeling no pain to experiencing excruciating pain. Pain scales were also used at varying time intervals to record the chronology of the pain. The time intervals used where initial intensity of the pain (See Question 4.2.1 Appendix 1),

the present intensity of the pain (See Question 4.2.2 Appendix 1) and the intensity of the pain at its worst (See Question 4.2.3 Appendix 1).

The present intensity of the pain was also an indicator of the point prevalence of pain in the hands and/or wrists of chiropractors in South Africa. A comparison of the initial and present intensity of the pain would be indicative of whether the pain was progressive. A comparison of the initial pain and the pain at its worst would be indicative of an isolated traumatic event. The purpose of this questionnaire was to evaluate the pain experienced by chiropractors specifically in their hands and wrists.

## Data analysis

SPSS version 11.5 was used to analyse the data (SPSS Inc, Chicago, Ill, USA). Characteristics of the sample were described using frequency tables, bar charts and summary statistics. EpiInfo version 6.04 (CDC, Atlanta, USA) was used to calculate exact binomial 95% confidence intervals around the estimates of prevalence of hand and wrist pain. Categorical factors associated with hand and wrist pain were analysed bivariately using Pearson's chi square tests or Fisher's exact tests as appropriate. Quantitative variables were analysed with student's independent t-tests for relationships with hand pain and wrist pain. Logistic regression models were constructed to assess the independent association between various factors and possible occupational overuse syndromes whilst controlling for confounders. Backwards-stepwise elimination was used as the modelling technique based on likelihood ratios. Odds ratios (OR) and 95% CI were reported. A p value of $<0.05$ was considered as statistically significant.

# Chapter 4

## Results and Discussion

Only the figures of results that feature in the discussion are shown here. The full list of results can be seen in appendix 8.

**Results**

**4.1. Descriptive analysis**

**Demographics of the sample**

One hundred and eight chiropractors participated in the survey. Their mean age was 37.1 years (SD 12.9 years), with a range from 25 to 75 years. The majority of participants were male (62%, see Table 1), therefore this sample was considerably different to that of Cromie *et al.* (2000) in which the sample was predominantly female (78%), this was comparable to the demographics from which their sample was drawn (25% male and 75% female). It was not possible to determine the male to female ratio of the sample of chiropractors in South Africa, as their gender was not specified on the Allied Health professions register. The study conducted by Cromie *et al.* (2000) revealed that more male participants had hand and wrist symptoms than did female participants with a p value of $< 0.005$, the same was true for thumb symptoms with a p value of $< 0.001$ (Cromie *et al*, 2000.) Cromie *et al. (2000)* gave no reason for this finding.

The sample in this study had a high proportion of Caucasian participants (92.6%). For further ethnicity analysis the sample was divided into Caucasian and non-Caucasian since the numbers in the other racial groups were very low and did not permit statistical comparison. The reason for the high proportion of Caucasian participants may be comparable to the current racial demographic distribution of chiropractors in South Africa at the time the questionnaire was sent out. Most participants were right handed (83.3% - Table 3).

## Work environment of the sample

The average time that the participants had been in practice for was 9.9 years (SD 11.7 years), and ranged from 6 months to 45 years. The number of patients treated per day is shown in Figure 1. The majority treated 11-20 patients daily. Cromie also investigated the number of patients seen per day as a possible risk factor in the development of workers musculo-skeletal disorders, 41.4% of participants reported that they thought treating a large number of patients per day was a major factor in the development of their musculo-skeletal disorders (Cromie *et al.*, 2000.) There was, however, no numerical value describing what was regarded as large number of patients.

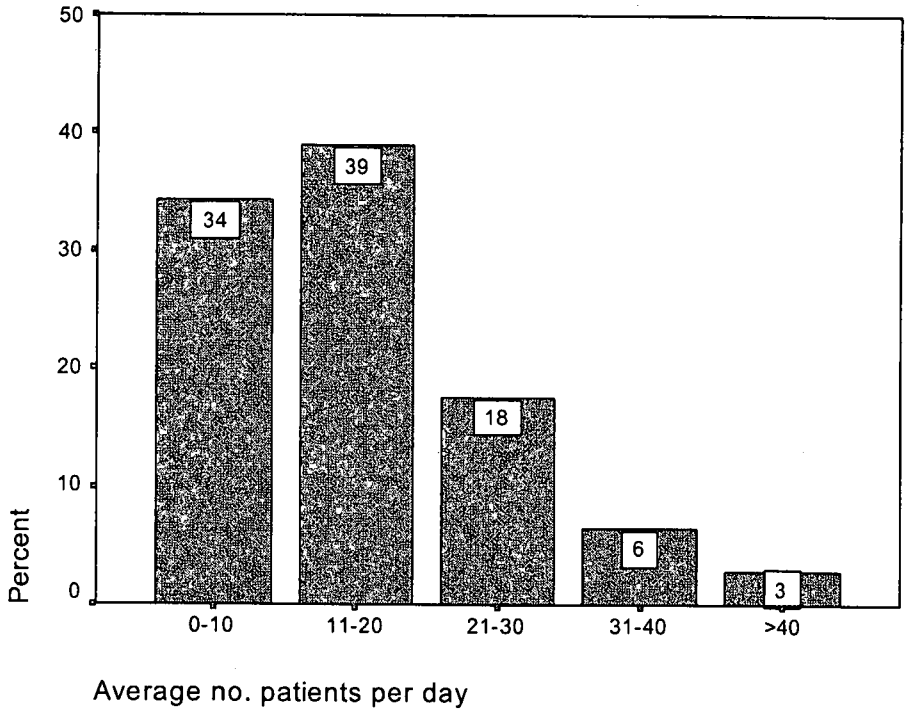



**Figure 1: Number of patients treated daily**

Most participants worked 20-30 hours per week in practice, this included `hands on` work and other activities routinely used while in practice. (Figure 2). The study by Cromie correlated the prevalence of thumb symptoms to the hours worked per week; it concluded that that the prevalence of thumb symptoms increased in a linear relationship to the hours worked per week. It was noted that

the prevalence of thumb symptoms was near 60% in therapists that worked more than 20 hours per week (Cromie *et al.*, 2000). Thumb pain was not investigated separately in this study but an indicator of thumb pain may be seen by the number of participants who experienced pain in area three in the pain location diagram.

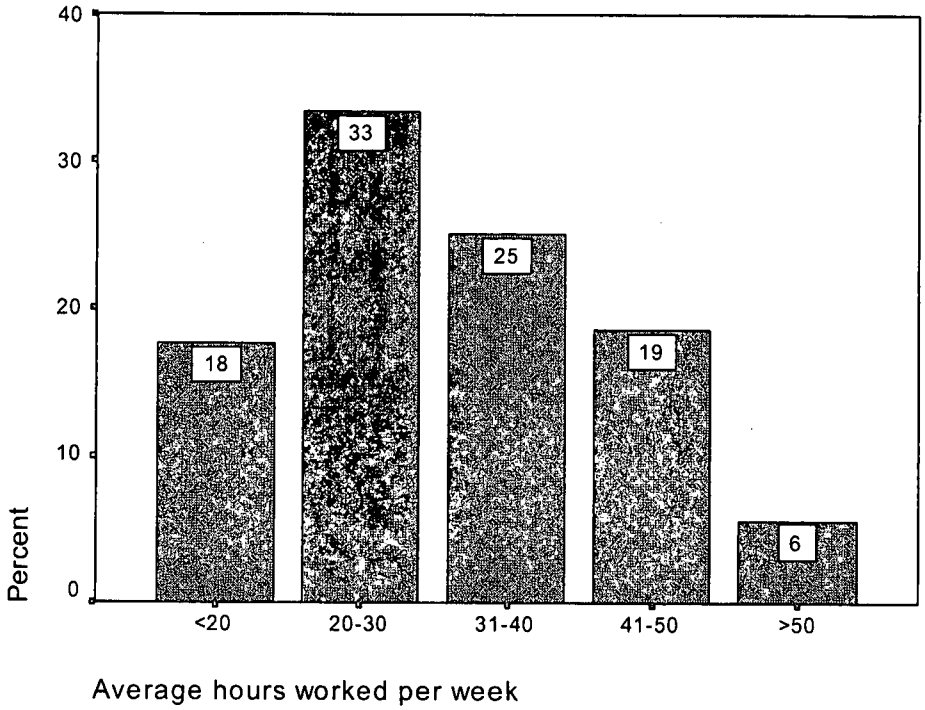
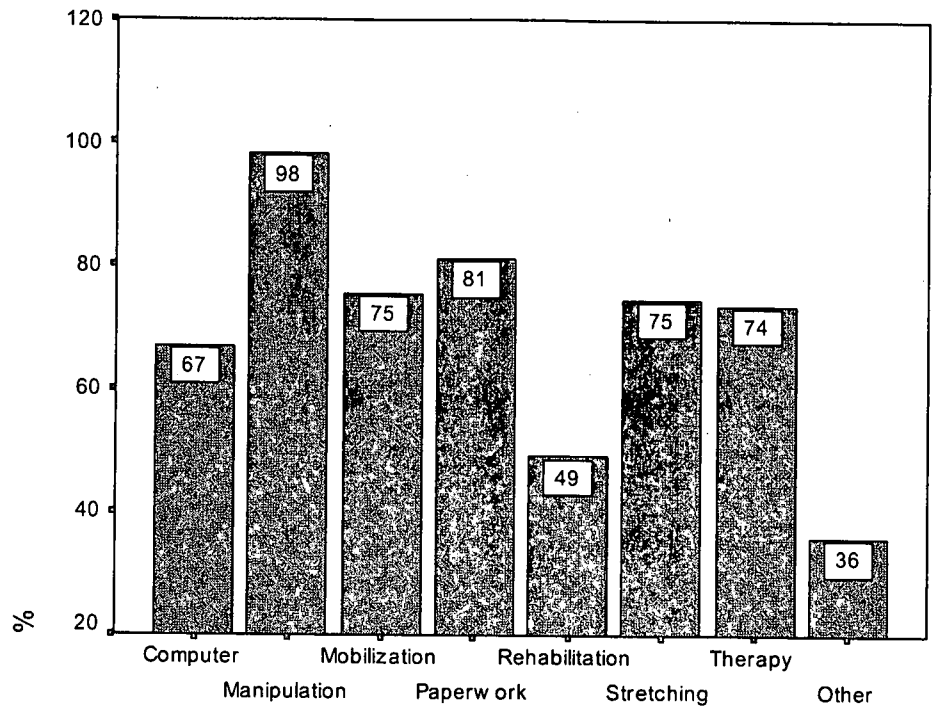



**Figure 2: Hours worked per week**

Figure 3 shows the percentage of participants who replied positively to performing a list of specified work activities. Almost all (98%) performed manipulations, while 81% did paperwork, 75% mobilization and 75% stretching. The study by Cromie *et* al. (2000) noted that mobilization, manipulation and other hands on techniques were associated with an increased risk of workers musculo-skeletal disorders, other activities including administrative tasks were not associated with workers musculo-skeletal disorders (Cromie *et al.*, 2000). Soft tissue therapy was included under the `other ` column but was not a significant contributor.

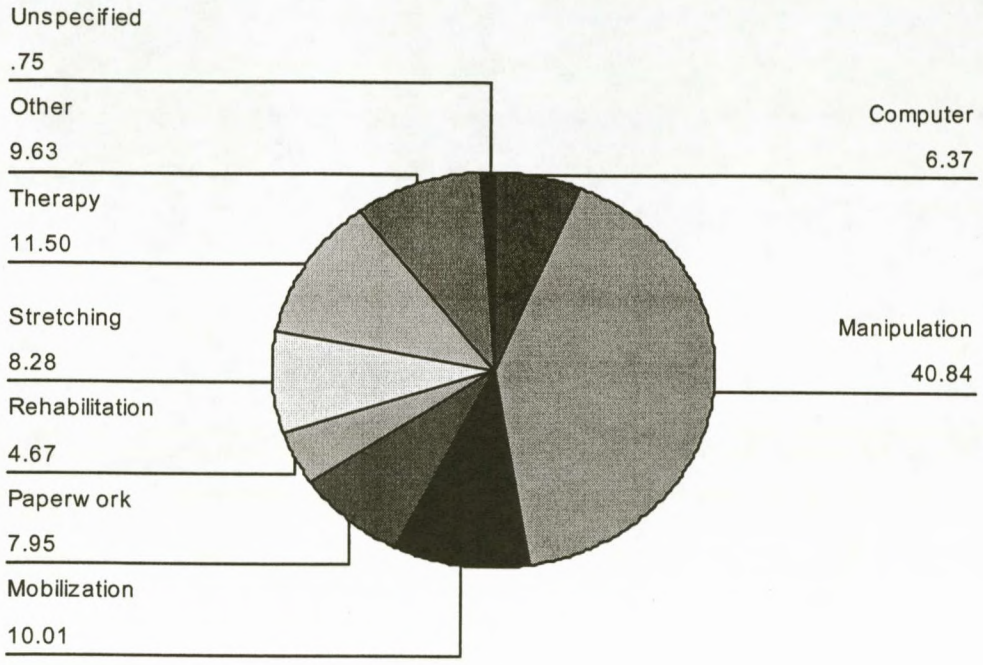



* *Therapy = therapeutic modalities e.g. therapeutic ultrasound*

**Figure 3: Percentage of participants who perform various work activities**

Figure 4 shows that the highest percentage of time was spent on manipulation (mean 40.8 % of time), this is a considerable amount of time considering that the actual manipulation is not a time consuming procedure, the large time allocation may be due to the participant including the screening for manipulative lesions and the set up procedure in the time allocated to manipulation. This was followed by therapeutic modalities (11.5%), mobilization (10%), and other activities (9.6%), the most common other activity specified was soft tissue therapy.

**Figure 4.**




All activities excluding paperwork, computer work and unspecified activities can be regarded as manual therapeutic techniques. Non- manipulative techniques account for 44.09% of time in practice while manipulation accounts for 40.84% of time while in practice.

Figure 5 shows the percentage of respondents who performed various non-manipulative techniques. Ischaemic compression was the most common technique used by participants (80.6%). Cross fibre massage (73.1%), dry needling (76.9%), massage (74.1%) and PNF (68.5%) were also frequently used. The responses help to understand the etiological fraction of work-related factors as recommended by the World Health Organisation (WHO, 1998.)

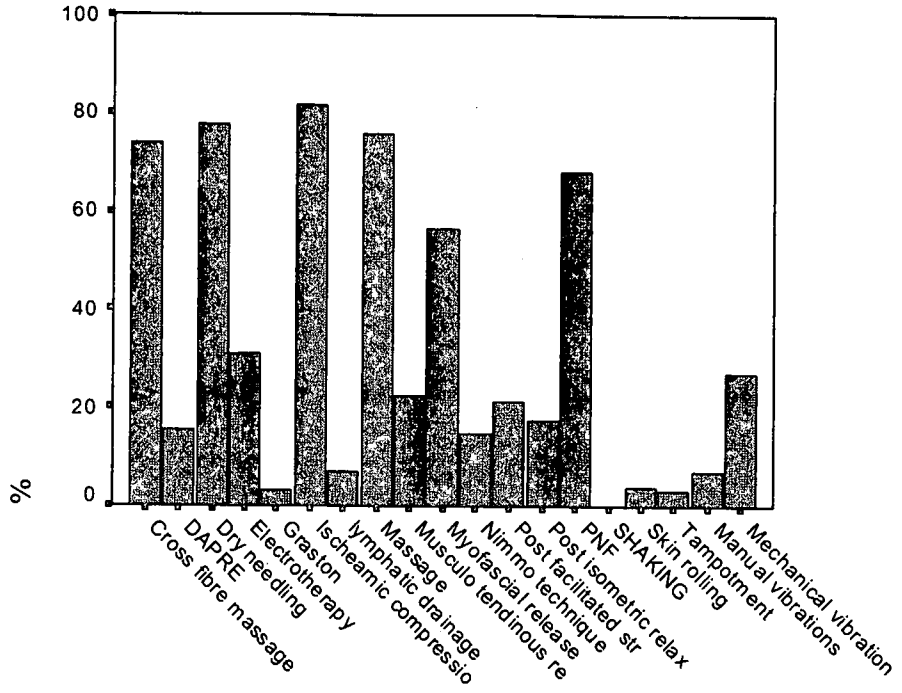



**Figure 5: Percentage of participants using specified non manipulative techniques**

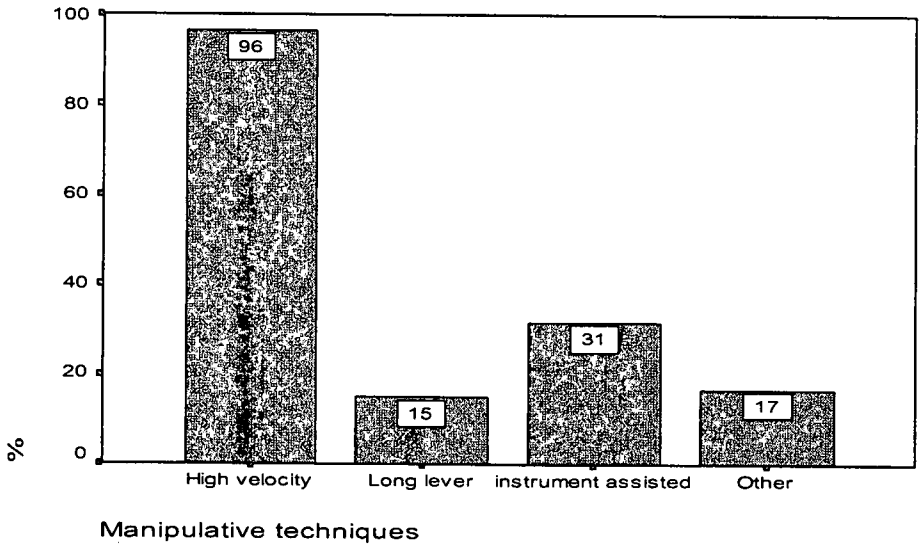



**Figure 6: Percentage of participants using specified manipulative techniques**

Figure 6 shows the manipulative techniques used by participants. Almost all (96%) used high velocity low amplitude thrust.

## 4.2. Prevalence of wrist and hand pain

**Medical History**

Twenty- eight (25.9%) participants had sustained trauma to the hands or wrists previously whilst in 21 of these cases the trauma was a dislocation, fracture or sprain. Nineteen of the participants who reported hand or wrist pain also had previously experienced trauma to their hands or wrists (32.2% for hand pain and 31.1% for wrist pain).

There were nine participants who had a systemic condition (8.3%), of which four reported hand or wrist pain (6.8% for hand pain and 6.6% for wrist pain).

Fifty- seven participants (52.8%) reported that they had played a sport that could result in an injury to the hands or wrists. Thirty three of these also reported hand or wrist pain (55.9% for hand pain, and 54.1% for wrist pain).

Wrist pain was reported in 61 participants, with a prevalence of 56.48% (95% CI 46.60% - 66.0%). Hand pain was reported in 59 participants, prevalence of 54.63% (95% CI 44.76% - 64.24%). Either hand or wrist pain was found in 79 subjects, 73.15% (95% CI 63.76% - 81.22%). Forty-one subjects had both wrist and hand pain, prevalence of 37.96% (95% CI 28.80% - 47.81%). These prevalence figures where lifetime prevalence figures.

The prevalence of musculo-skeletal pain was recently investigated in the Quebec working population, the one year prevalence of upper extremity musculo-skeletal pain in men was reported as sometimes present (33.9%) and always present (19.7%), in females the prevalence was slightly higher and was reported as sometimes present (34.6%) and always present (22.3%) of the time (Bourbonnais *et al.*, 2005).

Bork *et al.* (1996) too investigated work related musculo-skeletal disorders, but specifically in physical therapists, his study was conducted prior to the study conducted by Cromie *et al.*(2000). Bork *et al.*(1996) reported the 12 month prevalence of wrist and hand pain to be 29.6% (Bork *et al., 1996.*) Cromie *et al.*(2000) noted the 12 month prevalence of hand or wrist pain to be 21% and noted that the 4.3% of the participants reported symptoms that lasted more than 3 days (Cromie *et al*, 2000.) Therefore, the point prevalence of hand and wrist pain in chiropractors (73%) appears to be much higher than the period (1 year)

prevalence of hand and wrist pain in physical therapists (29.6%) and general upper extremity pain in the working population (+/- 20% - 30%) (Bork *et al., 1996;* Bourbonnais *et al.*, 2005.)

## 4.3. Characteristics of the wrist and hand pain (n=79)

### Onset

Hand pain was found to have a mean onset of 3.41 years ago (SD 4.13 years) with a range of 0.1 to 20 years. Wrist pain was first experienced on average 3.31 years prior (SD 4.08) with a range of 0.1 to 20 years. This cannot be correlated with previous studies in physical therapists as in the study by Bork *et al.*(1996) and Cromie *et al.*(2000) the prevalence was over a specific time period and the initial onset of the pain was not documented chronologically.

### Severity

For the 79 participants who reported hand or wrist pain, their mean percentage of time that they experience this pain was 20.66%, or as illustrated by the example in the questionnaire 1 in every 5 days, (SD 25.9) with a range from 0.01% to 100%. The descriptive statistics for pain severity measured by NRS are shown in Table 4 for initial, present and worst pain.

**Table 4: Descriptive statistics for severity of hand or wrist pain**

| | | NRS initially | NRS presently | NRS Worst |
|---|---|---|---|---|
| N | Valid | 79 | 79 | 78 |
| Mean | | 3.70 | 1.76 | 5.81 |
| Median | | 3.00 | 1.00 | 6.00 |
| Std. Deviation | | 2.388 | 2.027 | 2.222 |
| Minimum | | 1 | 0 | 1 |
| Maximum | | 10 | 9 | 10 |

**Signs and symptoms**

Figure 7 shows that the most common symptom reportedly experienced by the participants were weakness in the hands and wrists (30%), with numbness, swelling and deformities and other symptoms being relatively rare.

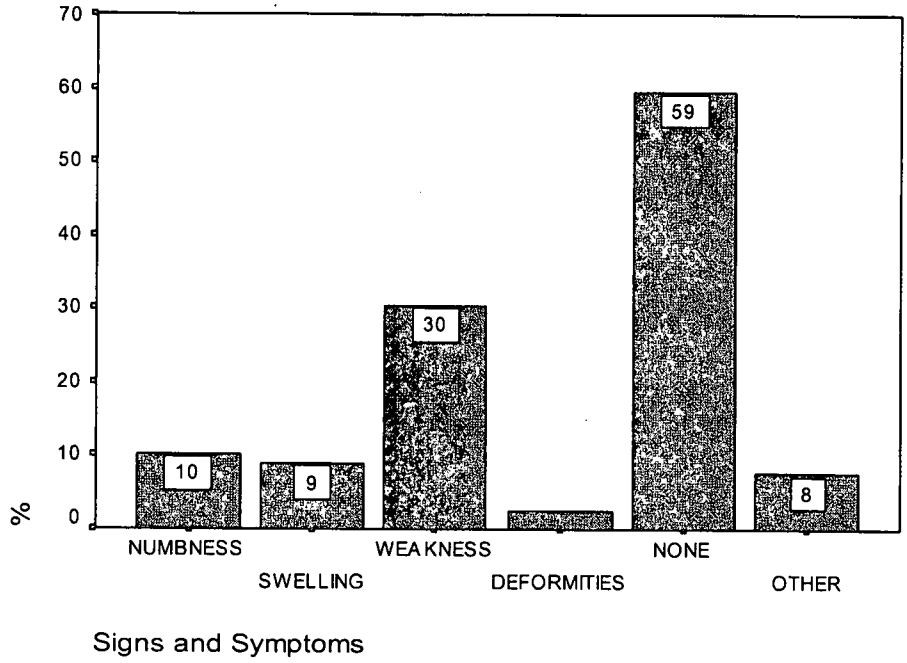
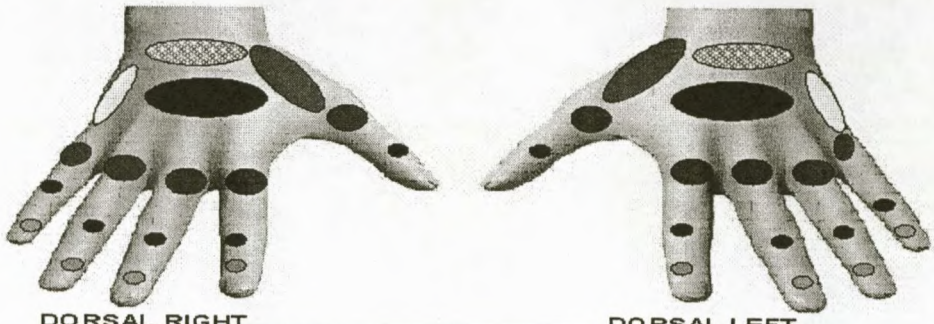



**Figure 7: Percentage of affected participants reporting various signs and symptoms (n=79)**

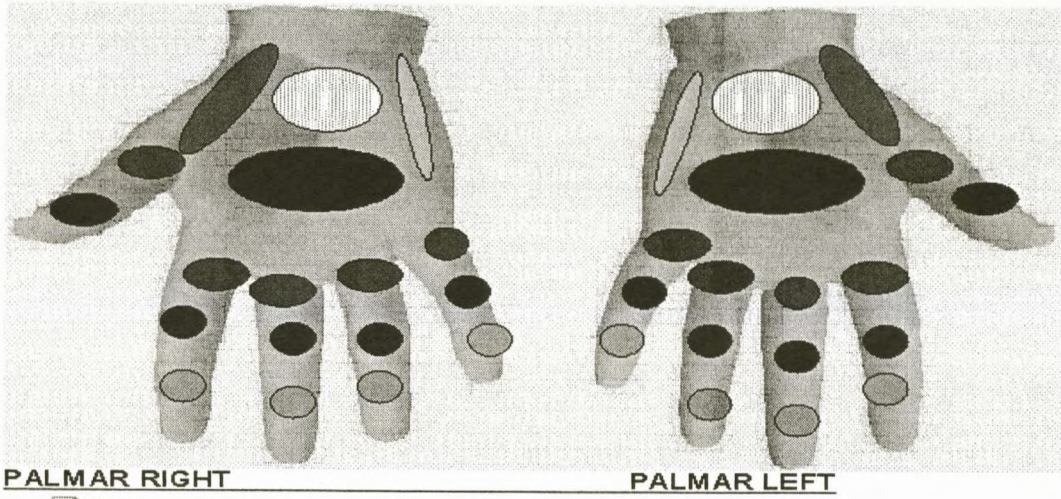
**Anatomical location of the pain (only significant percentages shown)**

**DORSAL ASPECT OF HAND**



| DORSAL RIGHT | | DORSAL LEFT |
|---|---|---|
| D1 | | |
| D2 | (18%) | (14%) |
| D3 | (41%) | (42%) |
| D4 | (5%) | (4%) |
| D5 | (4%) | (4%) |
| D6 | | |
| D10 | (14%) | (18%) |

**PALMAR ASPECT OF HAND**



| PALMAR RIGHT | | PALMAR LEFT |
|---|---|---|
| P1 | | |
| P2 | (9%) | (10%) |
| P3 | (25%) | (22%) |
| P4 | (1%) | (1%) |
| P5 | (3%) | |
| P9 | (6%) | (6%) |
| P10 | (18%) | (16%) |

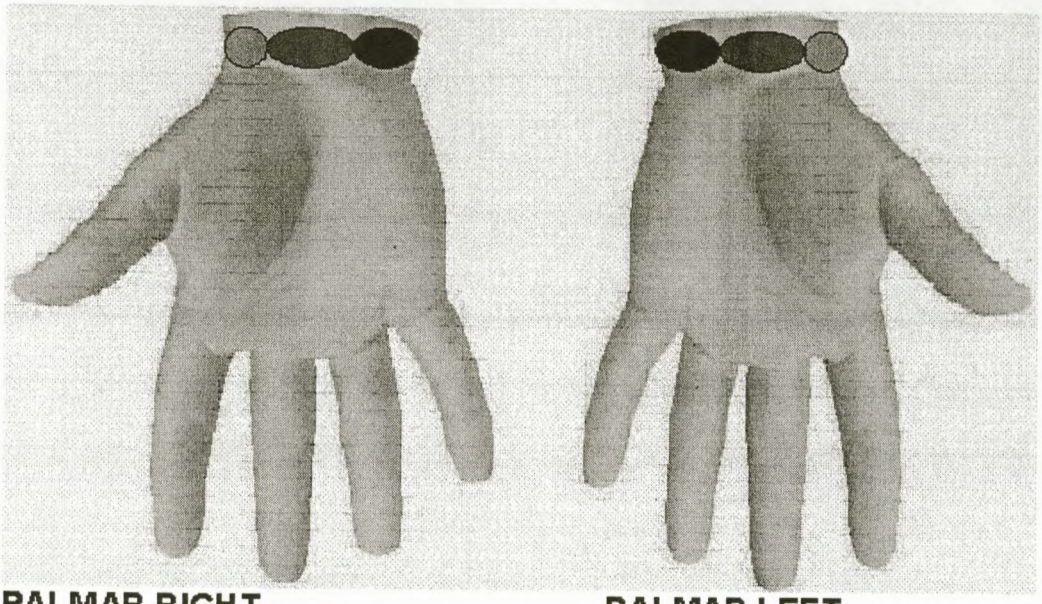
Therefore the most common location of pain in the hands was in the area of the metacarpophalangeal joints followed by the interphalangeal joints and radial side of the hand. This is consistent with previous findings by Snodgrass and Rivett (2002) who attributed the pain in the metacrapophalangeal and interphalangeal joints to be due to the biomechanical overload and forces transmitted directly through these joints during the application of manual. It appears that many therapists are affected bilaterally, which is consistent with the findings of Ranney *et al.* (1995). The pain may be due to the vulnerability of the hand in manipulative

procedures if it is incorrectly positioned or inflexible during the application of a manipulative thrust placing biomechanical stress on the soft tissues and joints of the hands and fingers (Traino, 2000).

Pain on the radial side of the hand may be due to de Quervain's tenosynovitis. Pain along the dorsal aspect of the distal radius may indicate intersection syndrome (Forman *et al.*, 2005.)

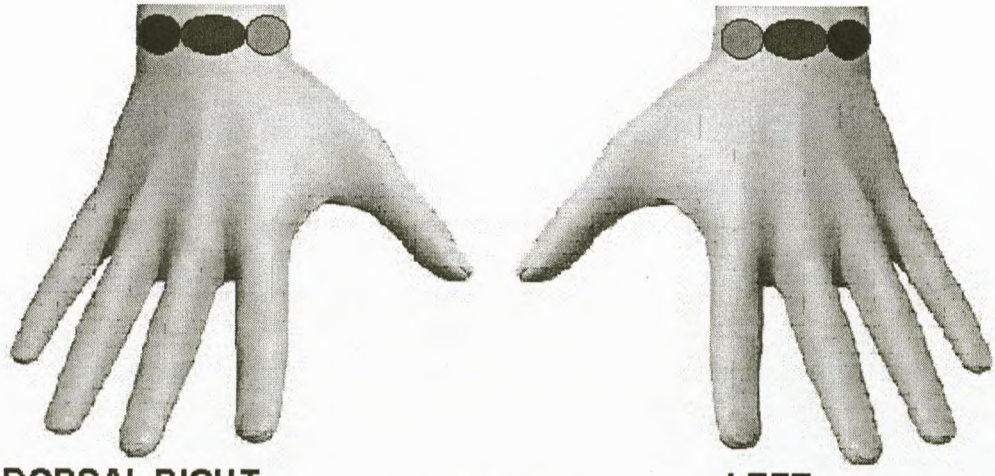
Work related injury to the thumb has become a recognized problem for physiotherapists (Reglar and James, 1999;Cromie *et al.*, 2000; West and Gardener, 2001). It is of particular interest that metacarpophalangeal joint was the most common site of pain, on both the dorsal and palmar aspect of the hand and wrist in chiropractors. The interpretation of the pain allocation diagram did not distinguish between the metacapophalangeal joints of the five separate phalanges. This would be of interest as a high proportion of the pain may be in the metacarpophalangeal joint of the thumb specifically and should be further investigated in the future.

## PALMAR ASPECT OF WRISTS



| PALMAR RIGHT | | PALMAR LEFT |
|---|---|---|
| ❑ P6 | (13.9%) | (9%) |
| ❑ P7 | (11.4%) | (11%) |
| ❑ P8 | (11.4%) | (13%) |

## DORSAL ASPECT OF WRISTS



| DORSAL RIGHT | | LEFT |
|---|---|---|
| DR6 | (22%) | (13%) |
| DR7 | (25%) | (18%) |
| DR8 | (27%) | (24%) |

All areas in the wrist seem to be affected. The central dorsal aspect of the wrist is the area in which pain is most commonly felt. Manual therapy has been found to

be related to wrist symptomatolgy (Cromie *et al.*, 2000). Byfield previously noted that the first metacarpophalangeal joint and the wrist articulations are particularly prone to biomechanical stresses during manipulative procedures (Byfield, 2005). Pain over the ulnar styloid can indicate a fracture or nonunion, whereas pain immediately distal in the hollow between the pisiform and ulnar styloid usually indicates a triangular fibrocartilaginouc complex injury (Forman *et al.*, 2005.) Due to the forces used in a chiropractic adjustment it seems unlikely that a fracture would occur, it is more likely that soft tissue injury would occur prior to a fracture. In future research x-ray analysis and soft tissue ultrasound analysis would help identify and classify these injuries more accurately.

**Pain at work**

Pain was most commonly felt during work and after work. Chiropractic practice involves the constant performance of various forms of manipulative therapy and other manual tasks in a variety of different working postures, which subject the musculoskeletal system to potentially large repetitive mechanical loads which may be the reason most therapists reported feeling the pain during work or directly after work (Traino, 2000).

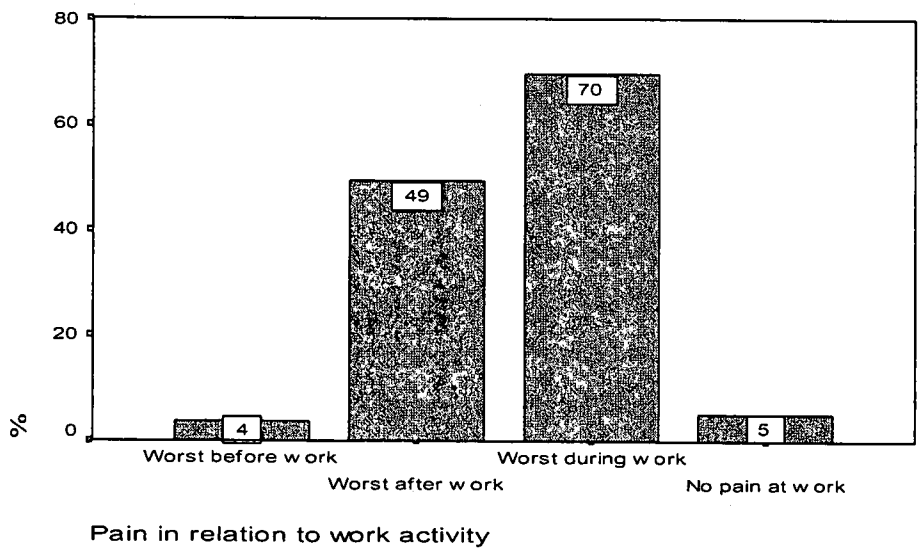



**Figure 16: Percentage of affected participants by pain in relation to work activities (n=79)**

**Table 5: Less severe pain on returning to work after leave of 3 days or more**

| | Frequency | Valid Percent |
|---|---|---|
| always | 26 | 32.9 |
| often | 25 | 31.6 |
| sometimes | 20 | 25.3 |
| rarely | 6 | 7.6 |
| never | 2 | 2.5 |
| Total | 79 | 100.0 |

Responses shown in Table 5 suggest that in the vast majority of cases, the pain dissipated over a period of 3 days without work, suggesting that work was a significant factor attributed to the pain felt by the participants. 71 out of 79 (89.9%) affected participants answered positively to the question stating that the pain always, often or sometimes was less severe when returning to work after a period of leave for 3 days or more.

**Pain related to performing chiropractic manipulation**

Figure 17 above shows that adjustments to the lumbar area caused the most hand or wrist pain in affected participants (56%).

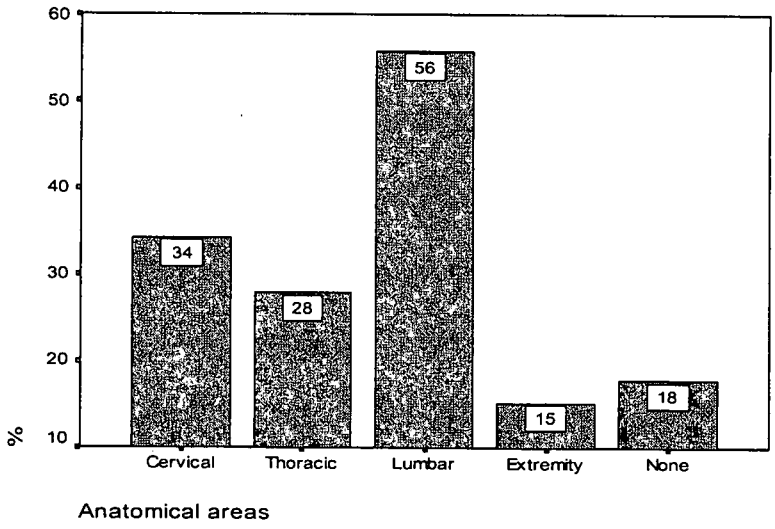



**Figure 17: Anatomical areas associated with most hand or wrist pain when performing chiropractic adjustments to them in 79 affected participants**

Figure 18 shows that patients positioned on their side (46%) or prone (41%) followed by supine (35%) caused the most amount of hand or wrist pain in affected practitioners. This may be due to the constant lifting of patients, readjusting their body weight and positioning of tables prior to the thrust that

present professional physical risk factors for the chiropractor (Byfield, 2005.) Other factors that may be involved may include the specific biomechanics associated with each of these manipulative procedures regarding the torque and pressure transmitted through the therapists' hands and wrists while manipulating a patient. Further research is needed to investigate this phenomenon.

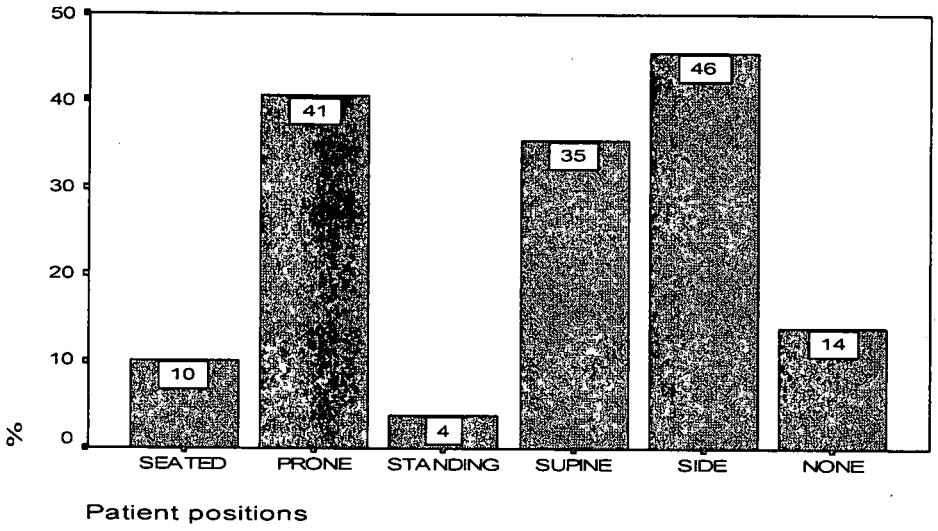



**Figure 18: Patient positions associated with most hand or wrist pain when performing chiropractic adjustments in 79 affected participants**

**Self - diagnosis**

Chiropractors are trained to understand injury and its causes, which lend some credibility to their self-reported symptoms. At the same time, they may be more self-aware than other populations because of their training and thus tend to over-report symptoms. There is little evidence to support either of these views, and further research is necessary to clarify the accuracy of the self-reporting of symptoms by chiropractors. The majority of affected participants thought their pain was due to pathology in the joints (63%). Just under half indicated the ligaments (46%), while 43% selected the tendons. The other options were relatively rarely indicated.

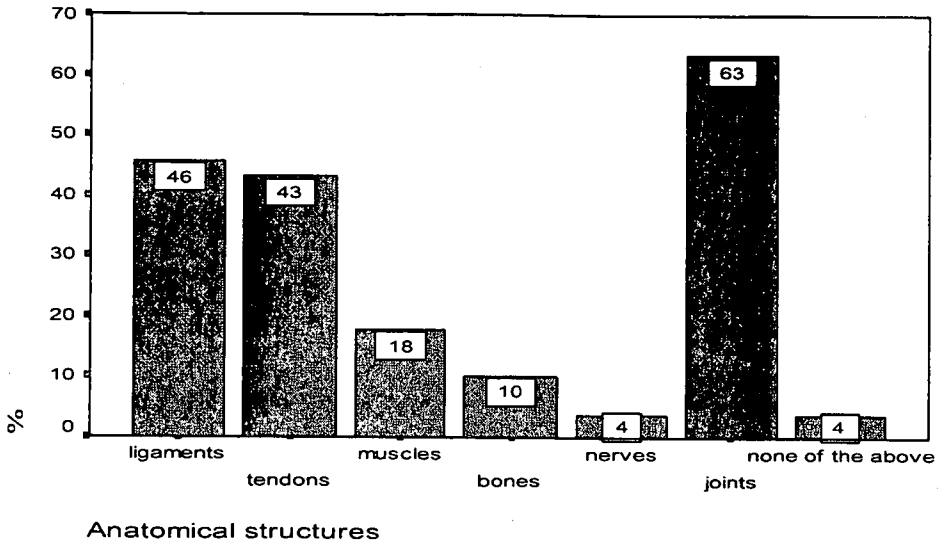



**Figure 19: Percentage of affected participants' responses to "I think the pain in my hands/wrists is due to pathology in the following anatomical structures"**

Forty- nine (62%) affected participants mentioned other as the cause for their pain. Of these, OA was specified in 3 cases (6.1%) and over use was mentioned in 41 cases (83.7%).

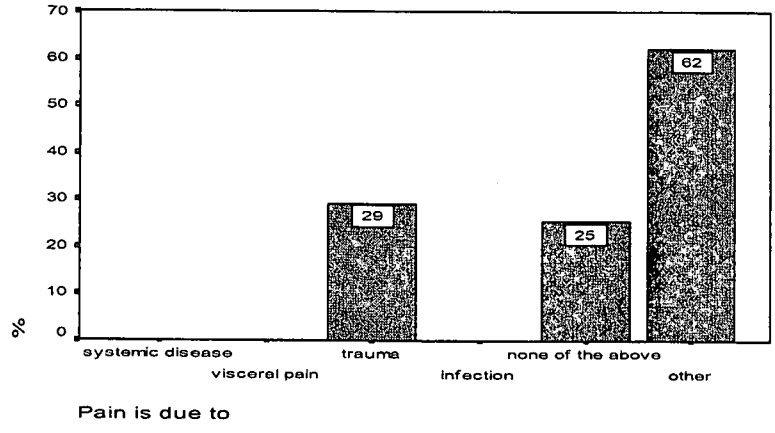



**Figure 20: Percentage of affected participants' responses to cause of pain in their hands/wrists**

## 4. Inferential analysis

**Factors associated with wrist and hand pain**

**Demographic factors**

## Age

**Table 6: T-test for the comparison of mean age between those with and without hand and wrist pain**

| | | | Age | | | t-test | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | Std. Deviation | Std. Error Mean | t-statistic | P value |
| Do you ever experience hand pain at work? | yes | 59 | 34.66 | 10.697 | 1.393 | -2.166 | 0.033* |
| | no | 49 | 39.98 | 14.771 | 2.110 | | |
| Do you ever experience wrist pain at work? | yes | 61 | 33.61 | 8.745 | 1.120 | -3.323 | 0.003* |
| | no | 47 | 41.57 | 15.876 | 2.316 | | |

* Statistically significant at 0.05 level

Table 6 shows that the age of the participant was significantly associated with both hand (p=0.033) and wrist pain (p=0.003). The younger the participant, the more likely they were to experience pain. The mean age of those in the sample who reported hand pain was 34.66 years, while those not experiencing hand pain were on average 39.98 years old. Similarly the mean age of those suffering from wrist pain was 33.61 years and those without were 41.57 years. This is consistent with Cromies *et al.*(2000) findings in physical therapists where the first episode of WMSD occurred for the majority of therapists in the first 5 years of practice (Cromie *et al.*, 2000). Other possible factors include that, initially, a chiropractor may not be able to afford therapeutic modalities and therefore spend more time using manual techniques. The chiropractor may also have fewer patients when initially opening a practice and therefore will have more time to spend on each patient, and due to this spend more time in the application of manual therapeutic techniques.

## Gender

**Table 7: Gender by hand and wrist pain**

| | | GENDER | | | |
|---|---|---|---|---|---|
| | | Male | | Female | |
| | | Count | Column % | Count | Column % |
| Do you ever experience hand pain at work? Fisher's exact p=0.168 | yes | 33 | 49.3% | 26 | 63.4% |

| | | | | | |
|---|---|---|---|---|---|
| | no | 34 | 50.7% | 15 | 36.6% |
| Do you ever experience wrist pain at work? Fisher's exact p=0.027* | yes | 32 | 47.8% | 29 | 70.7% |
| | no | 35 | 52.2% | 12 | 29.3% |

* statistically significant at 0.05 level.

Gender was significantly associated with wrist pain (p=0.027) but not with hand pain (p=0.168). 47.8% of males had wrist pain but 70.7% of females had wrist pain. Thus females were more likely to have wrist pain than males. This trend was also observed with hand pain (49.3% of males and 63.4% of females) but it was not statistically significant. It has previously been documented that that high job strain had a greater effect on women and this may be an influential factor in the manifestation of pain in female chiropractors wrists (Bourbonnais *et al.*, 2005). This may be due to differences in the application of therapeutic techniques by male and female chiropractors, this has not previously been investigated and further research is needed in this area. Male chiropractors may have more strength in their forearm and wrist flexors and extensors thus providing more stability to the wrist joint and prevent injury this too, requires further investigation.

### Work-related factors

### Years in practice

**Table 11: Comparison of mean years in practice between those with and without hand and wrist pain**

| | | | Years in practice | | | t-test | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | Std. Deviation | Std. Error Mean | t-value | P value |
| Do you ever experience hand pain at work? | yes | 59 | 7.9153 | 9.55842 | 1.24440 | -1.954 | 0.053 |
| | no | 49 | 12.2755 | 13.55777 | 1.93682 | | |
| Do you ever experience wrist pain at work? | yes | 61 | 7.3361 | 8.73819 | 1.11881 | -2.662 | 0.009* |
| | no | 47 | 13.2128 | 14.09045 | 2.05530 | | |

* statistically significant at 0.05 level

There was a marginally non - significant association between years in practice and hand pain (p=0.053). Those who experienced hand pain were in practice for

a shorter duration than those who did not experience hand pain. The same trend was found for wrist pain but it was statistically significant (p=0.009).

**Table 12: Correlations between years in practice and pain severity in those who reported hand or wrist pain (n=79).**

| | | NRS initially | NRS presently | NRS Worst |
|---|---|---|---|---|
| Years in practice | Pearson Correlation | .019 | .242(*) | .242(*) |
| | P value. (2-tailed) | .869 | .031 | .033 |
| | N | 79 | 79 | 78 |

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

There were marginally significant but weak positive correlations between years in practice and the severity of the pain presently and at its worst. Thus as the years in practice increased the worse the present pain was and the worse the worst pain was as illustrated by the participant using the numerical pain rating scale. However it should be noted that with correlation coefficients as low as 0.242, the correlation was very weak and would show up as a random scatter of points with no clear trend in a scatter plot. Nonetheless, the correlations were statistically significant. Therefore, years in practice may be an influential factor causing hand and wrist pain in chiropractors but due to the weak correlation's and high prevalence of pain amongst younger therapists its influence is questionable.

**Number of patients seen per day**

**Table 13: Average number of patients per day by hand and wrist pain**

| | | Average no. patients per day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-10 | | 11-20 | | 21-30 | | 31-40 | | >40 | |
| | | n | % | n | % | n | % | n | % | n | % |
| Do you ever experience hand pain at work? p=0.064 | yes | 22 | 59.5% | 26 | 61.9% | 8 | 42.1% | 2 | 28.6% | 1 | 33.3% |
| | no | 15 | 40.5% | 16 | 38.1% | 11 | 57.9% | 5 | 71.4% | 2 | 66.7% |
| Do you ever experience wrist pain at work? p=0.360 | yes | 22 | 59.5% | 25 | 59.5% | 10 | 52.6% | 2 | 28.6% | 2 | 66.7% |
| | no | 15 | 40.5% | 17 | 40.5% | 9 | 47.4% | 5 | 71.4% | 1 | 33.3% |

Table 13 shows the reported average numbers of patients seen per day in relation to hand and wrist pain experienced. Comparisons were done on the mean category (using t-tests) rather than proportions per category since some

categories had low numbers, thus invalidating the chi square test. The p value for the comparison of mean patients per day by hand pain was (0.064, marginally non-significant) and by wrist pain was 0.360. The trend was towards a lower number of patients in those who had pain than in those without. This may be a modification made by those with pain in order to cope with their pain. Thus this is probably a result of the pain and not a pre-existing factor related to development of pain. Soft tissue techniques are generally more time consuming than that of a manipulative procedure and therefore it could be assumed that if a therapist spent less time using soft tissue or non-manipulative techniques they could see more patients in a day. Therefore those therapists seeing only a few patients per day, could be assumed to be using more non manipulative techniques, and this could be responsible for the greater amount of hand pain.

**Work activities and time spent on activities**

**Table 15: Activities by hand and wrist pain**

| | | Hand pain | | Wrist pain | | p value for hand pain | p value for wrist pain |
|---|---|---|---|---|---|---|---|
| | | Count | Row % | Count | Row % | | |
| COMPUTER | no | 18 | 50.0 % | 20 | 55.6% | 0.542 | 1.000 |
| | yes | 41 | 56.9 % | 41 | 56.9% | | |
| MANIPULATION | no | 0 | .0% | 1 | 50.0% | 0.204 | 1.000 |
| | yes | 59 | 55.7 % | 60 | 56.6% | | |
| MOBLILIZATION | no | 13 | 50.0 % | 12 | 46.2% | 0.652 | 0.256 |
| | yes | 46 | 56.8 % | 49 | 60.5% | | |
| PAPER | no | 7 | 35.0 % | 8 | 40.0% | 0.080 | 0.134 |
| | yes | 52 | 59.1 % | 53 | 60.2% | | |
| REHABILITATION | no | 28 | 50.0 % | 30 | 53.6% | 0.340 | 0.564 |
| | yes | 31 | 59.6 % | 31 | 59.6% | | |
| STRETCHING | no | 10 | 35.7 % | 12 | 42.9% | 0.027* | 0.121 |
| | yes | 49 | 61.3 % | 49 | 61.3% | | |
| THERAPY | no | 12 | 41.4 % | 11 | 37.9% | 0.129 | 0.017* |
| | yes | 46 | 59.0 % | 50 | 64.1% | | |
| OTHER | no | 33 | 47.8 % | 39 | 56.5% | 0.072 | 1.000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | yes | 26 | 66.7 % | 22 | 56.4% | | |

* statistically significant at 0.05 level.

Only stretching activities were significantly associated with hand pain (p=0.027). Those who performed stretching were significantly more likely to have hand pain than those who did not. Performing therapeutic modalities was significantly related to wrist pain (p=0.017). Stretching includes post isometric relaxation and post facilitated relaxation both of which require the chiropractor to resist movements of the body part of which you wish to stretch. The resultant hand pain may be due to muscle fatigue or the maintenance of an awkward posture during the stretching posture causing a biomechanical strain in the hands. Since both stretching and the use of therapeutic modalities are non manipulative techniques, and are the only manual therapy techniques significantly associated with hand and wrist pain, it can be concluded that, in this study, non manipulative techniques had a more significant role in the development of hand and wrist pain than manipulative techniques.

**Non manipulative techniques**

**Table 19: The association between non –manipulative techniques used and hand and wrist pain**

| | | Hand pain | | Wrist pain | | p value for hand pain | p value for wrist pain |
|---|---|---|---|---|---|---|---|
| | | n | Row % | n | Row % | | |
| Cross fibre massage | no | 12 | 42.9% | 11 | 39.3% | 0.190 | 0.026* |
| | yes | 44 | 57.9% | 49 | 64.5% | | |
| DAPRE | no | 49 | 53.8% | 52 | 57.1% | 0.794 | 0.794 |
| | yes | 10 | 58.8% | 9 | 52.9% | | |
| Dry needling | no | 9 | 36.0% | 7 | 28.0% | 0.040* | 0.001* |
| | yes | 50 | 60.2% | 54 | 65.1% | | |
| Electrotherapy | no | 38 | 50.7% | 42 | 56.0% | 0.203 | 0.832 |
| | yes | 21 | 65.6% | 19 | 59.4% | | |
| Graston | no | 58 | 55.8% | 59 | 56.7% | 0.327 | 1.000 |
| | yes | 1 | 25.0% | 2 | 50.0% | | |
| Ischeamic compression | no | 5 | 23.8% | 6 | 28.6% | 0.003* | 0.006* |
| | yes | 54 | 62.1% | 55 | 63.2% | | |
| lymphatic drainage | no | 54 | 53.5% | 55 | 54.5% | 0.452 | 0.135 |
| | yes | 5 | 71.4% | 6 | 85.7% | | |
| Massage | no | 11 | 39.3% | 10 | 35.7% | 0.078 | 0.014* |
| | yes | 48 | 60.0% | 51 | 63.8% | | |
| Musculo tendinous release | no | 40 | 47.6% | 43 | 51.2% | 0.010* | 0.060 |
| | yes | 19 | 79.2% | 18 | 75.0% | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Myofascial release | no | 24 | 50.0% | 26 | 54.2% | 0.439 | 0.700 |
| | yes | 35 | 58.3% | 35 | 58.3% | | |
| Nimmo technique | no | 46 | 50.0% | 53 | 57.6% | 0.028* | 0.595 |
| | yes | 13 | 81.3% | 8 | 50.0% | | |
| Post facilitated stress | no | 44 | 52.4% | 46 | 54.8% | 0.487 | 0.642 |
| | yes | 15 | 62.5% | 15 | 62.5% | | |
| Post isometric relaxation | no | 45 | 50.6% | 48 | 53.9% | 0.079 | 0.312 |
| | yes | 14 | 73.7% | 13 | 68.4% | | |
| PNF | no | 12 | 35.3% | 12 | 35.3% | 0.007* | 0.003* |
| | yes | 47 | 63.5% | 49 | 66.2% | | |
| SHAKING | no | 59 | 54.6% | 61 | 56.5% | | |
| | yes | 0 | .0% | 0 | .0% | | |
| Skin rolling | No | 56 | 53.8% | 58 | 55.8% | 0.625 | 0.631 |
| | yes | 3 | 75% | 3 | 75% | | |
| Tampotment | no | 56 | 53.3% | 58 | 55.2% | 0.249 | 0.256 |
| | yes | 3 | 100.0% | 3 | 100.0% | | |
| Manual vibrations | no | 54 | 53.5% | 57 | 56.4% | 0.452 | 1.000 |
| | yes | 5 | 71.4% | 4 | 57.1% | | |
| Mechanical vibration | no | 43 | 53.8% | 44 | 55.0% | 0.827 | 0.662 |
| | yes | 16 | 57.1% | 17 | 60.7% | | |

* statistically significant at 0.05 level

Hand pain was significantly associated with the use of dry needling, ischaemic compression, musculo-tendinous release, Nimmo technique, and PNF. Wrist pain was significantly associated with the use of cross fibre massage, dry needling, ischaemic compression, massage, and PNF. Potential factors contributing to the development of hand and wrist pain in physical therapists has been postulated to be forces applied during mobilizations, which supports this notion, as many of the above mentioned techniques require the application of pressure to a specific area (Snodgrass and Rivett, 2002). No one part of the body is designed to do the same motion repeatedly for long periods, without rest, as required by these techniques (Green, 2002). Continuing to work when injured has been associated with increased risk of wrist and hand symptoms, as well as using electrotherapy to avoid stressing an injury (Cromie *et al.*, 2000). Dry needling requires delicate repetitive movements of the therapists' hands and wrists while fanning (stimulation of an active trigger point by altering the depth of the needle insertion). The cumulative effect of these delicate movements over a prolonged period of time may cause biomechanical stress to the therapists' hands and wrists.

## Manipulative techniques

**Table 20: The association between manipulative techniques used and hand and wrist pain**

| | | Hand pain | | Wrist pain | | p value for hand pain | p value for wrist pain |
|---|---|---|---|---|---|---|---|
| | | Count | Row % | Count | Row % | | |
| High velocity low amp thrust | no | 0 | .0% | 2 | 50.0% | 0.040* | 1.000 |
| | yes | 59 | 56.7% | 59 | 56.7% | | |
| Long lever | no | 49 | 53.3% | 53 | 57.6% | 0.591 | 0.595 |
| | yes | 10 | 62.5% | 8 | 50.0% | | |
| instrument assisted | no | 43 | 58.1% | 42 | 56.8% | 0.305 | 1.000 |
| | yes | 16 | 47.1% | 19 | 55.9% | | |
| OTHER | no | 51 | 56.7% | 54 | 60.0% | 0.439 | 0.122 |
| | yes | 8 | 44.4% | 7 | 38.9% | | |

* statistically significant at 0.05 level

The use of high velocity low amplitude thrust was significantly associated with hand pain (p=0.040) but not with wrist pain (p=1.000). No other manipulative techniques were significantly related to either hand or wrist pain. The hand may be vulnerable to unnecessary injury if incorrectly positioned or inflexible during a manipulative thrust placing additional biomechanical stress on the soft tissues and joints of the hands and fingers at the various contact points of the hand (Traino, 2000). There are at least twelve areas on the hand that can be used to contact the skin surface of the patient while performing a chiropractic adjustment (Grecco, 1953; States, 1968; Christensen, 1984; Schafer and Faye, 1989; Bergman and Peterson, 2002). Further research is required to identify exactly what type of adjustment is associated with pain e.g. Cervical adjustment with the patient supine and the therapist utilizing an index contact.

## Modification of techniques

**Table 21: Modification of non manipulative techniques due to hand pain**

| | | | Do you ever experience hand pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed non manipulative techniques due to pain | always | Count | 3 | 0 | 3 |
| | | Row % | 100.0% | .0% | 100.0% |

| | | | | | |
|---|---|---|---|---|---|
| | often | Count | 10 | 2 | 12 |
| | | Row % | 83.3% | 16.7% | 100.0% |
| | sometimes | Count | 28 | 7 | 35 |
| | | Row % | 80.0% | 20.0% | 100.0% |
| | rarely | Count | 10 | 16 | 26 |
| | | Row % | 38.5% | 61.5% | 100.0% |
| | never | Count | 8 | 24 | 32 |
| | | Row % | 25.0% | 75.0% | 100.0% |
| Total | | Count | 59 | 49 | 108 |
| | | Row % | 54.6% | 45.4% | 100.0% |

Pearson's chi square = 29.65, p<0.001

As expected there was a highly significant association between having modified non- manipulative techniques due to pain, and having experienced hand pain (p<0.001 – Table 21). Interestingly, some of those who modified their non-manipulative techniques due to pain did not report suffering from hand pain. They might have suffered from wrist pain or another type of pain.

**Table 22: Modification of non manipulative techniques due to wrist pain**

| | | | Do you ever experience wrist pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed non manipulative techniques due to pain | always | Count | 2 | 1 | 3 |
| | | Row % | 66.7% | 33.3% | 100.0% |
| | often | Count | 9 | 3 | 12 |
| | | Row % | 75.0% | 25.0% | 100.0% |
| | sometimes | Count | 26 | 9 | 35 |
| | | Row % | 74.3% | 25.7% | 100.0% |
| | rarely | Count | 14 | 12 | 26 |
| | | Row % | 53.8% | 46.2% | 100.0% |
| | never | Count | 10 | 22 | 32 |
| | | Row % | 31.3% | 68.8% | 100.0% |
| Total | | Count | 61 | 47 | 108 |
| | | Row % | 56.5% | 43.5% | 100.0% |

Pearson's chi square =14.68, p=0.005

Table 22 shows that there was also a significant association between wrist pain and having modified non -manipulative techniques (p=0.005).

**Table 23: Modification of manipulative techniques due to hand pain**

| | | | Do you ever experience hand pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed manipulative techniques due to pain | always | Count | 3 | 0 | 3 |
| | | Row % | 100.0% | .0% | 100.0% |
| | often | Count | 10 | 1 | 11 |
| | | Row % | 90.9% | 9.1% | 100.0% |
| | sometimes | Count | 19 | 7 | 26 |
| | | Row % | 73.1% | 26.9% | 100.0% |
| | rarely | Count | 15 | 13 | 28 |
| | | Row % | 53.6% | 46.4% | 100.0% |
| | never | Count | 12 | 28 | 40 |
| | | Row % | 30.0% | 70.0% | 100.0% |
| Total | | Count | 59 | 49 | 108 |
| | | Row % | 54.6% | 45.4% | 100.0% |

Pearson's chi square =21.71, p<0.001

Those with hand pain were more likely to modify their manipulative techniques than those without (p<0.001).

**Table 24: Modification of manipulative techniques due to wrist pain**

| | | | Do you ever experience wrist pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed manipulative techniques due to pain | always | Count | 3 | 0 | 3 |
| | | Row % | 100.0% | .0% | 100.0% |
| | often | Count | 10 | 1 | 11 |
| | | Row % | 90.9% | 9.1% | 100.0% |
| | sometimes | Count | 19 | 7 | 26 |
| | | Row % | 73.1% | 26.9% | 100.0% |
| | rarely | Count | 16 | 12 | 28 |
| | | Row % | 57.1% | 42.9% | 100.0% |
| | never | Count | 13 | 27 | 40 |
| | | Row % | 32.5% | 67.5% | 100.0% |
| Total | | Count | 61 | 47 | 108 |
| | | Row % | 56.5% | 43.5% | 100.0% |

Pearson's chi square =19.89, p=0.001

Table 24 shows that having wrist pain was also associated with modifying manipulative techniques (p=0.001).

## 5. Prevalence of occupational overuse syndrome

Possible occupational overuse syndrome for the purposes of this study was defined as:

1. Hand or wrist pain and
2. having changed non manipulative and manipulative techniques due to pain always, often or sometimes and
3. worst pain after or during work activity and
4. less severe pain always, often or sometimes after taking leave from work for more than 3 days, and
5. self diagnosis of cause of pain due to overuse (including combination of trauma and overuse).

According to this definition, there were 19 possible occupational overuse syndrome cases (prevalence of 17.6%, 95% CI 10.94% to 26.10%).

**Factors associated with Occupational overuse syndrome**

**Table 25: Logistic regression analysis of factors associated with possible occupational overuse syndrome.**

| | B | S.E. | Wald | df | Sig. | OR | 95.0% C.I. for OR | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| Gender (female vs. male) | 1.353 | .631 | 4.594 | 1 | .032 | 3.870 | 1.123 | 13.341 |
| Average hours worked per day | 0.720 | 0.276 | 6.792 | 1 | .009 | 2.054 | 1.195 | 3.529 |
| PFS | 1.323 | .626 | 4.472 | 1 | .025 | 3.745 | 1.184 | 11.844 |
| Constant | -2.877 | .878 | 10.733 | 1 | .001 | .056 | | |

There were three factors that were independently associated with possible OOS. Females were 3.87 times more likely than males to have possible OOS (95% CI 1.123 to 13.341 p = 0.032). Every additional 10 hours of work per day, increased the risk of OOS by 2.054 times (95% CI 1.195 to 3.529, p=0.009). Chiropractors performing PFS were 3.745 times more likely to get possible OOS than those who did not (95% CI 1.184 to 11.844, p=0.025). The model predicted possible OOS with 82.5% accuracy. The prevalence of occupational overuse syndrome was not investigated by Cromie who rather investigated the prevalence of all musculo-skeletal disorders in physical therapists` therefore no correlations can be made to Cromie *et al*s. (2000) work with regards to occupational overuse syndrome specifically. Research should be done to determine what the prevalence of occupational overuse syndrome is amongst physical therapists

using the same criteria used in this research in order to do a direct comparison between the professions.

# Chapter 5

## Conclusions and Recommendations

## Conclusions

### Hypothesis one:

**The prevalence of hand and / or wrist pain will be greater than that of physical therapists (29.6%) (Bork *et al.,1996).***

The prevalence of hand and / or wrist pain was found in 79 subjects, 73.15% (95% CI 63.76% - 81.22%), this was considerably greater than the prevalence of hand and / or wrist pain in physical therapists (29.6%) as reported by Bork *et al.,* (1996). Therefore, hypothesis one is accepted, as this result has statistical significance, as the confidence intervals do not overlap with the prevalence of hand and or wrist pain in physical therapists.

### Hypothesis two:

**The prevalence of wrist pain will be greater than the prevalence of hand pain.**

Wrist pain was reported in 61 participants, with a prevalence of 56.48% (95% CI 46.60% - 66.0%). Hand pain was reported in 59 participants, prevalence of 54.63% (95% CI 44.76% - 64.24%). Therefore, the prevalence of wrist pain was greater than the prevalence of hand pain but it must be noted that this was by a very small margin (1.85%). Due to the large overlap of the confidence intervals of the prevalence of hand pain and wrist pain, it can be said that there is no significant difference in the prevalence of hand or wrist pain in the chiropractic population.

**Hypothesis three:**

**The following factors may be associated with and increased prevalence of pain**

- **Age**
- **Gender**
- **Time allocation of activities while at work**
- **Non manipulative techniques used at work**

- **Age**

The participants mean age was 37.1 years (SD 12.9 years), with a range from 25 to 75 years. Age was significantly associated with both hand (p=0.033) and wrist pain (p=0.003). The mean age of those in the sample who reported hand pain was 34.66 years, while those not experiencing hand pain were on average 39.98 years old. Similarly the mean age of those suffering from wrist pain was 33.61 years and those without, was 41.57 years. Therefore, this hypothesis is accepted.

- **Gender**

The gender distributions of the participants were male (62%) and female (38%). Gender was significantly associated with wrist pain (p=0.027) but not hand pain. 47.8% of males had wrist pain but 70.7% of females had wrist pain. Thus, females were more likely to have wrist pain than males. This trend was also observed with hand pain but it was not statistically significant. Therefore, this hypothesis is accepted.

- **Time allocation of activities while at work**

Those who experienced hand pain did not spend significantly different amounts of time on any of the work activities than those who did not therefore this hypothesis is rejected.

- **Non- manipulative techniques used at work**

Hand pain was significantly associated with the use of dry needling, ischaemic compression, musculo-tendinous release, Nimmo technique, and PNF.
Wrist pain was significantly associated with the use of cross fibre massage, dry needling, ischaemic compression, massage, and PNF. Therefore the above-mentioned non- manipulative techniques were associated with an increased prevalence of pain and the hypothesis is accepted.
Therefore, in summary, hand and wrist pain appear to have a greater prevalence amongst chiropractic practitioners than in physical therapists. The hand and wrist seem to be affected in similar proportions. Age, gender and the use of certain non- manipulative techniques were significantly associated with hand and wrist pain while time allocation to certain activities at work did not appear to be an influential factor in the development of hand and wrist pain.

Other significant findings were that most of the participants who were affected by either hand or wrist pain (n=79) felt that the pain was worst during work (70%), or after work (49%). A large majority of the participants (89.9%) who reported pain felt that the pain was less severe when returning to work after leave of 3 days or more which suggests that, in the vast majority of cases, occupational overuse was responsible for the pain. 83.7% of the affected participants indicated that they thought occupational overuse to be the cause of the pain in their hands or wrists.

Adjustments to the lumbar area caused the most hand or wrist pain in affected participants (56%), while patients positioned on their side (46%) or prone (41%) caused the most amount of hand or wrist pain in affected practitioners. The majority of affected participants thought their pain was due to pathology in the joints (63%). The dominant hand was not necessarily the one that was affected the most in those with either wrist or hand pain.

The prevalence of occupational overuse syndrome amongst the participants was 17.6% using the criteria mentioned in chapter 3.There were three factors that were independently associated with possible occupational overuse syndromes (OOS). Females were 3.87 times more likely than males to have possible OOS.

With every 10 hour increase of working hours per day, the risk of possible OOS increased by 2.054 times. Chiropractors performing post-facilitated stretching techniques were 3.745 times more likely to get possible OOS than those who did not.

## Recommendations

- In future studies of a similar nature, it may be beneficial to use a questionnaire in an electronic format which can be e-mailed to participants, this would be more cost effective and allow the questionnaire to be sent to participants internationally as well as locally. This would help increase the sample size giving greater validity to the study.
- It would also be beneficial to attempt to locate and include chiropractors that have left the profession in order to minimise bias caused by the Healthy Worker effect.
- As many of the chiropractors in this study indicated that they believed the pathology to be in the joints of their hands and wrists, a follow - up study investigating pathological change in these joints by x-ray analysis may be of value.
- It may also be advisable that research studies focus on what modifications various chiropractors have made in their application of non- manipulative techniques that have helped reduce pain in their hands and wrists, these modifications can then be analysed and taught to students to help prevent the occurrence of hand and wrist pain in them in the future.
- It may also be beneficial to do a similar study using chiropractic students or qualified physical therapists in South Africa as the sample group and correlate the outcomes of that study with the outcomes of this one.
- It may also be beneficial to follow up on questionnaires sent out by phoning participants or e-mailing them encouraging them to reply in order to improve the response rate and have a greater sample size.

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**Appendix 1**

**Prevalence and factors associated with occupational overuse syndrome in the hands and wrists of chiropractors in South Africa**

**Please note that all the information obtained from this questionnaire will remain confidential and you the participant will remain anonymous once the questionnaire is returned.**

## 1. General information

1.1. Age

_____

1.2.1. Gender

☐ male

☐ female

1.2.2. Race Group ( Please note for statistical purposes only)

☐ Black
☐ Indian
☐ White
☐ Other (please specify)

_____

1.3. Dominant hand

☐ left

☐ right

☐ ambidextrous

1.4. Time in practice

( weeks , months or years ? please specify time period in your answer )

_____

1.5. What is the average number of patients you see per working day ?

☐ 0 – 10 patients

☐ 11 – 20 patients

☐ 21 – 30 patients

☐ 31 – 40 patients

☐ Greater than 40 patients

1.6. What is the average number of hours you spend in clinical practice per week **( Hands on work )**

☐ less than 20 hours per week

☐ 20 – 30 hrs per week

☐ 31 – 40 hrs per week

☐ 41 – 50 hours per week

☐ more than 50 hours a week

1.7.Please indicate which of the following activities you use in daily practice. Please then give an approximation of the time you spend doing this activity while in practice. **(all activities must add up to 100%)**

| | **Time %** |
|---|---|
| ☐ Computer work | _____ |
| ☐ Manipulation | _____ |
| ☐ Mobilization | _____ |
| ☐ Paper work | _____ |
| ☐ Rehabilitation | _____ |
| ☐ Stretching | _____ |
| ☐ Therapeutic modalities (IFC, ultrasound, Dry needling) | _____ |
| ☐ Other (please specify below) | _____ |

_____

_____

_____

**TOTAL**

**100 %**

1.8. Please indicate which of the following **non manipulative** techniques you use in practice

- ☐ Cross fibre massage
- ☐ Daily adjustable progressive resistive exercises
- ☐ Dry needling
- ☐ Electrotherapy
- ☐ Graston technique
- ☐ Ischaemic compression
- ☐ Manual lymphatic drainage
- ☐ Massage
- ☐ Musculo tendinous release
- ☐ Myofasicial release
- ☐ Nimmo technique
- ☐ Post facilitated stretch
- ☐ Post isometric relaxation
- ☐ Proprioceptiive neuromuscular facilitation
- ☐ Shaking
- ☐ Skin rolling
- ☐ Tampotment
- ☐ Vibrations (manual)
- ☐ Vibrations (Mechanical eg. Massage machine)

1.9. Please indicate what **manipulative technique/s** you use in your practice

- ❑ High velocity low amplitude thrust
- ❑ Long lever
- ❑ Instrument assisted
- ❑ Other (please specify below)

_____

_____

_____

_____

1.10. Please circle the appropriate response to the following statements regarding **hand and or wrist pain while in clinical practice.**

1.10.1. I have changed or modified the non manipulative techniques I use due to pain

Always Often Sometimes Rarely Never

1.10.2. I have altered the manipulative techniques I use in practice due to the pain

Always Often Sometimes Rarely Never

**2. Relevant medical history pertaining to the participant.**

2.1.Have you ever sustained severe trauma to your hands or wrists ?

- ☐ yes
- ☐ no

if yes please specify

_____

_____

_____

_____

2.2. Do you suffer from any systemic conditions

☐ yes
☐ no

if yes please specify

_____

_____

_____

_____

2.3.Do you partake in any sports or recreational activities that could result in the development of repetitive strain injuries in your hands and wrists ?

☐ yes
☐ no

If yes please specify

_____

_____

_____

_____

**3. Incidence of hand and wrist pain.**

3.1. Do you ever experience hand pain at work?

☐ Yes

When did you initially feel the pain? _____

( Please specify time period days? weeks? months ? Years ?)

☐ no

3.2. Do you ever experience wrist pain at work?

☐ Yes

When did you initially feel the pain? _____

( Please specify time period days? weeks? months ? Years ?)

☐ no

**IF YOUR ANSWERS TO QUESTION 3.1 AND 3.2 WERE NO YOU HAVE COMPLETED THE QUESTIONNAIRE. THANK YOU FOR YOUR PARTICIPATION.**

**IF YOUR ANSWER TO QUESTION 3.1 OR 3.2 WAS YES PLEASE COMPLETE THE REMAINDER OF THE QUESTIONNAIRE.**

**4. Characteristics of hand and/or wrist pain**

4.1. What percentage of your time do you experience hand pain
eg. 1 day a week (1/5) = 20%, 1 day a month (1/20) = 5%

_____ %

4.2. Please evaluate the severity of your pain, using the numerical pain rating scale. Circle the corresponding number

4.2.1. The severity of the pain **initially**
Please circle the appropriate number

(no pain) 0 1 2 3 4 5 6 7 8 9 10 (intense pain)

4.2.2. The severity of this pain **presently.**
Please circle the appropriate number

(no pain) 0 1 2 3 4 5 6 7 8 9 10 (intense pain)

4.2.3. The severity of this pain when it is at its **worst.**
Please circle the appropriate number

(no pain) 0 1 2 3 4 5 6 7 8 9 10 (intense pain)

4.3. Do experience any of the following signs and symptoms associated with hand and wrist pain?

- ☐ Numbness
- ☐ Swelling
- ☐ Weakness
- ☐ Hand and wrist deformities
- ☐ None of the above
- ☐ Other ( please specify)

_____

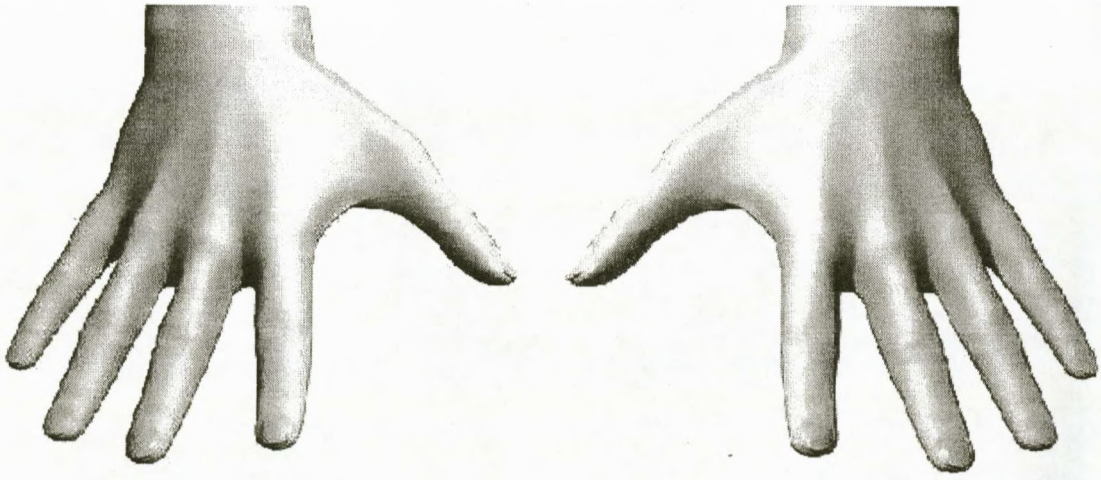
_____

_____

4.4.Please indicate ( by **marking with an X**, you may mark more than 1 area ) where in the following diagrams the pain is most often felt.

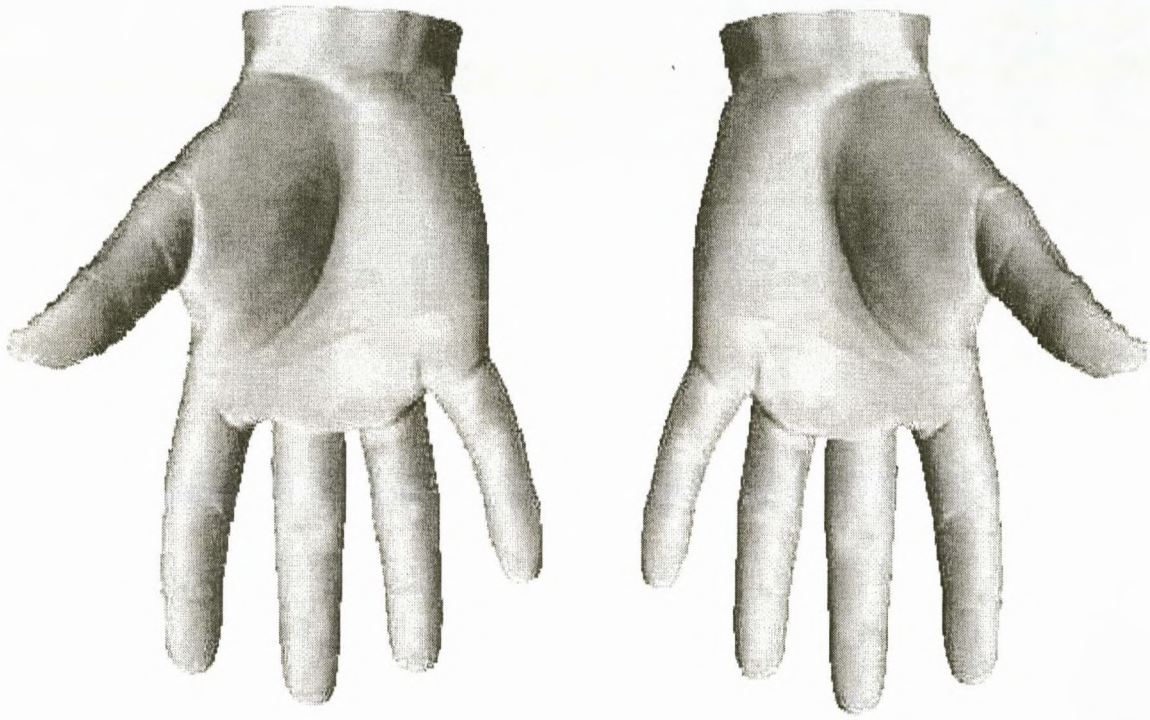
## 4.4.1. Dorsal Aspect

**Right Hand** **Left Hand**



## 4.4.2. Palmar Aspect

**Right Hand** **Left Hand**



**5. Pain at work.**

5.1. When is the pain worst in relation to work activities?
(please tick all appropriate response/s)

☐ Before activity

☐ After activity

☐ During activity

☐ I have no pain in relation to work activity

5.2. Please circle the appropriate response to the following statement

❑ When returning to work after taking leave for a period exceeding **three days** the pain is less **severe / occurs less frequently** .

Always Often Sometimes Rarely Never

**6. Pain related to performing Chiropractic manipulation**

6.1. Please indicate which of the following **anatomical areas** are associated with hand or wrist pain when you perform Chiropractic adjustments to them

☐ Cervical adjustments

☐ Thoracic adjustments

☐ Lumbar / Sacro-iliac adjustments

☐ Extremity adjustments

☐ None of the above

6.2. In which of the following **patient positions** do you most frequently experience hand and wrist pain when performing a Chiropractic adjustment?

☐ seated

☐ prone

☐ standing

☐ supine

☐ lateral recumbent / side lying

☐ None of the above

**7. Self Diagnosis**

7.1. I think the pain in my hand/s and/or wrist/s is due to a pathology in the following **anatomical structure/s**
(please mark the appropriate response/s)

- ☐ ligaments
- ☐ tendons
- ☐ muscles
- ☐ bones
- ☐ nerve
- ☐ joints
- ☐ None of the above

7.2. I think the pain in my hand/s and/or wrist/s is due to (please mark the appropriate response/s)

- ☐ systemic disease
- ☐ visceral referred pain
- ☐ previous trauma
- ☐ infection
- ☐ none of the above
- ☐ other (please specify)

_____

_____

_____

_____

_____

_____

**********

*********

Thank you

Michael Mathews

**Appendix 2**

Dear Participant

Welcome to my research study. Thank you for your interest.

**Title: The prevalence and factors associated with occupational overuse syndrome in the hands and wrists of chiropractors in South Africa**

Name of researcher: Michael Mathews ( 084 3067 545 or 031-204 2244 (DIT)
Name of supervisor: Dr A. Jones (M.Tech Chiropractic) ( 031 903 4467)
Name of Institution: Durban Institute of Technology

**Introduction:**

**In an independent study it was found that more therapists sustained injuries to the wrist and hand (10,8%) than any other anatomical area. Since Chiropractors are manual therapists it stands to reason that they too will sustain injuries to the hand and wrist. Repetitive strain injuries are usually caused or aggravated by poor work processes and unsuitable working conditions. Typically they involve repetitive or forceful movements or the maintenance of constrained or awkward postures. It is however not clear what particular factors associated with a Chiropractors daily working activities are associated with an increased prevalence of repetitive strain injuries in the hand and wrist particularly. Therefore this research aims to establish the prevalence of repetitive strain injuries in the hands and wrists of Chiropractors in South Africa, thus confirming that repetitive strain injuries are the source of pain in Chiropractic practitioners` hands. It also aims to establish what factors are associated with the occurrence of repetitive strain injuries. This will be assessed by means of a self administered questionnaire.**

**Procedure:**

You are requested to complete the questionnaire and informed consent form and then post it back to to the researcher in the self addressed stamped envelope provided.

**Please be assured that your personal particulars will remain anonymous.**

**Benefits: The results will be published in an article in a journal and be available in the Durban Institute of Technology library.**

Remuneration: None. Participation in this study is entirely voluntary.

Persons to contact for problems or questions:
Researcher: Michael Mathews (084 3067 545 or 031-204 2205 (D.I.T)
Supervisor: Dr A. Jones ( 031 903 4467)

Thank you for your most valuable time and participating in this survey.

**Appendix 3**

# INFORMED CONSENT FORM

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

**DATE:**

**TITLE OF RESEARCH PROJECT:**

**The prevalence and factors associated with occupational overuse syndrome in the hands and wrists of chiropractors in South Africa**

***NAME OF SUPERVISOR:***

***Dr A. Jones (M.Tech Chiropractic) 031 903 4467***

**NAME OF RESEARCH STUDENT:**

**Michael Mathews ( 084 3067 545 / 031 204 2205 (D.I.T)**

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

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

**Please Print in block letters: Please note for research purposed only**
**Please be assured that your personal particulars will remain anonymous**

Participant: _____ Signature: _____

**Appendix 4**

## CONFIDENTIALITY STATEMENT – FOCUS GROUP DECLARATION

**IMPORTANT NOTICE:**

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

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

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

**Please Print in block letters:**

Focus Group Member: _____ Signature:_____

Witness Name: _____ Signature:_____

Researchers Name: _____ Signature:_____

Supervisors Name: _____ Signature:_____

**Appendix 5**

## CODE OF CONDUCT

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

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

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

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

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

| Member represents | Member's Name | Signature | Contact Details |
|---|---|---|---|
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## Appendix 6

### LETTER OF INFORMATION – FOCUS GROUP

Dear Participant,

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

The title of my research project is:

The prevalence and factors associated with repetitive strain injuries in the wrists and hands of Chiropractors.

Background to the study:

A recent study concluded that manual therapists sustained more injuries to their hands and wrists than any other body part. The participants in this study were however nurses and physiotherapists. As Chiropractors we too are classified as manual therapists, there is no research to my knowledge investigating the incidence of hand and wrist pain amongst Chiropractors and what factors may be associated with an increased incidence of hand and wrist pain. The factors to be assessed include daily activities and various techniques used by the chiropractor while in practice.

It will also be of value to try and establish the anatomical source of the pain as well as the nature of the injury. Act 130 of 1993, Claiming compensation for occupational injuries and diseases, does account for repetitive strain injuries, defined as trauma to the musculo-tendinous junction, and does not account for joint degeneration and ligamentous pathology.

The research will utilise a self administered questionnaire to be given to participants at CASA congress to be held in Cape Town in September 2005. The findings and conclusions will be published in a medical journal thus allowing Chiropractors in South Africa to be aware of the results.

Objective of the study:

1. The research is necessary in order to establish the incidence of hand and wrist pain amongst Chiropractors in South Africa.
2. To obtain knowledge of possible risk factors compromising the function of Chiropractors hands and wrists.
3. Give Chiropractors information allowing them to take appropriate precautionary measures to maintain optimum function of their hands and wrists.

Your participation in this study is much appreciated and you are assured that your comments and contributions to the discussion will be kept confidential. The results of the discussion will only be used for research purposes.
If you have any further questions please feel free to contact me.

Michael Mathews ( 084 3067 545 / 031 204 2205 (D.I.T)

## Appendix 7

Pre-test Evaluation

1 What is your opinion of the subject presented in this questionnaire?
(Please mark the most appropriate box)

- 1.1 Extremely interesting ☐
- 1.2 Interesting ☐
- 1.3 Average ☐
- 1.4 Boring ☐
- 1.5 Very boring ☐

2 Do you think the topics raised in this questionnaire were adequately covered?

- 2.1 Yes ☐
- 2.2 No ☐

3 What is your opinion about the covering letter?
(Please mark one box only)

- 3.1 Very clear ☐
- 3.2 Clear ☐
- 3.3 Adequate ☐
- 3.4 Unclear ☐
- 3.5 Needs revising ☐

4 How would you describe the instructions accompanying each of the questions?
(Please mark one box only)

- 4.1 Very clear ☐
- 4.2 Clear ☐
- 4.3 Adequate ☐
- 4.4 Unclear ☐
- 4.5 Needs revising ☐

5 Do you think the questionnaire is too long?

- 5.1 Yes ☐
- 5.2 No ☐

6 What is your opinion of the wording of the questionnaire?
(Please mark the appropriate box/es)

- 6.1 The meaning of **all questions** is absolutely clear ☐
- 6.2 The meaning of **most** questions is clear ☐
- 6.3 There is too much chiropractic/ medical jargon ☐
- 6.4 The questions will not be understood by lay persons ☐
- 6.5 The questionnaire needs to be revised because it is unclear ☐

If you had any difficulty answering any question/s, please write the

number/s
of the question/s in the space below with a suggestion on how the question/s
can be improved?

_____
_____
_____
_____
_____
_____

Thank you for your most valuable time in helping me with my research project.
Please be reminded that the topics discussed above are strictly confidential.

## Appendix 8
## Full list of Results

### Descriptive analysis

#### Demographics of the sample

One hundred and eight chiropractors participated in the survey. Their mean age was 37.1 years (SD 12.9 years), with a range from 25 to 75 years. The majority of participants were male (62%, see Table 1), and of Caucasian ethnicity (92.6%, see Table 2). For further ethnicity analysis the sample was divided into Caucasian and non-Caucasian since the numbers in the other racial groups were very low and did not permit statistical comparison. Most participants were right handed (83.3% - Table 3).

**Table 1: Gender distribution in the sample**

| | Frequency | Percent |
|---|---|---|
| Male | 67 | 62.0 |
| Female | 41 | 38.0 |
| Total | 108 | 100.0 |

**Table 2: Racial distribution in the sample**

| | Frequency | Percent |
|---|---|---|
| Black | 1 | .9 |
| Indian | 7 | 6.5 |
| White | 100 | 92.6 |
| Total | 108 | 100.0 |

**Table 3: Dominant hand of sample participants**

| | Frequency | Percent |
|---|---|---|
| Left | 7 | 6.5 |
| Right | 90 | 83.3 |
| Ambidextrous | 11 | 10.2 |
| Total | 108 | 100.0 |

#### Work environment of the sample

The average time that the participants had been in practice for was 9.9 years (SD 11.7 years), and ranged from 6 months to 45 years. The number of patients treated per day is shown in Figure 1. The majority treated 11-20 patients daily.

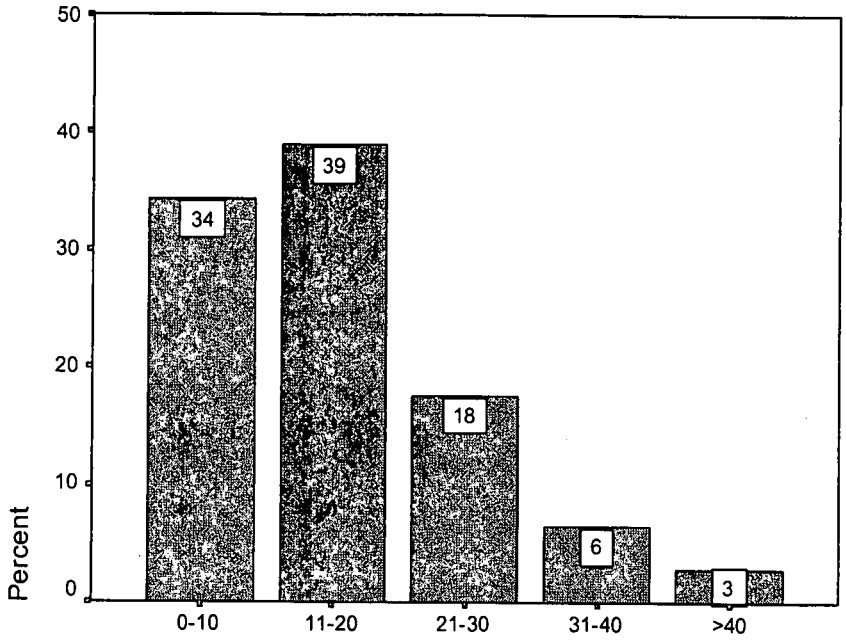


**Figure 1: Number of patients treated daily**

Most participants worked 20-30 hours per week in clinical practice (Figure 2). Figure 3 shows the percentage of participants who replied positively to performing a list of specified work activities. Almost all (98%) performed manipulations, while 81% did paperwork, 75% mobilization and 75 stretching.

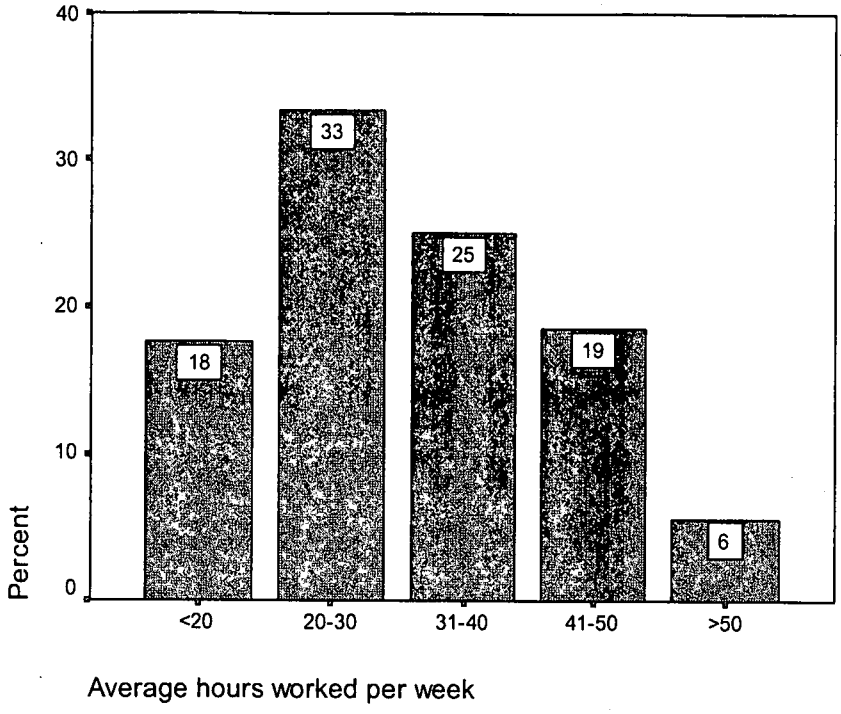


**Figure 2: Hours worked per week**

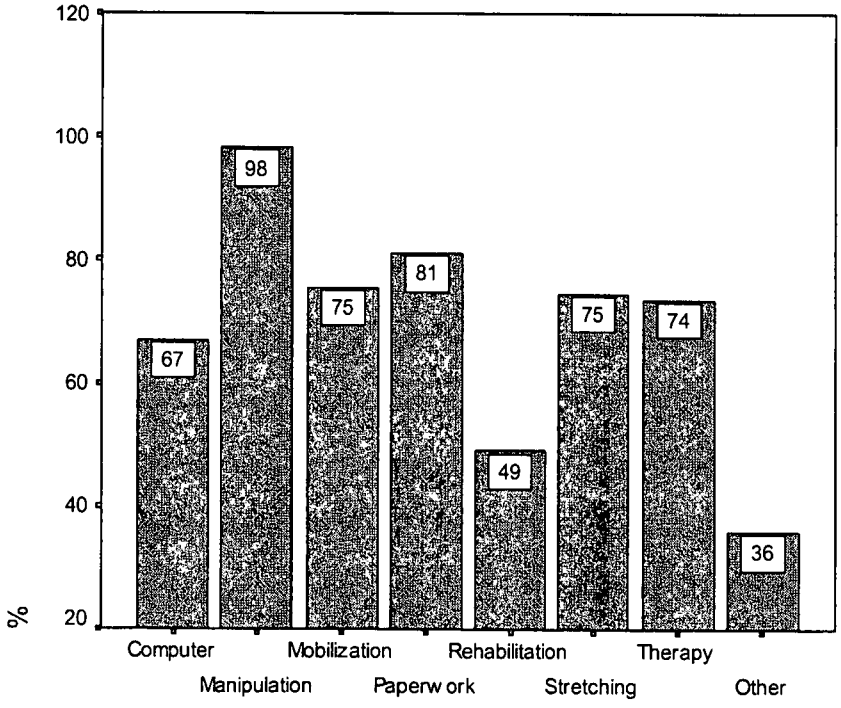


**Figure 3: Percentage of participants who perform various work activities**

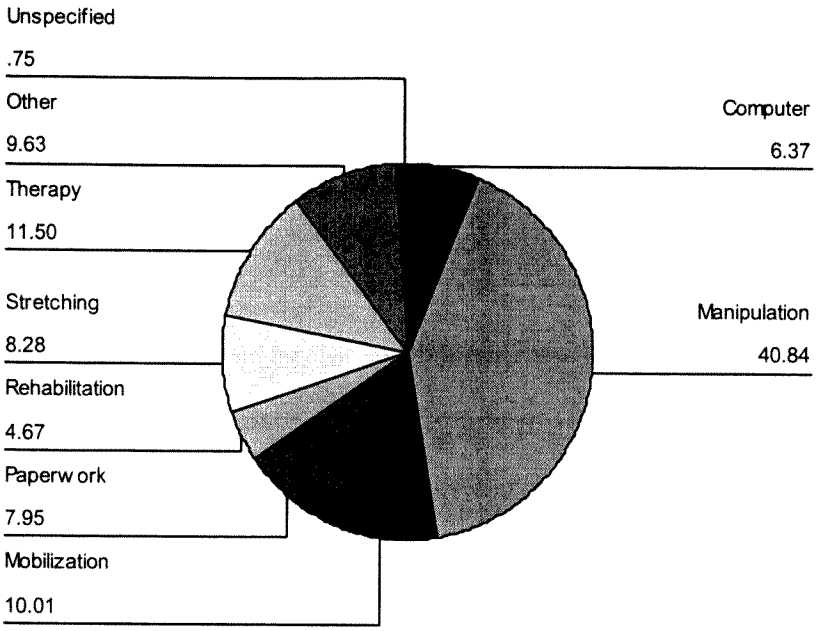


**Figure 4: Mean percentage of time spent in various work activities**

Figure 4 shows that the highest percentage of time was spent on manipulation (mean 40.8 % of time). This was followed by therapy (11.5%), mobilization (10%), and other activities (9.6%).

Figure 5 shows the percentage of respondents who performed various non-manipulative techniques. Ischaemic compression was the most common technique used by participants (80.6%). Cross fibre massage (73.1%), dry needling (76.9%), massage (74.1%) and PNF (68.5%) were also frequently used.

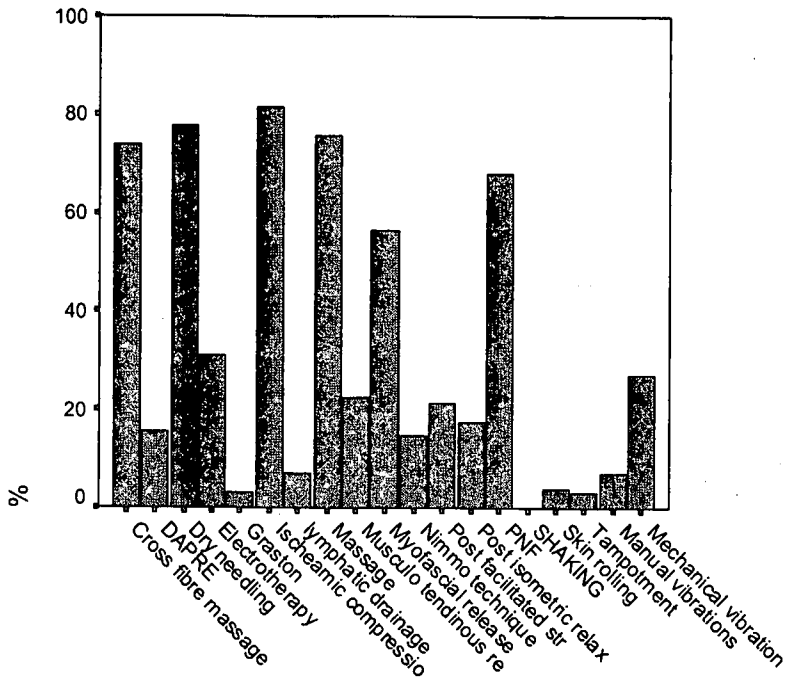


**Figure 5: Percentage of participants using specified non manipulative techniques**

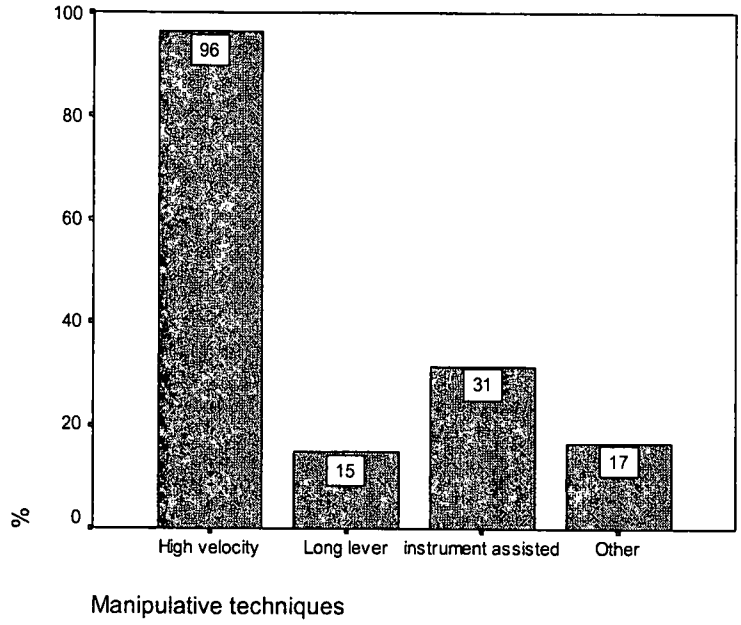


**Figure 6: Percentage of participants using specified manipulative techniques**

Figure 6 shows the manipulative techniques used by participants. Almost all (96%) used high velocity low amplitude thrust.

**Prevalence of wrist and hand pain**

Wrist pain was reported in 61 participants, with a prevalence of 56.48% (95% CI 46.60% - 66.0%). Hand pain was reported in 59 participants, prevalence of 54.63% (95% CI 44.76% - 64.24%). Either hand or wrist pain was found in 79 subjects, 73.15% (95% CI 63.76% - 81.22%). Forty –one subjects had both wrist and hand pain, prevalence of 37.96% (95% CI 28.80% - 47.81%).

**Medical History**

Twenty-eight (25.9%) participants had sustained trauma to the hands or wrists previously. In 21 of these cases the trauma was a dislocation, fracture or sprain. Nineteen of the participants who reported hand or wrist pain also had trauma (32.2% for hand pain and 31.1% for wrist pain).

There were 9 participants who had a systemic condition (8.3%). Four of those who reported hand or wrist pain had a systemic condition (6.8% for hand pain and 6.6% for wrist pain).

Fifty seven (52.8%) reported played a sport that could result in RSI to hands or wrists. 33 of these also reported hand or wrist pain (55.9% for hand pain, and 54.1% for wrist pain).

**Characteristics of the wrist and hand pain (n=79)**

**Onset**

Hand pain was found to have a mean time of onset of 3.41 years ago (SD 4.13 years) with a range of 0.1 to 20 years. Wrist pain was first experienced on average 3.31 years prior (SD 4.08) with a range of 0.1 to 20 years.

**Severity**

For the 79 participants who reported either hand or wrist pain, their mean percentage of time that they experience this pain was 20.66% (SD 25.9) with a range from 0.01% to 100%. The descriptive statistics for pain severity measured by NRS are shown in Table 4 for initial, present and worst pain.

**Table 4: Descriptive statistics for severity of hand or wrist pain**

| | | NRS initially | NRS presently | NRS Worst |
|---|---|---|---|---|
| N | Valid | 79 | 79 | 78 |
| Mean | | 3.70 | 1.76 | 5.81 |
| Median | | 3.00 | 1.00 | 6.00 |
| Std. Deviation | | 2.388 | 2.027 | 2.222 |
| Minimum | | 1 | 0 | 1 |
| Maximum | | 10 | 9 | 10 |

### Signs and symptoms

Figure 7 shows that the most common symptom was weakness (30%), with numbness, swelling and deformities and other symptoms being relatively rare.

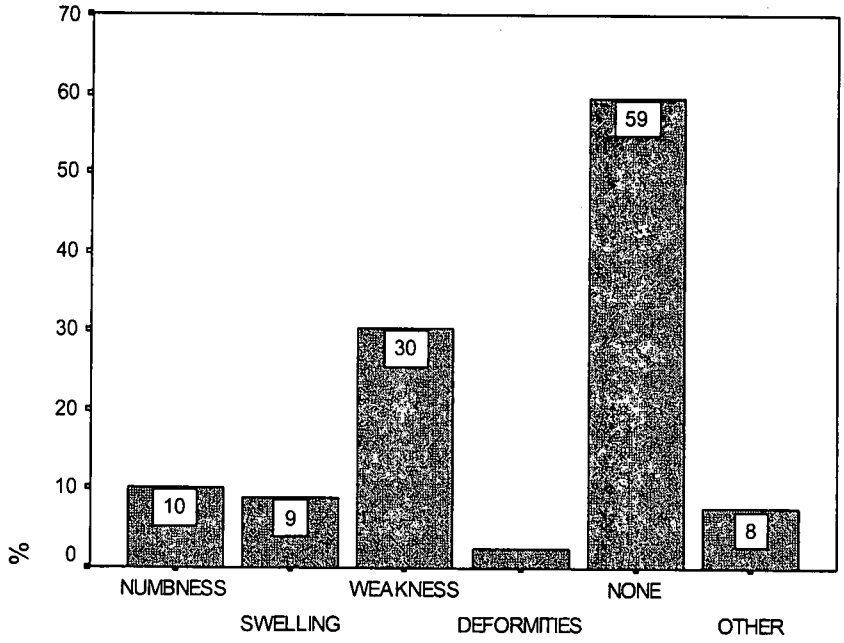


**Figure 7: Percentage of affected participants reporting various signs and symptoms (n=79)**

### Location of pain

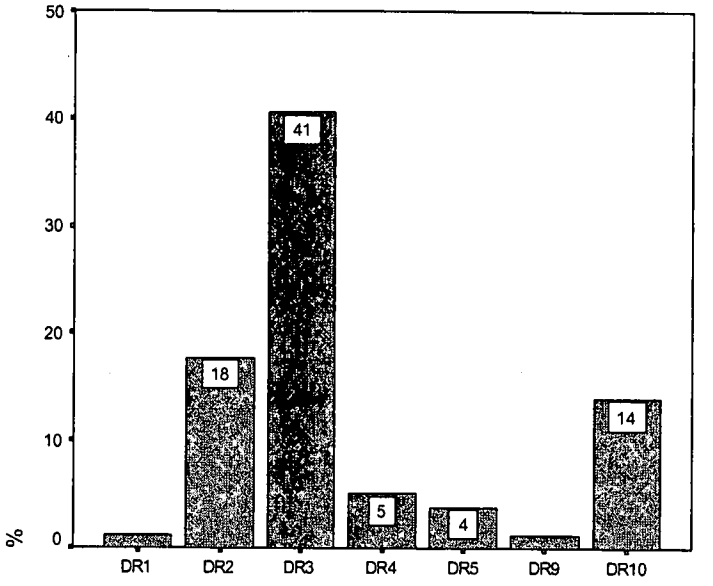


**Figure 8: Percentage of affected participants who indicated pain on the right hand dorsal aspect (n=79)**

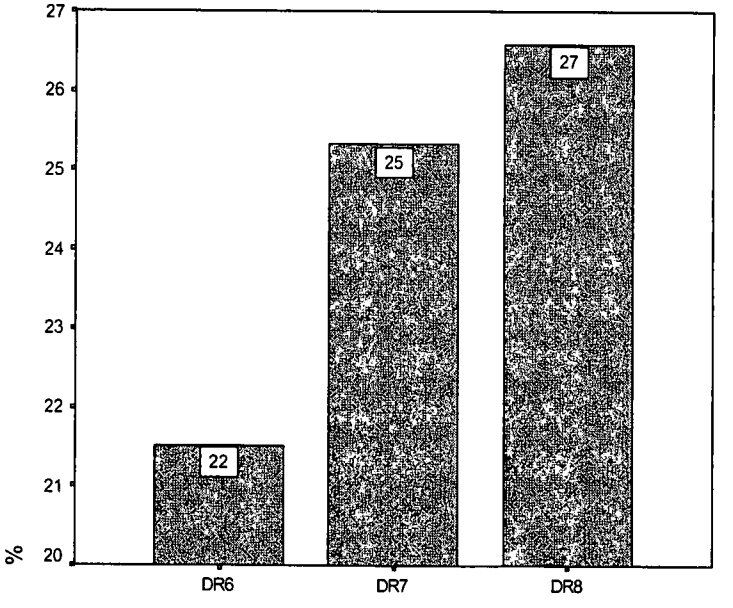


**Figure 9: Percentage of affected participants who indicated pain on the right wrist dorsal aspect (n=79)**

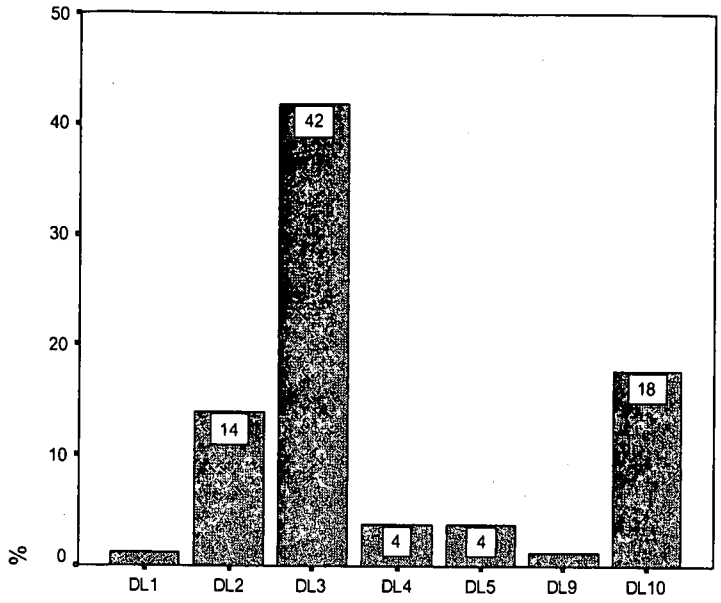


**Figure 10: Percentage of affected participants who indicated pain on the left hand dorsal aspect (n=79)**

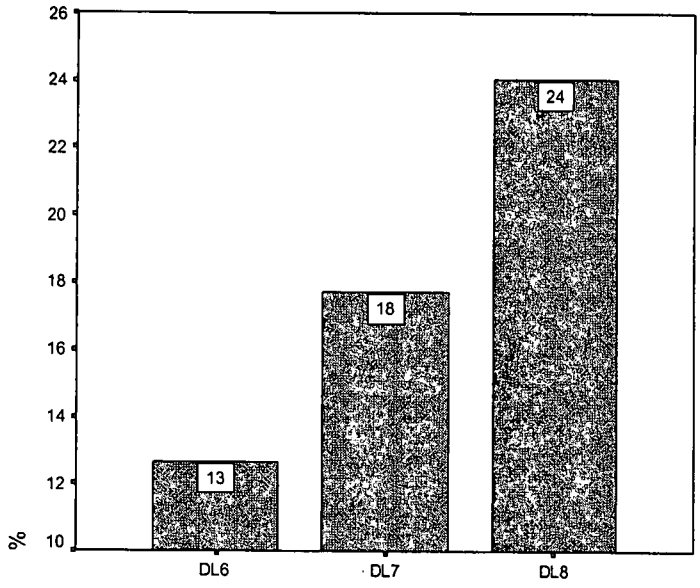


**Figure 11: Percentage of affected participants who indicated pain on the left wrist dorsal aspect (n=79)**

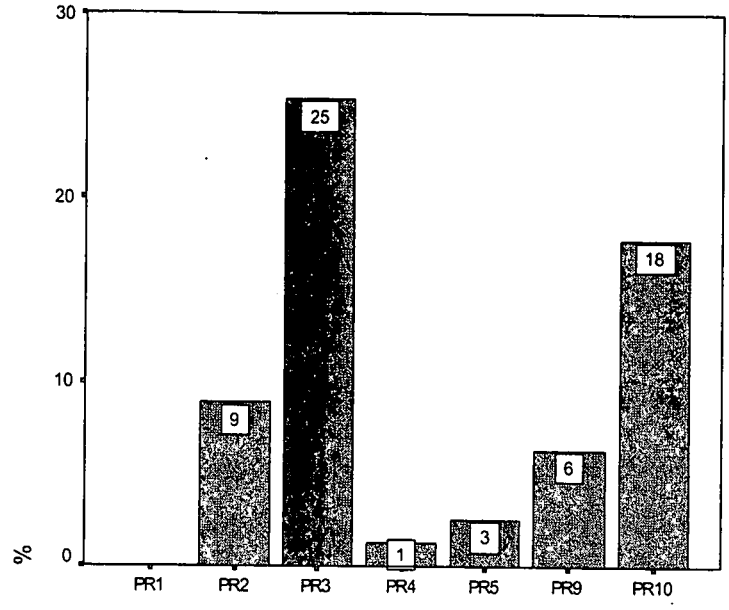


**Figure 12: Percentage of affected participants who indicated pain on the right hand palmer aspect (n=79)**

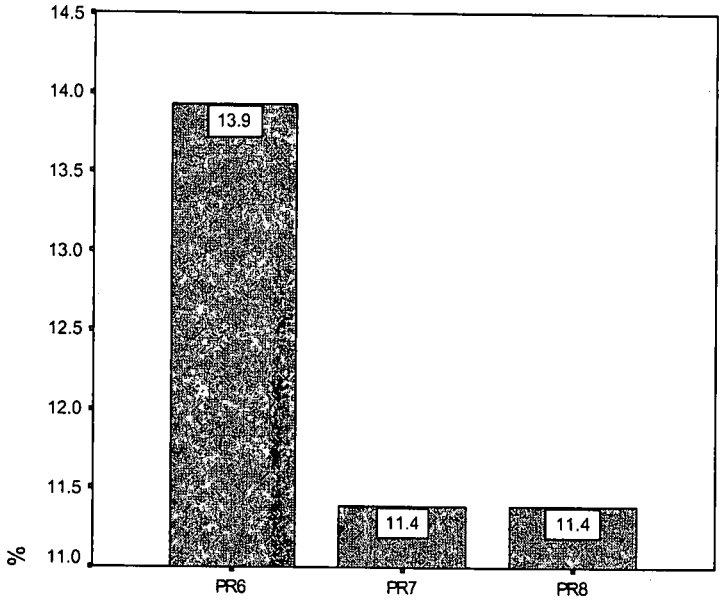


**Figure 13: Percentage of affected participants who indicated pain on the right wrist palmer aspect (n=79)**

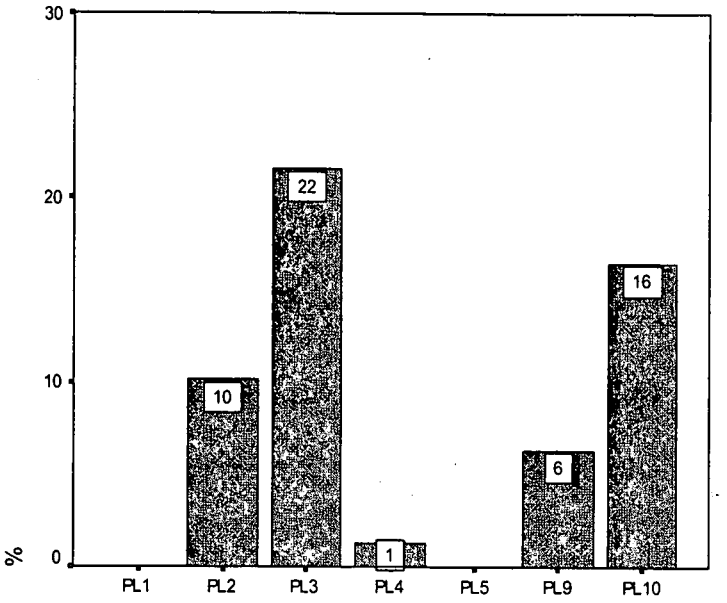


**Figure 14: Percentage of affected participants who indicated pain on the left hand palmer aspect (n=79)**

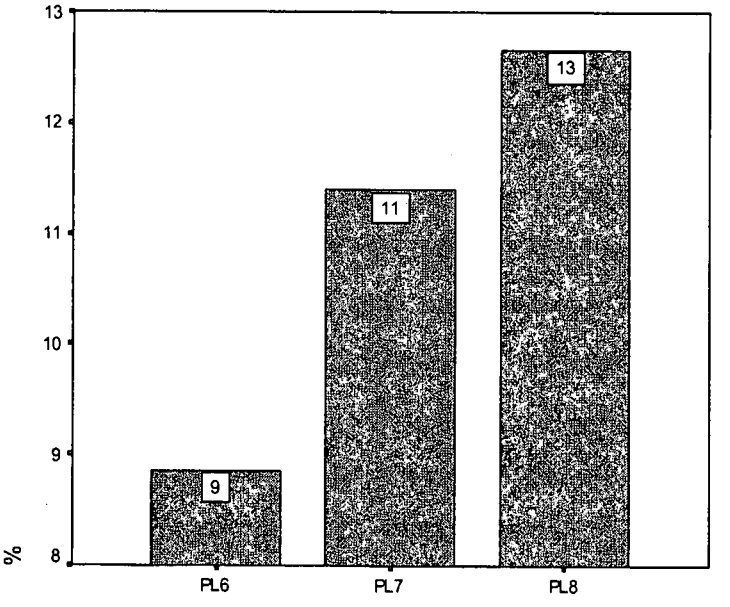


**Figure 15: Percentage of affected participants who indicated pain on the left wrist palmer aspect (n=79)**

**Pain at work**

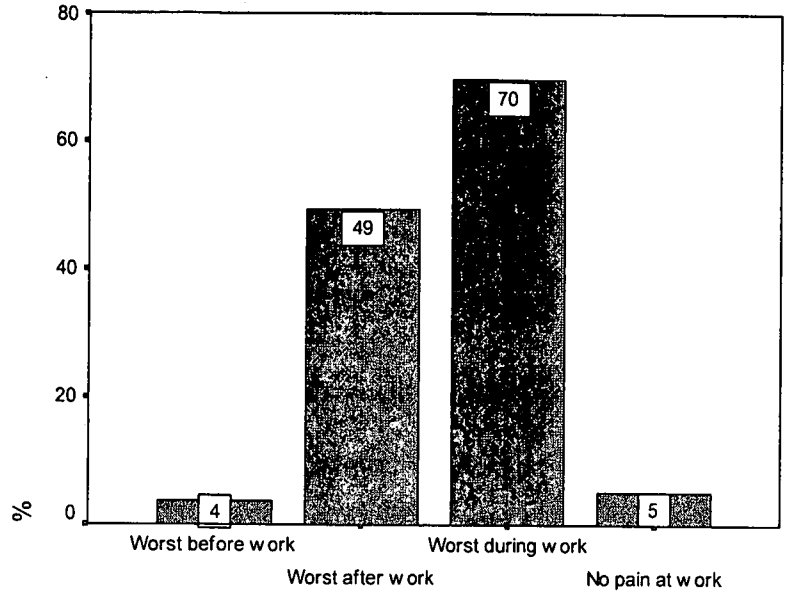


**Figure 16: Percentage of affected participants by pain in relation to work activities (n=79)**

Figure 16 shows that most of the participants who were affected by either hand or wrist pain (n=79) felt that the pain was worst during work (70%), or after work (49%).

**Table 5: Less severe pain on returning to work after leave of 3 days or more**

| | Frequency | Valid Percent |
|---|---|---|
| always | 26 | 32.9 |
| often | 25 | 31.6 |
| sometimes | 20 | 25.3 |
| rarely | 6 | 7.6 |
| never | 2 | 2.5 |
| Total | 79 | 100.0 |

Responses shown in Table 5 suggest that in the vast majority of cases, occupational overuse was responsible for the pain. 71 out of 79 (89.9%) affected participants answered positively to the question.

**Pain related to performing chiropractic manipulation**

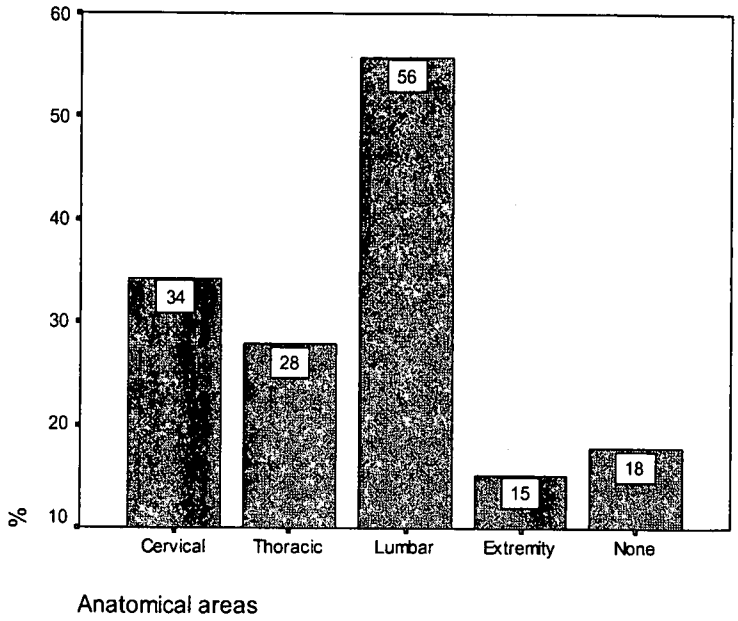


**Figure 17: Anatomical areas associated with most hand or wrist pain when performing chiropractic adjustments to them in 79 affected participants**

Figure 17 above shows that adjustments to the lumbar area caused the most hand or wrist pain in affected participants (56%).

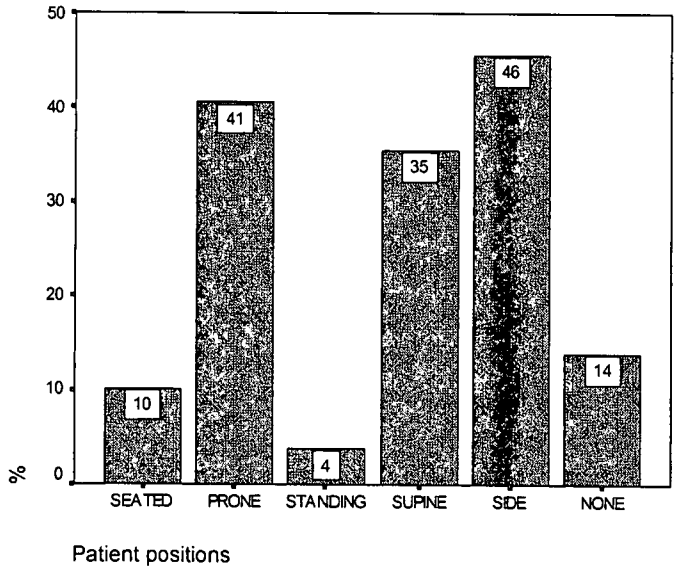


**Figure 18: Patient positions associated with most hand or wrist pain when performing chiropractic adjustments in 79 affected participants**

Figure 18 shows that patients positioned on their side (46%) or prone (41%) followed by supine (35%) caused the most amount of hand or wrist pain in affected practitioners.

**Self diagnosis**

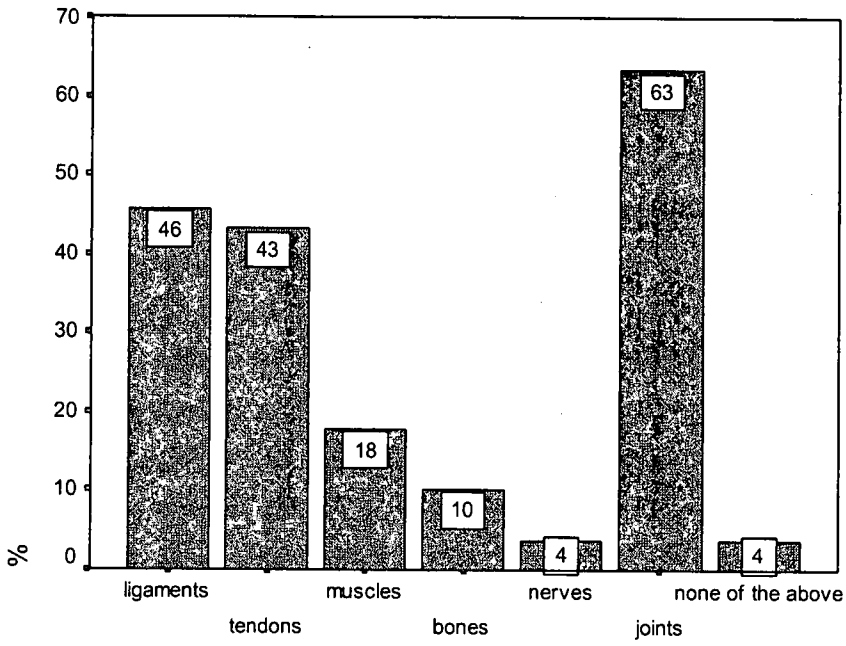


**Figure 19: Percentage of affected participants' responses to "I think the pain in my hands/wrists is due to pathology in the following anatomical structures"**

The majority of affected participants thought their pain was due to pathology in the joints (63%). Just under half indicated the ligaments (46%), while 43% selected the tendons. The other options were relatively rarely indicated.

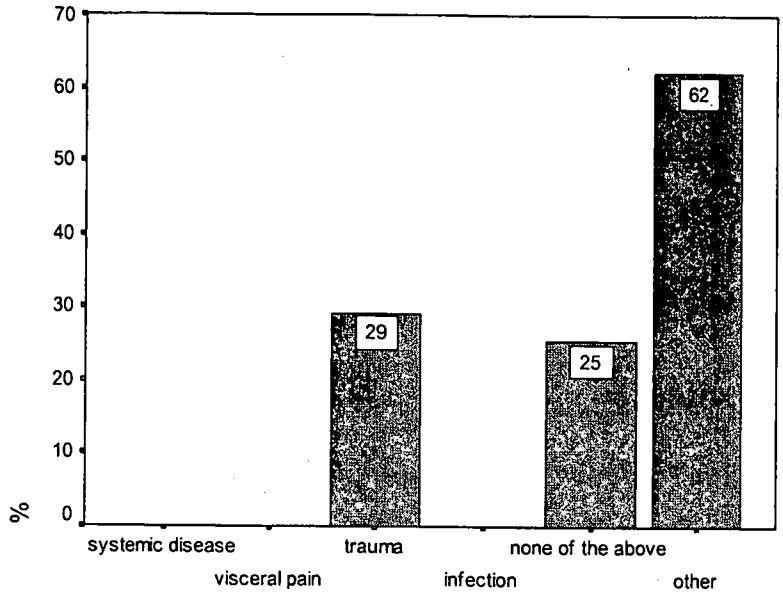


**Figure 20: Percentage of affected participants' responses to cause of pain in their hands/wrists**

Forty nine (62%) affected participants mentioned other as the cause for their pain. Of these, OA was specified in 3 cases (6.1%) and over use was mentioned in 41 cases (83.7%).

## Inferential analysis

### Factors associated with wrist and hand pain

### Demographic factors

### Age

**Table 6: T-test for the comparison of mean age between those with and without hand and wrist pain**

| | | | Age | | | t-test | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | Std. Deviation | Std. Error Mean | t-statistic | P value |
| Do you ever experience hand pain at work? | yes | 59 | 34.66 | 10.697 | 1.393 | -2.166 | 0.033* |
| | no | 49 | 39.98 | 14.771 | 2.110 | | |
| Do you ever experience wrist pain at work? | yes | 61 | 33.61 | 8.745 | 1.120 | -3.323 | 0.003* |
| | no | 47 | 41.57 | 15.876 | 2.316 | | |

* Statistically significant at 0.05 level

Table 6 shows that age was significantly associated with both hand (p=0.033) and wrist pain (p=0.003). The younger the participant, the more likely they were

to experience pain. The mean age of those in the sample who reported hand pain was 34.66 years, while those not experiencing hand pain were on average 39.98 years old. Similarly the mean age of those suffering from wrist pain was 33.61 years and those without was 41.57 years.

### Gender

**Table 7: Gender by hand and wrist pain**

| | | GENDER | | | |
|---|---|---|---|---|---|
| | | Male | | Female | |
| | | Count | Column % | Count | Column % |
| Do you ever experience hand pain at work? Fisher's exact p=0.168 | yes | 33 | 49.3% | 26 | 63.4% |
| | no | 34 | 50.7% | 15 | 36.6% |
| Do you ever experience wrist pain at work? Fisher's exact p=0.027* | yes | 32 | 47.8% | 29 | 70.7% |
| | no | 35 | 52.2% | 12 | 29.3% |

* statistically significant at 0.05 level.

Gender was significantly associated with wrist pain (p=0.027) but not with hand pain (p=0.168). 47.8% of males had wrist pain but 70.7% of females had wrist pain. Thus females were more likely to have wrist pain than males. This trend was also observed with hand pain (49.3% of males and 63.4% of females) but it was not statistically significant.

### Race

**Table 8: Racial group by hand and wrist pain**

| | | Racial group | | | |
|---|---|---|---|---|---|
| | | Caucasian | | Non-Caucasian | |
| | | Count | Column % | Count | Column % |
| Do you ever experience hand pain at work? Fisher's exact p = 0.726 | yes | 54 | 54.0% | 5 | 62.5% |
| | no | 46 | 46.0% | 3 | 37.5% |
| Do you ever experience wrist pain at work? Fisher's exact p = 0.134 | yes | 54 | 54.0% | 7 | 87.5% |
| | no | 46 | 46.0% | 1 | 12.5% |

Table 8 shows that there was no association between race and hand or wrist pain. The proportions of Caucasians and non-Caucasians who developed pain were similar. With wrist pain there was a slightly higher percentage of non-Caucasians (87.5%) than Caucasians (54%) who had pain, but because of the

small number of non-caucasians, the role of chance could not be ruled out, thus the difference was not statistically significant (p=0.134).

**Dominance**

**Table 9: Dominance by hand and wrist pain**

| | | Dominant hand | | | | | |
|---|---|---|---|---|---|---|---|
| | | Left | | Right | | Ambidextrous | |
| | | Count | Column % | Count | Column % | Count | Column % |
| Do you ever experience hand pain at work? p = 0.356 | yes | 2 | 28.6% | 51 | 56.7% | 6 | 54.5% |
| | no | 5 | 71.4% | 39 | 43.3% | 5 | 45.5% |
| Do you ever experience wrist pain at work? p=0.601 | yes | 5 | 71.4% | 49 | 54.4% | 7 | 63.6% |
| | no | 2 | 28.6% | 41 | 45.6% | 4 | 36.4% |

There was no difference in hand or wrist pain according to the dominant hand (p=0.356 and 0.601 respectively). Although differences in proportions were observed, the number of left handed and ambidextrous subjects was very low, thus chance could have played a role.

**Table 10: ANOVA test for comparison of mean pain points on right and left sides of hand between dominant hand groups in participants reporting either hand or wrist pain (n=79)**

| Dominant hand | | Pain points on right side | Pain points on left side |
|---|---|---|---|
| Left | Mean | 2.60 | 1.80 |
| | N | 5 | 5 |
| | Std. Deviation | 1.517 | 1.483 |
| Right | Mean | 2.59 | 2.23 |
| | N | 66 | 66 |
| | Std. Deviation | 1.636 | 1.855 |
| Ambidextrous | Mean | 2.25 | 2.88 |
| | N | 8 | 8 |
| | Std. Deviation | 2.053 | 2.031 |
| Total | Mean | 2.56 | 2.27 |
| | N | 79 | 79 |
| | Std. Deviation | 1.654 | 1.845 |
| p value | | 0.861 | 0.549 |

The number of pain points reported by participants on either side was summed up and compared between the dominant hands. Table 10 shows that the

dominant hand was not necessarily the one that was affected the most in those with either wrist or hand pain. It was only in the ambidextrous participants that the left side was affected more than the right side. However the differences were not statistically significant.

## Work-related factors

### Years in practice

**Table 11: Comparison of mean years in practice between those with and without hand and wrist pain**

| | | | Years in practice | | | t-test | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | Std. Deviation | Std. Error Mean | t-value | P value |
| Do you ever experience hand pain at work? | yes | 59 | 7.9153 | 9.55842 | 1.24440 | -1.954 | 0.053 |
| | no | 49 | 12.2755 | 13.55777 | 1.93682 | | |
| Do you ever experience wrist pain at work? | yes | 61 | 7.3361 | 8.73819 | 1.11881 | -2.662 | 0.009* |
| | no | 47 | 13.2128 | 14.09045 | 2.05530 | | |

* statistically significant at 0.05 level

There was a marginally non significant association between years in practice and hand pain (p=0.053). Those who experienced hand pain were in practice for a shorter duration than those who did not experience hand pain. The same trend was found for wrist pain but it was statistically significant (p=0.009). This may be related to the younger ages of affected participants.

**Table 12: Correlations between years in practice and pain severity in those who reported hand or wrist pain (n=79).**

| | | NRS initially | NRS presently | NRS Worst |
|---|---|---|---|---|
| Years in practice | Pearson Correlation | .019 | .242(*) | .242(*) |
| | P value. (2-tailed) | .869 | .031 | .033 |
| | N | 79 | 79 | 78 |

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

There were marginally significant but weak positive correlations between years in practice and the severity of the pain presently and at its worst. Thus as the years in practice increased the worst the present and worst pain was. However it should be noted that with correlation coefficients as low as 0.242, the correlation

was very weak and would show up as a random scatter of points with no clear trend in a scatter plot. Nonetheless, the correlations were statistically significant.

### Number of patients seen per day

**Table 13: Average number of patients per day by hand and wrist pain**

| | | Average no. patients per day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-10 | | 11-20 | | 21-30 | | 31-40 | | >40 | |
| | | n | % | n | % | n | % | n | % | n | % |
| Do you ever experience hand pain at work? p=0.064 | yes | 22 | 59.5% | 26 | 61.9% | 8 | 42.1% | 2 | 28.6% | 1 | 33.3% |
| | no | 15 | 40.5% | 16 | 38.1% | 11 | 57.9% | 5 | 71.4% | 2 | 66.7% |
| Do you ever experience wrist pain at work? p=0.360 | yes | 22 | 59.5% | 25 | 59.5% | 10 | 52.6% | 2 | 28.6% | 2 | 66.7% |
| | no | 15 | 40.5% | 17 | 40.5% | 9 | 47.4% | 5 | 71.4% | 1 | 33.3% |

Table 13 shows the reported average numbers of patients seen per day in relation to hand and wrist pain experienced. Comparisons were done on the mean category (using t-tests) rather than proportions per category since some categories had low numbers, thus invalidating the chi square test. The p value for the comparison of mean patients per day by hand pain was 0.064, marginally non-significant) and by wrist pain was 0.360. The trend was towards a lower number of patients in those who had pain than in those without. This may be a modification made by those with pain in order to cope with their pain. Thus this is probably a result of the pain and not a pre-existing factor related to development of pain.

### Hours in practice

**Table 14: Average hours in practice per week by hand and wrist pain**

| | | Average hours worked per week | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | <20 | | 20-30 | | 31-40 | | 41-50 | | >50 | |
| | | n | Column % | n | Column % | n | Column % | n | Column % | n | Column % |
| Do you ever experience hand pain at work? p=0.405 | yes | 10 | 52.6% | 18 | 50.0% | 14 | 51.9% | 14 | 70.0% | 3 | 50.0% |
| | no | 9 | 47.4% | 18 | 50.0% | 13 | 48.1% | 6 | 30.0% | 3 | 50.0% |
| Do you ever experience wrist pain at work? p=0.964 | yes | 12 | 63.2% | 20 | 55.6% | 14 | 51.9% | 10 | 50.0% | 5 | 83.3% |
| | no | 7 | 36.8% | 16 | 44.4% | 13 | 48.1% | 10 | 50.0% | 1 | 16.7% |

Hours worked per week was not different in those with and without hand (p=0.405) or wrist pain (p=0.964). This is shown in Table 14.

### Work activities and time spent on activities

## Table 15: Activities by hand and wrist pain

| | | Hand pain | | Wrist pain | | p value for hand pain | p value for wrist pain |
|---|---|---|---|---|---|---|---|
| | | Count | Row % | Count | Row % | | |
| COMPUTER | no | 18 | 50.0 % | 20 | 55.6% | 0.542 | 1.000 |
| | yes | 41 | 56.9 % | 41 | 56.9% | | |
| MANIPULATION | no | 0 | .0% | 1 | 50.0% | 0.204 | 1.000 |
| | yes | 59 | 55.7 % | 60 | 56.6% | | |
| MOBLILIZATION | no | 13 | 50.0 % | 12 | 46.2% | 0.652 | 0.256 |
| | yes | 46 | 56.8 % | 49 | 60.5% | | |
| PAPER | no | 7 | 35.0 % | 8 | 40.0% | 0.080 | 0.134 |
| | yes | 52 | 59.1 % | 53 | 60.2% | | |
| REHABILITATION | no | 28 | 50.0 % | 30 | 53.6% | 0.340 | 0.564 |
| | yes | 31 | 59.6 % | 31 | 59.6% | | |
| STRETCHING | no | 10 | 35.7 % | 12 | 42.9% | 0.027* | 0.121 |
| | yes | 49 | 61.3 % | 49 | 61.3% | | |
| THERAPY | no | 12 | 41.4 % | 11 | 37.9% | 0.129 | 0.017* |
| | yes | 46 | 59.0 % | 50 | 64.1% | | |
| OTHER | no | 33 | 47.8 % | 39 | 56.5% | 0.072 | 1.000 |
| | yes | 26 | 66.7 % | 22 | 56.4% | | |

* statistically significant at 0.05 level.

Only stretching activities were significantly associated with hand pain (p=0.027). Those who performed stretching were significantly more likely to have hand pain than those who did not. Performing therapeutic modalities was significantly related to wrist pain (p=0.017).

## Table 16: Comparison of mean percentage of time spent on each work activity between those who experience hand pain and those who do not

| activity | Do you ever experience hand pain at work? | N | Mean | Std. Deviation | Std. Error Mean | t-statistic | p value |
|---|---|---|---|---|---|---|---|
| Computer | yes | 59 | 6.00 | 6.384 | .831 | -0.523 | 0.602 |
| | no | 49 | 6.74 | 8.345 | 1.192 | | |
| Manipulation | yes | 59 | 39.87 | 21.667 | 2.821 | -0.631 | 0.529 |
| | no | 49 | 43.01 | 29.950 | 4.279 | | |
| Mobilization | yes | 59 | 9.26 | 9.704 | 1.263 | -0.892 | 0.374 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | no | 48 | 10.94 | 9.746 | 1.407 | | |
| Paperwork | yes | 59 | 8.03 | 6.513 | .848 | 0.056 | 0.955 |
| | no | 49 | 7.95 | 8.184 | 1.169 | | |
| Rehabilitation | yes | 59 | 5.19 | 6.244 | .813 | 1.140 | 0.257 |
| | no | 49 | 3.85 | 5.876 | .839 | | |
| Stretching | yes | 59 | 8.48 | 6.823 | .888 | 0.454 | 0.651 |
| | no | 49 | 7.80 | 8.599 | 1.228 | | |
| Therapy | yes | 58 | 13.48 | 16.093 | 2.113 | 1.730 | 0.087 |
| | no | 49 | 8.93 | 9.752 | 1.393 | | |
| Other | yes | 59 | 9.40 | 14.897 | 1.939 | -0.162 | 0.872 |
| | no | 49 | 10.02 | 24.444 | 3.492 | | |

Those who experienced hand pain did not spend significantly different amounts of time on any of the work activities than those who did not. This is shown in Table 16.

**Table 17: Comparison of mean percentage of time spent on each work activity between those who experience wrist pain and those who do not**

| % of time spent on: | Do you ever experience wrist pain at work? | N | Mean | Std. Deviation | Std. Error Mean | t-statistic | p value |
|---|---|---|---|---|---|---|---|
| Computer | yes | 61 | 5.77 | 7.035 | .901 | -0.929 | 0.355 |
| | no | 47 | 7.09 | 7.669 | 1.119 | | |
| Manipulation | yes | 61 | 39.49 | 25.943 | 3.322 | -0.827 | 0.410 |
| | no | 47 | 43.62 | 25.415 | 3.707 | | |
| Mobilization | yes | 61 | 9.53 | 8.828 | 1.130 | -0.594 | 0.554 |
| | no | 46 | 10.66 | 10.844 | 1.599 | | |
| Paperwork | yes | 61 | 8.56 | 7.909 | 1.013 | 0.923 | 0.358 |
| | no | 47 | 7.26 | 6.388 | .932 | | |
| Rehabilitation | yes | 61 | 4.95 | 6.297 | .806 | 0.722 | 0.472 |
| | no | 47 | 4.10 | 5.838 | .852 | | |
| Stretching | yes | 61 | 8.62 | 7.366 | .943 | 0.689 | 0.493 |
| | no | 47 | 7.59 | 8.045 | 1.174 | | |
| Therapy | yes | 61 | 13.03 | 15.561 | 1.992 | 1.430 | 0.156 |
| | no | 46 | 9.23 | 10.508 | 1.549 | | |
| Other | yes | 61 | 9.74 | 18.951 | 2.426 | 0.035 | 0.927 |
| | no | 47 | 9.61 | 20.859 | 3.043 | | |

Similarly, those who experienced wrist pain did not spend significantly different amounts of time on any of the work activities than those who did not. This is shown in Table 17.

**Table 18: Correlation between time spent on work activities and pain in those reporting either hand or wrist pain (n=79)**

| | | NRS initially | NRS presently | NRS Worst |
|---|---|---|---|---|
| Computer | Pearson Correlation | -.012 | .051 | .111 |
| | p value (2-tailed) | .920 | .652 | .334 |
| | N | 79 | 79 | 78 |
| Manipulation | Pearson Correlation | .139 | .048 | .131 |
| | p value (2-tailed) | .222 | .675 | .252 |
| | N | 79 | 79 | 78 |
| Mobilization | Pearson Correlation | -.023 | -.049 | .091 |
| | p value (2-tailed) | .843 | .667 | .426 |
| | N | 79 | 79 | 78 |
| Paperwork | Pearson Correlation | .020 | .014 | -.038 |
| | p value (2-tailed) | .860 | .901 | .743 |
| | N | 79 | 79 | 78 |
| Rehabilitation | Pearson Correlation | -.083 | .148 | .017 |
| | p value (2-tailed) | .467 | .193 | .883 |
| | N | 79 | 79 | 78 |
| Stretching | Pearson Correlation | -.014 | -.083 | -.025 |
| | p value (2-tailed) | .900 | .467 | .828 |
| | N | 79 | 79 | 78 |
| Therapy | Pearson Correlation | -.024 | -.003 | -.049 |
| | p value (2-tailed) | .835 | .980 | .674 |
| | N | 78 | 78 | 77 |
| Other | Pearson Correlation | -.102 | -.023 | -.141 |
| | p value (2-tailed) | .373 | .839 | .218 |
| | N | 79 | 79 | 78 |

Table 18 above shows that severity of pain was not correlated with amount of time spent on any of the work activities in those reporting hand or wrist pain.

**Non manipulative techniques**

**Table 19: The association between non –manipulative techniques used and hand and wrist pain**

| | | Hand pain | | Wrist pain | | p value for hand pain | p value for wrist pain |
|---|---|---|---|---|---|---|---|
| | | n | Row % | n | Row % | | |
| Cross fibre massage | no | 12 | 42.9% | 11 | 39.3% | 0.190 | 0.026* |
| | yes | 44 | 57.9% | 49 | 64.5% | | |
| DAPRE | no | 49 | 53.8% | 52 | 57.1% | 0.794 | 0.794 |
| | yes | 10 | 58.8% | 9 | 52.9% | | |
| Dry needling | no | 9 | 36.0% | 7 | 28.0% | 0.040* | 0.001* |
| | yes | 50 | 60.2% | 54 | 65.1% | | |
| Electrotherapy | no | 38 | 50.7% | 42 | 56.0% | 0.203 | 0.832 |
| | yes | 21 | 65.6% | 19 | 59.4% | | |
| Graston | no | 58 | 55.8% | 59 | 56.7% | 0.327 | 1.000 |
| | yes | 1 | 25.0% | 2 | 50.0% | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ischeamic compression | no | 5 | 23.8% | 6 | 28.6% | 0.003* | 0.006* |
| | yes | 54 | 62.1% | 55 | 63.2% | | |
| lymphatic drainage | no | 54 | 53.5% | 55 | 54.5% | 0.452 | 0.135 |
| | yes | 5 | 71.4% | 6 | 85.7% | | |
| Massage | no | 11 | 39.3% | 10 | 35.7% | 0.078 | 0.014* |
| | yes | 48 | 60.0% | 51 | 63.8% | | |
| Musculo tendinous release | no | 40 | 47.6% | 43 | 51.2% | 0.010* | 0.060 |
| | yes | 19 | 79.2% | 18 | 75.0% | | |
| Myofascial release | no | 24 | 50.0% | 26 | 54.2% | 0.439 | 0.700 |
| | yes | 35 | 58.3% | 35 | 58.3% | | |
| Nimmo technique | no | 46 | 50.0% | 53 | 57.6% | 0.028* | 0.595 |
| | yes | 13 | 81.3% | 8 | 50.0% | | |
| Post facilitated stress | no | 44 | 52.4% | 46 | 54.8% | 0.487 | 0.642 |
| | yes | 15 | 62.5% | 15 | 62.5% | | |
| Post isometric relaxation | no | 45 | 50.6% | 48 | 53.9% | 0.079 | 0.312 |
| | yes | 14 | 73.7% | 13 | 68.4% | | |
| PNF | no | 12 | 35.3% | 12 | 35.3% | 0.007* | 0.003* |
| | yes | 47 | 63.5% | 49 | 66.2% | | |
| SHAKING | no | 59 | 54.6% | 61 | 56.5% | | |
| | yes | 0 | .0% | 0 | .0% | | |
| Skin rolling | No | 56 | 53.8% | 58 | 55.8% | 0.625 | 0.631 |
| | yes | 3 | 75% | 3 | 75% | | |
| Tampotment | no | 56 | 53.3% | 58 | 55.2% | 0.249 | 0.256 |
| | yes | 3 | 100.0% | 3 | 100.0% | | |
| Manual vibrations | no | 54 | 53.5% | 57 | 56.4% | 0.452 | 1.000 |
| | yes | 5 | 71.4% | 4 | 57.1% | | |
| Mechanical vibration | no | 43 | 53.8% | 44 | 55.0% | 0.827 | 0.662 |
| | yes | 16 | 57.1% | 17 | 60.7% | | |

* statistically significant at 0.05 level

Hand pain was significantly associated with the use of dry needling, ischaemic compression, musculo-tendinous release, Nimmo technique, and PNF. Wrist pain was significantly associated with the use of cross fibre massage, dry needling, ischaemic compression, massage, and PNF.

### Manipulative techniques

**Table 20: The association between manipulative techniques used and hand and wrist pain**

| | | Hand pain | | Wrist pain | | p value for hand pain | p value for wrist pain |
|---|---|---|---|---|---|---|---|
| | | Count | Row % | Count | Row % | | |
| High velocity low amp thrust | no | 0 | .0% | 2 | 50.0% | 0.040* | 1.000 |
| | yes | 59 | 56.7% | 59 | 56.7% | | |
| Long lever | no | 49 | 53.3% | 53 | 57.6% | 0.591 | 0.595 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | yes | 10 | 62.5% | 8 | 50.0% | | |
| instrument assisted | no | 43 | 58.1% | 42 | 56.8% | 0.305 | 1.000 |
| | yes | 16 | 47.1% | 19 | 55.9% | | |
| OTHER | no | 51 | 56.7% | 54 | 60.0% | 0.439 | 0.122 |
| | yes | 8 | 44.4% | 7 | 38.9% | | |

* statistically significant at 0.05 level

The use of high velocity low amplitude thrust was significantly associated with hand pain (p=0.040) but not with wrist pain (p=1.000). No other manipulative techniques were significantly related to either hand or wrist pain.

## Modification of techniques

**Table 21: Modification of non manipulative techniques due to hand pain**

| | | | Do you ever experience hand pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed non manipulative techniques due to pain | always | Count | 3 | 0 | 3 |
| | | Row % | 100.0% | .0% | 100.0% |
| | often | Count | 10 | 2 | 12 |
| | | Row % | 83.3% | 16.7% | 100.0% |
| | sometimes | Count | 28 | 7 | 35 |
| | | Row % | 80.0% | 20.0% | 100.0% |
| | rarely | Count | 10 | 16 | 26 |
| | | Row % | 38.5% | 61.5% | 100.0% |
| | never | Count | 8 | 24 | 32 |
| | | Row % | 25.0% | 75.0% | 100.0% |
| Total | | Count | 59 | 49 | 108 |
| | | Row % | 54.6% | 45.4% | 100.0% |

Pearson's chi square = 29.65, p<0.001

As expected there was a highly significant association between having modified non manipulative techniques due to pain, and having experienced hand pain (p<0.001 – Table 21). Interestingly, some of those who modified their non manipulative techniques due to pain did not report suffering from hand pain. They might have suffered from wrist pain or another type of pain.

**Table 22: Modification of non manipulative techniques due to wrist pain**

| | | | Do you ever experience wrist pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed non manipulative techniques due to pain | always | Count | 2 | 1 | 3 |
| | | Row % | 66.7% | 33.3% | 100.0% |
| | often | Count | 9 | 3 | 12 |
| | | Row % | 75.0% | 25.0% | 100.0% |
| | sometimes | Count | 26 | 9 | 35 |
| | | Row % | 74.3% | 25.7% | 100.0% |
| | rarely | Count | 14 | 12 | 26 |
| | | Row % | 53.8% | 46.2% | 100.0% |
| | never | Count | 10 | 22 | 32 |

| | | | | | |
|---|---|---|---|---|---|
| | | Row % | 31.3% | 68.8% | 100.0% |
| Total | | Count | 61 | 47 | 108 |
| | | Row % | 56.5% | 43.5% | 100.0% |

Pearson's chi square =14.68, p=0.005

Table 22 shows that there was also a significant association between wrist pain and having modified non manipulative techniques (p=0.005).

**Table 23: Modification of manipulative techniques due to hand pain**

| | | | Do you ever experience hand pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed manipulative techniques due to pain | always | Count | 3 | 0 | 3 |
| | | Row % | 100.0% | .0% | 100.0% |
| | often | Count | 10 | 1 | 11 |
| | | Row % | 90.9% | 9.1% | 100.0% |
| | sometimes | Count | 19 | 7 | 26 |
| | | Row % | 73.1% | 26.9% | 100.0% |
| | rarely | Count | 15 | 13 | 28 |
| | | Row % | 53.6% | 46.4% | 100.0% |
| | never | Count | 12 | 28 | 40 |
| | | Row % | 30.0% | 70.0% | 100.0% |
| Total | | Count | 59 | 49 | 108 |
| | | Row % | 54.6% | 45.4% | 100.0% |

Pearson's chi square =21.71, p<0.001

Those with hand pain were more likely to modify their manipulative techniques than those without (p<0.001).

**Table 24: Modification of manipulative techniques due to wrist pain**

| | | | Do you ever experience wrist pain at work? | | Total |
|---|---|---|---|---|---|
| | | | yes | no | |
| Changed manipulative techniques due to pain | always | Count | 3 | 0 | 3 |
| | | Row % | 100.0% | .0% | 100.0% |
| | often | Count | 10 | 1 | 11 |
| | | Row % | 90.9% | 9.1% | 100.0% |
| | sometimes | Count | 19 | 7 | 26 |
| | | Row % | 73.1% | 26.9% | 100.0% |
| | rarely | Count | 16 | 12 | 28 |
| | | Row % | 57.1% | 42.9% | 100.0% |
| | never | Count | 13 | 27 | 40 |
| | | Row % | 32.5% | 67.5% | 100.0% |
| Total | | Count | 61 | 47 | 108 |
| | | Row % | 56.5% | 43.5% | 100.0% |

Pearson's chi square =19.89, p=0.001

Table 24 shows that having wrist pain was also associated with modifying manipulative techniques (p=0.001).

**Prevalence of occupational overuse syndrome**

Possible occupational overuse syndrome for the purposes of this study was defined as:

1. Hand or wrist pain and
2. having changed non manipulative and manipulative techniques due to pain always, often or sometimes and
3. worst pain after or during work activity and
4. less severe pain always, often or sometimes after taking leave from work for more than 3 days, and
5. self diagnosis of cause of pain due to overuse (including combination of trauma and overuse).

According to this definition, there were 19 possible occupational overuse syndrome cases (prevalence of 17.6%, 95% CI 10.94% to 26.10%).

**Factors associated with OOS**

**Table 25: Logistic regression analysis of factors associated with possible OOS**

| | B | S.E. | Wald | df | Sig. | OR | 95.0% C.I. for OR | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| Gender (female vs. male) | 1.353 | .631 | 4.594 | 1 | .032 | 3.870 | 1.123 | 13.341 |
| Average hours worked per day | 0.720 | 0.276 | 6.792 | 1 | .009 | 2.054 | 1.195 | 3.529 |
| PFS | 1.323 | .626 | 4.472 | 1 | .025 | 3.745 | 1.184 | 11.844 |
| Constant | -2.877 | .878 | 10.733 | 1 | .001 | .056 | | |

There were three factors which were independently associated with possible OOS. Females were 3.87 times more likely than males to have possible OOS (95% CI 1.123 to 13.341 p = 0.032). With every 10 hour increase of working hours per day, the risk of possible OOS increased by 2.054 times (95% CI 1.195 to 3.529, p=0.009). Chiropractors performing PFS 3.745 times more likely to get possible OOS than those who did not (95% CI 1.184 to 11.844, p=0.025). The model predicted possible OOS with 82.5% accuracy.