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WORK-RELATED THUMB DISORDERS IN SOUTH AFRICAN PHYSIOTHERAPISTS TREATING MUSCULOSKELETAL CONDITIONS USING MANUAL THERAPY TECHNIQUES

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree

of

Master of Science in Physiotherapy

Johannesburg, 2013

DECLARATION

I, Heather Theresa Jenkins declare that this research report is my own work. It is being submitted for the Degree of Master of Science in Physiotherapy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

---------- (Signature of the candidate)

09 September, 2013.

DEDICATION

To God be the glory, for His grace and strength to complete this report;

To my husband, Selwyn and children Stephen, Melissa and Stacy-Lee for their prayer and support during my study period.

ABSTRACT

Of all the structures in the hand, the thumb is the most vulnerable to biomechanical and work-related injuries in physiotherapists using manual therapy techniques. The objectives of the current study were to determine the prevalence and factors associated with work – related thumb problems (WRTP) in South African physiotherapists and establish the strategies they used in the management of the thumb problems. A cross-sectional, descriptive study design was used and data were collected using an internet-based questionnaire.

The life-time prevalence of WRTP in South African physiotherapists using manual therapy techniques was 65.3% in survey one and 67.5% in survey two. The factors that were significantly associated with WRTP in all 395 respondents were hyperextension >10° of the knee on the non-dominant side (p=0.02), passive F of the thumb to the anterior forearm (p=0.04), hyperextension >30°of the non-dominant IP joint of the thumb (p=0.02) and the treatment of more than six patients a day with manual therapy to the cervical spine (p=0.02). The factors that were significantly associated with WRTP in all 395 respondents in the univariate analysis were put in a regression analysis. The factors that remained significantly associated with WRTP were the cervical treatment of up to six patients a day (p=0.01) and hyperextension>30° of the non-dominant IP joint of the thumb (p=0.05).

The factors that were significantly associated with WRTP in the 258 respondents who had WRTP were all grades of transverse glides applied to the spine (p<0.001), grade II-IV unilateral and central posterior-anterior pressures to the spine (p< 0.001), Additional occupational factors significantly associated with WRTP (p<0.001) included an increase in thumb use in the performance of manual techniques, inadequate training in injury prevention, a high, repetitive workload, working with a current injury, working in sustained, uncomfortable positions, inadequate rest periods, working at or near your physical limits and manual chest physiotherapy (p=0.005).The strategies most commonly used by the physiotherapists in the management of the WRTP were the modification of the technique and the use of a different technique. Randomised control trials are recommended to investigate the effectiveness of the preventative and management strategies of WRTP in physiotherapists.

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TABLE OF CONTENTS

DECLARATION.....**II**

DEDICATION.....**III**

ABSTRACT.....**IV**

ACKNOWLEDGEMENTS.....**V**

TABLE OF CONTENTS.....**VI**

INDEX OF FIGURES.....**X**

INDEX OF TABLES.....**XI**

LIST OF ABBREVIATIONS.....**XIII**

CHAPTER ONE.....**1**

INTRODUCTION.....**1**

1.1 Problem statement.....**2**

1.2 Significance of study.....**3**

1.3 Aim of the study.....**3**

1.4 Objectives.....**3**

1.5 Overview of Research report.....**4**

CHAPTER TWO.....**5**

LITERATURE REVIEW.....**5**

2.1 Introduction.....**5**

2.2 Prevalence of WRTP in physiotherapists.....**7**

2.3 WRTP reported by physiotherapists 9

2.4 Potential risk factors 10

2.4.1 Intrinsic factors 10

2.4.2 Extrinsic factors 20

2.5 Management strategies 24

2.6: Summary 26

CHAPTER 3 27

METHODS 27

3.1 Introduction 27

3.2 Study design 27

3.3 Ethical clearance 27

3.4 Study period 27

3.5 Sample 27

3.5.1 Participants 27

3.5.2 Sample size 28

3.5.3 Inclusion criteria 28

3.5.4 Exclusion criteria 28

3.6 Study tool 28

3.7 Variables 29

3.7.1 Categorical variables 29

3.7.1.1 Personal factors 29

3.7.1.2 Employment history 29

3.7.1.3 Education factors 29

3.7.1.4 Occupational factors 29

3.7.2 Ranked (ordinal) variables 30

3.8 Management strategies 30

3.9 Validation of questionnaire 30

3.10 Procedure 31

3.11 Analysis of data 31

3.12 Summary **32**

CHAPTER FOUR **33**

RESULTS **33**

4.1 Introduction **33**

4.2 Response rate **33**

4.3 Flow of respondents through study **33**

4.4 The prevalence of WRTP in physiotherapists using manual therapy techniques **35**

4.5 Demographic characteristics of the respondents and their relationship with WRTP **35**

4.6 Hypermobility **41**
4.6.1 Generalised hypermobility 41
4.6.2 Thumb hypermobility 43

4.7 Educational factors **47**

4.8 Employment factors **48**
4.8.1 Employment history 48
4.8.2 Work characteristics 48

4.9 Work-related Thumb problems **54**
4.9.1 Specific Work-related thumb problems 54
4.9.2 Frequency of Work-related thumb problems 55
4.9.3 Intensity of pain 55
4.9.4 Activity limitation /participation restriction 55
4.9.5 The timing of the initial incident 57

4.10 Occupational factors **58**

4.11 Management strategies **59**

4.12 Questionnaire Two Results **60**
4.12.1 Demographic data 61
4.12.2 Prevalence of WRTP 61

CHAPTER FIVE 63

DISCUSSION OF RESULTS 63

5.1 Introduction 63

5.2 Prevalence 63

5.3 Intrinsic factors associated with WRTP 64

5.4 Extrinsic factors 69

5.5 Management Strategies 72

CHAPTER 6 76

CONCLUSION AND RECOMMENDATIONS 76

6.1 Conclusions 76

6.2 Limitations of Study 77

6.3 Recommendations 78

REFERENCES 79

APPENDIX A: CLEARANCE CERTIFICATE 85

APPENDIX B - SAMPLE SIZE CALCULATION 86

APPENDIX C – PANEL OF EXPERTS 87

APPENDIX D – VALIDATION COMMENTS 88

APPENDIX E: CROSS TABULATION- "Feeling of joint instability" and age 90

APPENDIX F: CROSS TABULATION- MP joint hyperextension and age 91

APPENDIX G: QUESTIONNAIRE 1 93

APPENDIX H: QUESTIONNAIRE 2 106

INDEX OF FIGURES

Figure 2.1 - Conceptual framework: WRTP in manual physiotherapists 5

Figure 2.2 - Conceptual framework: Factors associated with WRTP in manual therapists. 6

Figure 2.3 - X-ray views of the CMC joint 11

Figure 2. 4 - Oblique radiographic projection to show CMC mechanics in retroposition 12

Figure 2.5 - The resting CMC joint 13

Figure 2.6 - Oblique radiographic projection to show CMC mechanics in opposition 14

Figure 2.7 - Hand positions of PA glides performed on a load cell on a table. 17

Figure 2.8 - Categorisation of hand placement 18

Figure 4.1 - Flow diagram of respondents 34

Figure 4.2 - Prevalence of WRTP in physiotherapists using manual therapy techniques. 35

Figure 4.3 - Timing of preventative education and prevalence of WRTP. 47

Figure 4.4 - Work Areas and Prevalence of WRTP in the respondents. 49

Figure 4.5 - Frequency of WRTP 55

Figure 4.6 - Work area of initial episode. 57

Figure 4.7 - Management strategies used for WRTP. 60

INDEX OF TABLES

Table 4.1 - Age distribution and WRTP prevalence in participants 35

Table 4.1.1 - Prevalence of WRTP in the 20-30 years and 51-60 years age group 36

Table 4.2 - Height distribution and WRTP prevalence in participants 36

Table 4.2.1 - Prevalence of WRTP within height groups with heights < 150cm and 161-170cm..... 37

Table 4.3 - Weight distribution and WRTP prevalence in participants 37

Table 4.3.1 - Prevalence of WRTP within weight groups with weights<50 kg and 50-60kg..... 38

Table 4.4 - Race distribution and WRTP prevalence in participants 38

Table 4.4.1 - Prevalence of WRTP within race groups..... 38

Table 4.5 - Qualifications distribution and WRTP prevalences 39

Table 4.5.1 - Prevalence of WRTP in OMTG, No qualification group, and Study population 39

Table 4.6 - Relationship of the demographic factor categories with WRTP 40

Table 4.7 - Distribution of Generalised hypermobility and prevalence of WRTP 41

Table 4.8 - Generalised hypermobility and prevalence of WRTP

within generalised hyper mobility groups..... 42

Table 4.9 - Relationship of generalised hypermobility with WRTP..... 42

Table 4.10 - Thumb hypermobility and prevalence of WRTP..... 43

Table 4.11 - Prevalence of WRTP in respondents who have thumb hypermobility >30° 44

Table 4.12 - Pevalence of WRTP in respondents who have thumb hyper mobility (0°-30°) 45

Table 4.13 - Relationship of the thumb hypermobility categories with WRTP..... 46

Table 4.14 - Preventative education received 47

Table 4.15 - Employment history of the respondents and prevalence of WRTP..... 48

Table 4.16 - Work Experience of Respondents: Years worked and prevalence of WRTP..... 50

Table 4.17 - Work Experience: WRTP relative to the number of patients treated per day in different

body regions..... 51

Table 4.18 - Association of employment factors with WRTP 52

Table 4.19 - Relationship between significant factors and the presence of WRTP 53

Table 4.20 - Specific thumb problems 54

Table 4.21 - Level of activity limitation of respondents 56

Table 4.22 - Timing of initial episode of WRTP 57

Table 4.23 - Prevalence and association of work –related factors aggravating the thumb problem 58

Table 4.24 - Prevalence and association of spinal mobilising techniques with WRTP 59

Table 4.25 - Demographic distribution of study sample in Survey Two 61

Table 4.26 - Gender distribution and WRTP prevalence in participants 62

LIST OF ABBREVIATIONS

CMC joint : Carpometacarpal joint

MP joint : Metacarpophalangeal joint

IP joint : Interphalangeal joint

LF : Little finger

OMTG : Orthopaedic Manipulative Therapy Group

SASP : South African Society of Physiotherapists

WRTP : Work-related thumb problems

F : Flexion

E : Extension

OA : Osteoarthritis

RCT : Randomised controlled trial

SNAG : Sustained natural apophyseal glides

CHAPTER ONE

INTRODUCTION

Physiotherapists are skilled professionals in the health care team who "assess, treat and prevent human movement disorders, restoring normal function or minimising dysfunction and pain in adults and children with physical impairment, to enable them to achieve the highest possible level of independence in their lives; preventing recurring injuries and disability in the workplace, at home, or during recreational activities and promoting community health for all age groups" (www.physiosa.org.za). Physiotherapists may work or specialise in a number of work areas including cardiopulmonary, neurological, paediatrics, manual therapy, geriatrics, orthopaedics, community health and sport. In some of these areas, for example, in orthopaedic out-patient departments or private practises treating mainly musculoskeletal disorders, a hands-on approach of manual therapy is predominantly employed.

The increased use of their hands in therapy puts these physiotherapists treating musculoskeletal disorders using manual therapy techniques at risk of developing work- related musculoskeletal disorders of the wrists and hands (Bork et al., 1996; Cromie et al., 2000; West and Gardner, 2001; Snodgrass and Rivett, 2002; Barnes et al., 2011). Glover (2002) reported "An unacceptable irony given that physiotherapy is used to treat musculoskeletal injuries is that Chartered Society of Physiotherapy members are at particular risk themselves from this type of injury, sustained during the course of their work." The World Health Organisation (2003) defined a work-related musculoskeletal disorder as a form of ill-health ranging from light transitory disorders to irreversible disabling injuries that is induced or aggravated by work and the circumstances of its performance (Luttman et al., 2003).

Of all the structures in the hand, the thumb is the most vulnerable to biomechanical and work-related injuries in physiotherapists (Cromie et al., 2000; Snodgrass et al., 2003; Wajon and Ada, 2003, Atkinson et al., 2004; McMahon et al., 2006). The factors that were found to be associated with

WRTP included manual therapy techniques, trigger point therapy and massage (Wajon and Ada, 2003; Mc Mahon et al., 2006 and Barnes et al., 2011). Mc Mahon et al. (2006) found a significant association of these factors with WRTP. Additional factors associated with WRTP included having hypermobility of the thumb joints and the inability to stabilise the thumb while performing physiotherapy techniques (Mc Mahon et al., 2006, Wajon et al., 2007). The inability to stabilise the thumbs is the reason why young graduate physiotherapists report WRTP (Buckingham et al., 2007). Several studies have shown that younger physiotherapists report work-related musculoskeletal disorders during their first five years of employment (Bork et al., 1996; Cromie et al., 2000). Other factors that contribute to WRTP are repetition of the same tasks, the treatment of many patients daily, exceeding of physical limitations, working in the same position for long periods as well as working in uncomfortable positions (Cromie et al., 2000; Wajon and Ada, 2003; Barnes et al., 2011).

The mobilising techniques which seem to be the most provocative are the ones transmitting forces through the thumbs such as unilateral and central posterior- anterior glides (Wajon and Ada, 2003; Snodgrass et al., 2009, 2010). The use of the thumb in these techniques results in the thumb being used as a pseudo weight-bearing joint when the force is applied through it. The thumb is not designed for this function and thus a potential for repetitive strain injuries as well as osteoarthritis (OA) of the CMC joint develops (Snodgrass et. al, 2003). Pain, weakness, stiffness as well as difficulty performing manual techniques or basic activities of daily living may be the end result (Snodgrass et. al, 2003; Wajon and Ada, 2003).

1.1 Problem statement

There are limited studies available on WRTP in physiotherapists treating musculoskeletal conditions in South Africa. To date there is only one published study in South Africa (Barnes et al., 2011). This was a local study done in the city of Bloemfontein in the Free State.

1.2 Significance of study

The presence of WRTP in physiotherapists could result in several consequences. Physiotherapists could move to another field of practise or worse still leave the profession as a result of WRTP (Reglar and James, 1999; Snodgrass and Rivett, 2002; Wagons and Ada, 2003). The quality of life of the physiotherapists in later years could be affected by OA of the CMC joint of the thumb, often as a result of the cumulative trauma to the thumbs associated with the physiotherapy techniques resulting in early retirement of physiotherapists (Snodgrass and Rivett, 2002). 'A physiotherapist's hands are a vital tool in the assessment and treatment of patients and it is crucial that they are protected from injury wherever possible' (Regular and James, 1996). For these reasons it is necessary that there is on-going research into the prevalence and factors associated with WRTP in physiotherapists. In addition, if factors are preventable, interventions should be found which could prevent the problems highlighted in the earlier discussion (Wajon and Ada, 2003; McMahon et al, 2006, Barnes et al., 2011). Importantly, the information gained in the study can be used in our academic institutions at undergraduate level and in post graduate training programmes by making the results available to the local academic institutions as well as publishing the results in local and international journals.

1.3 Aim of the study

To determine the prevalence and factors associated with WRTP in South African physiotherapists treating musculoskeletal conditions using manual therapy techniques.

1.4 Objectives

- To determine the prevalence of WRTP in South African physiotherapists treating musculoskeletal conditions using manual therapy techniques.
- To determine what factors are associated with WRTP in these physiotherapists.
- To establish which methods the physiotherapists use to treat WRTP during application of manual techniques.

1.5 Overview of Research report

The research report is organised as follows:

- Chapter 2 presents the review of the literature
- Chapter 3 discusses the methods
- Chapter 4 present the results
- Chapter 5 elaborates and discusses the results
- Chapter 6 provides the conclusions and recommendations for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this literature review, the relevant literature on the prevalence of WRTP in physiotherapists using manual therapy techniques, factors associated with the development of the disorders as well as the intervention strategies for these WRTP are reviewed. The search engines used for this review were The Cochrane Library, EBSCO HOST (Academic Search Complete, CINAHL, ERIC, MEDLINE, and SPORTS Discuss), Pedro, PubMed and Science Direct. All articles post 2000 are reviewed. In addition, important relevant articles prior to this are included. The key words/phrases used to obtain the relevant articles were prevalence of work-related thumb pain, thumb pain in physiotherapists, factors associated with thumb pain, manual therapy.

The literature review is outlined as follows;

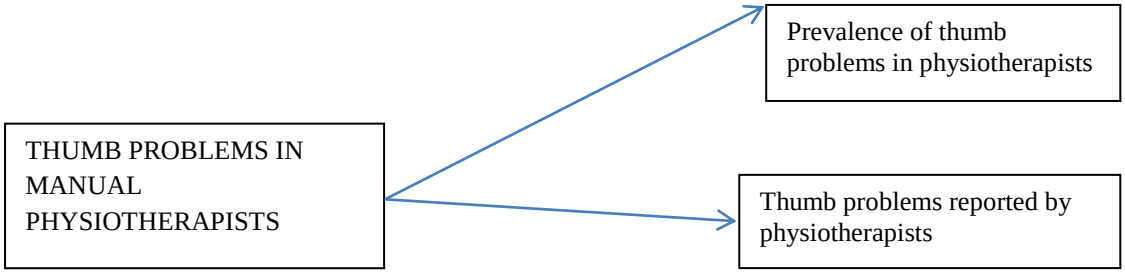


Figure 2.1 - Conceptual framework: Work-related thumb problems in manual physiotherapists

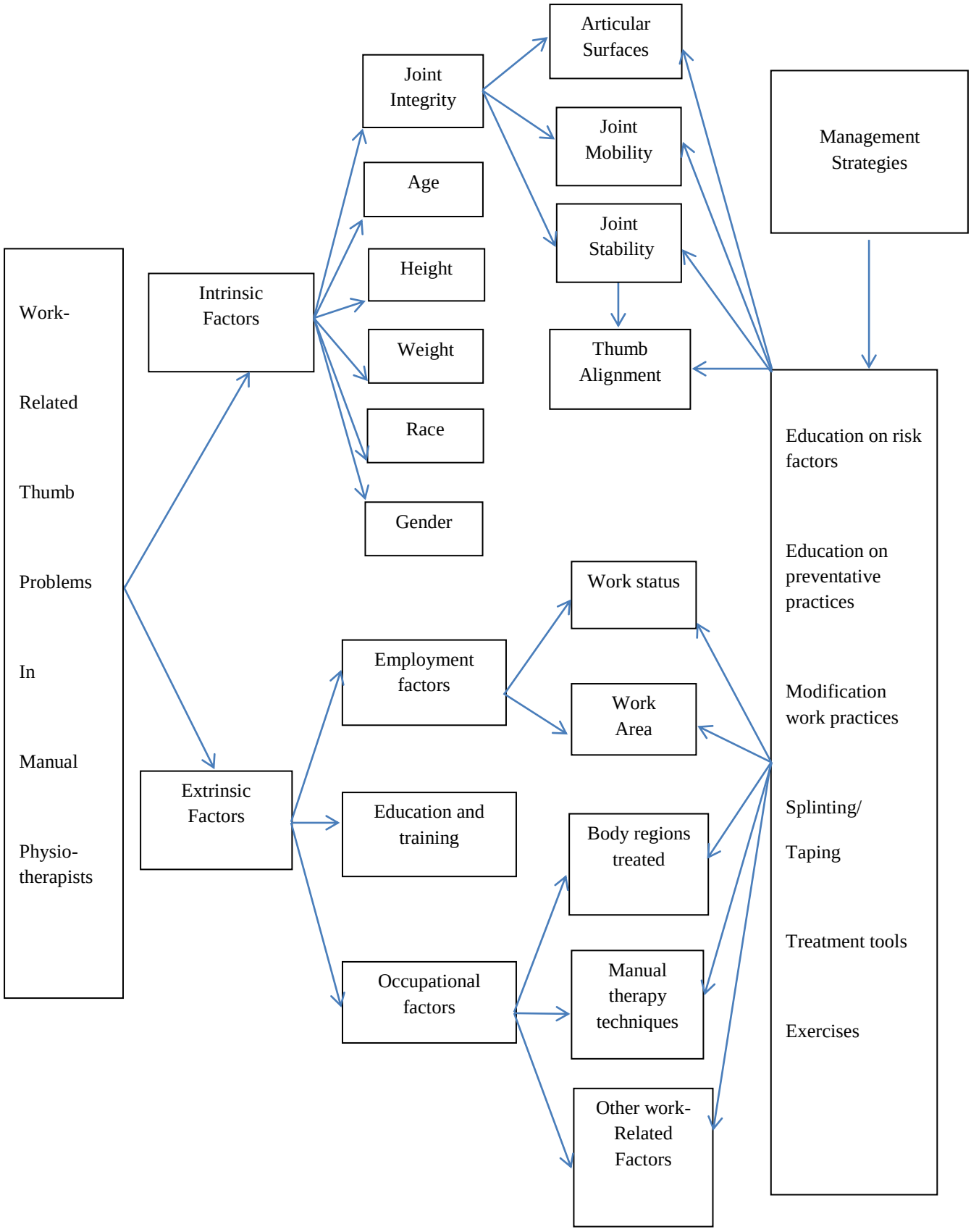


Figure 2.2 Conceptual framework: Factors associated with WRTP in manual therapists.

2.2 Prevalence of WRTP in physiotherapists

Prevalence measures the proportion of individuals who manifest a disorder at a specified time, or during a specified period (Saha et al., 2005). Point prevalence is the proportion of individuals who manifest a disorder at a given point in time (e.g., one day or one week), while period prevalence measures the proportion of individuals who manifest a disorder during a specified period of time. Annual prevalence which measures the proportion of individuals over a period of twelve months is an example of period prevalence. Lifetime prevalence is the proportion of individuals in the population who have ever manifested a disorder, who are alive on a given day. Several international studies have reported on either the lifetime prevalence or the annual prevalence of work-related musculoskeletal disorders in physiotherapists (Bork, 1996; Cromie et al., 2000; West and Gardner, 2001; Useh et al., 2001; Rozenfeld et al., 2010, Nordin et al., 2011).

The lifetime prevalence of work-related musculoskeletal disorders in physiotherapists in two American studies (Bork, 1996, Holder, 1999) was 32% while the prevalence in the surveys conducted subsequent to these were higher. In the studies conducted in Australia, Cromie et al. (2000) and West and Gardiner (2001) reported that the prevalence of work-related musculoskeletal disorders was 91% and 55% respectively. Useh et al. (2001) also reported a higher life time prevalence of work-related musculoskeletal disorders of 78%. An annual prevalence of 91.3% and 71.6% was reported by Adegoke et al. (2008) and Nordin et al. (2011) respectively. In these surveys, the low back region was the area with the highest prevalence of work-related musculoskeletal disorder affecting 29%-69.8% of respondents (Bork, 1996; Holder, 1999; Useh et al., 2003; Adegoke et al., 2008; Rosenfeld et al., 2010; Nordin et al., 2011).The neck was the next most prevalent injury in the study by Cromie et al. (2000) and Rozenfeld et al. (2010) affecting 45.5% to 47.6% of respondents. The life-time prevalence of hand injuries ranged from 25% to 33.9% (Cromie et al., 2000; West and Gardner, 2001; Obembe et al., 2008; Rozenfeld et al., 2010).

In surveys focussing on thumb and wrist disorders among physiotherapists (Barnes et al., 2011; McMahon et al., 2006; Wajon and Ada, 2003), the life time prevalence of WRTP was high, ranging from 62.5 % to 83 %. The difference in research design as well as the demographic characteristics of the three studies could account for the difference in the reported prevalence rates. Mc Mahon et al. (2006) and Wajon and Ada (2003) surveyed a random cross-section of physiotherapists while Barnes et al. (2011) surveyed all physiotherapists practising in a localised geographical location. The only South African study which was a survey localised to physiotherapists practicing in Bloemfontein in the Free State, reported a 62.5% (n=55) prevalence of thumb and wrist disorders (Barnes et al., 2011) whereas McMahon et al. (2006) and Wajon and Ada (2003) reported a 65.3% and an 83% lifetime prevalence respectively in national surveys conducted in Australia.

Wajon and Ada (2003), in contrast to the other two studies, included only physiotherapists with post-graduate qualifications in manual therapy. In Wajon and Ada's study (2003), 82% of the physiotherapists had worked more than 10 years in manual therapy whereas the median number of years the respondents had been practicing physiotherapy was eight year in the study by Barnes et al. (2011). The majority of physiotherapists who participated in the study by Wajon and Ada (2003) were aged between 41-50 years (48 %, n= 74). In contrast to this, the mean age of the physiotherapists in the studies by Barnes et al. (2011) and Mc Mahon et al. (2006) was 31 years and 39 years respectively. This could account for the higher prevalence (83%) of work related thumb pain in the study by Wajon and Ada (2003).

The higher life time prevalence in Wajon and Ada's (2003) study could be due to the lower response rate to the questionnaire (10.7%, n=155).The surveys done by Barnes et al. (2011) and Mc Mahon et al. (2006) can be considered as good quality studies as they had very good response rates to their questionnaires, namely 84,6% (n=88) and 68% (n=961), respectively compared to Wajon and Ada's study which had a response rate of 10.7% (n=155) of all Australians registered with Musculoskeletal Physiotherapy Australia and 22% (n=155) of physiotherapists who had post graduate qualifications.

Furthermore, the survey by McMahon et al. (2006) reports on the development of the questionnaire and the testing of the validity of the questionnaire in three pilot studies which further enhanced the quality of their study. A limited pilot study was done by two physiotherapy lecturers to enhance the face and content validity of the questionnaire by Barnes et al. (2011) whereas Wajon and Ada (2003) did not report on the validation of the questionnaires used in their survey. Wajon and Ada (2003) did however report extensively on the prevalence of the WRTP of the responding manual therapists.

2.3 WRTP reported by physiotherapists

The most reported WRTP in all the studies was the sensation of thumb pain (Barnes et al., 2011; McMahon et al., 2006; Wajon and Ada, 2003). Using the visual analogue scale (VAS) of 0-10, a mean value for the severity of pain experienced by the respondents was 4.2 (Barnes et al. (2011) and 3.75 (Wajon and Ada, 2003). Other thumb impairments included instability (22 %), weakness (ten %), and stiffness (five %), triggering (0.3 %) and three % reported other symptoms (McMahon et al., 2006).

The joints of the thumb commonly affected by these impairments in these physiotherapists was reported in four studies (West and Gardner, 2001; Wajon and Ada, 2003; Mc Mahon et al., 2006, Wajon and Ada, 2007). All these studies reported that the metacarpophalangeal (MP) joint was the most commonly affected joint of the thumb. West and Gardner (2001) reported 72 % of the physiotherapists experiencing pain in this joint, Mc Mahon et al. (2006) reported 31 % and Wajon and Ada reported 43 % and 47 % in their 2003 and 2007 studies respectively. The carpometacarpal (CMC) and interphalangeal (IP) joints are affected less frequently with the studies lacking agreement of the joint of the thumb least affected. With increasing age, the location of pain was found to be different (Wajon and Ada, 2003). They found that the youngest age group reported the highest incidence of MP joint pain and the oldest group had the highest incidence of pain in the CMC joint. Wajon and Ada, (2003) proposed that the MP joint pain could be linked to hypermobility of the MP

joints which made control of the MP joint difficult. They also reasoned that symptoms were more likely to move from the MP joint to the CMC joint of the thumb as time and instability progressed.

If the application of ergonomic principles is applied in the management of these WRTP experienced by physiotherapists using manual therapy techniques, one of the recommendations would be to discontinue the activities causing the thumb problem. However the effectiveness of manual therapy techniques has been demonstrated in a RCT (Korthals-de Bos et. al, 2003). It demonstrated that spinal mobilisation using manual therapy techniques is more effective and less costly than physiotherapy (exercises) or care by a general practitioner. It would therefore be unwise to dicontinue the techniques (Wajon and Ada, 2003). Preventative strategies should be sought to address the problem. This could be done by first identifying the potential risk factors.

2.4 Potential risk factors

There are many potential contributing factors that could explain why physiotherapists experience WRTP. These factors can be categorised into intrinsic or personal factors and extrinsic or environmental factors.

2.4.1 Intrinsic factors

These factors include the inherent physical attributes the physiotherapists possess (Snodgrass and Rivett, 2002; Atkinson and Maher, 2004; Wajon and Ada, 2003). This will include the age, gender, race and general size (weight and height) of the physiotherapist as well as the joint integrity. The joint integrity relates to the articular surfaces of the joints, mobility, stability and alignment of the joints of the thumb (Snodgrass and Rivett, 2002).

The joint at the base of the thumb, the CMC joint is a functionally unique and distinguishing feature of humans (Moulton et al., 2001). The CMC joint is biconcavoconvex, meaning that there are two reciprocally interlocking saddle shapes that oppose each other (Edmunds, 2011). The geometry of the trapezium in the CMC joint is concave in the anteroposterior view and convex in the lateral view

(Figure 2.3). The geometry of the thumb metacarpal surface in the joint is convex in the lateral view and concave in the anteroposterior view (Figure 2.3).

The differing radii of curvature of the concavo-convex articular surfaces allow a wide range of circumduction or opposition of the thumb (Moulton et. al., 2001; Austin, 2005). This allows the thumb to position itself so that it can work with the other digits of the hand enabling all forms of grasp and dexterity functions of the hand (Atkinson and Maher, 2004; Austin, 2005).

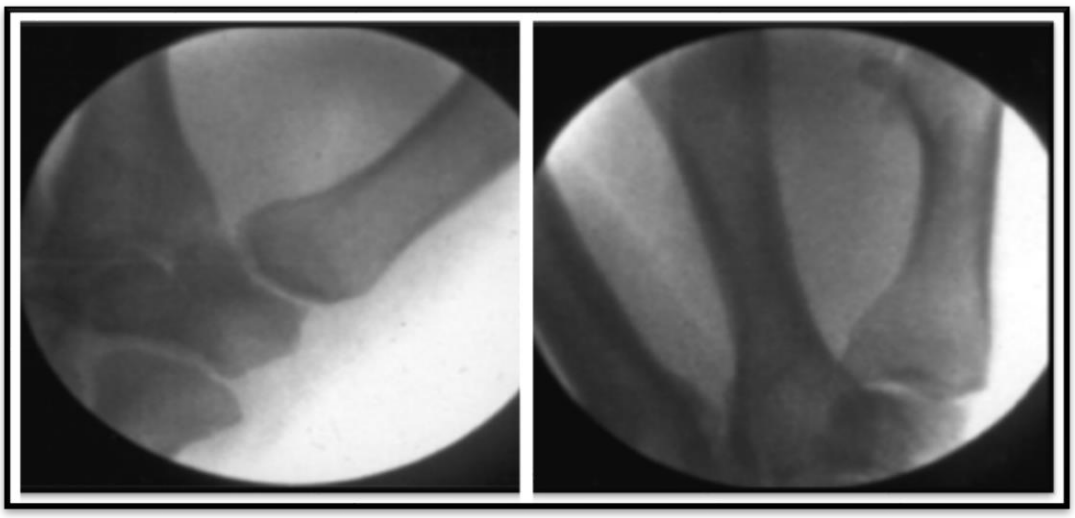


Figure 2.2 - X-ray views of the CMC joint

A. Anterior-posterior view. B. Lateral views (Edmunds, 2011).
In the AP view, the trapezium is concave and the thumb metacarpal is convex.
B In the lateral view, the trapezium is convex and the thumb metacarpal is concave.
Image taken from Edmunds (2011), page 174

The osseous configuration of the CMC joint of the thumb allows for maximum mobility for the intricate functions of the hand, there are positions where there is incongruity of the joint surfaces resulting in decreased stability of the CMC joint (Zancolli et al., 1987). For this reason Atkinson and Maher, (2004) questioned the physiotherapists' use of the thumbs in the application of longitudinal pressures used for some of the examination and treatment techniques. Atkinson and Maher (2004)

reproducing diagrams from Zancolli et al.(1987) illustrated diagrammatically (figure 2.4) how longitudinally directed forces would result in decreased articular contact and tend to sublux the metacarpal base (*) resulting in decreased stability of basal joint pain of the thumb during retroposition of the thumb which is the opposite movement to opposition of the thumb.

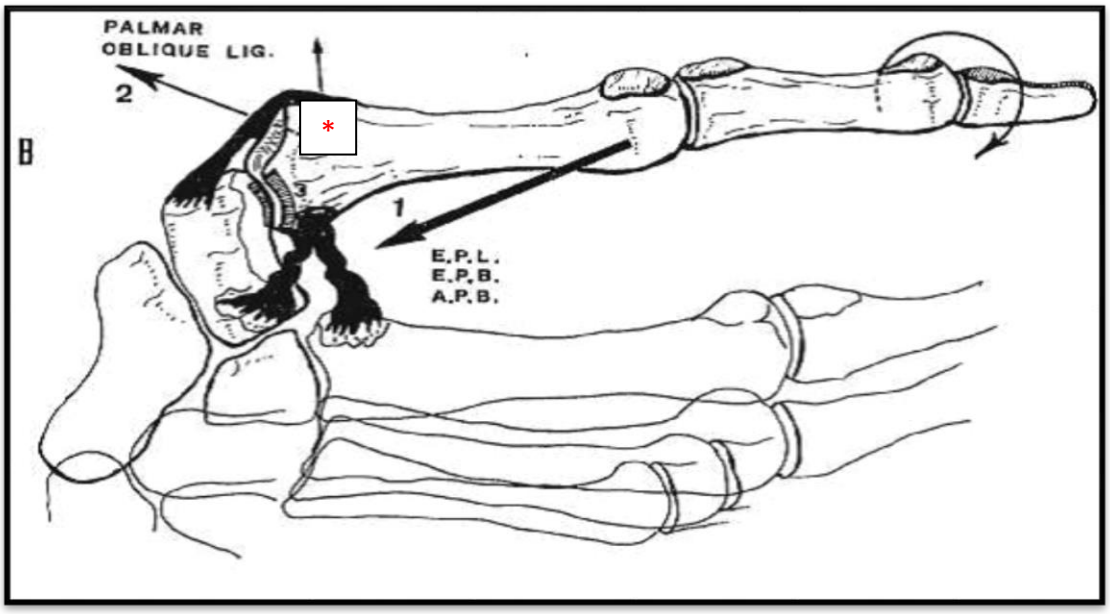


Figure 2.3 - Oblique radiographic projection to show CMC mechanics in retroposition

Retroposition produced by; 1.Retroposition muscles:

Extensor pollicis longus (Epl), Extensor pollicis brevis (Epb), Abductor pollicis brevis (Apb)

2. Activity of the palmar oblique Ligament **and** 3. Articular contact **(**decreased)

Physiological subluxation (*) occurs if the thumb is pinched against the radial side of the hand

.

Diagram taken from Zancolli et.al (1987), Figure 8B, page 23.

For this reason Atkinson and Maher, (2004) advocated that manual therapy examination and treatment techniques are best taught avoiding longitudinal pressure through the thumbs as the decreased stability at the base of the thumb will limit the surface area that is available to transmit the load across the joint resulting in stress on the ligaments and would account in part for the WRTP experienced by manual physiotherapists. According to Edmunds (2011), the key to the function and stability of the CMC

joint are the dorsal ligament complex, the beak of the thumb metacarpal and the recess in the trapezium (adjacent to the volar beak ligament) into which the volar beak inserts (Figure 2.5).

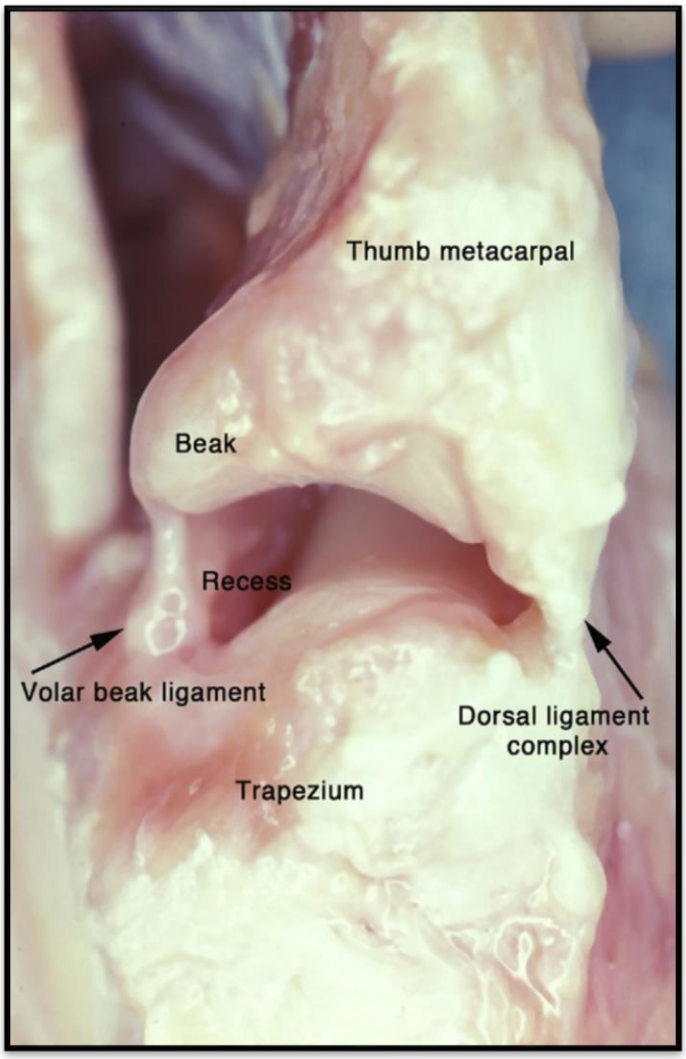


Figure 2.5 - The resting CMC joint

The volar beak with its attached volar beak ligament is disengaged from its recess in the volar trapezium.
The volar (palmar) beak ligament and the dorsal ligament complex are both lax in this position.
Image taken from Edmunds (2011), page172

These anatomical keys permit screw home torque rotation in the final phase of opposition, (Edmunds, 2011; Zancolli et al. (1987). Edmund (2011) emphasised the importance of the strength of the dorsal ligament complex in the force couple which consists of the dorsal ligament complex (2) and opposition muscles (1) in compressing the volar beak of the thumb metacarpal into the trapezium in the final stages of opposition (Figure 2.6).

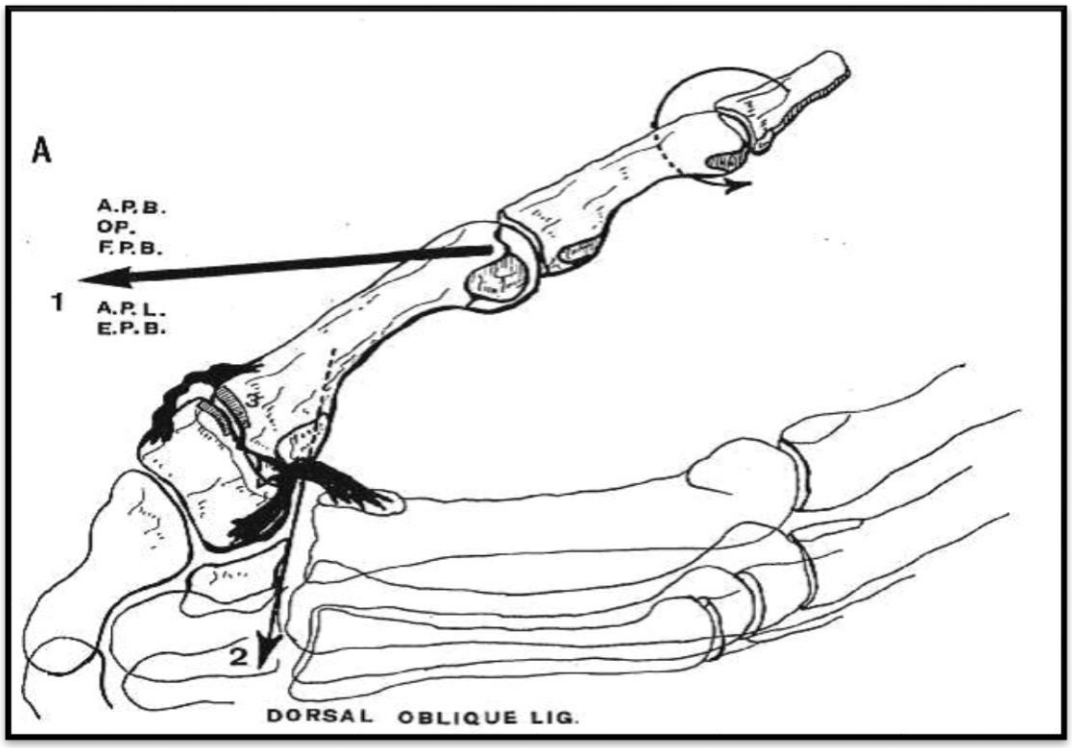


Figure 2.6 - Oblique radiographic projection to show CMC mechanics in opposition

Opposition produced by:

1. Opposition muscles:
Abductor pollicis brevis (Apb), Opponens pollicis (Op), Flexor pollicis brevis (Fpb), Abductor pollicis longus (Apl), Extensor pollicis brevis (Epb)

2. Dorsal ligament complex and 3**. Good articular contact.**

Diagram taken from Zancolli et.al (1987), figure 8A, page 23

In this position, a lax, incongruous CMC joint is converted to a rigidly stable, congruous joint (3) for precision grip and power gasp activities (Edmunds, 2011). However, although maximal in opposition, only 53% of the surface area of the trapezium is in contact with the metacarpal which could concentrate the pressure on the trapezium (Neumann and Bielefeld, 2003). In addition, the base of the first metacarpal is approximately 34% larger than the trapezium which would further concentrate the pressure on the trapezium (Colditz and Koekebakker, 2012). The result of years of "wear and tear" is degeneration (OA) of the CMC joint which could result in functional limitations including inability to open jars, turn keys or other resistive pinch grasps (Valdes and Marik 2010). Wilder et al. (2006)

investigating a sample size of 3327 participants in a community-based longitudinal study designed to follow the natural history of OA, reported a 21 % incidence of radiographic evidence of CMC arthritis in both males and females over 40 years. Although a 19% (n=4) prevalence of radiographic thumb CMC joint OA was present in the female physiotherapists in the Snodgrass et al (2003) study, the researchers admitted that the small sample size of the pain group in the study (n=24) could have inflated the prevalence figures. A meaningful comparison of the studies for radiographic degeneration of the thumb CMC joint can therefore not be done.

Koff et al. (2003) in cadaveric studies found cartilage wear patterns on both the volar-ulnar and dorso-radial regions of the trapezium while Kovler et al. (2004) found the dorso-radial quadrants of the trapezium more degenerated. Koff et al. (2003) theorised abnormally high stresses to be the cause while joint impingement from thumb pronation in lateral pinch was proposed by Kovler et al. (2004). In another study reviewing the theories of thumb instability and resultant degeneration, Moulton (2001), showed in a study on twenty fresh-frozen cadaveric forearm specimens that hyperextension of the MP joint is not always a compensatory response to adduction of the first metacarpal and subluxation of the CMC joint in OA. Although the range of motion in the first MP joint varies between individuals, it is usually far more restricted in range than the other MP joints of the hand (Austin, 2005). This is due to the reinforcement extracapsularly on its palmar surface by two sesamoid bones which are maintained in position by fibres of the collateral ligaments and inter-sesamoid ligaments. Moulton (2001) explained how increased ligament laxity of the MP joint, resulting in hyperextension could accelerate the development of CMC OA by adversely influencing the loading patterns of the thumb. When the base of the first metacarpal is pulled into flexion, the load is concentrated on the palmar CMC joint surface very close to the insertion of the palmar beak ligament where the first metacarpal and trapezium contact each other during functional activities. Degeneration then progresses in the CMC joint in a dorso-radial direction (Moulton, 2001).

Moulton (2001) also reported on how race could result in accelerated degenerative changes in the MP joint. Instability of the CMC joint could be related to race and gender according to Simpson (2006).

With regards to race, Moulton (2001) reported that people of African, Asian and Middle Eastern descent have increased joint laxity, which if it occurs at the MP joint, could result in the accelerated degeneration changes in this joint resulting in WRTP. Women are more prone to an increase in soft tissue laxity (Simpson, 2006) and more so during menopause (Hurwitz et al., 1996). The result is that women are ten to twenty times more likely to develop CMC joint arthritis than their male counterparts (Pellegrini, 2001). In addition less osseous stability of the joint is especially common in women who have a shallower trapezium saddle with thinner articular cartilage than men (Poole and Pellegrini, 2000). This results in less congruency of the articulating surfaces which also predisposes to degeneration of the joint (Poole and Pellegrini, 2000). In spite of the biomechanical changes that would predispose women to accelerated degeneration of the CMC joints of the thumb which would imply an increased prevalence or WRTP in women, there is controversy on whether gender is significantly associated with in physiotherapists. No significant association was found between gender and the development of work-related thumb pain (Barnes et. al., 2011; Wajon and Ada, 2003). In contrast, Adegoke et al. (2008), Glover (2002) and Bork (1996) reported a significantly higher prevalence of work-related thumb pain among female physiotherapists whilst Cromie (2000) and Mc Mahon (2006) reported the higher prevalence in male physiotherapists. Cromie (2000) contributed their findings to a greater usage of manual therapy techniques by the male physiotherapists while Mc Mahon (2006) reasoned that there are a great number of males in the orthopaedic out-patient area of practice where more time is spent performing manual therapy techniques which increased the risk of WRTP in the male physiotherapists.

Other potential intrinsic risk factors proposed by Snodgrass and Rivett (2002) and researched by Snodgrass et al. (2003), Hu et al. (2009) and Mc Mahon et al. (2006) were generalised laxity and specific hypermobility of the individual thumb joints. Self assessment for generalised hypermobility using the Beighton nine point scale (Beighton, 1973) was done by the physiotherapists in Mc Mahon's (2006) study while the assessment for hypermobility was done by the researchers in the studies done by Snodgrass (2003) and Hu et al. (2009). Mc Mahon et al. (2006) found a significant association between WRTP and MP and IP hyperextension ($p \leq 0.001$). Snodgrass et al. (2003) did not

find any difference in the mobility of the MP and IP joints between the pain and non-pain groups in their study groups but the pain group showed a significantly increased mobility at the CMC joints of the thumb (p= 0.04) .

The effect of generalised hypermobility and hand technique employed by physiotherapists on thumb tip force generation was tested in studies by Snodgrass et al. (2003) and Hu et al. (2009). In Hu et al's (2009) study, the participants were divided into a Novice group who had no exposure to manual therapy techniques and an Experienced group which consisted of physical therapy clinicians who had a minimum of three years orthopaedic experience. In contrast all the participants in Snodgrass et al's (2003) study were physiotherapists and were allocated to one of two groups; a Pain group and a Non-pain group. Work-related thumb pain needed to have been present within the previous year for the physiotherapist to be included in the Pain group. In the study by Hu et al. (2009), the participants were asked to perform posterior-anterior (PA) glides with maximum force with the dominant thumb on a load cell using three different hand placements as illustrated in Figure 2.7.

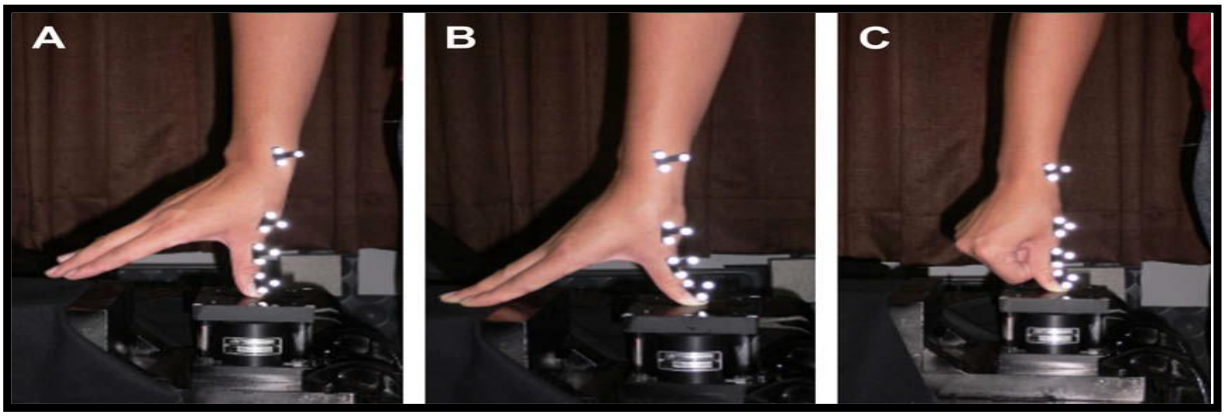


Figure 2.7 - Hand positions of PA glides performed on a load cell on a table.

A: Unsupported PA glides. B: PA glides with digits support. C: PA glides with IP supported by index finger

Image taken from Hu et al. (2009), page 492.

In contrast, the physiotherapists in the Snodgrass et al. (2003) study were instructed to use the hand placement that they would use in the clinical setting and then were categorised to one of three groups

according to their hand placement using photographs (Figure 2.8). They found extreme variability of hand placements and force with no significant differences between the Pain and Non-pain groups for force production or hand position during performance of the PA mobilisation technique.

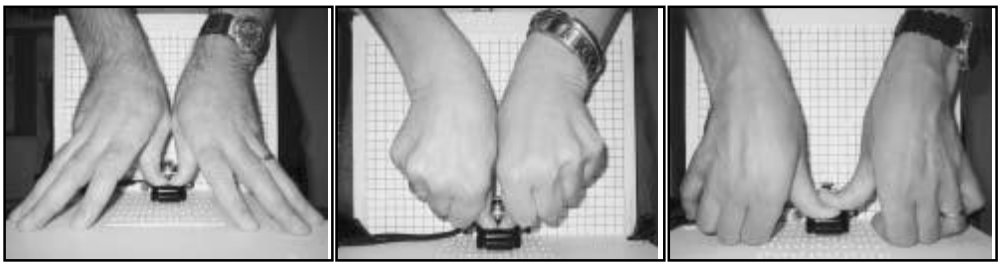


Figure 2.8 - Categorisation of hand placement

A: Thumbs not supported by index fingers, MP joints touching. B: Thumbs supported by index fingers. C: Thumbs not supported by index fingers, MP joints not touching.

Image taken from Snodgrass et al. (2003), page 244.

Hu et al. (2009) however, found inverse significant correlations ($p<0.05$) between joint laxity measured using the Beighton score and the force transmitted through the thumb tip with all three hand placements in the Novice group and in hand placement without digital support in the Experienced group. When applying more stable techniques however, experienced physiotherapists were able to compensate for the excessive flexibility because of their experience and training. Hu et al. (2009) concluded that higher forces could be delivered to the cervical spinous process if the IP joint of the thumb was supported by the neighbouring index finger during application of the PA glide as the supported position prevents hyper-extension of the joints of the thumb. They advocated that physiotherapists with excessive thumb hypermobility resulting in instability of the thumb joints adopt this supported thumb position to protect the thumb joints from injury.

Hu et al. (2009) and Snodgrass et al. (2003) reported on the hand placement during PA mobilisation and whether or not there was support for the thumb during application of the technique. Wajon et al. (2007) however reported on the alignment of the MP and IP joints during the application of the PA

mobilisation technique and investigated the association of the alignment of the thumb with work-related thumb pain. The study (Wajon et al., 2007) found a significant association between the alignment of the thumb during performance of PA glides and thumb pain. A surprise finding was that those physiotherapists who hyperextended their MP joint during the application of PA glide did not demonstrate an increase in the presence of work-related thumb pain as they had expected and was reported in earlier studies by Moulton (2001). Wajon et al. (2007) reasoned that the physiotherapists in their study applied longitudinal pressures through the tips of their thumbs whereas lateral pinch was used in Moulton's (2001) study. As longitudinal pressures were applied through the thumbs, maintenance of the MP and IP joints in extension during the performance of the PA glides was found to be least likely to be associated with thumb pain because the compressive force is transmitted longitudinally up the thumb to larger proximal joints which decreases the likelihood of thumb pain in the physiotherapist (Wajon et al., 2007). This was in agreement with Buckingham et al. (2007) who reasoned that the most efficient way to apply a vertical force at a point of contact was to remain perpendicular to the point. Whereas extension of the MP and IP joints during application of the PA mobilisation of the spine was recommended by Wajon et al. (2007), Buckingham et al. (2007) advocated neutral to slight flexion of the MP and IP joints for the application of the PA mobilisation to the spine.

Snodgrass and Rivett (2002) like Wajon and Ada (2007), also recommended extension of the MP joints but Snodgrass and Rivett (2002) unlike Wajon and Ada (2007) recommended hyperextension of the IP joint and not extension for PA glides to spine as Wajon and Ada did (2007). According to Snodgrass and Rivett (2002), hyperextension of the IP joint helps the physiotherapist place the pad of the thumb on the patient while positioning the rest of the thumb vertically over the IP joint for the application of the pressure. If the physiotherapists lack IP joint extension, Snodgrass and Rivett (2002) reasoned that the base of the thumb will be positioned further away from the point of contact when the thumb pad is applying the pressure. This resulted in greater compressive forces through the CMC and MP joints which would result in an increase in work-related thumb pain. As discussed

earlier, Hu's (2009) study disproved this and recommended the supported thumb position for physiotherapists who had excessive thumb mobility.

However it is not only the intrinsic physical attributes specific of the physiotherapists and the thumb alignment during application of the techniques that are associated with WRTP in physiotherapists treating musculoskeletal conditions using manual therapy techniques. Extrinsic factors associated with WRTP in physiotherapists have been reported in many studies (Cromie et al., 2000; Snodgrass and et. al., 2003, Wajon and Ada, 2003, Mc Mahon et. al., 2006 and Barnes et al., 2011)

2.4.2 Extrinsic factors

Extrinsic factors relate to the work setting of the physiotherapist. This includes the work status of the physiotherapist (part-time or full-time as well as number of hours worked daily or the number of patients treated daily using manual therapy techniques or the number of years performing manual therapy techniques), main area of practice, the body regions treated, as well as other work related factors.

Treating a high number of patients a day or working long hours was found to be aggravating factors in the studies done by Wajon and Ada (2003), Mc Mahon et al. (2006) and Barnes et al. (2011). Treating a high number of patients was reported by 76% and 95.9% of physiotherapists in studies by Mc Mahon et al. (2006) and Barnes et al. (2011) respectively. Working for long hours was reported by 61% of the respondents in the study done by Wajon and Ada (2003) and 73.9% of the respondents in the study by Barnes et al. (2011). Hours worked per week or years worked in a current area of practice was not significantly associated with WRTP (Mc Mahon et al., 2006). The highest percentage of WRTP (75%) was seen in the respondents who worked with orthopaedic out patients. Mc Mahon et al. (2006) found a significant association between the presence of WRTP and the current area of physiotherapy practice ($p < 0.001$).

Manual therapy techniques such as Maitland mobilisation, Mulligan mobilisation, manipulation and some soft tissue techniques require significant input from the physiotherapist's hands. Some techniques use the pad or tip of the thumb to apply the pressure and result in repetitive exertion of high level forces through the thumb joints (West and Gardner, 2001). An example of such a technique is the PA mobilisation or manipulation technique employed in the examination and treatment of vertebral disorders (Maitland, 2001). Other techniques include trigger point therapy where thumb pressure is applied to points of maximal tenderness or tightness in a muscle (Simons and Travell, 1999). The Sustained Natural Apophyseal Glides (SNAGS) applied to the spinous processes described by Mulligan (2003) is another example of a technique requiring sustained thumb pressures. An increased frequency and rate of oscillation of the thumb pressures as well as an increased length of time a technique is applied during manual therapy may also result in stress or strain the thumb joints (Snodgrass et. al., 2002).

An average thumb-tip force registered from a grade III central PA glide was reported to be 40 N (Hu et al., 2009). However the thumb tip force generated by physiotherapy manual therapy educators was 122.86 N when PA mobilisation was applied to a simulated neck of a hypothetical patient with hypomobility of C6 (Buckingham et al., 2007). In their experimental study only two fourth year physiotherapy students out of a total of 25 physiotherapy students could reach the target force set by the educators and still maintain the recommended alignment associated with stability of the thumb joints. Fourteen students could reach the target force but could not concurrently maintain their thumbs in the recommended position. The other nine students could not reach the required force or maintain the recommended thumb alignment (Buckingham et al., 2007). The researchers reasoned that if occupational factors were already affecting the stability of fourth year students, the results explained the findings of Cromie et al. (2000) who found that young graduate physiotherapists reported more WRTP. In fact Cromie et al. (2000), West and Gardiner (2001) and Barnes et al. (2011) reported that the most injuries and musculoskeletal conditions were reported by physiotherapists within the first five years of their working (56.4% and 56% and 47.7% respectively). Barnes et al. (2011) also

suggested that this could be due to the increased work load after graduating resulting in increased repetition of forces through the thumbs which could be responsible for the increased thumb pain.

Due to the increasing use of orthopaedic mobilisation techniques using the thumbs, there are worldwide reports of thumb pain in physiotherapists using manual therapy techniques in their management of musculoskeletal conditions (Cromie et al., 2000, West and Gardiner 2001, Wajon and Ada, 2003, Mc Mahon et al., 2006, Barnes et al., 2011). In the study by Wajon and Ada (2003) and Mc Mahon et al. (2006), the manual techniques described by Maitland (central and unilateral PA glides and transverse glides) were responsible for a greater percentage (75% to 87%) of physiotherapists work –related thumb pain. Wajon and Ada (2003), Mc Mahon et al. (2006) and Barnes et al. (2011) all reported that soft tissue techniques also aggravated the physiotherapists work-related thumb pain with 69%, 70% and 65.5 % of the physiotherapists reporting work-related thumb pain respectively.

A modified hand placement is recommended in an editorial column in a Manual therapy journal by Jull (2011) for all grades of the cervical PA glides to help decrease the WRTP in practicing physiotherapists so that less physiotherapists move to other areas of specialisation or leave the profession altogether. Hu (2009) had recommended support of IP joint of the thumb with the neighbouring index finger to prevent possible injuries to the thumb during PA glides to the spine. The importance of thumb support during the hand placement was not demonstrated however in an earlier study by Snodgrass et al. (2003). Buckingham et al. (2007) and Walsh (2011) proposed the use of taping applied to the thumb to help maintain the MP joint of the thumb in an extended position towards optimising conditions for the delivery of the posterior-anterior glide to the spine. Jull (2011) however advocated that the thumbs be used to localise and transmit the movement/force to the cervical segment, rather than being a point of movement/force production, resulting in less stress and pain in the thumbs. Jull (2011) recommended that the physiotherapist gain a good base of support for the thumbs by gently gripping the transverse process of cervical segment with the interphalangeal region of the index or middle fingers using a lumbrical grip, while the other fingers support the side of

the neck and the thumbs are placed on the cervical spinous process or articular pillar of the zygapophyseal joint as required. The hands and thumbs then become the stable and fixed 'operational unit' and movement is produced with forearm (elbow) flexion and extension. This ensures that the force required for segmental movement is produced more proximally to the point of contact on the neck. The effect is that the thumbs are not as a point of force production, resulting in less stress and pain in the thumbs.

Other factors that were associated with WRTP include the repeated execution of the same task, working with a current thumb injury, exceeding physical limitations without enough rest periods during the day (Mc Mahon et al., 2006; Barnes et al., 2011) as well as working in the same position for long periods and, working in uncomfortable positions (Barnes et al., 2011). Repeated execution of the same task was reported by the majority of the respondents (86% to 98.1%) as the main occupational factor associated with WRTP in these respondents. Education on preventative strategies and the creation of awareness amongst physiotherapists regarding WRTP was proposed by both studies and was received by 65.5% of the respondents in the South African study before the onset of their work-related thumb pain (Barnes et al, 2011) and only 29% of the respondents in the Australian study (Mc Mahon et al., 2006). In fact 37.8% - 40% of the respondents in these studies were of the opinion that there was inadequate thumb injury prevention training. According to Barnes et al. (2011) and Cromie et al. (2000), knowledge of ergonomics as well as education does not appear to offer the physiotherapists immunity from work-related injuries. Barnes et al. (2011) suggested that it was the demand of the job physically that was most likely to predispose to WRTP rather than the lack of education on preventative strategies.

Management strategies have been used by physiotherapists in an attempt to decrease the WRTP. These include modification of the manual therapy techniques, decreased use of manual therapy techniques, use of electrotherapy, use of hand therapy tools, splinting, taping of the thumb, stabilising exercises, stretching, massage, medication, surgery, decreasing work hours or changing occupations (Snodgrass et al., 2003; Wajon and Ada, 2003).

2.5 Management strategies

The most frequently used strategy was modification of manual therapy techniques and avoidance of manual therapy techniques (Snodgrass et al., 2003; Wajon and Ada, 2003). This was done by 87.5% and 74% of respondents in the study by Snodgrass et al. (2003) and Wajon and Ada (2003) respectively. Hand tools or ergonomic aids were used by 20.8% of the physiotherapists (Snodgrass et al., 2003). A change in career was considered by 27% (Wajon and Ada, 2003). Splinting and taping was utilised by approximately one third of physiotherapists in the prevention and treatment of WRTP (Snodgrass et al., 2003; Wajon and Ada, 2003, Mc Mahon et al., 2006).

Taping as a strategy for the prevention of work-related thumb pain proposed by Buckingham et al. (2007) was researched in a study by Walsh et al. (2011). They investigated the use of a taping applied to the thumb to help maintain the MP joint of the thumb in an extended position towards optimising conditions for the delivery of the posterior-anterior glide technique in line with the observation of Wajon et al. (2005). Forty final year student physiotherapists participated and were asked to apply a grade III PA mobilisation onto the seventh cervical vertebra of one of thirty two asymptomatic models and were then instructed to apply the same mobilisation onto a force measurement instrument, in both the taped and untaped conditions, while the alignment of their MP and IP joints was recorded using a video recorder. Thumb alignment improved in 72.5% of participants post taping, with significant increases in the number of MP joints maintained in a neutral alignment thus potentially influencing one of the contributory factors to work-related thumb pain (Walsh et al., 2011).

Splints which are designed to hold the distal end of the first metacarpal from the palm, thus preventing dorso-radial translation of the metacarpal base was proposed on recommendation by Colditz (2000) and Moulton (2001). This was considered especially important in physiotherapists who had difficulty in maintaining the correct alignment of the joints of the thumbs (Poole and Pellegrini, 2000). Careful assessment of the physiotherapist performing the technique aggravating the symptoms was suggested by Wajon and Ada (2005) to determine the appropriate splint provision. Wajon and Ada (2005) described several potential splints. These included the short opponens splint which only

supports the CMC joint, the dorsal blocking splint which includes the MP and IP joints and the strap splint which she designed and tested. In a systematic review, Kjeken et al. (2011) investigated the design and effects of splints and exercise programs in hand OA. The study by Wajon and Ada (2003) was included in the review. The systematic review showed consistent evidence for the reduction of hand pain when using the supportive thumb splints. Limited evidence was found for the effects of hand exercises and a combination of hand exercises and splints.

Valdes and von der Heyde (2012) developed and proposed an exercise program for CMC OA based on biomechanical principles gleaned from a literature review. Because of the decreased intra-osseous stability, they advocated strengthening of the thenar intrinsic muscles, thumb extensors and abductors. They also promoted preservation of the range of the CMC joint which would limit the increased muscle forces and stress on the CMC joint. In addition, Valdes and von der Heyde, (2012) discouraged lateral pinch and key pinch strengthening exercises in patients with advanced OA of the CMC joint as this encourages further subluxation and resistive grip exercises increase the force of the load on the trapezium six to twenty four times thereby increasing work-related thumb pain. Using the above principles, the use of exercise and splints as a preventative and management strategy for WRTP in physiotherapists using manual therapy techniques should be further investigated using randomised control trials.

It was proposed by some researchers that WRTP could also be prevented by the use of manual therapy tools to take the stress off the thumb joints (Maher et. al., 2002; Waddington, 2007). Trials of two manual therapy tools, Superthumb (Superthumb Pty Ltd, 2001) and a prototype of the Kneeshaw device was done by Maher et al. (2002). It revealed that physiotherapists who participated in the study did not find the devices comfortable or practical for use when compared to an alternate hand position in which pressure is applied with the ulnar side of the hand in the region of the pisiform bone. Since then, another tool, the MobDyn II was developed and tested for back and hand comfort in a study by Waddington et al. (2007).The mobilizing tool with a moulded rubber tip was found to be acceptably comfortable in use with asymptomatic backs and hands. It's use on symptomatic backs and by

physiotherapists who have work-related thumb pain was not tested (Waddington et. al., 2007). Screening of physiotherapy students for hypermobility was proposed as another preventative strategy. It was suggested by Snodgrass (2002) that those physiotherapists with hypermobility be made more aware of their inherent risk and take additional precautionary measures like splinting or taping of their thumbs during the application of manual therapy techniques using the thumbs. They also recommended the increased student awareness and education of all students on the potential risks and preventive strategies for WRTP in physiotherapists using manual therapy techniques.

2.6: Summary

WRTP have long been recognised as a prevalent problem especially in physiotherapists who administer manual therapy techniques (Reglar and James et. al., 1999; Cromie et al., 2000; West and Gardner, 2001; Wajon and Ada, 2003; McMahon et al., 2006; Barnes et. al., 2011). The workload demands of manual therapy, poor technique or intrinsic factors in the thumbs of these physiotherapists may be contributing to this problem. It is therefore important that a national South African study highlights the prevalence, aggravating factors and management strategies that are effective for this condition.

CHAPTER 3

METHODS

3.1 Introduction

This chapter outlines the methodology used in the study. Study design, ethical clearance, sample size and selection are explained. The procedure followed in the collection of the data as well as the statistical analysis of data is also described.

3.2 Study design

Observational study design using a cross-sectional, questionnaire-based method was done.

3.3 Ethical clearance

Ethical clearance was obtained from the Human Research Ethics Committee at the University of the Witwatersrand, Protocol number, M120429 (Appendix A).

3.4 Study period

The questionnaire was validated during May to July 2012. The pilot study was carried out in July 2012. Data collection was done from August to November 2012 for questionnaire one and December 2012 to February 2013 for questionnaire two.

3.5 Sample

3.5.1 Participants

The sample consisted of South African physiotherapists who completed the internet- based questionnaire on the Survey Monkey website. They were physiotherapists treating or have previously treated musculoskeletal conditions using manual therapy techniques. The way the physiotherapists were accessed for the study is explained in the procedure of the study.

3.5.2 Sample size

The sample size required for this survey was calculated to be 284 using 95% confidence levels and a 5% margin of error (http://www.ifad.org/gender/tools/hfs/anthropometry/ant_3.html). The formula and calculation is described in Appendix B.

3.5.3 Inclusion criteria

- ✓ South African physiotherapists who work in private practice as well as in the public sector treating musculoskeletal conditions using manual techniques.
- ✓ Physiotherapists older than 21 years
- ✓ Both males and females.

3.5.4 Exclusion criteria

- ✓ Any structural deformities affecting the upper limbs due to non-work-related causes.
- ✓ Any disease affecting the hands (e.g., Rheumatoid Arthritis, Scleroderma, Systemic Lupus Erythematous)
- ✓ Any injuries or operations to the thumb due to non-work-related causes.

3.6 Study tool

A questionnaire (Appendix E) was developed using similar studies from the literature (Mc Mahon et. al., 2006; Wajon and Ada, 2003; Barnes et al., 2011). An additional brief questionnaire (Appendix F) had to be designed to elicit information on gender which was omitted from the initial questionnaire due to a technical error. The literature revealed that there was still controversy whether gender was associated with the development of WRTP (Barnes et al., 2011). It was therefore considered important that this factor is included in this research report. The first question in Questionnaire two automatically excluded participants that had not responded to questionnaire one. The second question automatically excluded participants who had exited questionnaire one or who had been excluded from questionnaire one due to the exclusion criteria. The remaining questions included the gender question,

a question on age as well as a question eliciting information on the physiotherapists' membership with the special interest groups which specialise in the use of manual therapy techniques. The final question included the main outcome question on the presence or absence of WRTP.

3.7 Variables

3.7.1 Categorical variables

The categorical variables measured in the questionnaire included:

3.7.1.1 Personal factors

The personal information collected included the age, gender, height, weight and the qualifications of the respondents and their membership of special interest groups. Information on the presence or absence of generalised or thumb hypermobility was also collected. This was assessed by the participants who were all physiotherapists.

3.7.1.2 Employment history

The employment details elicited were the number of years worked as a physiotherapist, their current work status, the number of years worked in the different work areas, the number of years worked treating the different body regions and the number of patients treated per day with pathology in the different regions.

3.7.1.3 Education factors

The respondents provided information on whether they received education on the prevention of WRTP and when the education was received.

3.7.1.4 Occupational factors

Information was collected on the work-related activities that were associated with their WRTP.

3.7.2 Ranked (ordinal) variables

These included the level of current pain intensity and the level of difficulty associated with family responsibilities, recreational activities, social activities, self-care activities and occupation.

3.8 Management strategies

The physiotherapists provided information on the management strategies used to prevent or treat the WRTP and the effect of these management strategies.

3.9 Validation of questionnaire

Following compilation of the questionnaire, a panel of eight "experts" were invited to validate the questionnaire. All the experts had post graduate qualifications with a minimum of five years clinical experience (Appendix C). They included clinical physiotherapists, physiotherapy lecturers in manual therapy techniques as well as a lecturer with expertise in questionnaire development. The panel of "experts" commented on both the content of the questionnaire and the length of time taken to complete the questionnaire manually and online. The recommended changes to the questionnaire are included in Appendix D. The questionnaire was piloted following initial review by the 'expert' panel. It was sent to twelve physiotherapists employed in four private practices in Port Elizabeth. The physiotherapists were asked to comment on the content of the questionnaire and the time it took to complete. The average time taken to complete the questionnaire by this group of physiotherapists was twelve minutes. The question in which the physiotherapists had to quantify the time they spent on manual therapy was removed from the questionnaire as the practising physiotherapists found it difficult to quantify time in hours per week for manual therapy techniques. This was not a factor that was significantly associated with WRTP in a study surveying 1562 physiotherapists, in which 65% of the respondents had WRTP (Mc Mahon et al., 2006). A copy of the validated questionnaire is included in Appendix E.

3.10 Procedure

To access all physiotherapists, a link (www.surveymonkey.com/s/HeatherJenkinsSurvey) to questionnaire one was sent to the ten branch chairpersons of the South Africa Society of Physiotherapists as well as the chairpersons of the OMTG and Sports Therapy Special Interest Groups. A request was made to send the e-mail to all the members of the branch and to encourage physiotherapists using manual therapy techniques to complete the questionnaire. Follow up reminder e-mails were sent after 2 weeks and then a month later. The data collection period for questionnaire one was August to November 2012. The web link (www.surveymonkey.com/s/THUMBSURVEY) for questionnaire two was sent to the same group of physiotherapists in December 2012 due to the technical problems described earlier. Data collection for questionnaire two occurred from December 2012 to February 2013. The data from questionnaire two will be reported on separately from the data of questionnaire one.

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3.11 Analysis of data

The data collected from the Survey monkey website was exported to Microsoft Excel 2010 and then to Stata/IC 10.0 version 10 software to be analysed. Description analysis was done for both questionnaires to reduce ranked data to means and standard deviations and the categorical data to frequencies and percentages. Tests for association were conducted using the Pearson's chi squared test for categorical data and Spearman's rank correlation for ranked data (Mc Donald, 2009). In addition, univariate analysis and odds ratios for the potential risks factors associated with WRTP were determined. If one is not included into the 95% interval for the odds ratio, then the odds ratio is significant. From the 95% confidence interval we conclude with 95% certainty that the true but the unknown odds ratio fall within these limits. Relationship of the data that were significantly associated with WRTP in all 395 respondents was tested in a regression analysis. Testing was done at the 0.05 level of significance.

3.12 Summary

A cross-sectional, questionnaire-based study was done. A self-administered internet based questionnaire was validated, piloted and then used to collect data on the demographic characteristics, prevalence and associated factors of WRTP in physiotherapists using manual therapy treating musculoskeletal conditions. A second brief questionnaire was used to collect data on the association of age with WRTP in physiotherapists. The data from both questionnaires was analysed using Stata IC/ 10.0.

CHAPTER FOUR

RESULTS

4.1 Introduction

In this chapter, the results of the data analysis are presented. The results of survey one is presented first followed by the results of survey two. Flow diagrams, figures and tables are used to present the data where appropriate. The tables and figures will present the demographics; the work characteristics of the physiotherapists, a description of the WRTP including the prevalence and factors associated with the problem.

4.2 Response rate

The link to the questionnaire one was sent to all 3532 members registered with the South African Society of Physiotherapists (SASP) as well as members of the OMTG and Sports Group which are special interest groups within the society. Four hundred and fifty six (456) physiotherapists responded to the invitation to participate in the study. The **response rate was 12.9% of the total population of physiotherapists registered with the SASP**. However not all physiotherapists were eligible to participate as only physiotherapists using manual therapy techniques were invited to participate. Therefore physiotherapists in other specialities would not have responded to the e-mail. If this is taken into consideration, the calculated response rate would be greater. A calculation of the response rate using physiotherapists registered with the OMTG of the SASP in 2012 (N=1412) would give an estimated response rate of 32.3% which could possibly be less as not all physiotherapists using manual therapy techniques are registered with the OMTG. However the sample size calculated for the study was 284 (Appendix B). The respondents included in the study (n=395) represent 39% (n=111) more respondents than required.

4.3 Flow of respondents through study

The flow diagram below illustrates the flow of respondents through the study in response to questionnaire one.

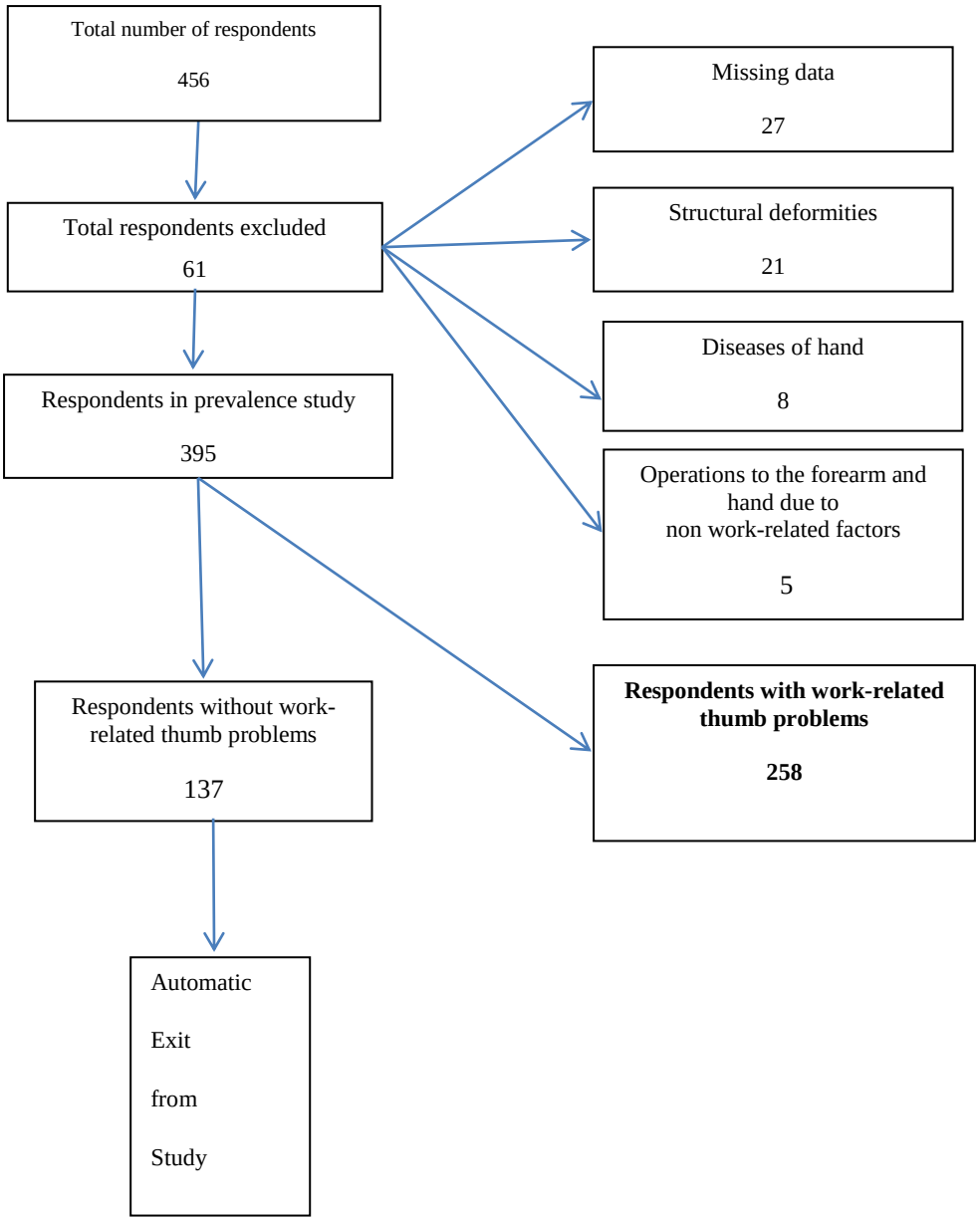


Figure 4.1 - Flow diagram of respondents

The flow diagram shows that 86.6% of the respondents (n=395) completed the prevalence study. The respondents who were excluded from this section of the survey are demonstrated and the reasons are given. Thereafter, the respondents that did not have WRTP (n=137) exited the study and the remaining respondents (n=258) proceeded with the section of the survey on the occupational factors associated with their WRTP and the management strategies used to prevent or treat the WRTP.

4.4 The prevalence of WRTP in physiotherapists using manual therapy techniques

The prevalence of WRTP in physiotherapists using manual therapy techniques is illustrated in Figure 4.2.

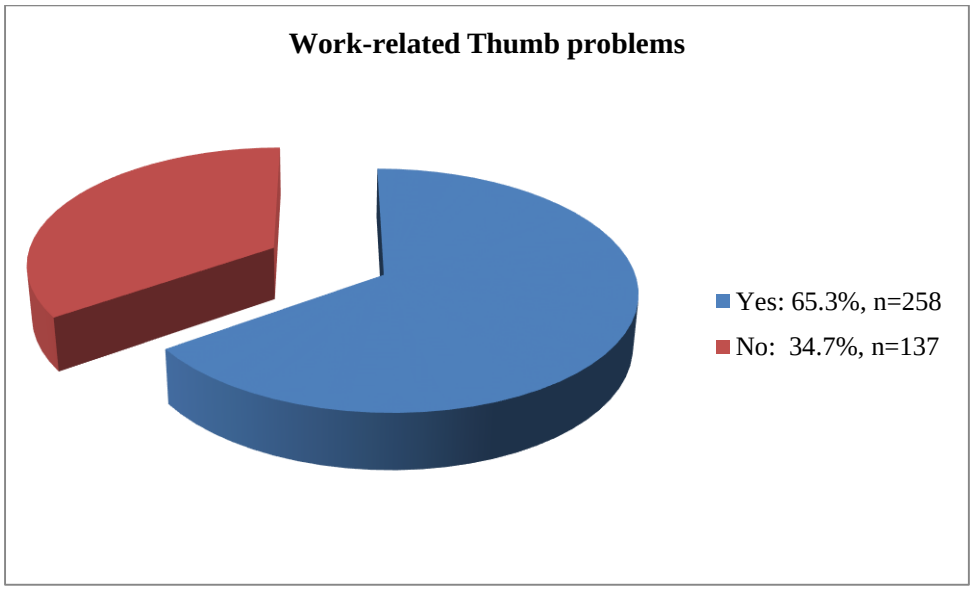


Figure 4.2 - Prevalence of WRTP in physiotherapists using manual therapy techniques (N=395).

The life time prevalence of WRTP among the respondents was 65.3% (n=258).

4.5 Demographic characteristics of the respondents and their relationship with WRTP

The age distribution of the respondents with WRTP is shown in Table 4.1.

Table 4.1 Age distribution and WRTP prevalence in participants (n=395)

Age range (years)	WRTP n (%)	No WRTP n (%)	Total n (%)
20-30 years	84 (21.3)	36 (9.1)	120 (30.4)
31-40 years	78 (19.7)	49 (12.4)	127 (32.1)
41-50 years	55 (13.9)	33 (8.3)	88 (22.3)
51-60 years	33 (8.3)	12 (3.1)	45 (11.4)
>60 years	8 (2.0)	7 (1.8)	15 (3.8)
Total n (%)	258 (65.3)	137 (34.7)	395 (100)

The majority of the respondents (62.5%, n=247), were younger than 40 years. Only 15.2 % (n=60) of the respondents were older than 50 years. The greatest prevalence of WRTP was evident in the 20-30 years age group (21.3%, n=84). Age was not significantly associated with WRTP in the respondents (p=0.34).

The prevalence of WRTP within the 20-30 years age group as well as the 51-60 years age group which also had a high prevalence of WRTP is shown in Table 4.1.1

Table 4.1.1 Prevalence of WRTP in the 20-30 years and 51-60 years age group

Age group in years	**20-30**	**51-60**
WRTP	84 (70.0)	33 (73.3)
No WRTP	36 (30.0)	12 (26.7)
Total n (%)	120 (100)	45 (100)

A high prevalence of WRTP was found in the 51-60 years age group (73.3%, n=33) and the 20-30 years age group (70%, n=84)

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The height distribution of the respondents with WRTP is shown in Table 4.2

Table 4.2 Height distribution and WRTP prevalence in participants (n=395)

Height (cm)	**WRTP n (%)**	**No WRTP n (%)**	**Total n (%)**
<150	3 (0.7)	1 (0.3)	4 (1)
151-160	56 (14.2)	27 (6.8)	83 (21)
161-170	108 (27.3)	56 (14.2)	164 (41.5)
171-180	76 (19.2)	46 (11.7)	122 (30.9)
>180	15 (3.8)	7 (1.8)	22 (5.6)
Total n (%)	258 (65.3)	137 (34.7)	395 (100)

The majority of the study population were in the 161cm to 170cm height range distribution (41.5%, n=164). Twenty seven percent of the respondents (27.3%, n=108) who had WRTP were in this height range. Height was not significantly associated with WRTP in the respondents (p=0.92).

Within the height groups of respondents less than 150cm and between 161 and 170 cm, a high prevalence of WRTP was demonstrated. The results are shown in Table 4.2.1

Table 4.2.1 Prevalence of WRTP within height groups with heights < 150cm and 161-170cm

Height (cm)	**<150**	**161-170**
WRTP	3 (75.0)	108 (65.9)
No WRTP	1 (25.0)	56 (34.1)
Total n (%)	4 (100)	164 (100)

The highest prevalence of WRTP was found in the respondents with heights less than 150cm (n=3).

The weight distribution of the respondents with WRTP is shown in Table 4.3.

Table 4.3 Weight distribution and WRTP prevalence in participants (n=395)

Weight (kg)	**WRTP n (%)**	**No WRTP n (%)**	**Total n (%)**
<50 kg	13 (3.3)	3 (0.7)	16 (4.0)
50-60 kg	85 (21.5)	44 (11.1)	129 (32.6)
61-70 kg	73 (18.6)	45 (11.3)	118 (29.9)
71-80 kg	52 (13.2)	22 (5.5)	74 (18.7)
81-90 kg	23 (5.8)	16 (4.1)	39 (9.9)
>90 kg	12 (3.0)	7 (1.8)	19(4.8)
<50 kg	13 (3.3)	3 (0.7)	16 (4.0)
Total n (%)	258 (65.3)	137 (34.7)	395 (100)

Respondents weighing between 50 and 60 kilograms formed the largest part of the study population (32.6%, n=129). Weight was not significantly associated with WRTP in the respondents (p=0.55).

The 50-60kg weight group and the weight group less than 50 kg had the greatest prevalence of WRTP within their groups. The results are shown in Table 4.3.1.

Table 4.3.1 Prevalence of WRTP within weight groups with weights<50 kg and 50-60kg

Weight (kg)_	**<50**	**50-60**
WRTP	13 (81.2)	85 (65.9)
No WRTP	3 (18.8)	44 (34.1)
Total n (%)	16 (100)	129 (100)

The weight group of respondents that weighed less than 50 kilograms (4%, n=16) had the highest prevalence of WRTP (81.2%, n=13).

The race distribution of the respondents with WRTP is shown in Table 4.4.

Table 4.4 Race distribution and WRTP prevalence in participants (n=395)

Race	**WRTP n (%)**	**No WRTP n (%)**	**Total n (%)**
Asian	14 (3.6)	6 (1.5)	20 (5.1%)
Black	6 (1.5)	6 (1.5)	12 (3.0%)
Coloured	16 (4.0)	11 (2.8)	27 (6.8%)
White	222 (56.2)	114 (28.9)	336 (85.1)
Total n (%)	258 (65.3)	137 (34.7)	395 (100)

The majority of the study population were white physiotherapists (85.1%, n=336). Race was not significantly associated with WRTP in the respondents (p=0.58).

Further analysis of the study population within the race groups follows in Table 4.4.1

Table 4.4.1 Prevalence of WRTP within race groups

Race group	**Asian**	**Black**	**Coloured**	**White**
WRTP	14 (70)	6 (50.0)	16 (59.3)	222(66.1)
No WRTP	6 (30)	6 (50.0)	11 (40.7)	114 (33.9)
Totals n (%)	20 (100)	12 (100)	27 (100)	336 (100)

The majority of physiotherapists in the Asian population reported WRTP (70.0%, n=14). The Black physiotherapists reported the lowest prevalence of WRTP (50%, n=6). The qualifications of the respondents were not significantly associated with WRTP in the respondents (p=0.50).

The qualifications distribution of the respondents with WRTP is shown in Table 4.5.

Table 4.5 Qualifications distribution and WRTP prevalence (n=395)

Qualification	WRTP n (%)	No WRTP n (%)	Total n (%)
OMTG	130 (32.9)	69 (17.5)	199 (50.4)
Nil	92 (23.3)	49 (12.4)	141 (35.7)
Other	9 (2.3)	39 (9.8)	48 (12.1)
Sports and Exercise	18 (4.6)	17 (4.3)	35 (8.9)
Community Health	9 (2.3)	4 (1.0)	13 (3.3)
Paediatrics	6 (1.5)	2 (0.5)	8 (2.0)
Neurology/Neurosurgery	5 (1.2)	1 (0.3)	6 (1.5)
Respirology/cardiothoracic	3 (0.7)	1 (0.3)	4 (1.0)
Orthopaedic surgery	2 (0.5)	0 (0)	2 (0.5)
Trauma	2 (0.5)	0 (0)	2 (0.5)
Total			458 (115.9)

There were physiotherapists that had more than one post graduate qualification (n>395, n=458). Other areas of qualification included women's' health, neuromuscular stimulation, acupuncture and dry needling, Mc Kenzie, ergonomics, neuro- development therapy, pilates, craniosacral therapy, Masters in Business Administration (Health) and Bachelor of Arts (Social sciences). Fifty percent of the study population (50.4%, n=199) had post graduate qualification in Orthopaedic manipulative therapy. These physiotherapists had the greatest prevalence of WRTP (32.9%, n=130).

Further analysis of the respondents in the OMT group and those with no qualifications is shown in Table 4.5.1. These two groups are also compared with the total study population of this study.

Table 4.5.1 Prevalence of WRTP in OMTG, No qualification group, and Study population

Physiotherapy group	OMTG	No qualification	Study population
WRTP	130 (65.3)	92 (65.3)	258 (65.3)
No WRTP	69 (34.7)	49 (34.7)	137(34.7)
	199 (100)	141(100)	395 (100)

The respondents who had post graduate qualifications in OMT as well as those without any post graduate qualifications each had a 65.3% life time prevalence of WRTP. This was equal to the life time prevalence of WRTP in the study population.

Table 4.6 shows the relationship of the demographic factors within their categories and the presence WRTP.

Table 4.6 Relationship of the demographic factor categories with WRTP (n=258)

Demographic factor	**Category**	**WRTP n (%)**	**Odds Ratio (OR)**	**95% Confidence Interval**	**p- value**
Age	20-30 years	84 (32.5)	1	-	-
	31-40 years	78 (30.2)	0.8	0.4-1.3	0.2
	41-50 years	55 (21.3)	0.7	0.4-1.3	0.3
	51-60 years	33 (12.8)	1.2	0.5-2.5	0.7
	>60 years	8 (3.1)	0.5	0.2-1.4	0.2
Weight	<50kg	13 (5.0)	1	-	-
	50-60kg	85 (32.9)	0.8	0.5-1.4	0.5
	51-60kg	73 (28.3)	1.2	0.7-2.2	0.5
	61-70kg	52 (20.1)	0.7	0.3-1.5	0.4
	81-90kg	23 (8.9)	2.2	0.6-8.3	0.2
	>90kg	12 (4.6)	0.9	0.3-2.4	0.8
Height	<150cm	3 (1.2)	1	-	-
	150-160cm	56 (21.7)	0.9	0.5-1.6	0.8
	161-170cm	108 (41.9)	0.8	0.4-1.4	0.4
	171-180cm	76 (29.4)	1.4	0.1-14.5	0.7
	>180cm	15 (5.8)	1.0	0.4-2.8	0.9
Qualification	Community health	9 (3.5)	1	-	-
	Neurology	5 (1.9)	-	-	-
	Nil	92 (35.6)	1.4	0.3-6.5	0.6
	OMTG	130 (50.4)	1.7	0.4-7.9	0.4
	Ortho surgery	2 (0.8)	-	-	-
	Paediatrics	6 (2.3)	2.2	0.2-2.0	0.5
	Other	29 (11.2)	1.1	0.2-5.7	0.9
	Respiratory, cardiothoracic	3 (1.2)	1.5	0.1—25.4	0.8
	Sports	18 (7.0)	0.7	0.1-3.6	0.7
	Trauma	2 (0.8)	-	-	-

None of the demographic factor categories were significantly associated with WRTP ($p>0.05$).

4.6 Hypermobility

4.6.1 Generalised hypermobility

Table 4.7 illustrates the generalised hypermobility and the prevalence of WRTP in the respondents.

Table 4.7 Distribution of Generalised hypermobility and prevalence of WRTP (n=395)

Generalised Hypermobility	Category	**WRTP n (%)**	**No WRTP n (%)**	**Total n (%)**
Elbow hyperextension>10°	Yes: Dominant	37 (9.4)	22 (5.6)	59 (15.0)
	Yes: Non-dominant	28 (7.1)	18 (4.5)	46 (11.6)
	No	220 (55.7)	114 (28.9)	334 (84.5)
	Total n (%)	285 (72.1)	154 (39.0)	439 (111.1)
Knee hyperextension>10°	Yes: Dominant	48 (12.1)	13 (3.3)	61 (15.4)
	Yes: Non-dominant	43 (10.9)	11 (2.8)	54 (13.7)
	No	209 (52.9)	123 (31.1)	332 (84.0)
	Total n (%)	300 (75.9)	147 (37.2)	447 (113.1)
Passive flexion of thumb to anterior forearm	Yes: Dominant	41 (10.4)	15 (3.8)	56 (14.2)
	Yes: Non-dominant	37 (9.4)	10 (2.5)	47 (11.9)
	No	209 (52.9)	122 (30.9)	331 (83.8)
	Total n (%)	287 (72.6)	147 (37.2)	434 (109.9)
Passive hyperextension of MP joint of LF	Yes: Dominant	36 (9.1)	16 (4.0)	52(13.2)
	Yes: Non-dominant	29 (7.3)	12 (3.0)	41 (10.4)
	No	219 (55.4)	120(30.4)	339 (85.8)
	Total n (%)	284 (71.9)	148 (37.5)	432(109.4)
Bend trunk forwards to touch floor with knees	Yes	74 (18.7)	42 (10.6)	116 (29.4)
	No	184 (46.6)	95 (24.0)	279 (70.6)
	Totals	258 (65.3)	137 (34.7)	395 (100)

The respondents that were hypermobile were in the minority (less than 15.4 %, $n<61$) for four out of five of the parameters. More respondents (29.4%, n=116) of the respondents could bend forward and touch the floor with the palms with the knees extended.

The prevalence of WRTP within each generalised hypermobility group is shown in Table 4.8.

Table 4.8 Generalised hypermobility and prevalence of WRTP within generalised hyper mobility groups (n=395)

Category	Elbow hyperextension> 10° n (%)	**Knee hyperextension >10° n (%)**	**F of thumb to anterior forearm n (%)**	**Passive LF hyperextension >90° n (%)**	**Touch palms to floor with knee extension n (%)**
WRTP	65 (62 .0)	91 (79.1)	78 (75.7)	65 (69.9)	74 (63.8)
No WRTP	45 (38.0)	24 (20.9)	25 (24.3)	28 (30.1)	42 (36.2)
Totals	105 (100)	115 (100)	103 (100)	93 (100)	116 (100)
p value	0.80	0.06	0.09	0.70	0.70

Within the generalised hypermobility categories, the greatest prevalence of WRTP was found in respondents who had hyperextension of the knees (79.1%, n=78). Generalised hypermobility was not associated with WRTP in the respondents (p>0.05).

The relationship of the generalised hypermobility categories with WRTP is shown in Table 4.9.

Table 4.9 Relationship of generalised hypermobility with WRTP (n=258)

Demographic factor	**Category**	**WRTP n (%)**	**Odds Ratio(OR)**	**95% Confidence Interval**	**p- value**
Elbow hyperextension>10°	No	220 (55.7)	1	-	-
	Yes: dominant	37 (14.3)	1.04	0.34-3.1	0.9
	Yes: non-dominant	28 (10.8)	0.81	0.42-1.5	0.5
Knee hyperextension>10°	No	209 (81)	1	-	-
	Yes: dominant	48 (18.6)	1.2	0.3-4.8	0.8
	Yes: non-dominant	43 (16.7)	2.3	1.1-4.6	**0.02**
Passive F thumb to anterior forearm	No	209 (81)	1	-	-
	Yes: dominant	41 (15.9)	1.4	0.5-4.1	0.5
	Yes: non-dominant	37 (14.3)	2.1	1.0-4.5	**0.04**
Passive LF hyperextension >90	No	219 (84.9)	1	-	-
	Yes: dominant	36 (13.9)	1.1	0.4-3.3	0.8
	Yes: non-dominant	29 (11.2)	1.2	06-2.7	0.4
Touch palms to floor with knees E	No	184 (71.3)	1	-	-
	Yes	74 (28.7)	0.9	0.6-1.4	0.7

Non-dominant knee hyperextension greater than ten degrees (p=0.02) and passive flexion of the non-dominant thumb to the anterior forearm (p=0.04) was significantly associated with WRTP. The risk of developing WRTP increased 2.3 fold in respondents who had knee extension greater than ten degrees on the non-dominant side.

4.6.2 Thumb hypermobility

The hypermobility characteristics of the MP joints and IP joints of the thumbs of the respondents are presented in Table 4.10.

Table 4.10 Thumb hypermobility and prevalence of WRTP (n=395)

Thumb hypermobility	Category	WRTP n(%)	No WRTP n(%)	Total n (%)	p value
IP joint hyperextension, (CMC, MP in E): Dominant	Yes between 0°-30°	108 (27.3)	69 (17.5)	177 (44.8)	
	Yes, >30°	62 (15.7)	20 (5.1)	82 (20.7)	
	No	88 (22.3)	48 (12.1)	136 (34.4)	0.31
	Totals n (%)	258 (65.3)	137 (34.7)	395 (100)	
IP joint hyperextension, (CMC, MP in E): Non-dominant	Yes between 0°-30°	107 (27.1)	67(17.0)	174 (44.0)	
	Yes, >30°	62 (15.7)	17 (4.3)	79 (20.0)	
	No	89 (22.5)	53 (13.4)	142 (35.9)	**0.02**
	Totals n (%)	258 (65.3)	137 (34.6)	395 (100)	
MP joint hyperextension, (CMC joint in E): Dominant	Yes between 0°-30°	121 (30.6)	62 (15.7)	183 (46.3)	
	Yes, >30°	37 (9.4)	17 (4.3)	54 (13.7)	
	No	100 (25.3)	58 (14.7)	158 (40.0)	0.75
	Totals n (%)	258 (65.3)	137 (34.6)	395 (100)	
MP joint hyperextension, (CMC joint in E): Non-dominant	Yes between 0°-30°	123 (27.3)	56 (14.2)	179 (45.3)	
	Yes, >30°	34 (8.6)	18 (4.5)	52 (13.2)	
	No	101 (25.6)	63 (15.9)	164 (41.5)	0.38
	Totals n (%)	258 (65.3)	137 (34.7)	395 (100)	

Thumb hypermobility	Category	WRTP n(%)	No WRTP n(%)	Total n (%)	p value
MP joint hyperextension, (CMC joint in F): Dominant	Yes between 0°-30°	132 (33.4)	64 (16.2)	196 (49.6)	0.31
	Yes, >30°	38 (9.6)	16 (4.0)	54 (13.7)	
	No	88 (22.3)	57 (14.4)	145 (36.7)	
	Totals n (%)	258 (65.3)	137 (34.7)	395 (100)	
MP joint hyperextension, (CMC joint in F) Non-dominant	Yes between 0°-30°	132 (33.4)	61 (15.4)	194 (49.1)	0.10
	Yes, >30°	38 (9.6)	15 (3.8)	53 (13. 4)	
	No	88 (22.3)	61 (15.4)	148 (37.5)	
	Totals n (%)	258 (65.3)	137 (34.6)	395 (100)	

Although only a minority of physiotherapists had generalised hyper mobility (<15.4%, n=16), the majority of the respondents (>44%, n=174) had hypermobility of the joints of the thumbs between 0°-30°. More physiotherapists had hyperextension between 0°-30° of the dominant MP joint with the CMC joint in flexion (49.6%, n=196). Non dominant IP hyperextension with the CMC and MP joints in E was significantly associated with WRTP in the respondents (**p=0.02**).

The prevalence of WRTP in respondents with thumb hypermobility (>30°) is shown in Table 4.11.

Table 4.11 Prevalence of WRTP in respondents who have thumb hypermobility >30°

Category	IP joint hyper E (CMC/MP joints in E): Dominant	IP joint hyper E (CMC/MP joints in E): **Non-dominant**	**MP joint hyper E (CMC joint in E): Dominant**	**MP joint hyper E (CMC joint in E): Non-dominant**	**MP joint hyper E (CMC joint in F): Dominant**	**MP joint hyper E (CMC joint in F): Non-dominant**
WRTP n (%)	62 (75.6)	62 (78.5)	37 (68.5)	34 (65.4)	38 (70.3)	38 (71.7)
No WRTP	20 (24.4)	17 (21.5)	17 (31.5)	18 (34.6)	16 (29.7)	15 (28.3)
Totals n (%)	82 (100)	79 (100)	54 (100)	52 (100)	54 (100)	53 (100)

The highest prevalence of WRTP was found in respondents with IP joint hyperextension greater than 30° with the CMC/MP joints in E (Dominant: 75.6%, n=62; Non-dominant: 78.5%, n=62).

The prevalence of WRTP in respondents with thumb hypermobility (0°-30°) is shown in Table 4.12.

Table 4.12 Prevalence of WRTP in respondents who have thumb hyper mobility (0°-30°)

Category	IP joint hyper E Dominant	**IP joint hyper E Non-dominant**	**MP joint hyper E (CMC joint in E):Dominant**	**MP joint hyper E (CMC joint in E):Non-dominant**	**MP joint hyper E (CMC joint in F):Dominant**	**MP joint hyper E (CMC joint in F) Non-dominant**
WRTP n (%)	123 (64.0)	132 (66.3)	121 (66.1)	123 (68.7)	132 (67.3)	133 (68.5)
No-WRTP n (%)	69 (36.0)	67 (33.7)	62 (33.9)	56 (31.3)	64 (32.7)	61 (31.5)
Totals n (%)	192 (100)	199 (100)	183 (100)	179 (100)	196 (100)	194 (100)

The highest prevalence of WRTP was found in respondents with MP joint hyperexention (0°- 30°) with the CMC joint in flexion (Dominant: 67.3%, n=132; Non-dominant: 68.5%, n=133).

The relationship of the thumb hypermobility categories with WRTP is shown in Table 4.13.

Table 4.13 Relationship of the thumb hypermobility categories with WRTP (n=258)

Generalised Hypermobility	Category	WRTP n (%)	Odds Ratio (OR)	95% Confidence Interval	p value
IP joint hyperextension, (CMC, MP in E): Dominant	No	88 (34.1)	1	-	-
	Yes between 0°-30°	108 (41.9)	0.8	0.5-1.3	0.5
	Yes, >30°	62 (24.0)	1.7	0.9-3.1	0.07
IP joint hyperextension, (CMC, MP in E): Non-dominant	No	89 (34.5)	1	-	-
	Yes between 0°-30°	107 (41.5)	0.9	0.6-1.5	0.8
	Yes, >30°	62 (24.0)	2.2	1.1-4.1	**0.02**
MP joint hyperextension, (CMC joint in E): Dominant	No	100 (38.7)	1	-	-
	Yes between 0°-30°	121 (46.9)	1.1	0.7-1.8	0.6
	Yes, >30°	37 (38.9)	1.3	0.6-2.4	0.5
MP joint hyperextension, (CMC joint in E): Non-dominant	No	101 (39.1)	1	-	-
	Yes between 0°-30°	123 (47.7)	1.4	0.9-2.1	0.2
	Yes, >30°	34 (13.2)	1.2	0.6-2.3	0.6
MP joint hyperextension, (CMC joint in F) Dominant	No	88 (34.1)	1	-	-
	Yes between 0°-30°	132 (51.2)	1.3	0.8-2.1	0.2
	Yes, >30°	38 (14.7)	1.5	0.8-3.0	0.2
MP joint hyperextension, (CMC joint in F) Non-dominant	No	87 (33.7)	1	-	-
	Yes between 0°-30°	133 (51.5)	1.5	0.9-2.3	0.1
	Yes, >30°	38 (14.7)	1.8	0.9-3.5	0.1

The risk of developing WRTP increased 2.2 fold in respondents who had IP joint hyperextension (CMC, MP in E) >30° on the non-dominant side (**p= 0.02**).

4.7 Educational factors

Table 4.14 below quantifies the number of physiotherapists who received education on the prevention of WRTP when performing manual therapy techniques.

Table 4.14 Preventative education received (n=395)

Educational	Category	WRTP n (%)	No-WRTP	Total n (%)	p value
Education received	Yes	122 (30.9)	64 (16.2)	186 (47.1)	0.9
	No	136 (34.4)	73(18.5)	209 (52.9)	
	Totals n (%)	258 (65.3)	137 (34.7)	395 (100)	

Slightly more respondents received preventative education (52.9%, n=209) than those who did not (47.1%, n=186). Educational factors were not associated with WRTP in the respondents (p=0.91).

Figure 4.3 shows when the respondents received preventative education.

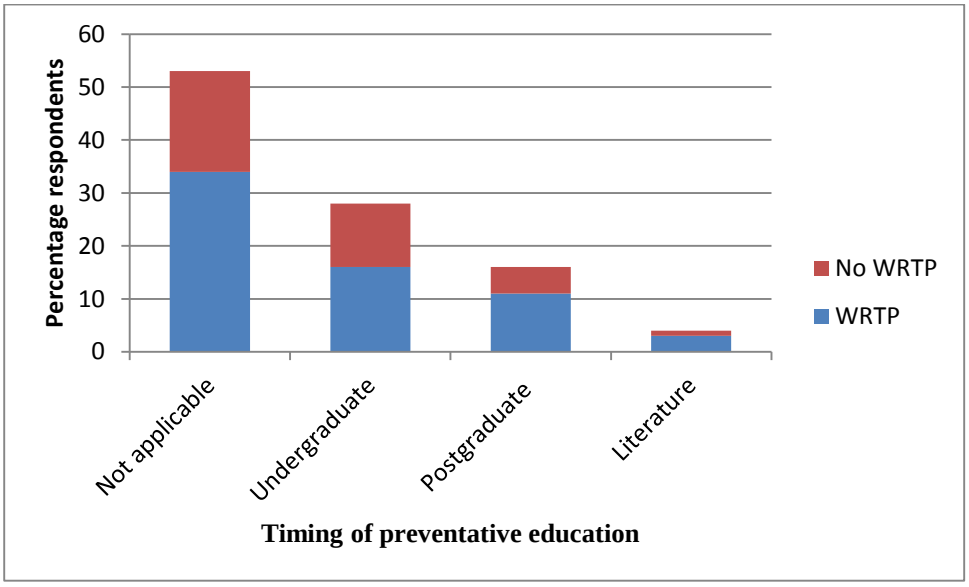


Figure 4.3 Timing of preventative education and prevalence of WRTP (n=395)

Of the physiotherapists who received education on the protection of their thumbs, the majority (28.1%, n=111) received education at undergraduate level.

4.8 Employment factors

4.8.1 Employment history

The past and current employment histories of the respondents are shown in table 4.15.

Table 4.15 Employment history of the respondents and prevalence of WRTP (n=395)

Employment	Category	WRTP	No WRTP	Total
Past employment	Full time	253 (64.0)	134 (33.9)	387 (98.0)
	Part time	31 (7.8)	15 (3.8)	46 (11.6)
Totals n (%)		284 (71.8)	149 (37.7)	433 (109.6)
Current employment	Full time	229 (58.0)	123 (31.1)	352 (89.1)
	Part time	27 (6.8)	13 (3.3)	40 (10.1)
	Currently retired	2 (0.5)	1 (0.3)	3 (0.8)
Totals n (%)		258 (65.3)	137 (34.7)	395 (100)

The past employment history shows that some of the respondents were in full- time and part-time employment in their years working as a physiotherapist (n is greater than 395). The majority of the study population (89.1%, n=352) were currently in full time employment.

4.8.2 Work characteristics

The **work areas** of the respondents are shown in Figure 4.4. The prevalence of WRTP in each work area is also shown.

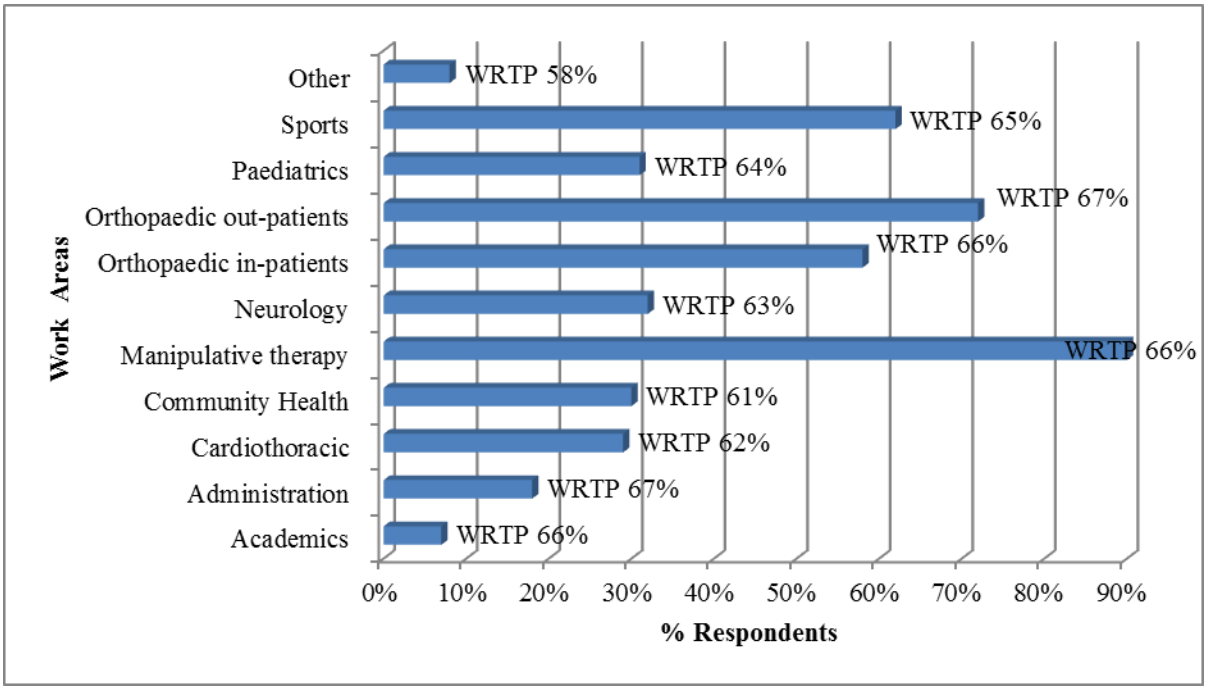


Figure 4.4 - Work Areas and Prevalence of WRTP in the respondents (n=395)

The majority of the respondents worked in areas requiring the use of manual therapy techniques using the thumbs. This included the treatment of orthopaedic out-patients (72%, n=286), sports patients (62%, n=244) and the treatment of patients in work areas using manipulative therapy (90%, n=356). The greatest prevalence of WRTP occurred in physiotherapists working in outpatients (67.1%, n=192).

The prevalence of WRTP according to the **work experience** of the respondents is shown in Table 4.16 and Table 4.17. Table 4.16 shows the numbers of years the respondents have treated pathology in patients in the different body regions and Table 4.17 shows the number of patients treated.

Table 4.16 Work Experience of Respondents: Years worked and prevalence of WRTP (n=395)

Years worked	Category	cervical region	Maxilla-facial region	Thoracic region	Lumbar sacral region	Upper limb	Lower limb
1-5 years	WRTP n (%)	64 (66.7)	52 (73.2)	62 (67.4)	65 (68.4)	64 (69.6)	64 (67.4)
	No-WRTP n (%)	32 (33.3)	21(26.8)	30 (32.6)	30(31.6)	28 (30.4)	31 (32.6)
	Totals n (%)	96 (100)	71 (100)	92 (100)	95 (100)	92 (100)	95 (100)
6-10 years	WRTP n (%)	55 (66.3)	27 (71.0)	54 (69.3)	56 (65.9)	54 (67.5)	53 (66.2)
	No-WRTP n (%)	28 (33.7)	11 (29.0)	24 (31.7)	29 (34.1)	26 (32.5)	27 (33.80
	Totals n (%)	83 (100)	38 (100)	78 (100)	85 (100)	80 (100)	80 (100)
11-15 years	WRTP n (%)	47 (67.7)	22 (61.1)	48 (64.0)	47 (62.7)	41 (60.3)	41 (61.2)
	No-WRTP n (%)	28 (32.3)	14 (38.9)	27 (36.0)	28 (37.2)	27 (39.7)	26 (38.8)
	Totals n (%)	75 (100)	36 (100)	75 (100)	75 (100)	68 (100)	67 (100)
16-20 years	WRTP n (%)	17 (54.8)	11 (64.7)	16 (55.2)	17 (54.8)	16 (55.2)	16 (55.2)
	No-WRTP n (%)	14 (45.2)	6 (35.3)	13 (44.8)	14 (45.2)	13 (44.8)	13 (44.8)
	Total n (%)	31 (100)	17 (100)	29 (100)	31 (100)	29 (100)	29 (100)
>20 years	WRTP n (%)	71 (67.6)	29 (63.0)	70 (68.6)	72 (65.4)	69 (67.0)	71 (67.0)
	No-WRTP n (%)	34 (32.4)	17 (37.0)	32 (31.4)	35 (34.6)	34 (33.0)	35 (33.0)
	Total n (%)	105 (100)	46 (100)	102 (100)	107 (100)	103 (100)	106 (100)

The study sample has representation of respondents treating all body regions with more respondents treating patients for more than 20 years except in the maxillofacial region.

Table 4.17 Work Experience: WRTP relative to the number of patients treated in different body regions (n=395)

Number of patients	Category	Cervical region	Maxilla-facial region	Thoracic region	Lumbar sacral region	Upper limb	Lower limb
1-2 patients	WRTP n (%)	78 (55.3)	90 (66.2)	131 (60.9)	57 (58.8)	143 (65.9)	134 (65.7)
	No-WRTP n (%)	63 (44.7)	46 (33.8)	84 (39.1)	40 (41.2)	74 (34.1)	70 (34.3)
	Total n (%)	141 (100)	136 (100)	215 (100)	97 (100)	217 (100)	204 (100)
3-4 patients	WRTP n (%)	125 (70.2)	3 (75.0)	64 (69.6)	126 (65.0)	76 (66.7)	82 (65.6)
	No-WRTP n (%)	53 (29.8)	1 (25.0)	28 (30.4)	68 (35.0)	38 (33.3)	43 (34.6)
	Total n (%)	178 (100)	4 (100)	92 (100)	194 (100)	114 (100)	125 (100)
5-6 patients	WRTP n (%)	40 (76.9)	2 (100)	18 (72.0)	54 (75.0)	11 (61.1)	14 (60.9)
	No-WRTP n (%)	12 (3.0%)	0 (0)	7 (18.0)	18 (25.0)	7 (38.9)	9 (39.1)
	Total n (%)	52 (100)	2 (100)	25 (100)	72 (100)	18 (100)	23 (100)
7-8 patients	WRTP n (%)	9 (60.0)	3 (100)	6 (54.5)	13 (65.0)	4 (57.1)	3 (50.0)
	No-WRTP n (%)	6 (40)	0 (0)	5 (45.5)	7 (35.0)	3 (42.9)	3 (50.0)
	Total n (%)	15 (100)	3 (100)	11(100)	20 (100)	7 (100)	6 (100)
9-10 patients	WRTP n (%)	0 (0)	0 (0)	1 (100)	2 (100)	1 (50.0)	1 (50.0)
	No-WRTP n (%)	0 (0)	1 (100)	0 (0)	0 (0)	1 (50.0)	1 (50.0)
	Total n (%)	0 (0)	1 (100)	1 (100)	2 (100)	2 (100)	2 (100)
10-12 patients	WRTP n (%)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	2 (100)
	No-WRTP n (%)	1 (00)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Total n (%)	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)	2 (100)
>12 patients	WRTP n (%)	1 (100)	0 (0)	1 (100)	2 (66.7)	2 (100)	1 (100)
	No-WRTP n (%)	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)	0 (0)
	Total n (%)	1 (100)	0 (0)	1 (100)	3 (100)	2 (100)	1 (100)

More respondents treated 3-4 patients per day with pathology in the cervical region (45%, n=178) and lumbosacral region (49%, n=194). In sub-groups which had more 10% respondents, a high prevalence

of WRTP was found in respondents treating 5-6 patients per day in the cervical region (76.9%, n=40), and the lumbar sacral region (75%, n=54).

The association of employment factors with WRTP is shown in Table 4.18

Table 4.18 Association of employment factors with WRTP (n=395)

Variable	Category	WRTP	No WRTP	Total	p-value
Past employment	Full time	253 (64.0)	134 (33.9)	387 (98.0)	0.5
	Part time	31 (7.8)	15 (3.8)	46 (11.6)	0.8
	Totals n (%)	284 (71.8)	149 (37.7)	433 (109.6)	
Current employment	Full time	229 (58.0)	123 (31.1)	352 (89.1)	
	Part time	27 (6.8)	13 (3.3)	40 (10.1)	
	Currently retired	2 (0.01)	1 (0.0025)	3 (0.007)	
	Totals n (%)	258 (65)	137 (35)	395 (100)	0.9
Work experience: Wok areas worked	Academics	48 (65.7)	25 (34.3)	73 (100)	0.4
	Administration	20 (66.7)	10 (33.3)	30 (100)	0.7
	Cardiothoracic	71 (62.3)	43 (37.7)	114 (100)	0.5
	Community Health	73 (61.3)	46 938.7)	119 (100)	0.4
	OMT	234 (65.7)	122 (34.3)	356 (100)	0.5
	Neurology	80 (63.5)	46 (36.5)	126 (100)	0.2
	Orthopaedic in-patients	150 (65.8)	78 (34.2)	228 (100)	0.7
	Orthopaedic out-patients	192 (67.1)	94 (32.9)	286 (100)	0.2
	Paediatrics	80 (64.50)	44 (35.5)	124 (100)	0.9
	Sports	158 (64.7)	86 (35.3)	244 (100)	0.1
	Other	18 (58.1)	13 (41.9)	31 (100)	0.5
Work experience: Body region-number of years	Cervical region	254 (65.1)	136 (34.9)	390 (100)	0.7
	Maxilla facial	141 (67.8)	67 (32.2)	208 (100)	0.7
	Thoracic region	250 (66.5)	126 (33.5)	376 (100)	0.7
	Lumbar region	257 (65.4)	136 (34.6)	393 (100)	0.7
	Upper limb	244 (65.6)	128 (34.4)	372(100)	0.5
	Lower limb	245 (65.0)	132 (35.0)	377 (100)	0.9
Work experience: Body region-number of patients	Cervical region	253 (65.2)	135 (34.8)	388 (100)	**0.02**
	Maxilla facial	98 (67.1)	48 (32.9)	146 (100)	0.3
	Thoracic region	221 (64.1)	124 (35.9)	345 (100)	0.5
	Lumbar region	254 (65.5)	134 (34.5)	388 (100)	0.3
	Upper limb	238 (65.9)	123 (31.1)	361 (100)	0.9
	Lower limb	237 (65.3)	126 (34.7	363 (100)	0.8

A significant association was found between WRTP and the number of patients treated per day with cervical region symptoms (**p=0.02**).

Factors that were significantly associated with WRTP in the **total study population (N=395)** were tested in a regression analysis and the results are presented in Table 4.19.

Table 4.19 Relationship between significant factors and the presence of WRTP (n=258)

Variable	**Category**	**WRTP n (%)**	**Odds Ratio (OR)**	**95% Confidence Interval**	**p value**
Cervical spine treatment	1-2 patients	78 (30.2)	1	-	-
	3-4 patients	125 (48.8)	1.9	1.2 - 3.0	**0.01**
	5-6 patients	40 (15.5)	2.7	1.3 - 5.7	**0.01**
	7-8 patients	9 (3.5)	1.3	0.4 - 4.0	0.61
	9-10 patients	0 (0)	-	-	-
	10-12 patients	0 (0)	-	-	-
	>10 patients	1 (0)	-	-	-
IP hyper-E (CMC/MP joints in E): non dominant					
	No	89 (34.5)	1	-	-
	Yes (0°-30°)	107 (41.5)	1.4	0.6 - 3.4	0.4
	Yes (>30°)	62 (24.0)	4.3	1.01 - 18.1	**0.05**
Knee hyper- E >10°	No	209 (81.0)	1	-	-
	Dominant	48 (18.6)	1.2	0.2 – 6.8	0.8
	Non-dominant	43 (16.7)	1.9	0.9 – 4.0	0.1
Thumb flexion to anterior forearm	No	209 (81.0)	1	-	-
	Dominant	41 (15.9)	1.2	0.3 – 4.4	0.8
	Non-dominant	37 (14.3)	1.6	0.7 – 3.7	0.3

WRTP remained significantly associated with the number of patients treated per day with cervical region symptoms (**p=0.01**) and hyperextension greater than 30° of the non-dominant thumb IP joint with CMC and MP joints in E (**p=0.05**). The odds of having WRTP in physiotherapists treating up to

5-6 patients per day with cervical symptoms is 2.7 times greater than it is for respondents who treat 1-2 patients per day with cervical symptoms.

4.9 Work-related Thumb problems

4.9.1 Specific Work-related thumb problems

The specific WRTP experienced by the respondents are shown in Table 4.20 in decreasing order of prevalence.

Table 4.20 Specific thumb problems (n=254)

WRTP	Dominant	Non dominant	Both thumbs
Deep thenar muscle tenderness	152 (59.8%)	98 (38.6 %)	82 (32.3%)
MP joint pain	140 (55.1 %)	99 (39.0%)	78 (30.7 %)
CMC joint pain	142 (55.9 %)	93 (36.6 %)	76 (29.9%)
Thenar muscle spasm	135 (53.1 %)	85 (33.5 %)	71 (27.9%)
Difficulty with precision grip activities	92 (36.2 %)	49 (19.3%)	40 (15.7 %)
IP joint pain	72 (28.3 %)	54 (21.2 %)	46 (18.1%)
MP joint feeling of instability	57 (22.4 %)	48 (18.9%)	30 (11.8%)
Carrying of heavy objects	63 (24.8 %)	40 (15.4 %)	29 (11.4%)
CMC joint feeling of instability	45 (17.7 %)	33 (13.0 %)	22 (8.7%)
IP joint feeling of instability	39 (15.3%)	29 (11.4 %)	25 (9.8%)
CMC stiffness	35 (13.8%)	20 (7.9%)	17 (6.7%)
MP stiffness	39 (15.3%)	24 (9.4%)	22 (8.7%)
IP stiffness	33 (13.0%)	13 (5.1%)	12 (4.7 %)
Muscle weakness	23 (9.0%)	22 (8.7%)	15 (5.9%)
Sensory problems	21 (8.3%)	10 (3.9%)	8 (3.1%)
Other	2 (0.8%)	3(1.2%)	2 (0.8 %)
None of the above	11 (4.3%)	4 (1.6%)	4 (1.6%)

The thumb problem affecting more of the respondents was deep thenar muscle tenderness which affected 59.8% (n=152) of the respondents dominant thumbs, 38.6% (n=98) of the respondents non-dominant thumbs and 29.9% (n=76) of the respondents both thumbs. More respondents experienced pain and a feeling of instability in the MP joint and CMC joints of the thumb than in the IP joints of the thumb. The other thumb problem experienced by the respondents included De Quervain's tenosynovitis (3 respondents which represents 0.01% of the respondents), locking or clicking of

extensor tendons and locking of the IP joint (1 respondent each which represents 0.003% of the respondents).

4.9.2 Frequency of Work-related thumb problems

The frequency of the WRTP as reported by the respondents is illustrated in Figure 4.5

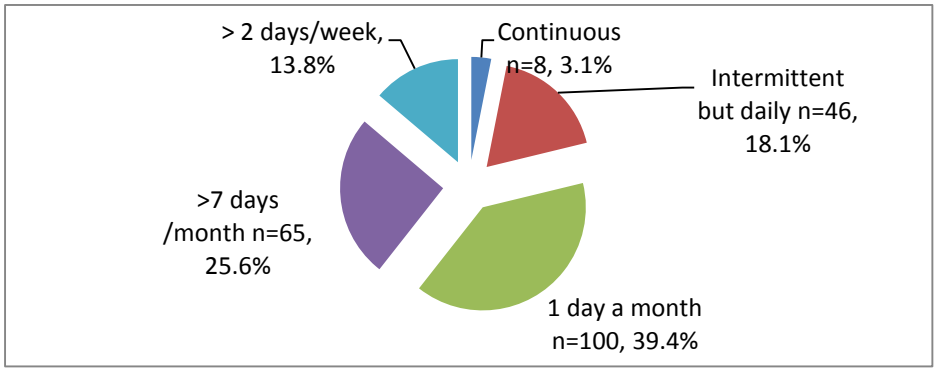


Figure 4.5 - Frequency of WRTP (n=254)

The majority of respondents, 39.4% (n=100) experienced pain on one day a month while a minority of physiotherapists, 3.1% (n=8) had continuous pain.

4.9.3 Intensity of pain

A mean value of 3.41 (± 1.81) was given for the intensity of pain experienced by the respondents; using the numerical rating scale of 0-10 (0 represents no pain and 10 represents unbearable pain). The range of the pain experienced was 0-8.

4.9.4 Activity limitation /participation restriction

Using a scale of 0-10 (0 means no difficulty and 10 means maximum difficulty); the means values for the level of difficulty for the following activities are shown in Table 4.21. The results of the

Spearman's test which was used to determine the relationship between the level of activity limitation and the current intensity of WRTP in the respondents is also shown.

Table 4.21 Level of activity limitation of respondents (n=254)

Activity limitation	Means (±SD)	r value
Family/home responsibilities	1.07 (±1.75)	0.4
Recreation (sport, hobbies,	1.33 (±1.95)	0.4
Social activities	0.47 (±1.21)	0.4
Self-care activities	0.79 (±1.57)	0.4
Occupation	3.24 (±2.63)	0.5

The most limited activity reported by respondents was with occupation with the means value for the respondents being 3.24. A weak positive linear relationship was found between the intensity of the respondents' current pain and the level of difficulty for all the activities. Increase in the intensity of pain resulted in an increase in the level of difficulty in the performance of the functional activities.

Physiotherapists in this survey generally chose to continue to work with the thumb problems. On an annual basis, only eight respondents (0.03%) reported that they had taken sick leave due to thumb problems, five respondents (0.02%) took less than five days sick leave, one respondent (0.004%) took six to ten days and two respondents (0.01%) took more than 10 days sick leave. Four respondents (0.02%) lodged a claim with the Compensation Commissioner for thumb problems. Three respondents (0.01%) listed the reasons. These included De Quervain's tenosynovitis fractured distal phalanx of the thumb and OA in the joints of the thumb.

4.9.5 The timing of the initial incident

The timing of the initial incident is shown in Table 4.22.

Table 4.22 Timing of initial episode of WRTP (n=254)

Timing of initial episode	Dominant thumb	Non- dominant thumb
Undergraduate	11 (4.3%)	6 (2.4%)
0-5 years after graduating	103 (40.5%)	69 (27.2%)
6-10 years after graduating	51 (20.1%)	43 (16.9%)
10-20 years after graduating	50 (19.7%)	42 (16.5%)
> 20 years after graduating	19(7.5%)	18 (7.1%)
Do not know	2 (0.8%)	5 (2.0%)
No problem	18 (7.1%)	71 (28.0%)

More respondents (44.8%, n=114) had experienced WRTP in their dominant thumb and 29.5% (n=75) had experienced WRTP in their non-dominant thumb within the first 5 years of graduating (undergraduates included). The work area of the initial incident is illustrated in Figure 4.6.

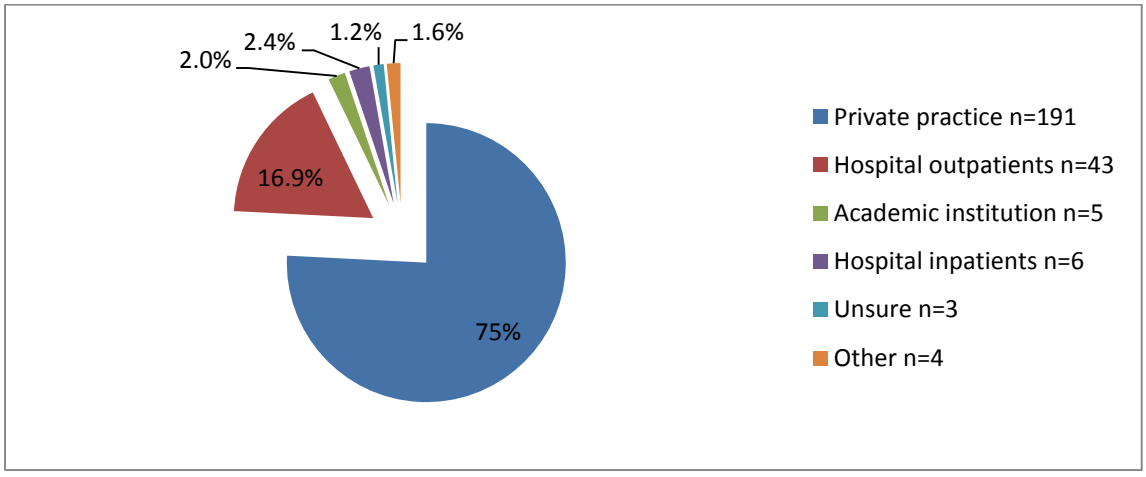


Figure 4.6 - Work area of initial episode (n=254)

Most respondents (75.2 %, n=191) reported that their initial episode of WRTP was in private practice followed by the hospital out-patient department (16.9%, n=43).

4.10 Occupational factors

The distribution of the work-related factors that resulted in the aggravation of the WRTP is listed in Table 4.23. Their association with WRTP in the respondents is also shown.

Table 4.23 Prevalence and association of work –related factors aggravating the thumb problem (n=254)

Work-related factor	n (%)	p-value
Soft tissue techniques using thumbs	217 (85.4)	**<0.001**
Passive joint mobilisation/manipulation techniques	211 (83.1)	**<0.001**
Treating large number of patients a day	159 (62.6)	**<0.001**
Performing same task over and over	156 (61.4)	**<0.001**
Increase in thumb use	150 (60.2)	**<0.001**
Continue to work when thumb is injured	143 (56.3)	**<0.001**
Inadequate training in thumb injury prevention	80 (31.5)	**<0.001**
Working in the same position	78 (30.7)	**<0.001**
Working in uncomfortable working positions	53 (20.9)	**<0.001**
Working at or near your physical limits	44 (17.3)	**<0.001**
Not enough rest breaks	43 (16.9)	**<0.001**
Percussion, vibration, shaking	14(5.5)	**0.005**
Nil	2 (0.01)	**<0.001**

Soft tissue techniques, followed by joint mobilisation techniques resulted in WRTP in the majority of the respondents (85.4%, n=217). All work-related factors were significantly associated with the respondents WRTP.

The prevalence and association of WRTP with passive mobilising techniques is presented in Table 4.24.

Table 4.24 Prevalence and association of spinal mobilising techniques with WRTP (n=254)

Mobilisation technique	Category	n (%)	p-value
Central PA pressures	Grade I	8 (3.1)	0.1
	Grade II	42 (16.5)	0.1
	Grade III	147 (57.9)	<0.001
	Grade IV	112 (44.1)	<0.001
Unilateral PA pressures	Grade I	6 (2.4)	<0.001
	Grade II	47 (18.5)	<0.001
	Grade III	153 (60.2)	<0.001
	Grade IV	112 (44.1)	<0.001
Transverse glides	Grade I	9 (3.5)	<0.001
	Grade II	45 (17.7)	<0.001
	Grade III	104 (40.9)	<0.001
	Grade IV	82(32.3)	<0.001
Mulligan techniques	Grade I	2 (0.01)	0.5
	Grade II	29 (33.8)	<0.001
	Grade III	66 (26)	<0.001
	Grade IV	49 (19.3)	<0.001

The majority of physiotherapists reported that unilateral and central posterior-anterior grade III pressures aggravated the thumb problem (60.2%, n=153 and 57.9%, n=147 respondents respectively).

All spinal mobilisation techniques except grade I and II central PA glides and grade I Mulligan techniques were significantly associated with WRTP ($p<0.05$).

4.11 Management strategies

The management strategies used by the respondents to treat and prevent the WRTP are presented in Figure 4.7 according to the relief obtained.

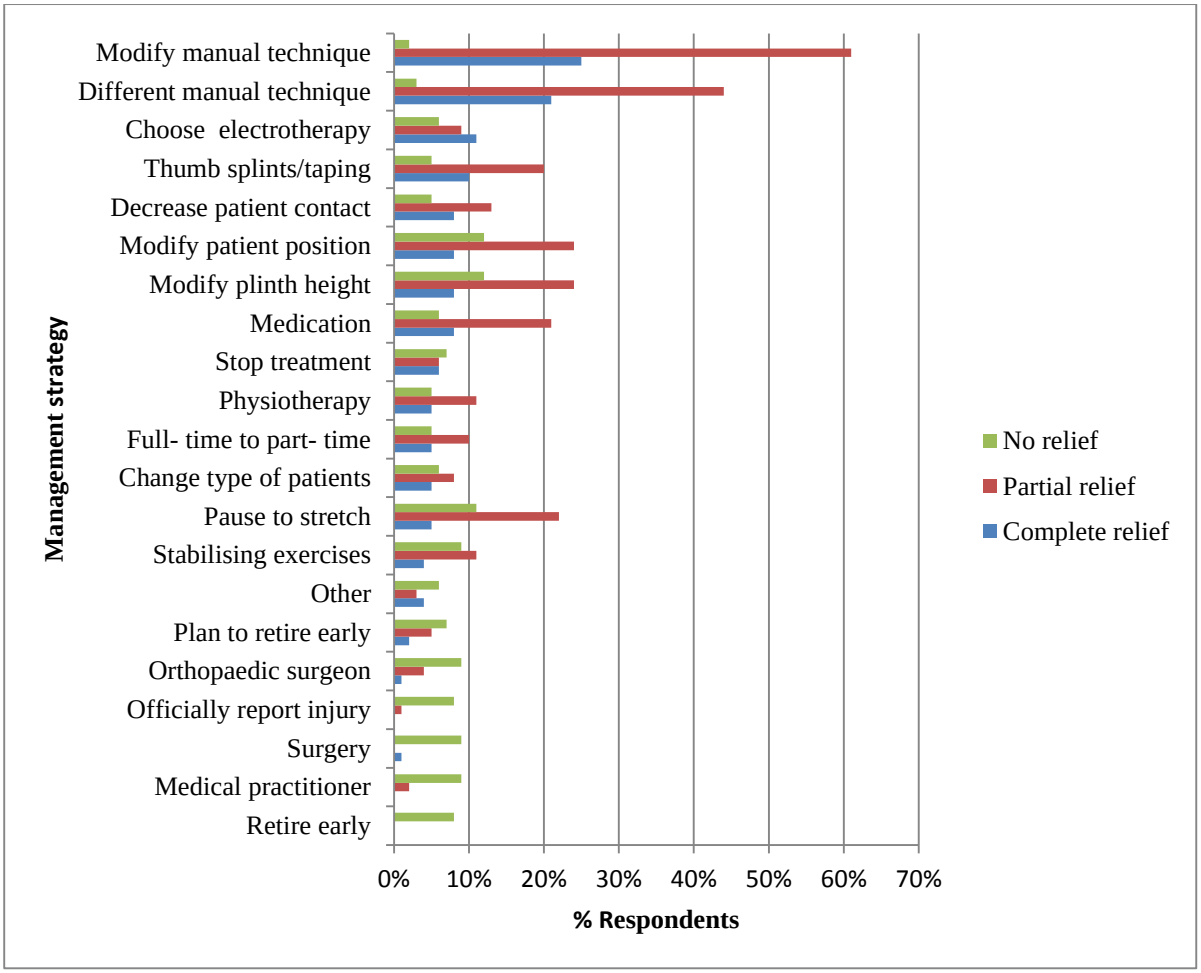


Figure 4.7 Management strategies used for WRTP (n=249)

The majority of the respondents modified their techniques with only 24.5% (n=61) of the respondents obtaining complete relief and 60.6% (n=151) obtaining partial relief and 2% (n=6) obtaining no relief.

4.12 Questionnaire Two Results

The link to the survey was sent to all 3532 members registered with the South African Society of Physiotherapists (SASP) as well as members of the OMTG and Sports Group which are special interest groups within the society. Three hundred and six (306) physiotherapists responded to the invitation to participate in the second survey. Two hundred and forty-three (243) which represents 79.4% of the respondents completed the survey. This represents 61.5% of the respondents of the first

survey as respondents that had not completed questionnaire one (Appendix E) were excluded from completing questionnaire 2 (Appendix F).

4.12.1 Demographic data

The demographic characteristics of the respondents in survey two is shown in Table 4.25

Table 4.25 Demographic distribution of study sample in Survey Two (n=243)

Demographic factor	Category	Total n (%)
Age	20-30 years	69 (28.4)
	31-40 years	71 (29.2)
	41-50 years	57 (23.5)
	521-60 years	33 (13.6)
	>60 years	13 (5.3)
	Total	243 (100)
Gender	Female	226 (92.9)
	Male	17 (7.1)
	Total	243 (100)

The majority of the respondents (57.6%, n=139) were in the 20-30 and 30-40 age group. There were 19.1% (n=46) respondents that were older than 50 years. The sample contains a good mix of youth and experience as in survey one.

4.12.2 Prevalence of WRTP

The prevalence of WRTP in respondents in survey two was 67.5% (n=164).

Table 4.26 shows the prevalence of WRTP in the males and females in the study sample.

Table 4.26 Gender distribution and WRTP prevalence in participants (n=243)

Demographic factor	Category	WRTP n (%)	No WRTP n	Total n (%)	p value
Gender	Female	153 (68.3)	73 (31.7)	226 (100)	0.76
	Male	11 (64.7)	6 (35.3)	17 (100)	
	Total	164 (67.5)	79 (32.5)	243 (100)	

A higher prevalence of WRTP was evident in females (68.3%, n=153). Gender which was analysed from results of survey two showed no significant association with WRTP (p=0.76).

A discussion of all the results described in this chapter follows in chapter 5.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 Introduction

This chapter focuses on the discussion of the results of the study that were outlined in chapter four and relates them to other relevant research findings. The limitations of the study are also described.

5.2 Prevalence

The life-time prevalence of WRTP in the physiotherapists who participated in this study were similar for questionnaire one (65.3%, n=258) and questionnaire two (68%, n=164). The findings of a national study conducted in Australia by Mc Mahon et.al. (2006) concur exactly with the findings of questionnaire one of this study which also reported a life-time prevalence of 65.3% (n=961) of WRTP in the physiotherapists who participated in their study. The life-time prevalence reported for questionnaire one of this study was also similar to the South African study by Barnes et.al. (2011) while that reported for questionnaire 2 was higher than the lifetime prevalence reported by Barnes et al. (2011) who reported the life-time prevalence of wrist and thumb problems to be 62.5% (n=55). It is also possible that the life-time prevalence reported by Barnes et.al. (2011) could have been lower if they had reported thumb pain only and not reported wrist pain together with the thumb pain.

The current study reported a lower prevalence compared to Wajon and Ada's (2003) study, who reported 83% (n=129) in their study. Direct comparison of the present study with the study by Wajon and Ada (2003) would be difficult due to the very different demographic samples. In our study, all physiotherapists registered with the South African Society of Physiotherapists who have ever worked treating musculoskeletal conditions using manual therapy techniques were asked to participate in the study. Wajon and Ada (2003) who conducted the study in Australia only

included physiotherapists who had completed post-graduate education in manipulative therapy. If only manipulative therapy graduates were included in this study as was the case in the study by Wajon and Ada (2003), it will exclude an important sample from the study, namely the relatively newly qualified physiotherapists working one to five years in manual therapy which the literature reports to be more likely to develop work- related musculoskeletal disorders (Cromie et. al., 2000; Barnes et al., 2011; West and Gardner, 2001). Between 46 % and 47.7% of the physiotherapists' experienced work- related musculoskeletal injuries within the first five years of graduating (Cromie et. al., 2000; Barnes et al., 2011; West and Gardner, 2001). Similarly this study shows that 44.8% (n=114) of respondents had experienced pain in their dominant thumbs within the first five years of graduating. The reasons for this will be discussed in the next section.

5.3 Intrinsic factors associated with WRTP

Newly qualified physiotherapists in the 20-30 year age group in this study had a higher prevalence of 70% (n=84) of WRTP. The reasons for the increased prevalence rates in the younger physiotherapists using manual therapy techniques according to Cromie et.al (2000) was the reluctance of the younger physiotherapists to ask for help. It could also be linked to their increased workload or their inability to stabilise their thumb during the application of manual therapy techniques (Barnes et. al., 2011; Buckingham et. al., 2007, Walsh et. al., 2011). In this study the younger physiotherapists reported on their inability to stabilise the joints of their thumbs during application of manual therapy techniques (Appendix E). Of the respondents that reported on the inability to stabilise their MP joints (Dominant, 22.4%, n=57; non-dominant, 18.9%, n=48), the majority were younger than 30 years. In these respondents who were younger than 30 years, 20.8% (n=25) reported a feeling of MP joint instability of their dominant thumbs and 15.8% (n=19) reported a feeling of MP joint instability of their non-dominant thumbs (Appendix E). In comparison, in respondents older than 60 years, only 6.7% (n=1) reported a 'feeling of MP joint instability' of both thumbs. The reason for MP joint instability in the younger age group could be due their lack of work experience. The repetitive use of their thumbs during the

application of the manual therapy techniques especially to patients who are larger and/or more muscular may pose a challenge for the newly qualified physiotherapists. The increased force required for the larger or more muscular patients could, in my opinion, result in the physiotherapists' thumbs joints going into hyperextended positions which could eventually result in laxity of the ligaments of the thumb and hypermobility of the thumb joints. In fact, although the majority of physiotherapists did not possess generalised hypermobility (29.4%, n=116), the majority of the respondents (58.5%-66%, n=231-259) had hyperextension of the joints of the thumbs. In this study and the Mc Mahon et al. (2006) study, the majority of the respondents (both studies, 21%) had hyperextension greater than 30° of the IP joint of the thumb. Whereas 14% of respondents in this study had hyperextension greater than 30° of the MP joints of the thumbs, 7-8% respondents in the Mc Mahon et al. (2006) study had hyperextension greater than 30° of the MP joints of the thumbs.

The presence of thumb hypermobility in the 20-30 year age group in the current study was verified by looking at the prevalence of thumb hyperextension in the different age groups (Appendix F). It showed that in the 20-30 year age group, hyperextension of the MP joint ,with the CMC joint in extension (dominant: 73.3%, n=88; non-dominant: 68.3%, n=82) and hyperextension of the MP joint, with the CMC in flexion (dominant: 74.2%, n=89; non-dominant: 65.8%, n=79) was evident in the respondents in this study. In the other age groups younger than 60 years, thumb hyperextension existed in 40% - 60% of the respondents. No other studies that were reviewed reported on the association of thumb hypermobility with age of the respondents.

In this study, statistical tests using Pearson's chi-squared test showed a significant association of non-dominant thumb IP joint hyperextension (CMC and MP joints in extension) and WRTP ($p=0.02$ according to chi square analysis). This finding is in contrast to what Snodgrass and Rivett (2002) reported. Whereas this study shows that hyperextension of the thumb IP joint results in an increased prevalence of WRTP (Non-dominant thumbs 78.5%, n=62/79; dominant thumbs 75.6%, n=62/82), Snodgrass and Rivett (2002) had theorised that **lack of hyperextension of the IP joint**

during the application of PA mobilisation to the spine would result in an increase in work-related thumb pain because the base of the thumb is positioned further away from the point of contact when the thumb pad is applying the pressure. The findings of this study are therefore in agreement with Buckingham et al., (2007) and Wajon and Ada (2007) who advocated that the thumb IP joint be positioned in neutral or slight flexion. These findings emphasise the importance of educating undergraduate students on MP and IP joint hypermobility and resultant instability as a factor that is significantly associated with thumb pain. An understanding of the biomechanics of the different thumb positions and the way it can predispose to degeneration of the thumb joints is important in the prevention of WRTP in future generations of physiotherapists specialising in the use of manual therapy techniques. These findings are therefore in agreement with Walsh et al. (2011), Hu et.al.(2009), Buckingham et.al.(2007), Wajon and Ada (2003, 2007) who recommended education, support of the thumbs in the optimal position using taping or splints and the modification of work practices especially in physiotherapists who have hypermobility of the joints of the thumbs.

Only one of the studies reviewed, Mc Mahon et al. (2006) gave detail on the type of WRTP in sufficient detail to use in comparing with results from this study. The WRTP reported by their respondents included instability, weakness, stiffness, triggering and pain. Thumb weakness was reported by 10 %(n=64) of their respondents and 9% (n=23) of the respondents in this study. Stiffness and instability of the thumbs was reported by 5% (n=30) and 22% (n=138) of their respondents but the joint location was not given. In our study 22.4% (n=57) reported MP joint instability while 17.7% (n=45) reported CMC joint instability and 15.3% (n=39%) reported IP joint instability. A mean value of 3.41 using the numerical rating scale of 0-10 was given for the pain experienced by the respondents in our study. The mean value was similar to respondents in the study by Wajon and Ada (2003) but less than the value reported by the respondents in the study by Barnes et.al, (2011) whose mean values were 3.75 and 4.2 respectively. Mc Mahon et al. (2006) and Barnes et.al.(2011) did not report on which thumb joint was the most commonly affected by pain. In this study and the study by Wajon and Ada (2003), the MP joint was mostly

affected, affecting 55.1% (n=140) of the respondents in this study and 43% (n=55) in Wajon and Ada's (2003) study.

The other questionnaire- based studies focussing on WRTP (Wajon and Ada, 2003; Mc Mahon et al, 2006; Barnes et al., 2011) did not report on activity limitation and participation restriction except for it limitation related to the practice of physiotherapy. On a scale of 0 to 10, a mean value of 3.2 was recorded by the respondents in this study where 0 means no difficulty and 10 means maximum difficulty for occupation and 0.47-1.33 for other activity limitations in this study. This could be because the physical demands on the thumbs of the physiotherapists during the application of manual techniques using the thumbs is much higher than what is required in everyday functional activities or recreational activities.

Physiotherapy is a female-dominated profession in South Africa as shown by the latest statistics obtained from the SASP for 2013 which reveal that females represent 87.8% (n=3103) of the physiotherapists registered with the society. Although we were unable to confirm the gender of our sample in survey one, there is a strong possibility that the sample in survey one were mostly females. In survey two, females represented 93% (n=226) of the sample and had a 68.3% (n=153) prevalence of WRTP. Several reasons have been documented in the literature and discussed in chapter two as to why females may be more prone to develop degenerative changes than their male counterparts (Poole and Pellegrini, 2000; Hurwitz, 1996). Some of the reasons included less osseous stability due to a more trapezium and thinner articular cartilage and increased soft tissue laxity. Studies by Adegoke et al, (2008), Glover (2002) and Bork et al, (1996) reported significantly higher prevalence of work-related thumb pain in female physiotherapists but no explanations were given. Review of the questionnaire-based studies (Wajon and Ada, 2003; Mc Mahon et al., 2006) on the association of gender with WRTP, however, has shown that controversy existed on whether gender was associated with the development of WRTP in manual therapists. This study concurs with Wajon and Ada's (2003) study and Barnes et al.'s (2011) study in finding that gender was not significantly associated with WRTP (p=0.76). In contrast

with all the studies, Cromie et al. (2000) and Mc Mahon et al. (2006) reported a higher prevalence of WRTP in male physiotherapists which they both attributed to the greater use of manual techniques by male physiotherapists.

This study also found a prevalence of 81.2% (n=13) of WRTP in respondents whose weight was less than 50 kilograms and 75% (n=3) prevalence in respondents shorter than 150 centimetres in height. However the height and weight of the physiotherapist was not significantly associated with WRTP in the physiotherapists. As this was a questionnaire-based study, it did not calculate body mass index as exact weight and height measurements using standardised, validated equipment would be necessary. The questionnaire based studies which specifically researched work-related thumb pain in physiotherapists did not report on the height and weight of the physiotherapist and their association with WRTP (Wajon and Ada, 2003; Mc Mahon et. al., 2006; Barnes et al., 2011). A physiotherapist with a bigger build may have greater strength and stability in their thumbs may be more able to apply a stronger grade of technique to a larger patient who has a high body mass index or a heavy, muscular patient with possibly less strain to their thumbs. However, shorter physiotherapists who do not use height adjustable plinths may have less thumb strength and would probably experience difficulty maintaining their thumb alignment in the recommended position to prevent strain to their thumbs if they were treating a larger, muscular patient. Snodgrass et al. (2003) and Rozenfeld et al. (2010) did not find a significant association between BMI and work-related thumb pain. However this was a study with a small sample size and a study with larger sample size would be needed to investigate this factor.

In this study no significant association was found between age (p=0.34) or race (p=0.58) and WRTP. This study agreed with Wajon and Ada (2003) and Mc Mahon et al. (2006) which also did not find a significant association between age and WRTP. In contrast to this study, a statistically significant difference (p=0.005) between the race groups which included Blacks, Whites, Coloured and Indians recording pain was reported in Thistlethwaite's (2005) study. Over 50% of the study population was Indians and the researcher hypothesised that this group of

physiotherapists, with a general tendency for hypermobility (Simpson, 2006) would increase the tendency for joint instability and the development of WRTP.

5.4 Extrinsic factors

Physiotherapists working in the areas requiring manual therapy using the thumbs (manipulative therapy, orthopaedic out patients and sports patients) represent the majority of the respondents. On sub-analysis of the work areas of the physiotherapists, a high prevalence of WRTP was seen in physiotherapists working one to five years with sports patients (73.3%, n=63) and orthopaedic out patients (72.5%, n=66). Mc Mahon et al. (2006) reported a similar prevalence (75%, n=720) of WRTP in physiotherapists that were working currently with orthopaedic outpatients. Mc Mahon et al. (2006) found a significant association ($p<0.001$) between the presence of thumb problems and the current area of practice in contrast to this study which found no significant association between WRTP in the physiotherapists and the current work areas of the physiotherapists. In this study and the studies by Mc Mahon et al. (2006) and Barnes et al (2011) there was no significant association between the years worked in a current area of practice and WRTP.

The employment-related characteristic that was significantly associated with WRTP in physiotherapists in this study, was the number of patients treated with cervical spine pathology ($p=0.02$, according to chi square analysis). An explanation could be that the use of the pisiform or treatment tools in the cervical region is not usually possible due to the contours in this body region. The thoracic and lumbar region lends itself to the use of the pisiform or treatment tools which results in the "saving of the thumbs". A further explanation could be that stronger grades of treatment can be applied with the heel of the hand in other body regions like the thoracic or lumbar region but not in the cervical region. Wajon and Ada (2003), Mc Mahon et al. (2006) and Barnes et al. (2011) did not report on the association of with the body region and number of patients treated by the physiotherapists.

Wajon and Ada (2003) and Mc Mahon et.al. (2006) however did report on other occupational factors that aggravated the WRTP and Barnes et.al, (2011) and Cromie et.al. (2000) reported on the occupational factors that aggravated both wrist and thumb symptoms in their respondents. Wajon and Ada (2003) found that 85% (n=131) of the respondents reported that central posterior–anterior glides and 87% (n=134) reported that unilateral posterior glides aggravated their symptoms and performing passive accessory movements aggravated 75% (n=469) of the respondents in the study of McMahon et al. (2000). In this study 83.1% (n=211) of the respondents reported that passive joint mobilisation techniques aggravated their symptoms. None of the studies reported which grade of movement aggravated the symptoms. The grade III unilateral glides (60.2%, n=153) and central posterior-anterior glides (57.8%, n=147) were the two techniques in our study that aggravated the symptoms of a greater number of respondents. A significant association was found between the presence of WRTP and grades II to IV unilateral and central posterior-anterior glides and Mulligan techniques as well as all grades of the transverse glides to the spine ($p<0.001$). Grade I unilateral ($p=0.1$) and central posterior- anterior glides ($p=0.06$) and Mulligan techniques ($p=0.54$) were not found to be significantly associated with thumb problems. An explanation for the lack of association of thumb problems with the grade I movements (unilateral and central posterior glides, Mulligan techniques) is that less force is used by the thumbs during the application of the grade I techniques compared to the force used in the stronger grades of movement (grades II to IV). The result is less stress being transmitted through to the CMC and MP joints of the thumb during the application of grade I techniques. The fact that grade I transverse glides to the spine were significantly associated with WRTP could be due to the position of the thumb during the application of the technique. Whereas the thumb can positioned with the CMC joint in a position of opposition with the posterior-anterior techniques and Mulligan techniques which results in congruence of the joint surfaces and less stress to the surrounding soft tissues, the thumb is less likely to be in a position of "congruence" when performing all grades of the transverse glides resulting in more stress to the joint surfaces and

surrounding soft tissues (Zancolli and Ziedenberg, 1987; Atkinson and Maher, 2004; Edmunds, 2011).

In this study a greater percentage of respondents (85.4%, n=217) said that soft tissue techniques aggravated or caused their symptoms. Only 69% (n= 106) of the respondents in Wajon and Ada's (2003) study and 65.5% (n=36) respondents in the study of Barnes et.al. (2011) and (75%, n=439) of the respondents in the study of Mc Mahon et al. (2006) reported that performing soft tissue techniques aggravated their thumb symptoms. Mc Mahon et al. (2006) and the current study found a significant association between the presence of WRTP and the hands on activity of manual therapy, trigger point therapy and massage ($p<0.001$).

Other occupational factors significantly associated with WRTP in manual physiotherapists that were evident in the current study included the high, repetitive workload, treating large number of patients daily, working with a current injury, working in sustained positions for prolonged periods, working in uncomfortable positions, inadequate rest periods and working at your physical limits ($p<0.001$). Aggravation of the symptoms due to the high, repetitive workload was reported by 61.4% (n=156) of the respondents in this study and 62% (n=96) in the study by Wajon Ada (2003). A greater percentage of physiotherapists experienced aggravation of symptoms due to the repetitive work load with 80% (n=865) of the respondents in study by Mc Mahon et al. (2006) and 98% (n=86) of the respondents in the study by Barnes et al, (2011) reporting it to be an aggravating factor. The treatment of many patients a day was reported by just 62.6% of the respondents in our current study, 76% of the respondents in the study by Mc Mahon et al. (2006), 80% in Wajon and Ada's study (2003) and (95.9%, n=84) of the respondents in the study by Barnes et al. (2011). All the studies reviewed confirm that a high percentage of physiotherapists are experiencing WRTP. It would seem important therefore that physiotherapists apply wisdom to this situation and heed the advice given to our patients who have musculoskeletal disorders. This advice, an important management strategy for WRTP, includes

joint protection, job rotation and avoiding of sustained postures or repetitive action (Glover, 2002).

5.5 Management Strategies

Physiotherapists were asked to report on the management strategies that they use to treat or prevent the symptoms and the relief obtained with the management strategies. Many respondents modified their techniques (87.5%, n=218). Two studies (Wajon and Ada, 2003 and Mc Mahon et al., 2006) similar in approach and focussing on WRTP also reported on the management strategies used by the physiotherapists. Neither study reported on the relief obtained with the management strategies. Cromie et al. (2000) and West and Gardner (2001) reported on management strategies but their study sample was not confined to physiotherapists treating musculoskeletal problems using manual therapy techniques. In addition they were reporting on all musculoskeletal problems and not just WRTP. Therefore it is difficult to fully compare the results of Cromie et al. (2000) and West and Gardner's (2001) results with this study.

The greatest number of participants in this study modified their technique as a management strategy for their thumb problem (87.5%, n=218). Wajon and Ada (2003) reported that 82 % of their participants changed the technique. It is not clear if the techniques were modified or a different technique was used. Modification of the techniques resulted in complete relief for 24.5% (n=61) of the physiotherapists while 60.6% (n=151) obtained complete relief in the current study. The literature provides support for the spinal manipulative therapy in the management of spinal pain (Ingeborg et. al, 2003). There is an opposing thought however, in which Atkinson and Maher (2004) questions the wisdom of physiotherapists' persisting in the application of longitudinal pressures through the thumbs in spite of the inherent risks of degeneration of the basal joints of the thumb. Although this study and previous studies (Cromie et al., 2000; West and Gardner, 2001; Wajon and Ada, 2003; Mc Mahon et al, 2006; Barnes et al., 2011) show that the manual therapy techniques using the thumbs are associated with WRTP in physiotherapists, it would be

unwise to discontinue the techniques before studies can be done to test the efficacy of the modified techniques that result in less strain to the physiotherapists' thumbs.

Splinting and taping was used as a management strategy by 35.7% (n=87) of the respondents in this study, 32% (n=203) of the respondents in the study by Mc Mahon et al. (2006) and 29% (n=44) of the respondents in Wajon and Ada's study (2003). Relatively few (35.7%, n=87) of the respondents used taping or splinting as a management strategy in spite of the literature demonstrating that taping of the thumb during the application of manual techniques involving the thumb resulted in improved thumb alignment which could potentially decrease WRTP (Walsh et al., 2011).The maintenance of good alignment of the thumb during application of the manual techniques is important in decreasing the stress on the CMC and MP joints of the thumb (Atkinson and Maher, 2004; Wajon and Ada, 2007; Hu et al., 2009; Snodgrass and Rivett, 2002). This study showed that 85% (n=74) of the respondents that used taping or splinting as a strategy, obtained complete or partial relief with taping or splinting of their thumbs so it would seem that it wise to use taping or strapping as a management or preventative strategy for WRTP. There is a need however for RCT on the efficacy of splinting and taping as a management strategy for WRTP in physiotherapists. This is especially important for undergraduates and newly qualified physiotherapists who are prone to the development of WRTP within their first five years of graduating (Cromie et al., 2000; Barnes et al., 2011; West and Gardner, 2001; Adegoke, 2008).

Stabilising exercises were used by only 14% (n=87) of the respondents in the study by Mc Mahon et al. (2006), no respondents in Wajon and Ada's study and (24%, n=60) of the respondents in this study. The efficacy of stabilising and stretching exercises in preventing WRTP could also be investigated because 63.3% (n= 38) of the 60 respondents that used stabilising exercises obtained complete or partial relief of their symptoms and 71.6% (n=68) obtained complete or partial relief of their thumb symptoms with stretching exercises. It is a concern that so few physiotherapists used stretching and stabilising exercises as a management strategy for their thumb problems despite the fact that as physiotherapists we prescribe exercises daily to the patients for the

management of their musculoskeletal disorders. In addition, Jacobs (2005) found that exercise may be an effective strategy to improve thumb stability that is necessary during PA spinal mobilisation.

Another response to WRTP was modifying work habits and 26.9% (n=67) of the current study participants decreased patient contact and a similar percentage, 25% (n=39) is reported by Wajon and Ada (2003). A related response is the plan to retire early where 14% (n=35) of the respondents reported this intention. Wajon and Ada (2003) did not report on whether their respondents planned to retire early but reported that 27% (n= 41) had reconsidered their career. It is debatable whether early retirement or a change in career could be avoided by preventative education. Barnes et al., 2011 was of the opinion that it was the physical nature of the work that predisposes the physiotherapists to injury and not the lack of preventative education. One school of thought could be that if preventative education is given, the likelihood of WRTP could be delayed or alleviated. This is supported by the lowest prevalence (57.7%, n=64) of WRTP being evident in respondents who received education on the prevention of WRTP at undergraduate level in the current study. This emphasises the importance of preventative education at undergraduate level. Many of the respondents felt very strongly about the importance of education to prevent WRTP in manual physiotherapists. In fact 26.7% (n=103) physiotherapists took the time to write a comment on this question in the survey. Many volunteered advice regarding the technical aspects of the delivery of the techniques and the use of treatment tools and supplements. The comments were varied with some respondents reporting that adequate education was given and some feeling that very little time was spent on this topic and it definitely merited as much time as is given to back care education in the physiotherapy undergraduate course.

If emerging research on this subject is communicated on an on-going basis to undergraduate students, the physiotherapists will be well informed of the factors associated with the performance of manual therapy techniques involving the thumbs and the strategies used in their prevention and

this could result in a decreased prevalence of WRTP in physiotherapists using manual therapy techniques as preventative strategies are implemented.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

The following conclusions can be made from the results and discussion of this study:

6.1 Conclusions

- The life-time prevalence of WRTP in South African physiotherapists treating musculoskeletal conditions using manual therapy techniques is 65.3% according to questionnaire one and 67.5% according to questionnaire two.
- A high prevalence of WRTP was evident in the 20-30 years and 51-60 years age groups, physiotherapists less than 50 kilograms, physiotherapists with generalised hypermobility of the thumb and physiotherapists with hyperextension of the knees. A high prevalence of WRTP was also evident in physiotherapists working in areas for one to five years using manual therapy techniques. Although these findings were prevalent, they were not statistically significant.
- Factors that were significantly associated with WRTP were knee hyperextension >10°on the non-dominant side (p=0.02), passive F of the thumb to the anterior forearm (p=0.04), hyperextension >30° of the non-dominant IP joint of the thumb with the CMC and the MP joints of the thumb in extension (p=0.02) and the manual treatment of the cervical spines of up to six patients a day (p=0.02).

  The factors that remained significantly associated with WRTP when put into a regression analysis were hyperextension >30° of the non-dominant IP joint of the thumb with the CMC and the MP joints of the thumb in extension (p=0.05) and the cervical spine treatment of up to six patients treated in a day (p=0.01).
- Occupational factors significantly associated with WRTP included manual therapy techniques and soft tissue mobilisation techniques using the thumbs, a high, repetitive workload, treating a large number of patients daily, working with a current injury, working in

sustained positions for prolonged periods, working in uncomfortable positions, inadequate rest periods, inadequate training in injury prevention, working at or near your physical limits ($p<0.001$) and percussion, vibrations and shaking ($p=0.005$).

- The stronger grades of manual therapy techniques using the thumbs (grade II-IV Mulligan techniques, unilateral and central posterior-anterior spinal mobilisation) and all grades of transverse glides to the spine were also significantly associated with work-related problems ($p<0.001$).
- The management strategies most commonly used by the physiotherapists in the prevention of WRTP were the modification of the technique and the use of a different technique.

6.2 Limitations of Study

A few limitations are acknowledged and are discussed below.

- The low response rate of between 20-25% could result in low-response bias that could question the validity of our findings. However, the Hikmet and Chen's (2003) study supported the validity of the results of low response rates when they investigated the low mail survey response rates of information technology users in health care organisations. Although this study had a lower response rate than the national study done in Australia (Mc Mahon et al., 2006), both studies had very similar demographic sample and the prevalence rate of WRTP in both studies was exactly the same, namely 65.3%.
- Internet-based questionnaire bias: Klovning et al. (2009) reported that a web-based survey reported a higher illness severity and attracted an age based sample, namely younger respondents. Mayr et al, (2012) was in agreement with Klovning et al. (2009) but also demonstrated that after adjusting for the bias, the same results can be expected.
- Being mainly retrospective in design, the information received was associated with a recall bias and based purely on the respondent physiotherapists' opinions, interpretation and

memory. Recall bias is therefore acknowledged. There was also no objective measure to confirm answers provided. Therefore conclusions cannot be drawn regarding the cause/effect of thumb problems due to work-related factors and the effectiveness of the management strategies need to be evaluated in intervention studies.

- Gender was excluded from the initial questionnaire due to a technical error and therefore its association with other factors in survey one was not determined. The results therefore give a close but not exact representation of the gender ratios for survey one. However they do align with the ratio of male to female in the overall number of physiotherapists registered with the SASP.
- The questions on generalised and thumb hypermobility required that the respondents assess themselves, however the validity of self assessment was not tested. In a questionnaire- based study it is acceptable for the opinion of the respondents to be used as in this case, since physiotherapists are skilled professionals that are capable of performing such self assessment.

6.3 Recommendations

- A longitudinal study which follows the newly qualified physiotherapists for at least 5 years which would investigate a possible cause effect relationship and preventative strategies for WRTP in physiotherapists.
- A RCT investigating different preventative and management strategies for WRTP.
- Research studies that investigate the effectiveness of the modified techniques used by physiotherapists treating musculosketal conditions using manual therapy techniques.
- An increased awareness at undergraduate and postgraduate level of the risk factors associated with WRTP in manual physiotherapists.

REFERENCES

- Adegoke BOA, Akodu AK, Oyeyemi AL. Work-related musculoskeletal disorders among Nigerian Physiotherapists. BMC Musculoskeletal Disorders 2008; 9: 112.
- Atkinson BW, Maher T. Thumb pain in physiotherapists: Biomechanical causes of pain and alternate and alternate methods of preventing distress in treatment. Journal of Manual & Manipulative therapy 2004; 12(4):187-191.
- Austin N. The Wrist and Hand Complex. In: Levangie P., Norkin C. Ed. Joint structure and function: A comprehensive analysis. Philadelphia: F.A.Davis Company, 2005:337-352.
- Barnes R, Moolman C, Roux Z, Shabort DJ, Yzel ME, Raubnheimer J. The lifetime prevalence of work-related thumb and wrist pain among physiotherapists in Bloemfontein. Occupational Health South Africa July/August 2011:16-22.
- Beighton P, Solomon L, Soskolne CL. Articular mobility in an African population. Annuls of Rheumatic Disease 1973; 32(5):413-8.
- Bork BE, Cook TM, Rosencrance JC, Englhardt KA, Thomason MJ, Wauford IJ, Worley RK. Work-related musculoskeletal disorders among physical therapists. Physical Therapy 1996; 76: 827-835.
- Buckingham G, Das R, Trott P. Position of undergraduate's students' during mobilisation is poor: An observational study. Australian Journal of Physiotherapy 2007; 53(1):55-59.
- Buckingham G, Das R, Trott P. Position of undergraduate's students' during mobilisation is poor: An observational study. Australian Journal of Physiotherapy 2007; 53(1):55-59.
- Colditz j: The biomechanics of thumb CMC immobilisation splint: design and fitting. Journal of Hand Therapy 2000; 12: 228-235.
- Colditz JC, Koekebakker N. A new splint design for the thumb CMC joint. http://www.4-hands.nl/wp-content/uploads/2012/02/White-Paper-20111.pdf (Accessed 23 July 2013).
- Cromie JE, Robertson VJ, Best MO. Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses. Physical Therapy.2000; 80(4):336-351.

- Edmunds JO. Current concepts of the anatomy of the thumb trapeziometacarpal joint. Journal of Hand Surgery Am. 2011; 36 (1):170-82.
- Glover W. Work-related strain injuries in Physiotherapists: Prevalence and prevention of musculoskeletal disorders. Physiotherapy 2002; 88(6):364-372.
- Hikmet N, Chen SK. An investigation into low mail response rates of information technology users in health care organizations. International Journal of Medical Informatics 2003; 72(1-3):29-34.
- Holder N, Clark H, DiBlasio M, Hughes CL, Scherpf JW, Harding L, Shepard KF. Cause, prevalence and response to occupational musculoskeletal injuries reported by physical therapists and physical therapy assistants. Physical Therapy 1999; 79 (7): 642-652.
- Hu M, Hsu A, Su F. Effect of general flexibility on thumb-tip force generation – implication for mobilization and manipulation. Manual Therapy 2009; 14(5):490-495.
- Hurwitz el, Aker PD, Adams AH, Mekeer WC, Shekelle PG. Manipulation and mobilisation of the cervical spine: A systematic review of the literature. Spine 1996; 21 (15): 1746-1760.
- Jacobs K. A randomized controlled trial examining the effect of an exercise program on improving the ability of physiotherapy students to stabilise their thumbs during postero-anterior mobilization techniques. Honours thesis 2005. University of South Australia.
- Jull G. Towards preventing thumb pain from application of cervical manual therapy 2011; 16(3): 207-208.
- Kjeken I, Smedslund G, Moe RH, Slatkowsky-Christensen B, Uhlig T, Hagen KB. Systematic review of design and effects of splints and exercise programs in hand osteoarthritis. Arthritis Care Res (Hoboken) 2011; 63(6):834-48.
- Koff MF, Ugwonali OF, Strauch RJ, Rossenwasser MP, Ateshian GA, Mow VC. Sequential wear patterns of the articular cartilage of the thumb CMC joint in osteoarthritis. The Journal of Hand Surgery 2003; 28A (4):597-604.

- Klovning A, Sandvik H, Hunskaar S. Web-based survey attracted age-biased sample with more severe illness than paper-based survey. Journal of Clinical Epidemiology 2009; 62: 1068-1074.
- Korthals-de Bos IB, Hoving JL, van Tulder MV, Rutten-van Molken MP, Ader HJ, de Vet HC, Koes BW, Vondeling H, Bouter LM. Cost effectiveness of physiotherapy, manual therapy, and general practitioner care for neck pain: economic evaluation alongside a randomised controlled trial. Brittish Medical Journal 2003; 326(7395): 911-916.
- Kovler M, Lundo K, Mc Kee N, Agur A. The human first metacarpal joint: osteoarthritic degeneration and 3-dimensional modelling. Journal of Hand Therapy 2004; 17:393-400.
- Luttman A., Griefahn B., Caffier G. "Preventing Musculoskeletal Disorders in the Workplace." Protecting Workers Health Series No 5. 2003. <http://www.who.int/occupational_health /publications /en/oehmsd3.pdf> [Accessed 15 February 2013].
- Maitland GD, Hengeveld E, Banks K, English K. Maitland's vertebral manipulation. Oxford: Butterworth-Heinemann 2001:253-353.
- Maher CG, Latimer J, Starkey I. An evaluation of Superthumb and the Kneeshaw device as manual therapy tools. Australian Journal of Physiotherapy 2002; 48(1):25-30.
- Mayr A, Gefeller O, Prokosh H, Pirkl A, Frohlich A, de Zwaan Web-based data collection yielded an additional bias-but had no direct effect on outcome bias. Journal of Clinical Epidemiology 2012; 65; 970-977.
- Mc Donald, JH. Handbook of biological statistics (2nd edition). Baltimore, Maryland: Sparky house Publishing, 2009; 7-12, 57-63, 191-197, 207-223, 247-255.
- McMahon M, Stiller K, Trott P. The prevalence of thumb problems in Australian physiotherapists is high: An observational study. Australian Journal of Physiotherapy 2006; 52(4): 287-292.

- Moulton MJ, Parentis MA, Kelly MJ, Jacobs C, Naidu SH, Pellegrini VD Jr. Influence of metacarpophalangeal joint position on basal joint-loading in the thumb. Journal of Bone Joint Surgery Am. 2001; 83-A (5):709-16.
- Mulligan BR. Manual Therapy, 'NAGS, SNAGS, MWMS. Wellington, New Zealand: Plane View Services Ltd., 2006; 10-41.
- Neumann DA, Bielefeld T. The CMC joint of the thumb: Stability, Deformity, and Therapeutic Intervention. Journal of Orthopaedic & Sports Physical therapy 2003; 33(7): 386-399.
- Nordin NAM, Leornard JHL, Thye LN. Work-related injuries among physiotherapists in public hospitals- A South Eastern picture. Clinics 2011; 66(3) 371-378.
- O'Brien VH, Giveans M.R. Effects of a dynamic stability approach in conservative intervention of the CMC joint of the thumb: A retrospective study. Journal of Hand Therapy 2013, 26(1):44-52.
- Obembe AO, Onigbinde AT, Johnson OE, Emechete AAI, Oyinlola MJ. Occupational injuries among physical therapists in South-west Nigeria. Nigerian Journal of Medical Rehabilitation Dec. 2008; 13(1 &2): 25.
- Pelligrini VD. Pathomechanics of the thumb trapeziometacarpal joint. Hand Clinics 2001; 17: 175-184.
- Poole JU, Pelligrini VD. Arthritis of the thumb basal complex. Journal of Hand Therapy 2000; 13: 91-107
- Reglar P, James G. Thumb pain in physiotherapists: a preliminary study. British Journal of Therapy and Rehabilitation 1999; 6: 505-509.
- Rozenfeld V, Ribak J, Danzinger J, Tsamir J, Carmeli E. Prevalence, Risk Factors and Preventive Strategies in Work-related Musculoskeletal Disorders among Israeli Physical Therapists. Physiotherapy Research International 2010; 15:176-184.

- Saha S, Chant D, Welham J, McGrath J. A Systematic Review of the Prevalence of Schizophrenia. PLOS.2005; 2 (5): e141 <http://www.ncbi.nlm.nih.gov/pmc/articles /PMC1140952/ [Accessed 10 July 2012].
- Simons D, Travell J, Simons L. Myofascial pain and dysfunction. The Trigger Point Manual 1999; 2nd Ed volume 2:11-173.
- Simpson MR. Benign joint hypermobility syndrome: evaluation, diagnosis, and management. Journal of American Osteopathic Association. 2006; 106 (9):531-6.
- Snodgrass SJ, Rivett DA. Thumb pain physiotherapists: Potential risk factors and proposed prevention strategies. Journal of Manual and Manipulative Therapy 2002, 10(4):206.
- Snodgrass SJ, Rivett DA, Robertson VJ, Stojanovski E. Forces applied to the cervical spine during posteroanterior mobilization. Journal of Manipulative and Physiological Therapeutics. 2009 32(1):72-83.
- Snodgrass SJ, Rivett DA, Chiarelli P, Bates AM, Rowe LJ. Factors related to thumb pain in physiotherapists. Australian Journal of Physiotherapy. 2003; 49(4):243-50.
- Snodgrass SJ, Rivett DA., Robertson VJ, Stojanovski E. A Comparison of Cervical Spine Mobilization Forces Applied by Experienced and Novice Physiotherapists. Journal of Orthopaedic Sports Physical Therapy 2010; 40(7):392-401.
- Sowers M, Lachance L, Hochberg M, Jamadar D. Radiographically defined osteoarthritis of the hand and knee in young and middle aged African American and Caucasian women. Osteoarthritis and cartilage 2000; 8: 69-77.
- Thistlethwaite A. Prevalence and perceived causes of thumb pain in female physiotherapists. [Research Report]. Durban (Kwa Zulu Natal): Durban University of Technology, 2005.
- Useh U, Igumbor EU, Madzivire DM. Occupational injuries among Physiotherapists: A case http://www.unisa.ac.za/contents/faculties/humanities/sosw/docs/ASPJ-2003/ASPJ2003-1-2-05-WHO-supported-injury-surveillance-activities-in-Africa-Mozambique-and-Ethiopia.pdfstudy in Zimbabwe**.** [Accessed January 2012].

- Valdes K, von der Heyde R. An exercise programme for carpometacarpal osteoarthritis based on biomechanical principles. Journal of Hand Therapy 2012; 25 (3):251-262.
- Valdes K, Marik T. A Systematic Review of Conservative Interventions for Osteoarthritis of the Hand. Journal of Hand Therapy 2010: 334-351.
- Waddington G, Lau G, Adams R. Manual application of controlled forces to thoracic and lumbar spine with a device: Rated comfort for the receiver's back and the applier's hands. Journal of Manipulative and Physiological Therapeutics 2007; 30 (5): 3654-373.
- Wajon A. The thumb strap splint for dynamic instability of the trapeziometacarpal joint. Journal of Hand Therapy 2000; 13: 326-7.
- Wajon A, Ada L. Prevalence of thumb pain in physical therapists practicing spinal manipulative therapy. Journal of Hand Therapy 2003; 16(3):237-44.
- Wajon A, Ada L. No difference between two splint and exercise regimens for people with osteoarthritis of the thumb: A randomized controlled trial. Australian Journal of Physiotherapy 2005, 51(4):245-249.
- Wajon A, Ada L, Retshauge K. Work related thumb pain in physiotherapists is associated with thumb alignment during performance of PA pressures. Manual therapy 2007, 12(1):12-16.
- Walsh T, Delahunt E, McCarthy Persson U. Effects of taping on thumb alignment and force application during PA mobilizations. Manual Therapy 2011, 16(3):264-269.
- West DJ, Gardner D. Occupational injuries of physiotherapists in North and Central Queensland. Australian Journal of Physiotherapy 2001; 47(3):179-86.
- Wilder FV, Barrett JP, Farina EJ. Joint specific prevalence of osteoarthritis of the hand. Osteoarthritis and Cartilage 2006; 14 (9): 953-957.
- Zancolli EA, Ziadenberg C, Zancolli E Jr. Biomechanics of the trapeziometacarpal joint Clinical Orthopaedic and Related Research. 1987 July ;(220):14-26.
- Sample size calculation. <http://www.ifad.org/gender /tools/hfs/anthropometry /ant_3.html> [Accessed February 2012].

- What is a physio? < http://www.physiosa.org.za/?q=node/3> [Accessed 15 February 2013]

APPENDIX A: CLEARANCE CERTIFICATE



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

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mrs Heather Jenkins

CLEARANCE CERTIFICATE	**M120429**
PROJECT	Work-Related Thumb Disorders in South African Physiotherapists Treating Musculoskeletal Conditions using Manual therapy Techniques
INVESTIGATORS	Mrs Heather Jenkins.
DEPARTMENT	Department of Physiotherapy
DATE CONSIDERED	04/05/2012
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 04/05/2012 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Dr H Meyezwa

DECLARATION OF INVESTIGATOR(S)
To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX B - SAMPLE SIZE CALCULATION

The required sample size (SS) WAS calculated using the formula: $SS = t^2 \times p\ (1-p) / m^2$

(http://www.ifad.org/gender/tools/hfs/anthropometry/ant_3.html)

SS = required sample size,

t = t value 1.96 for 95% confidence level

p = .83 for an 83% prevalence of thumb problems in manipulative physiotherapists using manual therapy techniques (Wajon and Ada, 2003).

m= margin of error at 5% (standard deviation of 0.05) indicates the degree of precision

Sample size= $1.96^2 \times .83(1-.83) / 0.05^2$

= 217

If the sample size is calculated using a prevalence of 65% for the only published study in South Africa (Barnes et al.,2011), the required sample size is calculated to be 350. This study however included all physiotherapists in the Bloemfontein area and not only those treating musculoskeletal using manual therapy techniques as is the case for the proposed study.

It was therefore decided that an average of the two studies would be used for this study. The required sample size for this study therefore will be 284.

APPENDIX C – PANEL OF EXPERTS

The qualifications of the panel of experts are presented in the table below.

Name of physiotherapist	Qualifications	Present employment
Maleke, Morake	B.Sc. (Physio), Medunsa, 1995 MPH, Wits, 2005 Ph. D, Wits, 2011	Lecturer, Wits University
Naidoo, Vaneshveri	B.Sc. (Physio), Medunsa, 1996 M.Sc. (OMT), 2009	Lecturer, Wits University
Oliver, Benita	B.Sc. (Physio), U Pretoria, 2003 M.Sc. (OMT), Wits, 2008	Lecturer, Wits University
Perry, Desiree	B.Sc. (Physio), UOFS, 1991 OMT 1, 1995	Private practice
Roodte, Nicola	B.Sc. (Physio), UCT, 1994 OMT 1, Stellenbosch, 2003	Private practice
Wood, Wendy- Anne	B.Sc. (Physio) OMT 1, 2001 M.Sc. (Orthopaedics), Wits, 2004 Ph. D, Wits, 2011	Sessional appointment lecturer, Wits University SASP Research foundation trustee, 2011, 2012.
Zieseness, Felicity	B.Sc. (Physio), UCT, 1979 OMT, Port Elizabeth, 2003	Retired due to work-related thumb problems .

APPENDIX D – VALIDATION COMMENTS

Question	**Comment**
Height, Weight, BMI?	National survey. Equipment standardisation questioned. Categories for height and weight suggested. Less time required to answer.
Training institution?	Question excluded. Relevance questioned.
Indicate time (in years) working in following areas…	Question categorised 1-5 years, 6-10 years etc. Requires less time to answer.
How would you define your work-load … How many hours per day do you work in these areas?	Listing of options suggested. Respondents tick the appropriate response. Instead of number of hours, number of patients a day suggested.
In your overall day, what %age of your time is spent in the following "hands-on" techniques?	Question excluded. Difficulty would be experienced by the respondents to answer this question.
If passive joint mobilisation is related to your thumb problem, which specific technique and grade of mobilisation cause your problem?	Options should be given and respondents tick the appropriate box.
With the CMC and MCP joints of your thumb in full extension, can you actively hyperextend (that is extend beyond 0°) the Metacarpophalangeal (MCP) joint of your thumb(s) ?	The two portions of the question were made more distinct by capitalising the first part of the sentence. Suggested for easier understanding of the question. WITH THE CMC JOINT OF YOUR THUMB IN EXTENSION, can you actively hyperextend the MP joint of your thumb?
With the CMC joint of your thumb in flexion Can you actively hyperextend the metacarpophalangeal (MCP) joint of your thumb(s)?	The two portions of the question were made more distinct by capitalising the first part of the sentence. Suggested for easier understanding of the question. WITH THE CMC JOINT OF YOUR THUMB IN FLEXION, can you actively hyperextend the MP joint of your thumb?
With the CMC and MCP joints of your thumb	The two portions of the question were made

in full extension Can you actively hyperextend the interphalangeal (IP) joint of the thumb (s) (IP) joint of your thumb(s)? (See picture to the right)	more distinct by capitalising the first part of the sentence. Suggested for easier understanding of the question. WITH THE CMC AND MP JOINT OF YOUR THUMB IN FULL EXTENSION, can you actively hyperextend the interphalangeal (IP) joint of your thumb?
In order to reduce strain on my thumb when working: I…(listing of intervention) response :ways, never, sometimes	Instead of always, never, sometimes which asks about the frequency of using the intervention, the question that should be asked is if there was relief obtained with using the intervention. Therefore no relief, partial relief and complete relief were recommended. Valuable information on the benefit of the management strategy would be obtained.
Do you think that your thumb problem was caused or exacerbated by a particular area of physiotherapy?	Excluded-repetition of the question
Which of the following describes your thumb problem?	Localisation of joint of the thumb for the different thumb problems was suggested. Additional thumb problems suggested.
Questions added: *If you experience pain, classify the intensity of your pain on a scale from 0-10 where 0 is no pain and 10 is unbearable pain; *To what degree is your thumb disorder affecting the following activities…Classify on a scale of 1-10. *Frequency of thumb problem ** In which work area did the thumb problem begin.	Relevant question. *Important to know the severity of the pain and whether the thumb problems interfere with daily function and participation. ** Relevant. Identifies work area where more work-related thumb problems could occur. Preventative measures can identify and address the problems.

APPENDIX E

Table E1: Prevalence of 'Feeling of joint instability' in MP and CMC joints of the thumb (n=254)

Joint	Category	n (%)
MP joint	Dominant thumb	57 (22.4%)
	Non dominant thumb	48 (18.9%)
CMC joint	Dominant thumb	45 (17.7%)
	Non dominant thumb	33 (12.9%)

Table E2: Prevalence of 'feeling of MP joint instability' in different age groups

Age Group	n	Category	'Feeling of MP joint instability'
20-30 years	120	Dominant thumb	25 (20.8%)
		Non dominant thumb	19 (15.8%)
31-40 years	127	Dominant thumb	19 (14.9%)
		Non dominant thumb	15 (11.8%)
41-50 years	88	Dominant thumb	7 (7.9%)
		Non dominant thumb	7 (7.9%)
51-60 years	45	Dominant thumb	5 (11.1%)
		Non dominant thumb	6 (13.3%)
>60 years	15	Dominant thumb	1 (6.7%)
		Non dominant thumb	1(6.7%)

APPENDIX F

Table F 1: Prevalence of hyperextension in MP joint (CMC in E) in different age groups: Dominant thumb

Age Group	n	Category	MP hypertext (C MC in E) n (%)
20-30 years	120	No	32(26.7%)
		Yes:0°-30°	70 (58.3%)
		Yes:>30°	18 (15.0%)
31-40 years	127	No	57 (44.9%)
		Yes:0°-30°	54 (42.5%)
		Yes:>30°	16 (12.6%)
41-50 years	88	No	36 (40.9%)
		Yes:0°-30°	41 (46.6%)
		Yes:>30°	11(12.5%)
51-60 years	45	No	27 (60.0%)
		Yes:0°-30°	12 (26.7%)
		Yes:>30°	6 (13.3%)
>60 years	15	No	6 (40.0%)
		Yes:0°-30°	6 (40.0%)
		Yes:>30°	3 (20.0%)

Table F 2: Prevalence of hyperextension in MP joint (CMC in E) in different age groups: Non dominant thumb

Age Group	n	Category	MP hypertext (C MC in E) n (%)
20-30 years	120	No	38 (31.7%)
		Yes:0°-30°	66 (55.0%)
		Yes:>30°	16 (13.3%)
31-40 years	127	No	58 (45.7%)
		Yes:0°-30°	53 (41.7%)
		Yes:>30°	16 (12.6%)
41-50 years	88	No	37 42.0%)
		Yes:0°-30°	40 (45.5%)
		Yes:>30°	11 (12.5%)
51-60 years	45	No	27 (60.0%)
		Yes:0°-30°	12 (26.7%)
		Yes:>30°	6 (13.3%)
>60 years	15	No	4 (26.7%)
		Yes:0°-30°	8 (5.3%)
		Yes:>30°	3 (20.0%)

Table F 3: Prevalence of hyperextension in MP joint (CMC in F) in different age groups: Dominant thumb

Age Group	n	Category	MP hypertext (C MC in E) n (%)
20-30 years	120	No	31 (25.8%)
		Yes:0°-30°	73 (60.8%)
		Yes:>30°	16 (13.4%)
31-40 years	127	No	50 (39.4%)
		Yes:0°-30°	56 (44.1%)
		Yes:>30°	21 (16.5%)
41-50 years	88	No	36 (40.9%)
		Yes:0°-30°	44(50.0 %)
		Yes:>30°	8 (9.1%)
51-60 years	45	No	22 (48.9%)
		Yes:0°-30°	18 (40.0%)
		Yes:>30°	5 (11.1%)
>60 years	15	No	6 (40.0%)
		Yes:0°-30°	5 (33.3%)
		Yes:>30°	4 (26.7%)

Table F4: Prevalence of hyperextension in MP joint (CMC in F) in different age groups: Non dominant thumb

Age Group	n	Category	MP hypertext (C MC in E) n (%)
20-30 years	120	No	41 (34.2%)
		Yes:0°-30°	63 (52.5%)
		Yes:>30°	16 (13.3%)
31-40 years	127	No	50 (39.4%)
		Yes:0°-30°	58 (45.7%)
		Yes:>30°	19 (14.9%)
41-50 years	88	No	32 (36.4%)
		Yes:0°-30°	9 (10.2%)
		Yes:>30°	32 (36.4%)
51-60 years	45	No	21 (46.7%)
		Yes:0°-30°	19 (42.2%)
		Yes:>30°	5 (11.1%)
>60 years	15	No	4 (26.7%)
		Yes:0°-30°	7 (46.7%)
		Yes:>30°	4 (26.6%)

Work-related thumb disorders in physiotherapists using manual therapy

Introduction to study

I am a physiotherapist and currently a postgraduate student at the University of the Witwatersrand, Johannesburg. I am researching work-related thumb disorders in South African physiotherapists treating musculoskeletal disorders using manual therapy techniques.
Of all the structures in the hand, the thumb is the most vulnerable to biomechanical and work-related injuries in physiotherapists (Cromie et. al., 2000; Snodgrass et. al., 2003; Atkinson et. al. 2004; McMahon et.al., 2006).The thumb is used as a pseudo weight-bearing joint when force is applied through it. The thumb is not designed for this function and thus a potential for repetitive strain injuries, cumulative trauma disorder as well as osteoarthritis of the carpometacarpal joint develops (Snodgrass et. al., 2003).'A physiotherapist 's hands are a vital tool in the assessment and treatment of patients and it is crucial that they are protected from injury wherever possible' (Regular and James, 1996). For these reasons it is necessary that there is ongoing research into the prevalence and factors associated with thumb disorders in physiotherapists. Information gained from the study will add to the body of knowledge of our profession and could be used in both the undergraduate and postgraduate courses run by our profession.

You are invited to participate in this study if you were/are treating musculoskeletal conditions using manual therapy techniques. If you agree to participate in the study, you will be required to fill out a questionnaire about factors causing and relieving thumb problems in physiotherapists using manual therapy techniques. An approximate time of 10-15 minutes is required to complete the questionnaire.Completion of the questionnaire will be considered as informed consent. Participation is voluntary and you are free to withdraw at any time. Your confidentiality will be assured as your name and personal information will not be used in the course of the study.

For further information and questions, the researcher can be reached at the Department of Physiotherapy, University of the Witwatersrand, Johannesburg, South Africa, or by email at physiosurvey@hotmail.com. Information and questions on ethical considerations and approval can be obtained from the chairman of the Human research Ethics Committee (Medical), Prof. P.E. Cleaton – Jones of the University of the Witwatersrand, Johannesburg, South Africa. Telephone: 011 717 1234, Fax: 011 717 1265.

Thank-you for your participation in this research study .
Heather Jenkins

1. OFFICE USE ONLY

Reference

*2. Do you have any structural deformities of the hand, forearm or elbow due to non work- related causes?

- Yes
- No

*3. Do you suffer from any diseases affecting the hands? (eg., Rheumatoid Arthritis, Scleroderma, Systemic Lupus Erythematosus)

- Yes
- No

Work-related thumb disorders in physiotherapists using manual therapy

***4. Have you had any operations to your thumb due to non work-related factors?**

- Yes
- No

***5. To which age group do you belong?**

- 20-30 years
- 31-40 years
- 41-50 years
- 51-60 years
- >60 years

***6. At which age did you retire? (retired physiotherapists only):**

- Not applicable
- 20-30 years
- 31-40 years
- 41-50 years
- 51-60 years
- >60 years

***7. What is your weght?**

- < 50 kg
- 50-60 kg
- 61-70 kg
- 71-80 kg
- 81-90 kg
- > 90 kg

***8. What is your height?**

- <150 cm
- 150-160 cm
- 161-170 cm
- 171-180 cm
- >180 cm

***9. To which race group do you belong? (for diagnostic profiling):**

- Asian
- Black
- Coloured
- White

Other (please specify)

Work-related thumb disorders in physiotherapists using manual therapy

*10. What post graduate diplomas/ degrees have you completed?

- ☐ Nil
- ☐ Community Physiotherapy
- ☐ Neurology and Neurosurgery for Physiotherapists
- ☐ Orthopaedic Manipulative Therapy
- ☐ Orthopaedic Surgery for Physiotherapists
- ☐ Paediatrics for Physiotherapists
- ☐ Respirology, Cardiology and Cardiothoracic Surgery for Physiotherapists
- ☐ Sports and Exercise Therapy
- ☐ Traumatology
- ☐ Other

Other (please specify)

*11. For how many years have you worked as a physiotherapist?

	0 years	1-5 years	6-10 years	11-20 years	greater than 20 years.
Full time	○	○	○	○	○
Part time (less than 15 hours a week)	○	○	○	○	○

*12. Please indicate how long, in years, you have worked in the following areas, in your total working experience.

	1-5 years	6-10 years	11-15 years	>20 years
Academics	○	○	○	○
Administrative post	○	○	○	○
Cardiothoracic	○	○	○	○
Community Physiotherapy and Public Health	○	○	○	○
Manual/Manipulative therapy	○	○	○	○
Neurology	○	○	○	○
Orthopaedic inpatients	○	○	○	○
Orthopaedic outpatients	○	○	○	○
Paediatrics	○	○	○	○
Sport	○	○	○	○
Other	○	○	○	○

Other (please specify)

Work-related thumb disorders in physiotherapists using manual therapy

***13. How many years have you worked in treating the following areas**

	1-5 years	6-10 years	11-15 years	16-20 years	>20 years
Necks(headaches or any cervical pathology)	○	○	○	○	○
Maxillo-facial region	○	○	○	○	○
Thoracic region	○	○	○	○	○
Lumbosacral region	○	○	○	○	○
Upper limb	○	○	○	○	○
Lower limb	○	○	○	○	○

***14. Indicate if you are currently working full time, part time or retired.**

Part time physiotherapists: Physiotherapists working less than15 hours per week.
Retired physiotherapists: Answers should pertain to your previous working experience.

- ○ Full time
- ○ Part time
- ○ Currently retired (was full time at time of retirement)
- ○ Currently retired (was part time at time of retirement)

***15. On a typical working day, how many patients do you treat with pathology in the following regions?**
Please note: This questions relates to your current working experience. Retired physiotherapists: This question relates to your previous working experience at the time of your retirement.

	1-2	3-4	5-6	7-8	9-10	10-12	>12
Cervical region(headaches or any cervical pathology)	○	○	○	○	○	○	○
Maxillo-facial region	○	○	○	○	○	○	○
Thoracic region	○	○	○	○	○	○	○
Lumbosacral region	○	○	○	○	○	○	○
Upper limb	○	○	○	○	○	○	○
Lower limb	○	○	○	○	○	○	○

***16. Have you ever received any education or advice regarding the protection of the thumbs?**

- ○ Yes
- ○ No

Work-related thumb disorders in physiotherapists using manual therapy

***17. If you were given advice regarding preventing thumb problems, when did this occur?**

- ☐ Not applicable
- ☐ As an undergraduate student :
- ☐ When working in an area which involves considerable use of the thumbs:
- ☐ As a postgraduate student
- ☐ Literature search

Describe advice given

***18. Do you have hypermobility of the following joints ?**

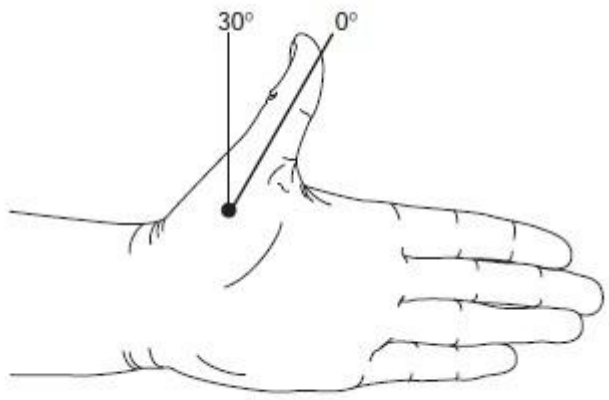
	Yes,dominant side	Yes,non-dominant side	No
Elbow hyperext > 10 °	☐	☐	☐
Knee hyperext > 10 °	☐	☐	☐
Passive flexion of the thumb to the flexor aspect of the forearm	☐	☐	☐
Passive little finger MP hyperextension > 90 °	☐	☐	☐

***19. Can you bend your trunk forwards with your knees extended and touch the floor with the palm of your hands?**

- ○ Yes
- ○ No

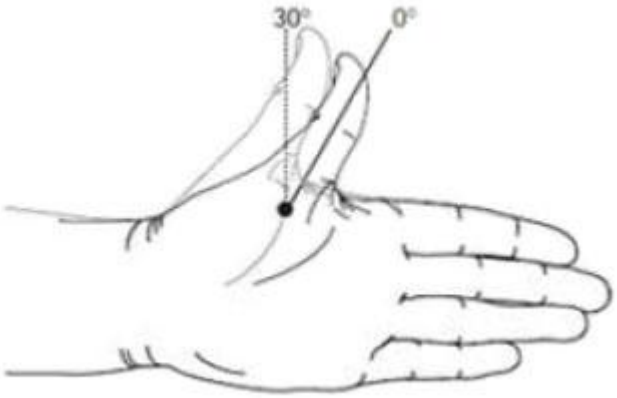
***20. WITH THE CARPOMETACARPAL(CMC) JOINT OF YOUR THUMB IN FULL EXTENSION,can you actively hyperextend the metacarpophalangeal (MP) joint of your thumb? (see picture below)**

	No	Yes, between 0 and 30 degrees	Yes, greater than 30 degrees
Dominant thumb	○	○	○
Non dominant thumb	○	○	○



***21. WITH THE CMC JOINT OF YOUR THUMB IN FLEXION, can you actively hyper-extend the MP joint of your thumb? (see picture below)**

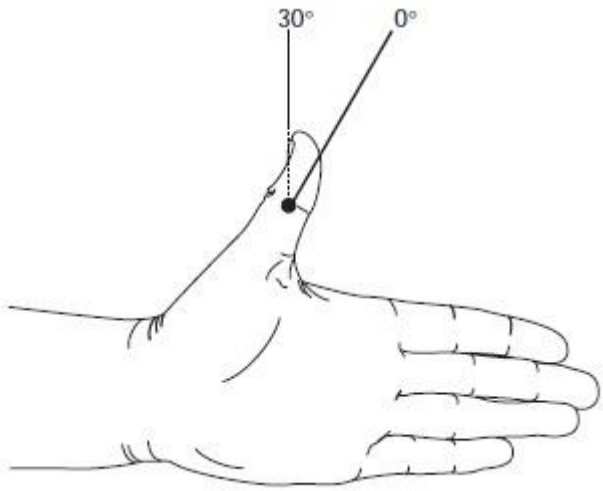
	No	Yes, between 0 and 30 degrees	Yes, more than 30 degrees
Dominant thumb	○	○	○
Non dominant thumb	○	○	○



***22. WITH THE CMC AND MP JOINT OF YOUR THUMB IN FULL EXTENSION, can you actively hyperextend the interphalangeal (IP) joint of your thumb? (picture below)**

	No	Yes, between 0 and 30 degrees	Yes, greater than 30 degrees
Dominant thumb	○	○	○
Non dominant thumb	○	○	○

Work-related thumb disorders in physiotherapists using manual therapy



***23. Have you ever experienced work-related thumb problems or has your work as a physiotherapist ever exacerbated any thumb problems ?**

- Yes
- No

Work-related thumb disorders in physiotherapists using manual therapy

*24. Which of the following describes your thumb problem?

	Dominant	Non-dominant
Pain in carpometacarpal joint (CMC joint)	☐	☐
Pain in metacarpophalangeal (MP) joint	☐	☐
Pain in interphalangeal (IP) joint	☐	☐
Thenar muscle spasm	☐	☐
Deep thenar muscle tenderness	☐	☐
Thenar muscle weakness	☐	☐
Feeling of instability of CMC joint	☐	☐
Feeling of instability of MP joint	☐	☐
Feeling of instability of IP joint	☐	☐
Stiffness of CMC joint	☐	☐
Stiffness of MP joint	☐	☐
Stiffness of IP joint	☐	☐
Sensory problems (numbness, pins and needles)	☐	☐
Difficulty with precision grip activities requiring force (opening tight containers,turning a stiff key/tight door knob/tap)	☐	☐
Carrying heavy objects, (eg., stack of plates) using lumbrical grip.	☐	☐
None of the above	☐	☐
Other	☐	☐

Please specify

Work-related thumb disorders in physiotherapists using manual therapy

*25. How often do you experience thumb problems?

- On one day of the month or less
- On seven or more days of the month
- On two or more days of the week
- Intermittent but daily
- Continuous

*26. If you experience pain, classify the intensity of your current pain on a scale from 0-10 where 0 is no pain and 10 is unbearable pain.

0 1 2 3 4 5 6 7 8 9 10

*27. To what degree is your thumb disorder affecting the following activities? (Choose a number that represents your level of difficulty, where 0 means no difficulty and 10 means maximum difficulty).

	0	1	2	3	4	5	6	7	8	9	10
Family/home responsibilities											
Recreation(sport, hobbies, leisure activities)											
Social activities											
Self care activities											
Occupation											

*28. When did your thumb problem begin?

	As an undergraduate	In the first 5 years of graduating	6-10 years after graduating	10-20 years after graduating	>20 years after graduating	Do not know	No problem
Dominant thumb							
Non dominant thumb							

*29. History of onset of thumb problem

	Gradual, insiduous onset	History of specific incident	Do not know	No problem
Dominant thumb				
Non dominant thumb				

History of specific incident (please specify)

Work-related thumb disorders in physiotherapists using manual therapy

*30. In which work area did your thumb problem begin?

- ○ Academic institution
- ○ Rehabilitation centre
- ○ Home care
- ○ Private practice
- ○ Industry
- ○ Unsure
- ○ Hospital
- ○ Outpatient department
- ○ Other

Other (please specify)

*31. Have you had surgery to your thumbs due to work-related problems?

- ○ Yes, dominant thumb
- ○ No
- ○ Yes, non-dominant thumb

Please specify

*32. In your opinion, which of the following work related activities / factors are associated with your thumb problem ?

You are allowed to choose more than one option.

- ☐ Other
- ☐ Increase in thumb use
- ☐ Treating a large number of patients in one day
- ☐ Performing the same task over and over
- ☐ Not enough rest breaks in one day
- ☐ Working at or near your physical limits
- ☐ Continuing to work when your thumb is injured
- ☐ Inadequate training in thumb injury prevention
- ☐ Working in the same position for long periods
- ☐ Working in uncomfortable positions
- ☐ Passive joint mobilisation/manipulative techniques
- ☐ Percussion, vibrations, shaking
- ☐ Soft tissue techniques using thumbs (massage, transverse frictions, myofascial release,etc.)
- ☐ Other
- ☐ Nil

Other (please specify)

Work-related thumb disorders in physiotherapists using manual therapy

***33. If passive joint mobilisation is related to your thumb problem, which specific techniques and grades of mobilisation cause your problems?**

	Nil	grade I	grade II	grade III	grade IV
Central posterior-anterior pressures	☐	☐	☐	☐	☐
Unilateral posterior-anterior pressures	☐	☐	☐	☐	☐
Transverse glides	☐	☐	☐	☐	☐
Mulligan techniques	☐	☐	☐	☐	☐

Other (please specify)

Work-related thumb disorders in physiotherapists using manual therapy

***34. What have you done to treat/ prevent your thumb problem? (You may choose more than one option from the interventions listed vertically).**

What have been the results of these interventions? (Choose one response from the horizontal list).

	No effect	Partial relief most times	Complete relief most times
Use different manual technique	○	○	○
Modify manual technique	○	○	○
Choose electrotherapy modality instead of manual technique	○	○	○
Modify plinth height	○	○	○
Modify patient position	○	○	○
Pause regularly to stretch	○	○	○
Stabilising exercises	○	○	○
Stop the treatment	○	○	○
Change the type of patients	○	○	○
Decrease patient contact	○	○	○
Officially reported injury	○	○	○
Use thumb splints, taping	○	○	○
Use medication	○	○	○
Consultation with general medical practioner	○	○	○
Consultation with orthopaedic specialist	○	○	○
Physiotherapy consultation	○	○	○
Full time to part time employment	○	○	○
Plan to retire early	○	○	○
Retired early	○	○	○
Surgery	○	○	○
Other	○	○	○

Other (please specify) or clarify interventions, where necessary, eg., splints or taping or techniques modified.

Work-related thumb disorders in physiotherapists using manual therapy

***35. Have you lodged a claim for work-related thumb problems to the Workmen's Compensation Commissioner or the Professional Provident Society (PPS)?**

- Yes
- No

Diagnosis of condition for claim

***36. Have you taken sick days leave due to work-related thumb problems in the last year?**

- No
- Yes, 6-10 days
- Yes, 1-5 days
- Yes, >10 days

37. Please add any comments you feel relevant to the study,

THANK YOU

IF YOU ANSWERED NO TO QUESTION 24, YOU DO NOT NEED TO FILL OUT THE REMAINDER OF THIS QUESTIONNAIRE.

HOWEVER YOUR RESPONSE IS IMPORTANT FOR STATISTICAL REASONS.

THANK YOU

IF YOU ANSWERED YES TO ANY OF QUESTIONS 2, 3 OR 4, YOU DO NOT NEED TO FILL OUT THE REMAINDER OF THIS QUESTIONNAIRE.

HOWEVER YOUR RESPONSE IS IMPORTANT FOR STATISTICAL REASONS.

END OF SURVEY

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY.

PRESS 'DONE' TO SEND SURVEY

Work-related thumb disorders in physiotherapists using manual therapy

Introduction to study

I am a physiotherapist and currently a postgraduate student at the University of the Witwatersrand, Johannesburg.I am researching work-related thumb disorders in South African physiotherapists treating musculoskeletal disorders using manual therapy techniques.

Of all the structures in the hand, the thumb is the most vulnerable to biomechanical and work-related injuries in physiotherapists (Cromie et. al., 2000; Snodgrass et. al., 2003; Atkinson et. al. 2004; McMahon et.al., 2006).The thumb is used as a pseudo weight-bearing joint when force is applied through it. The thumb is not designed for this function and thus a potential for repetitive strain injuries as well as osteoarthritis of the carpometacarpal joint develops (Snodgrass et. al., 2003).'A physiotherapist 's hands are a vital tool in the assessment and treatment of patients and it is crucial that they are protected from injury wherever possible' (Regular and James, 1996).

For these reasons it is necessary that there is ongoing research into the prevalence and factors associated with thumb disorders in physiotherapists. Information gained from the study will add to the body of knowledge of our profession and could be used in both the undergraduate and postgraduate courses run by our profession.

You are invited to participate in this study if you are/were treating musculoskeletal conditions using manual therapy techniques. If you agree to participate in the study, you will be required to fill out a questionnaire about factors causing and relieving thumb problems in physiotherapists using manual therapy techniques. LESS THAN A MINUTE IS REQUIRED TO COMPLETE THIS MINI SURVEY.Completion of the questionnaire will be considered as informed consent. Participation is voluntary and you are free to withdraw at any time. Your confidentiality will be assured as your name and personal information will not be used in the course of the study.

For further information and questions, the researcher can be reached by email at physiosurvey@hotmail.com.

Information and questions on ethical considerations and approval can be obtained from the chairman of the Human research Ethics Committee (Medical), Prof. P.E. Cleaton – Jones of the University of the Witwatersrand, Johannesburg, South Africa. Telephone: 011 717 1234, Fax: 011 717 1265.

Thank-you for your participation in this research study.
Heather Jenkins

***1. Did you participate in this survey before?**

- ○ Yes
- ○ No

***2. Were you prevented from completing the survey because of any of the following: structural deformities or operations of the hands due to non work-related causes, diseases affecting the hands or internet difficulties?**

- ○ Yes
- ○ No

Work-related thumb disorders in physiotherapists using manual therapy

***3. What is your gender?**

- Male
- Female

***4. To which age group do you belong?**

- 20-30 years
- 31-40 years
- 41-50 years
- 51-60 years
- >60 years

***5. Are you a member of the Orthopaedic Manipulative Therapists Group or Sports Therapy Group?**

- Yes
- No

***6. Have you ever experienced work-related thumb pain or has your work as a physiotherapist ever exacerbated your thumb pain?**

- Yes
- No

THANK YOU

IF YOU ANSWERED NO TO QUESTION 1, OR YES TO QUESTION 2, YOU DO NOT NEED TO COMPLETE THE QUESTIONNAIRE.
HOWEVER YOUR RESPONSE IS IMPORTANT FOR STATISTICAL REASONS.

END OF SURVEY

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY.

PRESS 'DONE' TO SEND SURVEY