Musculoskeletal Injury

as

“Part of the Job"

Health and Safety in Hand-Intensive Health- Care Occupations

Preventing Work-Related Upper Limb Disorders

Report submitted to the IOSH Research Committee

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Acknowledgements and Foreword

This study report was funded by the Institution of Occupational Safety and Health (IOSH) as part of the research study project 'Musculoskeletal Injury as Part of the Job? – Health and Safety in Hand-Intensive Health Care Occupations' (HITS).

The report includes parts that can be used for guidance by practitioners, i.e.:

- An **executive summary** written in non-academic language
- A **systematic review** of international models of good practice and codes of practice which can be used as a resource document by health and safety practitioners who are looking for guidance and specific risk assessment tools for the analysis of hand-intensive tasks.
- An appendix including a **self-assessment checklist** designed for the use by physiotherapists and physical therapists without prior occupational safety and health risk assessment training to identify work tasks in practice that may be creating a risk of upper limb disorders.

The report also includes the scholarly written literature review on upper limb disorders in hand-intensive occupations in health care and the scientific reports on

- a **cross-sectional study** on work-related upper limb disorders with Irish chartered physiotherapists, physical therapists and athletics therapists,
- and of a **follow-up study** on work-related upper limb disorders with physiotherapy, physical therapy, athletic therapy and training and sports therapy/physiotherapy assistant students.

The HITS Team would like to thank all chartered physiotherapists, physical therapists, athletics therapists and students for their participation in the survey, and their assistance in the pilot study. We also thank the professional bodies and training institutions for their co-operation and encouragement of participation in this study. Our appreciation also goes to our University colleagues; Dr. Tony Fitzgerald, Statistician, UCC, Ms. Denise Baker, who assisted with data entry, Ms. Colette Cunningham, who devised a sampling strategy for the hospital-based chartered physiotherapists, Ms. Lynda Coughlan for her administrative assistance and Ms. Anne Mangan, IPTAS for their invaluable contribution to this study.

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The HITS Team: Dr. Birgit Greiner (PI), Ms. Sheilah Nolan and Ms. Dervla Hogan

Abstract

The purpose of this study was to determine the prevalence of work-related upper limb disorders (WRULDs) in hand-intensive health care occupations, specifically in Irish chartered physiotherapists, physical and athletics therapists and to identify work risk factors and best practice strategies for the prevention of WRULDs.

Methods

Two questionnaire studies were conducted: A cross-sectional study with 347 employed and self-employed therapists and a follow-up study with 74 students at baseline in their final year of training with follow-up 12 months after graduation (n=22) to investigate early career onset of WRULDs.

Results

Musculoskeletal symptoms were high with 82.5% of experienced therapists reporting symptoms in at least one upper limb body part during the past year and a 25.7% annual prevalence of incapacitating symptoms. Upper limb symptoms to the shoulders, neck and thumbs accounted for most of the 12 month prevalence. Neck, shoulder and wrist symptoms accounted for most of the incapacitating symptoms. 37.5% reported at least one clinical diagnosis.

Work risk factors with significant associations to UL health included perceived physical effort during manual therapy, work organisation - specifically lack of sufficient breaks and input into scheduling, and psychosocial factors including social support, predictability of work and influence at work. Analyses accounted for demographics, physical work load, lifestyle factors and mental health. Therapists with injury prevention training and with risk assessments completed in their workplace had a lower rate of UL symptoms. One year incidence rate for new symptoms in graduates was 40% with 15 newly developed incidence cases, mainly in thumbs and neck.

Recommendations, conclusions

Results suggest that injury prevention training that goes beyond the current manual handling training programme with a particular focus on UL injury prevention is crucial at an early career stage. Guidance documents and detailed good practice models on work organisation, rest breaks, input into scheduling and provision of peer and professional support for the prevention of WRULDs needs to be considered and developed for hand-intensive health care occupations.

EXECUTIVE SUMMARY

Relevance of work-related musculoskeletal disorders (WRMSDs) and work-related upper limb disorders (WRULDs)

Work-related musculoskeletal disorders (WRMSDs) are one of the major health problems at Europe's workplaces, accounting for a large proportion of work-related injury, sickness absenteeism and long-term illness. Musculoskeletal disorders are the most common occupational disease. The European Agency for Occupational Safety and Health declared musculoskeletal injuries as a priority because of the extent and costs associated with it and owing to the fact, that most of the problems can be prevented or reduced by existing law and guidance on good practice.

The main focus of previous research on musculoskeletal injuries in healthcare workers has been on back injuries, in particular to nurses. Less attention has been given to work-related upper limb disorders (WRULDs) specifically for those who are performing hand-intensive tasks as part of their work; that include precision hand and wrist movements, repetitive hand motions and sustained awkward postures. Professional healthcare workers such as physiotherapists, physical therapists, sports therapists and manual/manipulative therapists are exposed to risk factors for upper limb disorders on a daily basis, despite the irony that they treat patients and clients with musculoskeletal disorders, and also have specialist knowledge of body mechanics and injury prevention strategies. However physiotherapists and physical therapists are just typical occupations from a range of other health care occupations with hand-intensive work characteristics such as podiatrists, sonographers, dentists and many more.

Although clear health and safety guidance exists for other hand-intensive occupations such as manufacturing workers and VDU workers, our systematic review shows that no international guidelines exist that guide the practice of risk assessment and management in hand-intensive health care occupations.

Aims and objectives of the HITS project

1. Describe **the magnitude of the problem** of WRULDs in health care professionals performing hand-intensive tasks, specifically in chartered physiotherapists (CPTs), physical therapists (PTs), athletics / manual therapists (ATs) in Ireland.

2. Investigate **determinants of WRULDs in the workplace** including both physical/ergonomic and organisational/psychosocial factors in different practice and organisational settings.

3. Describe what therapists do in their daily practice **to reduce strain and prevent injury** and investigate the role of self care and **self care training** in the prevention of WRULDs.

4. Determine the prevalence **of ULDs in students in their final month of training and changes in the musculoskeletal health** of physiotherapy / physical therapy, sports / manual therapy graduates approximately one year after graduation to specifically evaluate early career onset of symptoms.

5. In collaboration with the relevant professional bodies specify **recommendations for self care** in professional development training and design a **self care checklist** to be used by therapists without prior health and safety risk assessment training.

Methods

Two studies were conducted. One cross-sectional study with CPTS, PTs and ATs (Study 1), and a follow-up study with students in their final month of training in the relevant disciplines and one year into practice (Study 2).

Study 1: The entire sample included 347 part-time and full-time chartered physiotherapists (CPTs) in private practice (n=135), CPTs in hospitals (n=71) and physical therapists (PTs) and sports/athletic therapists (ATs) (n=141). In Ireland there is a distinct difference in the use of the terms *physiotherapist* and *physical therapist* and these professions have been historically organised as two separate professions. Mailed questionnaires included questions about demographics and work history, UL symptoms (neck, shoulder, elbows, wrists, fingers and thumbs), clinically diagnosed upper limb disorders, physical work risk factors (repetitive movements, duration of postures and exertion), psychosocial and work organisational risk factors (quantitative work demands and tempo, emotional work demands, influence at work, predictability and social support, scheduling and rest breaks), injury prevention training, health and safety risk assessment, and self care strategies.

Study 2: The sample included 74 students in their final month of training from four Irish Colleges. Students were followed up approximately 12 months after graduation. Follow-up data was available for 22 eligible

graduates who had started employment as therapists. The questionnaire was similar to the questionnaires used in Study 1 but included additional questions on injury prevention training.

Main results

Objective 1: What is the magnitude of the problem?

55.4% of all respondents reported that they had experienced work-related musculoskeletal pain or discomfort that lasted for more than 3 days in the past 12 months. A very large proportion (82.5%) of therapists experienced symptoms (pain, aches, discomfort, numbness) in at least one upper limb body part during the last year. More than half of all therapists (53.9%) had upper limb symptoms during the past 7 days. One out of four therapists (25.7%) suffered from upper limb symptoms during the past 12 months that were so severe that they were incapacitating and prevented them from carrying out normal activities at work, home or during leisure time.

The most affected body parts accounting for the 12-month and 7 day-prevalence rates were shoulder, neck and thumbs. 53.2% of all respondents reported that they experienced shoulder symptoms (aches, pain, discomfort) during the past 12 months, followed by neck symptoms (49.4%), thumb symptoms (46.2%), wrist symptoms (34.2%), elbows symptoms (28.2%) and finger symptoms (25.3%). Women were reporting significantly more neck and shoulder symptoms (56.3% and 57.6% respectively) than their male counterparts (35.4% and 44.2 %).

Neck (10.8%), shoulder (10.5%) and wrist (7.9%) symptoms accounted for most of the incapacitating conditions experienced in the past 12 months. The 12-month UL symptom prevalence increased significantly by age, specifically for shoulder, neck, elbows and fingers.

A substantial percentage of therapists (37.5%) reported at least one clinical diagnosis with the most common diagnoses of muscle tension (19.1%), shoulder tendonitis (12.9%), overuse syndrome (11.8%) and tennis elbow (9.7%). A total of 117 days of work were lost within the past 12 months due to work-related musculoskeletal pain or discomfort.

While many therapists experienced their first onset of symptoms late in their careers a considerable proportion also reported early career onset in the first 5 years after graduation or even earlier while training. Late onset was particularly pronounced in elbow symptoms.

Although a sizable percentage of respondents reported that they had shoulder and neck symptoms before training as a therapist (21% and 19%, respectively), the respective percentages were low for the other body parts, i.e. elbows (3.4%), wrists (3.3%), fingers (7.8%) and thumbs (5.2%) suggesting that onset of symptoms especially affecting the arms and fingers may be, at least partially, work-related.

Objective 2: Work determinants of ULDs

Work organisation factors:

Therapists who did not schedule their own appointments but used assistants or electronic booking were more than twice as likely (adjusted odds ratio = 2.3) to have UL symptoms in any body part in the past 12 months as compared to those therapists who scheduled their own appointments. This effect was independent of age, gender, employment status, rest time between clients / patients, hours of manual therapy, number of clients/patients treated per day and duration of an individual treatment.

Therapists who took less than 5 minutes of rest time after each patient/client were 2.3 times more likely to experience incapacitating UL symptoms when compared to those with 5 or more minutes of rest break.

Psychosocial factors:

Social support, influence at work and predictable work emerged as the most important work resources with a potential protective effect on UL symptoms. Therapists who received social support from supervisors, peers or other informed professionals were less likely to report UL symptoms. Especially peer support in self-employed therapists and supervisory support in employed therapists were associated with a reduced likelihood of experiencing UL symptoms and UL incapacitating symptoms in any body part.

The more influence at work, indicative of the degree of influence on the amount of work and the specific work tasks, and the higher the level of predictability of work, the less incapacitating symptoms were

reported. All effects were independent of alternative, non-work-related explanations such as age and gender, employment status, years of working as therapist, hours of manual work, previous leisure time injury, body mass index, and smoking and mental health morbidity.

Physical factors

Perceived effort or exertion across a range of static and dynamic actions usually performed during manual therapy were significantly associated with UL symptoms. Effort or exertion was perceived highest for repetitive thumb movements.

Objective 3: The role of health care maintenance and injury prevention

Risk assessment

An alarming seventy six percent (75.7%) of respondents had no health and safety risk assessment of their work completed. Therapists without risk assessment were significantly more likely to report UL symptoms in the past 12 months than those without risk assessment.

Injury prevention training

Therapists who had received injury prevention training were generally less likely to have had UL symptoms in the past 12 months, although this difference missed statistical significance (p=.057). The difference was not specific to any specific body site except shoulder (p=.007).

Health maintenance strategies:

What do therapists actually do in practice to reduce the strain on their body or arms when working? The most commonly used strategy employed by respondents (always or often**)** was adjusting plinth/bed height before treating a patient/client (83.3%). Other best practice strategies used by respondents on a regular basis were "modifying their own position" (76.3%) and "the position of the client/patient" (65.1%) and "select a technique that will not aggravate or provoke discomfort" (54%).

On the contrary, a large number of respondents reported never/hardly ever or seldom warming up or stretching before treating a client (80.2%), seeking assistance from other personnel (78.1%), taking more

rest breaks (63.6%), pause regularly to stretch and change position (50.1%), and doing fewer manual techniques (50.4%). A comparison of therapists who had received injury prevention training as compared to those who had never received injury prevention training showed that therapists with training were significantly more likely to engage in 6 out of a list of 12 best practices.

Contrary to previous research, the HITS study did not find evidence that many therapists were considering leaving their job in response to work strain. Only 7.4% of respondents stated that they would often or always consider changing their job.

Objective 4: Determine UL symptoms in students and follow-up

Study 2: For students in their final month of training the 1 year prevalence rate for ULDs in any body region was 77.2%. The 1-year incidence rate was 40.0%. In total, 16 graduates reported 15 incident cases. The greatest number of incident cases was seen in the thumbs (33.3%) and neck (23.5%).

All graduates (100%, n = 22) reported having received injury prevention / self care education as a student. 57.1% reported that the training they received was useful in work and they were able to apply that training in their current workplace.

Conclusions and recommendations for practice

The high annual prevalence rates of UL symptoms, of incapacitating UL symptoms and the specific UL clinical diagnoses in practicing CPTs, PTs and ATs and students warrant further attention by the community of health and safety practitioners and policy makers.

Supported by the evidence that those with previous injury prevention training were less likely to experience UL symptoms in any part in the past 12 months, and that those with injury prevention training engaged more in best practice health maintenance practices, training appears to be one of the key issues for preventing ULDs in hand-intensive health care occupations. In the current sample of practicing therapists, only 56% had received injury prevention training of some kind.

Training and continuing professional education may be used to increase awareness of health and safety issues in general, and may provide training in risk assessment methods that go beyond traditional manual

handling risk assessment but focus on UL-relevant risks. A particular target group for training may be self-employed practitioners who reported a lower rate of risk assessment in their workplaces.

In addition to training, considerations about work organisational factors may provide another avenue to risk reduction. The study results suggest, that therapist input into scheduling of clients/patients may be crucial and may facilitate variation between more or less physically and emotionally demanding treatments, or to schedule appropriate breaks after challenging treatments. Specific recommendations exist for sonographers as detailed in the systematic review of models of good practice in this report. Also organisation and scheduling of work that facilitates taking rest breaks between clients longer than 5 minutes to allow for sufficient recovery periods may be another step in preventing WRULDs.

As suggested by the study finding the maintenance of a good psychosocial work environment is also of great importance for both employed and self-employed therapists including some influence over work and predictability of work. For employed therapists supervisory support appears to be crucial as is training of supervisors in health and safety issues and in recognising WRULD issues. For employed therapists, social support is provided from colleagues and direct supervisors, however, for self employed therapists who work alone social support has to take other forms with continuing professional education and support through the professional bodies and other organisations.

Although all graduates reported having received some form of self-care training as students, it appears that training is not sufficient and/or is not implemented in the workplace as the 1-year incidence rate of those developing new symptoms was considerable. Education and training to recognise the risk factors associated with the development of upper limb symptoms and task specific risk assessments is warranted that may reduce stress on the upper limbs and reduce the risk of musculoskeletal injury development for graduates in the early years of their professional career.

1. BACKGROUND

1.1. Introduction

Work-related musculoskeletal disorders (WRMSDs) are one of the major health problems at Europe's workplaces, accounting for a large proportion of work-related injury, sickness absenteeism and long-term illness. According to Eurostat figures on recognised occupational diseases (EODS), musculoskeletal disorders are the most common occupational disease (1).The European Agency for Occupational Safety and Health declared musculoskeletal injuries as a priority because of the extent and costs associated with it and owing to the fact, that most of the problems can be prevented or reduced by existing law and guidance on good practice (2).

The extent and determinants of WRMSDs have been extensively researched in several occupations. Traditionally risky occupations included construction workers, poultry and food processing, cleaning operations using heavy polishers, visual display screen equipment users (VDU) and checkout operators. However, high rates of injury among healthcare workers are well documented (3), yet few studies have addressed these issues in particular in healthcare workers performing hand-intensive tasks as part of their daily responsibilities.

The main focus of previous research on musculoskeletal injuries in healthcare workers has been on back injuries, in particular to nurses and care workers. Less attention has been given to upper limb disorders in healthcare workers, specifically for those who are performing hand-intensive tasks as part of their work including precision hand and wrist movements, repetitive hand motions and sustained awkward postures. Professional healthcare workers such as physiotherapists, physical therapists, sports therapists, manual/manipulative therapists and hand therapists are exposed to risk factors for upper limb disorders on a daily basis, despite the irony that they treat patients and clients with upper limb disorders and musculoskeletal disorders, and also have specialist knowledge of body mechanics and injury prevention strategies. The scarce research evidence, mainly derived from American and Canadian studies, suggests that there is a perception among healthcare workers performing hand-intensive, repetitive tasks, that injury is "part of the job", often leading to premature retirement and career change.

Recent statistics released by the Occupational Injury Benefit (OIB) scheme in Ireland show that health professionals top the list of occupations giving rise to claims in 2010, while the type of injury/illness suffered remains the same as previous years, namely; musculoskeletal injuries that include the back, lower

limb disorders and upper limb disorders. Similarly, according to the Health and Safety Executive (UK) Statistics 2010 / 2011, musculoskeletal disorders was the most common type of work related illness, with 1.2 million people who worked during the last year suffering from an illness, (long-standing as well as new cases), they believed was caused or made worse by their current or past work. Workplace injuries and ill health (excluding cancer) cost society in the UK an estimated £14 billion in 2009/10(4).

Therefore, strategies to prevent work-related upper limb injury to healthcare workers have become priority due to the increased numbers of healthcare workers sustaining musculoskeletal disorders not only to the back but also to the upper limbs.

The HITS (**Hand-intensive T**asks & **S**afety) study started from the recognition that there is very little evidence on the extent and nature of work-related upper limb disorders and their specific work determinants in hand-intensive healthcare occupations in Ireland, in particular in physiotherapists, physical therapists and sports rehabilitation therapists. These specific healthcare workers were chosen as representing typical occupations in healthcare in Ireland, performing hand-intensive tasks as part of their daily work.

Although there is evidence that models of good practice and codes of practice for the prevention of upper limb disorders exist for machine operators and VDU workers, it is uncertain to what extent they are attributable to healthcare workers performing hand-intensive tasks. As the number of healthcare workers sustaining work-related upper limb disorders is high, there is cause for concern amongst this professional healthcare group.

1.2. What are Musculoskeletal Disorders?

Musculoskeletal disorders (MSDs) cover a broad range of inflammatory and degenerative conditions affecting the muscles, tendons, ligaments, joints, peripheral nerves and supporting blood vessels (5), and affect the lower limbs, back and upper extremities. Symptoms can include pain, tenderness, swelling, numbness and loss of function.

Likewise, upper limb disorders (ULDs) were defined as musculoskeletal symptoms or signs or clinical diagnoses affecting the neck, shoulder, upper arm, elbow, forearm, wrist, hand, fingers and thumbs and included injuries to or disorders of the muscles, ligaments, tendons, joints, nerves and blood vessels (6).

Whilst it is recognised that there are many contributing factors to MSDs, there are three main physical factors implicated in their occurrence that have been identified in many scientific studies namely; force

exerted in relation to strength of the muscle involved, the posture of the body segments involved and the repetitive nature and duration of the actions (7). In addition to physical factors being associated with MSDs and ULDs, occupational psychosocial factors or "work organisation factors" have also been reported as contributing factors to work-related musculoskeletal disorders (8). As discussed by the US National Occupational Research Agenda (NORA); six major components of work organisation include; scheduling, job design, interpersonal, career concerns, management style and organisational characteristics (9). High job stress and high job demands have been reported to be associated with upper extremity problems (10) and workers exposed to both physical and psychosocial workplace risk factors were more likely to report musculoskeletal disorders, suggesting an synergistic effect between both physical and psychosocial risk factors (11).

A frequently cited problem in epidemiological research is the uncertainty of classification systems for work-related musculoskeletal disorders and upper limb disorders. Some international agreement has been reached on the inclusion of diagnostic criteria related to MSDs and ULDs (6). Currently more than 165 International Classification of Disease, (ICD), codes are being used by clinicians for WRULDs and a number of studies have shown that varying conditions can be classified as *specific* and *non-specific* disorders.

Specific conditions are disorders that are medically diagnosed, with a well defined set of diagnostic criteria established from evidence-based approaches, whereas non-specific conditions are those which are ill defined and characterised by pain, discomfort, fatigue, limited movement and loss of muscle power, with pain being the primary symptom (6).

1.3. What are Upper-Limb Disorders?

Harrington et al (12), sought to create consensus case definitions for the more common work-related upper limb disorders. A group of health professionals, with an interest in the prevention and management of upper limb disorders participated in a Delphi exercise that resulted in agreement on case definitions and diagnostic criteria for 6 specific upper limb conditions namely; carpal tunnel syndrome; tenosynovitis of the wrist; De Quervain's disease of the wrist; lateral epicondylitis commonly known as tennis elbow; medial epicondylitis commonly known as golfer's elbow; shoulder encapsulitis or frozen shoulder; shoulder tendonitis and one non-specific condition; namely "non-specific diffuse forearm pain"(See Appendix 1 for detailed table).

Presently, considerable variation in terms and definitions used for work-related upper limb disorders exist both within and among countries, with some countries adopting umbrella terms that generally make

reference to the body parts affected and / or the causative risk factors, while others elected to maintain terms or definitions recognised by medical practitioners, patients, risk groups and researchers (6). Across EU Member States some governments have no official definitions for disorders or injuries to the upper limbs, whereas others including Ireland, Sweden, and the Netherland refer to injuries as ULDs and WRULDs(1). Germany, Denmark, and Finland refer to the injury by structure involved, and the United Kingdom (UK) refers to upper limb disorders as repetitive strain injuries (RSI's).

A similar picture exists internationally with both RSI and occupational overuse syndrome (OOS) used in Australia, cumulative trauma disorder (CTD) in the USA and occupational cervicobrachial disorder used in Japan. This clearly shows that the concept of WRULDs or RSIs are not understood in the same way internationally and may explain the varied prevalence rates reported between studies on WRULDs in all workers.

Consequently, the differing terminology and lack of clear case definitions for all upper limb disorders makes it difficult for medical diagnosis, reliable occupational disease and work-related illness statistics, and the development of a global policy on the prevention of work-related upper limb disorders in all occupations.

1.4. Definitions in the context of the HITS Study

In the context of this study:

- *Work-related upper limb disorder (WRULD)* is used for all upper limbs sites i.e. neck, shoulders, upper arm, elbow, wrist, hand, fingers and thumbs.
- *Healthcare workers* include; care providers or health professionals working in various health service settings including hospitals, clinical practice settings, out-patients clinics and private practice.
- *Hand-intensive tasks* performed by care providers and health professionals include; work that involves repetitive or intensive use of the hands over extended periods of time.
- Chartered Physiotherapists (CPT) are specialised members of the healthcare team in Ireland, providing acute rehabilitation and specialist services. CPTs work in a variety of health settings including private practice, hospitals, domiciliary health services, community services and outpatient services.
- Physical Therapists (PT) specialise in advanced palpatory and manual techniques exclusively and work mainly in private practice.

Internationally the terms 'physiotherapy' and 'physical therapy' are often used interchangeably. For clarification in this report, when referring to physiotherapist and physical therapist in an international context the term physiotherapist / physical therapist is used.

When referring to physiotherapist and physical therapist in the **Irish** context, the terms CPT / PT are used.

- Manual therapists provide non surgical management of pain to the joints (mobilisation and manipulation), soft tissue (massage) and nerves (neural dynamic interventions)(13).

1.5. Overview of the problem: Work-related upper limb disorders in hand-intensive healthcare workers

Injury rates among healthcare workers have been estimated to be nearly twice that of other service industries (14), however, only recently has this become a cause for concern due to the increased numbers of healthcare workers sustaining work-related upper limb disorders. Hand-intensive jobs in health care involve many activities or procedures that are known risk factors for WRULDs such as those that involve sitting or standing in static postures for long periods of time while using precision hand and wrist movements as seen in tasks performed by dentists, dental hygienists, surgeons, ophthalmologists and endoscopists; performing repetitive hand motions during hands on massage techniques or soft tissue palpation with or without hand tools, while applying pressure, as seen in tasks performed by physiotherapists, sports therapists, manual/manipulative therapists and physical therapists.

Similarly, sonographers are at risk of wrist and finger disorders when performing ultrasound scans due to manipulating the transducer while sustaining awkward static postures and increased workloads and performing repetitive motions.

Previous research has shown that the risks for sustaining injuries from repetitive tasks depend on the duration of activity, the force required to complete the activity, local contact stresses and work postures adopted (15).

Reported prevalence rates for musculoskeletal pain in dentists range between 64% and 93% (16) while a recent study on 126 dental hygiene students reported MSDs of the neck (64.29%), lower back (57.94%) and shoulder (48.41%) due to the physical burden of clinical work (17).

In a cross-sectional study of sonographers, (n=983), from the American Registry of Diagnostic Medical Sonography (ARDMS), respondents reported suffering from pain in the wrist (65%) and hand/fingers (61%)

due to manipulating the transducer when scanning (18). Similar findings were reported in further studies compiled from self-administered questionnaires suggesting that WRMSDs affect between 65%(19)and 91% (20) of sonographers who reported risk factors that aggravated MSD symptoms as – "applying sustained pressure on the transducer, abduction of the shoulder, sustained twisting of the neck and trunk and repetitive twisting of the neck and trunk (20).

Likewise, the limited research on surgeons performing precise movements as in endoscopic and laparoscopic procedures, reported over 80% (n=285) experienced discomfort in the neck, shoulders, back and thumb "endoscopists thumb" (21, 22),while a more recent study on 135 surgeons performing similar procedures indicated a high prevalence of WRMSDs mainly in the neck (82.9%), low back (68.1%) and upper back (52.6%) regions (22).

A similar picture emerges for ophthalmologists whose self-reported prevalence of MSD symptoms in the previous 30 days was 51.8%, with low back symptoms being the most common (39%), followed by upper limb (32.9%) and neck (32.6%) (14).

Another healthcare group that use techniques of manipulation of soft tissue include chiropractors. Chiropractic is a primary contact healthcare profession specializing in the art of manipulation of the joints, largely by hand alone. Holm (2006) (23), in a study to determine the prevalence and types of work-related injury among chiropractors in the United States (n = 397), reported 40.1% experienced a total of 252 injuries related to manipulation techniques when treating the lumbro-sacral area of their patient. Upper extremity injuries were most commonly reported including wrist/hand/finger (42.9%), shoulder (25.8%) followed by low back and elbow 24.6% and 11.9% respectively. The most common injury type reported was sprain (44.4%), tendonitis (35.3%) and muscle strain (32.5%).

The limited research on MSDs and ULDs identified that podiatrists, the healthcare professionals who specialise in the care and treatment of the feet, experience high levels of musculoskeletal disorders, in particular low back pain, due to poor working and static postures, repetitive movements, force applied to patients' feet and working in various work environments, in particular during domiciliary visits. In an observational study of podiatrists at their work place, carried out by the Health and Safety Laboratory in the UK, awkward postures, excessive grip force on clippers, duration of treatments, work overload and lack of self-care awareness in relation to ergonomics were identified as risk factors for musculoskeletal injury (24). However, this study identified the need for further investigation into WRMSDs and WRULDs in podiatrists, as the report identified that they are a vulnerable risk group within the healthcare professions for MSDs and ULDs.

As massage practitioners perform mobilisation and hands-on techniques every day similar to physical therapists, their work requires unique postural and physical demands, with most of the effort sustained, restrained and somewhat static during massage practice (25).

In a study of musculoskeletal injury among registered massage therapists (n=502) in Canada, there was a high prevalence of pain reporting in all upper limb sites, namely, wrist and thumb (80%) followed by low back (60%), neck and shoulders (26). In a study to determine the prevalence and severity of WRMSDs associated with massage techniques in practicing massage therapists in Ireland (n=133) with a response rate of 68%, therapists reported a career prevalence of MSD pain and discomfort of 90%, with a 12 month prevalence of MSD pain or discomfort in the shoulders (70%) and thumbs (70%) (27).

The study also reported the prevalence of MSD pain and discomfort was highest in younger massage therapists who had worked in the profession for between 1 – 5 years and were related to workload issues, namely; control over working hours and hours of massage practiced per week. This finding supports the work of Cromie (2000), Bork (1996), Mierzewjewski and Kumar (1999), Glover (2005) and West and Gardner (2001), who reported the first symptoms of musculoskeletal disorders and upper limb disorders occurred in physiotherapists and physical therapists within the first five years of practice (28-32).

1.6. Chartered Physiotherapists, Physical Therapists and Sport/Athletics Therapists: Relevant groups with hand-intensive work in health care.

Chartered Physiotherapists (CPTs), physical therapist (PTs) and sports/athletic therapists form large groups within hand-intensive healthcare occupations. In Ireland there is a distinct difference in the use of the terms *physiotherapist* and *physical therapist* and these professions have been historically organized as two separate professions[1].

Physiotherapy is a broad based health care profession that not only addresses musculoskeletal care of the physically active but also deals with a number of diverse medical fields. Chartered physiotherapists receive several years of University training, require a hospital type apprenticeship on graduation, and work in a

[1] Currently negotiations are ongoing with The Minister for Health in Ireland in relation to clarification of the title of "physiotherapist "and "physical therapist".

variety of health settings including private practice, hospitals, domiciliary health services, community services and outpatient services providing acute rehabilitation and specialist services.

On the other hand, physical therapists in Ireland are certified, first contact practitioners and specialise in advanced palpatory and manual techniques to assess and treat pain and discomfort in the soft tissues (33).

Physical therapy education lasts 3 years, specialises in manual techniques exclusively, and prepares therapists for work mainly in private practice. Sports / Athletic therapists specialize in musculoskeletal injuries related to physical activity.

Internationally the terms 'physiotherapy' and 'physical therapy' are often used interchangeably. Therefore, variations in reported prevalence rates of MSDs within the practice of physiotherapy and physical therapy are likely to be due, not only to the difference in sampling and the measurement of MSDs, the inconsistency in terms used for MSDs and diverse diagnostic criteria, but also due to the clear distinction in the practice of physiotherapy and physical therapy.

1.7. Research studies on work-related upper limb disorders in physiotherapists/physical therapists and sports / manual therapists.

Work risk factors that are known to expose workers to WRULDs have been highlighted in previous international studies, namely; repetitive tasks, high force manual techniques, techniques that exert direct pressure on certain joints during treatment and awkward and sustained postures (28-30, 32, 34-36).

Key findings on international studies on WRULDs in physiotherapists and physical therapists:

- Pain in the wrists and hands is common with annual prevalence of 29.6% in the general physical therapy population (37).
- Work-related thumb pain (WRTP) is a major problem among manipulative physiotherapists (36, 38-40)
- Younger physiotherapists, below the age of 30 years are more at risk of injury (30, 31, 35).
- The onset of a large proportion of work-related injury occurs within the first 5 years of practice (29, 30, 41-43).
- Working in specific clinical specialties can increase the risk of injury (31, 34, 42, 44-46).
- Failure to take rest breaks, high clinical workload due to understaffing, poor working conditions, treating a large number of patients per day contribute to the risk of injury (31, 34, 42, 44-46).

1.8. Research findings by injury site

1.8.1. Hands and Wrists

As physiotherapists, physical therapists and sports/manual therapists use their hands for several hands-on manipulative treatments, it is important that they are aware of the risk factors for upper limb disorders. As Reglar and James (1995) (47) highlighted;

"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"

Previous studies have indicated that, after the back, injury to the hands and wrists are the most prevalent type of musculoskeletal injury affecting chartered physiotherapists both in private practice and those working in hospitals or clinical settings, due to the *"degree of muscle activation involved in manual techniques"*(48). Bork et al (29), reported that physiotherapists performing manual therapy were 3.5 times more likely to suffer musculoskeletal disorders of the hands and wrists than those who did not routinely perform manual techniques. However, conflicting reports exist for physiotherapists and physical therapists working in various work settings.

Three major areas of clinical practice that were reported as contributing factors to work-related injuries in chartered physiotherapists working in hospitals, were identified in a study of members of the Chartered Society of Physiotherapists UK, namely; musculoskeletal out-patients (n=554, 31%), neurological rehabilitation (n = 242, 14%) and elderly care (n = 215, 12%) (31).

Likewise, 18% of physiotherapists working in hospital practice in Izmir, Turkey, suffered hand and wrist injuries they believed to be associated with heavy workload and repetitive tasks (44). Similar findings for hand and wrist symptoms were reported for physiotherapists working in a rehabilitation hospital in the State of Kuwait (46), physiotherapists in hospital practice in Nigerian hospitals (20.6%) and physiotherapists working in a paediatric specialty in South East Asian hospitals (12%) (45).

On the other hand, Holden et al (43) reported that physiotherapists working in an outpatients department reported higher hand and wrist injury (33%) compared to those working in hospitals (13%) while Maffeo et al (2000), reported that the wrist and hands were the most commonly affected injury sites in physical therapists working in private practice.(49).

Despite conflicting reports on hand/wrist symptoms in various work settings, one consistent finding in relation to hand/wrist symptoms is that manual therapy techniques such as joint/soft tissue mobilisation are associated with hand/wrist symptoms in healthcare workers performing hand-intensive tasks (28, 50, 51).

Table 1.1: Studies on hand and wrist injuries in physiotherapists/ physical therapists, sports/manual therapists

Study	12 month prevalence	Reported main risk factor
Bork et al (USA, 1996)	29.6% - career prevalence	Lifting or transferring patients, manual therapy techniques (joint mobilisation, manual resistive exercises).
Adegoke et al (Nigeria, 2008)	20.6% - 12 month prevalence	Poor work conditions, understaffing, and lack of proper equipment.
Glover et al, (2005)	12.5% - career prevalence	Work setting- musculoskeletal outpatients
Nordin et al (South East Asia, 2010)	39% - 12 month prevalence	Lifting and transferring patients, clinical workload and manual therapy in paediatrics.
Holden et al (USA, 1999)	23% - 24 month prevalence	Working in out-patient setting, static postures,
Maffeo et al (Arizona, 2000)	11% - career prevalence	Manual therapy – working in outpatient setting
Salik and Ozcan (2004)	18% - career prevalence	Repetitive tasks and heavy workload.
Alrowayeh et al (Kuwait, 2010)	11% -12 month prevalence	Manual therapy techniques in rehabilitation hospitals.
West and Gardner (Australia, 2001)	14% - 1 year prevalence	Repetitive tasks
Cromie et al, (Australia, 2000)	33% - 12 month prevalence	Repetitive tasks, treating a large number of patients in one day, work scheduling/not enough rest breaks and continuing to work when injured.
Wagon and Ada (2003)	29.6%	Manipulative therapy
Grooten et al (2011)	58.5% - career prevalence	Orthopaedic manual therapy techniques. Awkward postures High psychological demand.

1.8.2. Thumbs

Thumb pain is a common complaint of physical therapists (37) and is now a recognised problem in physiotherapists/physical therapists, sports/manual therapists who work mainly with patients and clients with musculoskeletal disorders.

Manual therapy, trigger-point therapy and massage were suggested as the risk factors for thumb pain and injury in physiotherapists/physical therapists due to the forces transmitted directly through the thumb during the application of manual techniques (36).

McMahon et al (52), reported lifetime prevalence of work-related thumb pain (WRTP) was 65% in a sample of registered physiotherapists in Australia. Physiotherapists working in orthopaedic outpatients and inpatients reported the highest rates of thumb problems, (75% and 60% respectively). In a similar study, 57% of physiotherapists working in an out-patients department attributed their thumb problems to their job (47). Similarly, Cromie et al (28), reported that 33.6% of respondents, (n=536), complained of thumb pain that lasted more than three days, with a severity score between 3 and 10 or greater on a visual analogue scale (VAS). In a study on manipulative physiotherapists in Ireland, career prevalence was 74% and was related to performance of manual and manipulative techniques (53), while West and Gardner (32), reported 91% of physiotherapists altered their manual techniques due to thumb pain. Manipulative physiotherapists working in private practice reported a higher prevalence of thumb pain than those working in a hospital setting (40).

Table 1.2: Research studies on work-related thumb pain in physiotherapists, physical therapists, sports/manual therapists.

Research Study	12 month Prevalence	Main risk factors
McMahon et al,(Australia, 2006)	65%	Working in out-patient setting, manual therapy and trigger point therapy
Reglar and James (Australia, 1999)	57%	Working in out-patient clinics
Cromie et al (Australia, 2000)	33%	Manual therapy techniques
Power and Fleming (Ireland, 2007)	74%	Manual and manipulative techniques
West and Gardner (Australia, 2001)	-	Manipulative therapy techniques.
Passier and McPhail (Australia,2011)	-	Work posture and movements, lifting and carrying, repetitive tasks.

1.8.3. Neck:

The reporting of neck pain and discomfort reported by physiotherapists/ physical therapists, sports/manual therapists coexists with back and hand injuries.

In a prospective cohort study on job strain, (job demand and job control), in physical therapists from the American Physical Therapy Association (APTA) n=882, with a 1 year follow up; 58% of physical therapists experienced a work-related ache or pain in the year prior to the follow up. Reported incidence symptoms during the follow up year that were not preceded by symptoms in the same body region was 33.4% with 10.2% reporting neck symptoms that were not reported previously (8).

Similarly, the prevalence of neck pain (21%) was the second most prevalent WRMSD in physiotherapists in the State of Kuwait (n= 212) and was significantly associated with gender, occurring more often in female physiotherapists. Pain (78.4%) was the most common complaint associated with neck injury, followed by cramp/spasm (76.1%) and stiffness (50%). Over 50% of physiotherapists had 2-5 episodes of neck pain, lasting 1-7 days, with 55.7% reporting development of neck pain was gradual (46).

Glover (2005) (31), reported no significance between male (13%) and female (14%) physiotherapists reporting neck pain or discomfort associated with work, however, 12 month prevalence of neck pain or discomfort was 25.7% with 15.6% reporting pain lasting more than 3 days. In a similar study by Cromie et al. (2000) (28), reported 12 month prevalence for neck pain in physical therapists was 47.6% , with 27.1% reporting symptoms which were moderate to severe. Male physical therapists (60%) reported higher neck symptoms than female physical therapists (42%) and were related to male physical therapists performing more manipulation and mobilisation techniques in practice than their female counterparts. Interestingly, physical therapists working in private practice reported more neck symptoms than physical therapists working in other areas; performing manual orthopaedic techniques was associated with increased risk of neck symptoms (OR = 1.9, 95% CI= 1.2 – 2.8).

Salik and Ozcan (2004), found that physiotherapists (n=120) working in a broad spectrum of practice in Izmir Turkey, reported neck pain (15.1%) mostly associated with working in neurological rehabilitation and related to patient transfer, repetitive movements and heavy lifting of equipment and patients. As the practice of physiotherapy is different in Turkey, with the majority of physiotherapists working in hospitals where the number of seriously ill patients treated on a daily basis far exceeds the number of available physiotherapists, workload was also a factor in the development of WRMSDs. Nordin (2010), reported a high prevalence of

neck pain (46.5%) among physiotherapists in Malaysia (n=81) mainly due to understaffing and high clinical workload.

West and Gardner (2001)(50), found that the average age of physiotherapists in North and Central Queensland (n=219) was 28 years of age when injury to the neck first occurred and was within the first 5 years of practice after graduating.12 month prevalence of neck pain was 20%, with 23% reporting the neck being the body area as a major injury site. Physiotherapists working in Nigeria (n=126) reported 12 month prevalence of neck injury was 34.1%, with 50% also experiencing injury in the first 5 years after graduation (42). Contrary to West and Gardner (2001) (50) and Adegoke (2008), physiotherapists employed in various levels of primary healthcare in the Republic of Slovenia (n=113) reported neck pain (19.5%) occurred at a later age and those most affected were between 41-50 years of age (54).

The reporting of neck pain and discomfort was also significant for massage therapists. Albert et al (2008) (55) reported that 66.5% of massage therapists (n=502) suffered pain in the neck region as a result of work, with female therapists working for less than 5 years reporting significantly more neck pain than their male counterparts. Almost 85% (84.6%) sought medical treatment for pain while 22.5% reported pain interfered with leisure time activity. A similar picture emerged for massage therapists in Taipei City with a quarter of massage therapists (25.5%, n=161) reporting neck pain; however only 3% missed work as a result of neck pain (56).

Table 1.3: Studies on neck injury in physiotherapists /physical therapists, sports/manual therapists

Study	Prevalence / Incidence	Reported risk factors
Campo et al (USA,2009)	12.2% - 12 month incident symptoms	Psychosocial risk factors (High demand, low control)
Alrowayeh et al(Kuwait, 2010)	21% - 1 year prevalence	Lifting, transferring and manual therapy
Glover (UK, 2005)	25.7% - 1 year prevalence	Work setting – general musculoskeletal
Cromie et al (Australia, 2000)	47.6% - 1 year prevalence	Repetitive tasks, treating a large number of patients, not enough rest breaks, continuing to work when injured.
Salik and Ozcan(Turkey, 2004)	15.1% - career prevalence	Transferring patients, repetitive tasks and lifting patients
Nordin et al, (Malaysia, 2010)	46.5% - career prevalence	Understaffing, clinical workload, manual techniques.
West and Gardner (Australia, 2001)	20% - 1 year prevalence	Static postures, bending and twisting.
Adegoke et al (Nigeria, 2008)	34.1% - 12 month prevalence	Treating a large number of patients, static postures
Rugelj (Rep. of Slovenia,2003)	19.5% - career prevalence	Not specified for neck
Albert et al (Canada, 2008)	66.5% - career prevalence	Massage therapy treatments
Jang et al (Taiwan, 2006)	25.5% - career prevalence	Poor neck posture, massage strokes.

1.8.4. Shoulders

Injury to the shoulders of physiotherapists, physical therapists and sports/manual therapists showed similar patterns to injury to the neck.

In the study by Campo (2009) (8), on job strain in physical therapists, 51% of physical therapists reported shoulder incidence that did not appear the previous year.

Physiotherapists aged between 31–40 years, working in rehabilitation hospitals and orthopaedic departments in the State of Kuwait, reported shoulder pain (48.8%) that lasted 1-7 days. Pain followed by cramp/spasm was the most common complaint (90.7% and 53.5% respectively) (46). In contrast, physiotherapists under the age of 30 years working in Nigerian hospitals, reported the highest prevalence of any ULD, with 22.2%

suffering from shoulder pain, despite the fact that 96.9% reported having received ergonomics training (42). Similarly, physiotherapists working in general physical therapy practice in Turkey reported the highest prevalence of shoulder pain (16.9%), followed by physiotherapists working in cardiopulmonary rehabilitation (16.7%) and neurological rehabilitation (15.1%) (57). Respondents indicated that lifting and transferring patients, prolonged static posture, and repetitive tasks were the activities that contributed to their pain in particular during clinical work.

Female physical therapists/physiotherapists working in hospitals, also reported higher career prevalence of shoulder pain/discomfort than their male counterparts, as reported in studies by Bork et al.(1996)(29) and Glover et al (2004)(31), (19% and 20% respectively). The most important job factors contributing to pain were; lifting and transferring patients, (26% and 56%); treating a large number of patients (19% and 67%); working in awkward, sustained postures (18% and 67%) and performing manual/repetitive tasks (18% and 73%).

Cromie et al (2000)(28), identified four workload risk factors associated with increased risk of shoulder injury namely; performing the same task repeatedly; treating a large number of patients in one day; work scheduling/not enough rest breaks and continuing to work when injured. The study also reported prevalence of symptoms was higher in therapists working in private practice and possibly related to income of the practice. Interestingly work activities identified as risk factors for shoulder injury in other studies namely; assisting patients during gait activity, carrying, lifting or moving equipment; working with agitated or confused patients and unanticipated movement by patients were not considered significant risk factors for development of shoulder symptoms.

Table 1.4: Studies on shoulder injury in physiotherapists/ physical therapists, sports/manual therapists

Study	Prevalence	Reported risk factors
Campo et al (USA,2009)	51% - 12 month incident symptoms	Work load
Alrowayeh et al(Kuwait, 2010)	48.8% - 1 year prevalence	Lifting and transferring dependent patients
Salik and Ozcan(Turkey, 2004)	16.9% - career prevalence	Work setting, transferring patients, static posture and repetitive tasks.
Adegoke et al (Nigeria, 2008)	22.2% -12 month prevalence	Treating a large number of patients in one day, static postures, lifting and transferring dependent patients
Bork et al (Iowa, USA, 1996)	19% - career prevalence	Transferring patients, treating a large number of patients, sustained postures and manual repetitive tasks.
Glover et al (UK, 2004)	20% - career prevalence	Transferring patients, work load, awkward postures and repetitive tasks
Cromie et al(Australia, 2000)	22.9% - 12 month prevalence	Performing the same task repeatedly, treating a large number of patients in one day, work scheduling/not enough rest breaks and continuing to work when injured.

Although the focus of this review is on upper limb disorders in physiotherapists/physical therapists and sports/manual therapists, a short summary of studies dealing with injury or strain to the back will be provided here as it has been identified as one of the most common injuries sustained.

Table 1.5 shows a summary of research of back pain/injury in physiotherapists and physical therapists, and sports/manual therapists.

Table 1.5: Summary of research of back pain/injury in physiotherapists and physical therapists

Research Study	Prevalence of back pain / injury	Reported risk factors
Cromie et al, (Australia, 2000)	62.5% low back (1 year prevalence) 41% upper back	Awkward positions Sustained postures
Glover et al, (UK 2005,)	44.2% (lifetime prevalence)	Working in the same position, Sustained postures Treating a large number of patients
Adegoke et al, (Nigeria, 2008)	69% (lifetime prevalence)	Treating a large number of patients Working in the same position
Nordin et al, (South East Asis, 2011)	51.7% (lifetime prevalence)	Lifting and transferring patients. Clinical workload
Alrowayeh et al (Kuwait, 2010)	32% (1 year prevalence)	Lifting and transferring Manual tasks
Salik and Ozcan (Turkey, 2004)	26% (lifetime prevalence)	Transferring the patient
Scholey and Hair (1980)	38% (annual prevalence)	Heavy lifting, frequent lifting and prolonged sitting
Campo (2008)	57% (1 year prevalence)	Patient transfers, bent and awkward postures.
Rugelj (2003)	73.7% (lifetime prevalence)	Handling of dependant patients
West and Gardner (2001)	35% (career prevalence)	Working in the same position for long periods”

1.9. WRULDs in hand-intensive healthcare students and early career practitioners.

Studies have shown that upper body musculoskeletal disorders represent an increasingly important issue for healthcare students and early career practitioners however; few studies have targeted physiotherapy/physical therapy and sports/manual therapy students.

In a study to determine the prevalence of musculoskeletal disorders in dental students and dental hygiene students in Turkey, it was reported that 86% reported one or more musculoskeletal symptom in the neck, back and upper limbs due to the position adopted by students during clinical practice (58). A similar picture emerged in a study on dental students in the United States, where Rising et al (59) found that 71% of students reported body pain, with the percentage increasing with years of study. Female dental students reported higher neck/shoulder pain with the frequency and duration of worst pain in the third year of study.

Limited research exists for physiotherapy/physical therapy and sports/manual therapy students training for hand-intensive occupations. However, studies have shown that the first symptoms of any MSD, occur in the early years of practice or even while therapists are still in training.

Glover (2005)(31), reported that 32% of physiotherapists first experienced first symptoms of injury during the first 5 years after graduation, with 12% sustaining injury while still students. The respondents in the study included only 4% of students in clinical practice, while the remainder of respondents included registered physiotherapists (n= 2688). However, the clinical setting was found to be significant for the type of complaint reported and the occurrence of the most significant injuries reported. Injuries to the thumb (76%) followed by wrist / hand (49%) occurred while working in general musculoskeletal clinical practice.

Glover suggested that "newly qualified physiotherapists do not appear to be putting their training or the principles they teach to patients into practice when it comes to how they approach work" (31) and are, therefore, at risk of sustaining injury early in their careers.

Similar findings were reported by West and Gardner (50), who reported that 16% of physiotherapists first experienced their injury as physiotherapy students. The average age of respondents was 28.5 years old when they first experienced injury, while 47% of those who were graduates (n=99) first experienced their first injury in the first 5 years after graduation. The average age of respondents experiencing onset of neck pain was 28 years and hand injuries was 30 years; suggesting that physiotherapists are quite young when the first symptoms of ULDs appear.

Graham (2005) in a study using qualitative research methods to explore how physiotherapists perceive WRMSDs found that early career physiotherapists felt that "*they take precautions that other healthcare workers, e.g. nurses might not take"* and that their " *skills and knowledge would serve to reduce the risk of a serious WRMSD".* Contrary to this perception, one physiotherapist felt that they were *"more at risk as they were not used to handling patients".* Bork et al (1996),(29), and Scholey and Hair (1989) (35) reported that despite their knowledge and expertise, physiotherapists and physical therapists are developing injury in their careers. Inexperience as a possible contributing factor to early career injury development was suggested by Molumphy et al (1985) (60), despite the students knowledge.

Several strategies to reduce occupational injury once they entered work were suggested by final year physiotherapy students at Curtin University in Australia that included; organisation of work, work scheduling, regular rest breaks, regulating numbers of patients treated and working hours, ergonomically designed workplaces, using adjustable plinths and ergonomic seating and taking time off when injured (61).

These strategies are consistent with strategies proposed by Cromie et al (28), and Jang et al, (56) that *"early intervention to recognise the point at which fatigue starts to affect work, and early modification of techniques, may reduce stress on the upper limbs and reduce the risk of musculoskeletal injury development".*

Potter et al (2006) (61) also suggested that educational institutions and employers need ""*to address occupational health and risk factors in physiotherapy, which would include: education on prevention, appropriate self-care management strategies within each work place; the need to maintain appropriate personal fitness levels in order to manage the physical demands of the job.*

In summary, early onset of work related musculoskeletal injury tends to be an issue, however, most studies focus on back pain (Table 1.6) and not upper limb disorders.

Table 1.6: Prevalence estimates of LBP in undergraduate physiotherapy and physical therapy students

Authors		**Lifetime**	**12-month**
Nyland and Grimmer, (41)	Physiotherapy Students	69.2%	63.2%
Falavigna et al, (62)	Physiotherapy Graduates	82.3%	73.7%
Cromie et al, (28)	Physical Therapy Students	-	62.5%
Mierzejewski and Kumar, (30)	Physiotherapy Students	49.2%	-
West and Gardner, (32)	Physiotherapy Graduates	35.0%	22.0%

1.10. Summary and Conclusions

International research studies suggest that musculoskeletal symptoms and disorders among healthcare workers are common, and healthcare professionals performing hand-intensive tasks as part of their daily work are at risk of work-related upper limb disorders.

The specific review of studies with physiotherapists, physical therapists and sports/manual therapists show that despite their knowledge of body mechanics and prevention and treatment of musculoskeletal injuries, physiotherapists, physical therapists and sports therapists are susceptible to upper limb injury and report considerable rates of symptoms in all upper limb sites. Although there is considerable variation in the prevalence estimates of ULDs and specific affected body site, probably due to variations in the definitions and measurement of ULDs and differences in sampling, there is consistent evidence that all upper limb sites are highly affected.

The main work risk factors consistently found in the literature included long hours of manual therapy, especially the use of specific techniques such as manipulative therapy and orthopaedic manual therapy, working in specific practice areas, the repetitiveness of motions, quantitative workload, e.g. a high number of patients/clients or understaffing, and sustained or awkward postures.

Previous research has focussed on healthcare workers in hospitals and clinical settings, however, as physiotherapists/physical therapists, sports/manual therapists work in various settings, with many working in

a self- employed capacity, further research in WRULDs is warranted to study in detail the specific situation of self employed practitioners.

According to the literature, a growing body of research suggests that healthcare professionals with hand-intensive work including physiotherapists/physical therapists, sports/manual therapists first experience injury or musculoskeletal symptoms as undergraduate students or early career graduates. From a health and safety perspective, this finding raises the argument on self care training and education, health and safety awareness including risk assessment at work, and the suggestion that early intervention to recognise the point at which injury starts to affect work, and early modification of techniques may reduce the risk of developing upper limb disorders. However, in most studies, the finding of an early onset of MSDs was based on the retrospective recall of the first onset of symptoms, which may or may not be an accurate account. Longitudinal studies are limited that follow-up therapists at the beginning of their career and record the incidence of new symptoms and injuries in relation to work.

Because physiotherapists and physical therapists have a certain degree of flexibility within their practice settings, this may have given some of them the opportunity to continue in their careers and move to speciality areas where their injuries are not aggravated. Further research into career change amongst physiotherapists/physical therapists, sports/manual therapists is needed to determine if they do move within their profession as a result of injury sustained early in their careers, or if they change to a self-employed capacity where they have more control over working hours and work load.

The perception that "injury is part of the job" in hand-intensive occupations raises the question in relation to reporting of early symptoms of ULDs and barriers to reporting, or if in fact there is a "strong survivor bias" in physiotherapy as suggested by West and Gardner (50) and Bork et al (29) and if practitioners are adopting strategies to reduce the risk of further injury as a self- preservation tactic. 'Survival of the fittest in this occupation' may actually lead to an underestimate of the 'true' prevalence of WRULDs in the respective research, possibly also aggravated by moderate response rates in some studies resulting in possibly non representative samples and biased estimates e.g. Turkey (57) 59%, Australia (50) 53%, USA (45) 56.6% and Nigeria (42) 58.1%.

Previous studies with hand-intensive health care occupations mainly focussed on physical work demands that were assumed to be associated with specific treatment techniques or numbers of treated patients/clients without specifically addressing the details of the physical risk factors (8, 44, 46). The commonly used questions of risk factors that respondents identified as contributors to their personal musculoskeletal injury (28, 31, 43) are very useful but may be limited as it measures opinions and attributions rather than self-

reported physical work factors that exist with or without the presence of ULDs. The use of detailed and validated ergonomics questionnaires that detail factors such as repetition of movement, force, duration, awkward postures and lack of recovery periods may be of further use and overcome some of the limitations of previous research (8, 43, 45). Furthermore, there is only limited evidence on the role of psychosocial and work organisation risk factors for the development of WRULDs and their interplay with physical work factors in hand-intensive occupations. This shows a clear gap in the study of the risks relating to the psychosocial aspects of work, such as influence over the work, quantitative and emotional demands, social support and scheduling issues.

Although the work-relatedness of the high rates of ULDs in hand-intensive occupations shown in the reviewed research is plausible, causation is difficult to demonstrate due to the cross-sectional design of most research with the exception of one longitudinal study (8). However, even with the use of a cross-sectional design it is possible to systematically exclude alternative (non-work-related) explanations by careful adjustment for common MSD risk factors such as lifestyle-related issues (smoking, body mass index, high impact sports), health related issues, such as previous leisure time injury and mental health.

Previous studies identified the need for further research that may more specifically inform health and safety practice, e.g. the role of risk assessment (28), preventive work design (29, 45), self care awareness training, work pacing and incorporation of rest breaks (40) and further education to address the problem of WRULDs in hand-intensive occupations in healthcare workers.

The HITS Study builds on the existing evidence obtained by the research studies with a view of overcoming some of the limitations of previous research by using a rigorous epidemiology framework and through the use of a multidisciplinary approach integrating occupational medicine, industrial psychology, population health and ergonomics to determine contributing factors to the aetiology of WRULDs.

The HITS Study will also frame some issues from a health and safety perspective, specifically in relation to prevention of WRULDs including injury prevention training and risk assessment.

1.11. Aims and Objectives of the HITS Study

The overall aim of the HITS study is to create a reliable scientific evidence base to inform strategies for effective prevention of work-related upper limb disorders in healthcare occupations, such as chartered physiotherapists, physical therapists and athletic therapists, with a specific focus on hand-intensive occupations with the following specific objectives:

1. To identify and summarise international models of good practice and codes of practice and standards in relation to the prevention of upper limb disorders in healthcare workers performing hand-intensive tasks.
2. To provide representative prevalence estimates of WRULDs using a range of self-reported health indicators among health care professionals performing hand-intensive tasks such as chartered physiotherapists/physical therapists, sports/manual therapists in Ireland and to determine high risk groups. Occupation-specific prevalence rates will be estimated and broken down by demographics, diagnoses and symptoms and compared with population based prevalence rates specifically for Ireland.
3. To investigate potential determinants of WRULDs in the workplace including both physical/ergonomic and organisational/psychosocial workplace factors and their synergistic effects in different practice and organisational settings. The following factors relevant to WRULDs related to hand-intensive tasks will be studied
    - Physical: force application, repetition, duration
    - Ergonomic: design of the workplace;
    - Work organisation: e.g. rest breaks, , control over work, predictability of work;
    - Psychosocial: e.g. demands, social support at work, emotional demands.

Potential confounders in the association between work risk factors and ULDs such as age, gender, years of experience, mental health, MSD – relevant lifestyle and prior leisure-time musculoskeletal injuries will be accounted for.

4. To detail self-care behaviour of therapists and the role of self care and self care training in the prevention of WRULDs.

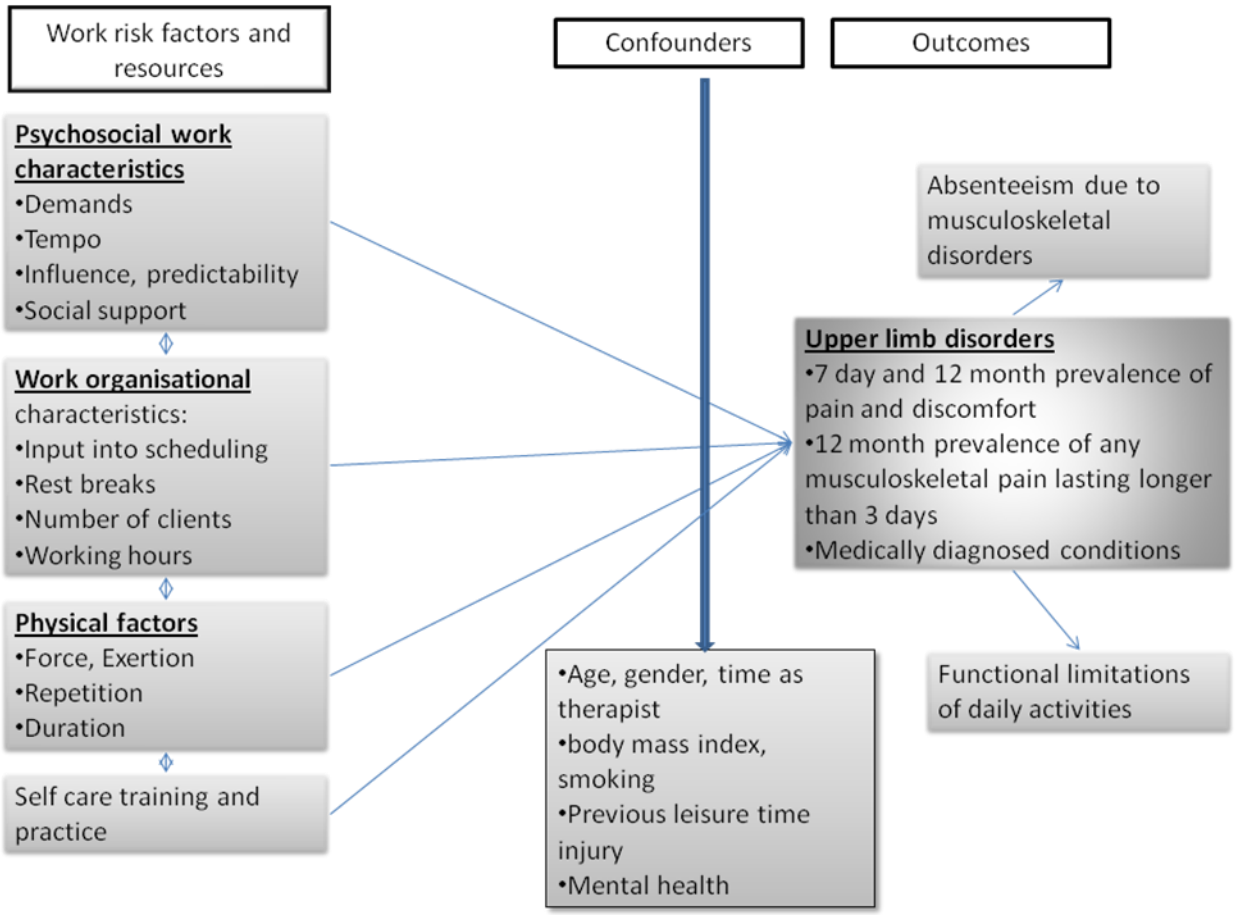
5. In collaboration with the relevant professional bodies we will specify recommendations for self care in professional development training programmes.
6. To determine the prevalence of ULDs in the final month of training and changes in the musculoskeletal health of physiotherapy/physical therapy, sports/manual therapy graduates 2011, approximately, 1 year after graduation to specifically evaluate early career onset of symptoms.

As our study addresses general determinants of WRULDs in hand-intensive occupations, the results will be generalisable to some degree to other healthcare professionals i.e. dentists, chiropodists, podiatrists and other healthcare professionals whose work involves hand-intensive tasks.

1.12. Theoretical model of the study

Based on an epidemiological model the factors were conceptualized as work risk factors and resources, confounders and outcomes. Although causal associations between risk factors/resources and outcomes could not be explored in the present study due to its cross-sectional nature, this model provided a useful orientation for analyses.

Figure 1.1: Theoretical model underlying the study



Work risk factors and resources included those work conditions that were hypothesised to either negatively (risk factors) or positively (resources) affect musculoskeletal health.

Risk factors encompassed psychosocial work characteristics such as high quantitative and emotional demands and a consistently high work tempo; work organisational characteristics such as a high number of

clients and long working hours in manual therapy; and physical work demands requiring a high force, repetition and duration.

Resources encompassed influence at work, predictability of work and social support by peers, supervisors or other professionals, input into scheduling of clients and rest breaks. Resources were also previous training and actual practice of self care at work, such as exercising proper body mechanics and properly adjusting work equipment.

Outcomes were upper limbs disorders within the past 7 days and 12 months, any work-related musculoskeletal pain lasting longer than 3 days in the past 12 months, medically diagnosed upper limbs disorders and upper limb symptoms that was so severe that it limited normal daily activities.

Confounders included those mainly personal aspects that may be an additional explanation for musculoskeletal health including age and gender, and well-known personal risk factors to MSDs such as a high body mass index, smoking, mental health and previous leisure time injuries.

2. SYSTEMATIC REVIEW ON INTERNATIONAL MODELS OF GOOD PRACTICE AND CODES OF PRACTICE IN RELATION TO PREVENTING UPPER LIMB MUSCULOSKELETAL INJURY IN HAND-INTENSIVE HEALTHCARE OCCUPATIONS.

2.1. Introduction

The review started with the recognition that there is little guidance, e.g. international models of good practice and codes of practice in relation to preventing upper limb musculoskeletal injuries in hand-intensive occupations in healthcare. This systematic review examines international models of good practice and codes of practice in relation to work-related upper limb musculoskeletal injuries in physiotherapists/ physical therapists and sports/manual therapists.

This report has made use of various national and international resources. Specific resources are referenced throughout the report where necessary. An additional "Appendix" section is also provided at the end of the document for resources retrieved but excluded, as they relate specifically to ethical practices in physiotherapy and physical therapy practice.

This review can be used in 2 different ways:

a) it provides a resource document for Health and Safety practitioners who are looking for guidance and specific risk assessment tools for the analysis of hand-intensive tasks or upper limb disorders; and

b) it provides distilled criteria for the prevention of upper limb disorders in hand-intensive health care work that can be used for developing comprehensive guideline documents for the prevention of upper limb disorders in hand-intensive tasks.

2.2. Background

The European Survey on Working Conditions (1) conducted in 2010 reported that 46% of European workers were complaining of backache, while 43% had muscular pains in the shoulders, neck and / or upper limbs. Following this survey, the European Commission proposed to combine existing directives for the prevention of MSDs in workers in order to address all factors contributing to work-related musculoskeletal disorders, particularly the organisation of work and its intensity. Surprisingly, this proposal met with alarming opposition from the heads of nine European employer organisations, including Business Europe, as they

claim it would "impose new administrative and financial burden for all employers"(63). However, the European Trade Union Confederation supports the proposed directive for the prevention of MSDs as it clearly recognises the problem of MSDs, including upper limb disorders in all workers.

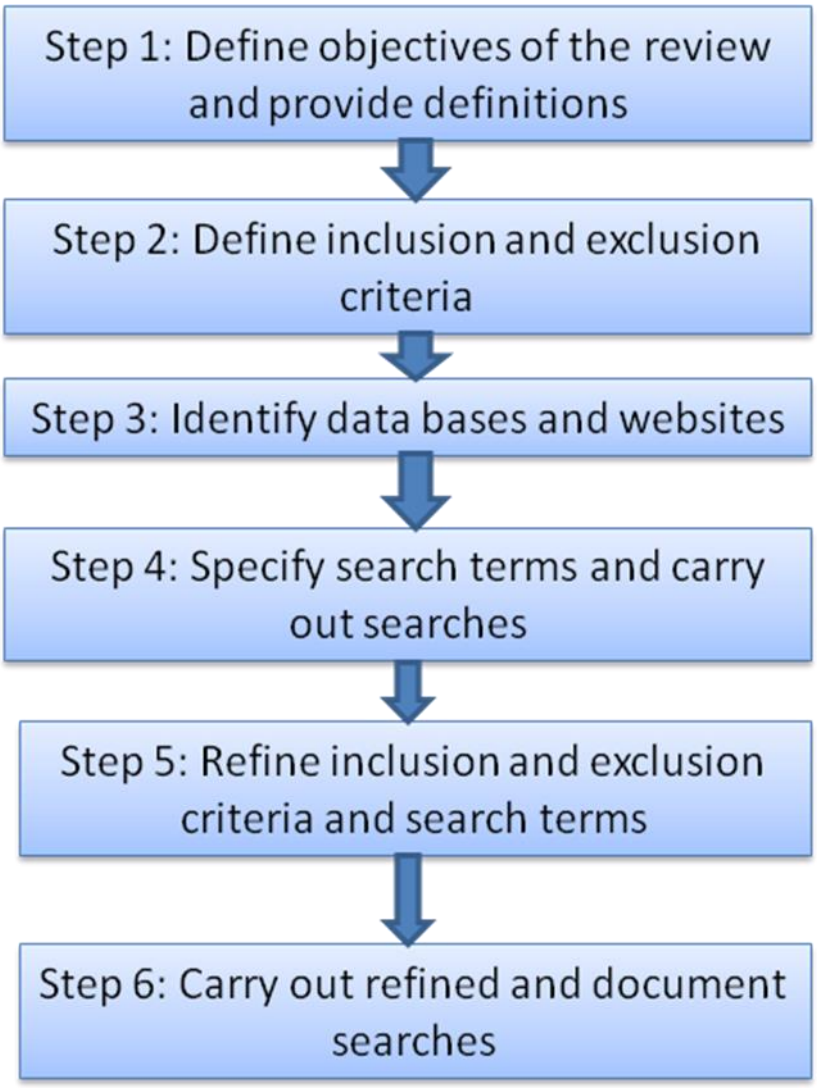
However, despite the existing Framework Directive on the Introduction of Measures to encourage improvements in the Safety and Health of Workers at Work, where employers were charged with developing a *"coherent overall prevention policy which covers technology, organisation of work, working conditions, social relationships and the influence of factors related to the working environment*" (Article 6:2 EC 1989 – 2005) (64) musculoskeletal injuries related to work are still a major concern amongst all workers, in particular upper limb disorders in hand-intensive occupations.

In spite of the existing legislation and standards to prevent MSDs ranging from manual handling of loads, working with display units, and exposure to vibration, there is no specific legislation relating to workers performing hand-intensive tasks in the healthcare profession, in particular in the physiotherapy/physical therapy, sports / manual therapy profession where there is a high risk of developing WRULDs due to the nature of their work.

As a consequence of this, it lead the reviewers to look for codes of practice and models of good practice in hand-intensive healthcare workers internationally, and subsequently in all occupations performing hand-intensive tasks, with a view to inform the health and safety community of important elements that need to be considered when striving to prevent upper-limb disorders in this at- risk healthcare group.

2.3. Methods

Figure 2.1: Steps in the Review Process



2.4. STEP 1: Define objective of the review and provide definitions

2.4.1. Objective

The review aimed to identify and summarise international models of good practice and codes of practice and standards in relation to upper limb disorders in healthcare workers performing hand-intensive tasks.

2.4.2. Definitions

Healthcare workers (Ref: 1.4) include; care providers or health professionals working in various health service settings including hospitals, clinical practice settings, out-patients clinics and private practice.

Codes of practice are a set of published guidelines and regulations to be followed by members of some profession, trade, occupation, and organisation. They provide practical guidance as to the observance of the provisions of legislation relating to the protection of workers.

"Good practice" solutions in health and safety were defined as: 'a reduction of the whole potential to cause harm to workers affected by identified risks, an improvement of working conditions, promoting health, safety and efficiency, the achievement of a permanent and identifiable reduction in the risk of harm to workers'(65).

For the purpose of this review, national legislation and EU directives and ISO standards were also considered.

Upper limb disorders were defined as musculoskeletal symptoms or signs or clinical diagnoses affecting the neck, shoulder, upper arm, elbow, forearm, wrist, hand and thumbs and included injuries to or disorders of the muscles, ligaments, tendons, joints, nerves and blood vessels (66).

Hand-intensive tasks (Ref: 1.4) performed by care providers and health professionals includes: work that involves repetitive or intensive use of the hands over extended periods of time.

2.5. STEP 2: Define inclusion and exclusion criteria

2.5.1. Criteria for inclusion of published codes of practice and models of good practice

- Publication language English
- Codes of practices for the prevention of work related upper limb disorders including RSI, ULDs, OOS and CTD for physiotherapists and physical therapists.
- Standards of healthcare workers addressing the prevention of MSDs which are relevant to hand-intensive tasks.
- General ergonomic standards adopted in the workplace for hand-intensive health care workers.
- Guidelines for the prevention and management of WRULDs
- Guidelines on occupational health in health care workers.

2.5.2. Exclusion criteria

- Publication language other than English
- Ethical Codes of practice that do not include safe work practices in relation to WRULDs.
- General codes of practice for manual handling that do address WRULDs.
- Standards not relevant to or only marginally relevant to health care workers with hand-intensive tasks (e.g. safety standards for machinery)

2.6. STEP 3: Identify data bases and websites

2.6.1. General scientific data bases

CINAHL including the Cochrane Library, MEDLINE, JSTOR, ISI Web of Knowledge, EBSCO and the library search also included Google Scholar and Google.

2.6.2. National and international health and safety data bases and internet sites including the following

OSHA	European Agency for Safety and Health at Work
HSE	The Health and Safety Executive - UK
HSA	The Health and Safety Authority – Ireland
IOSH	Institution of Occupational Safety and Health website and research data base
NIOSH	The National Institute for Occupational Safety and Health website and the NIOSHTIC-2 database
ILO	International Labour organisation website and the following data bases: Codes of practice, ILO norms (a data base on labour standards), APPLIS, ILOUEX (databases on the application of international labour standards), CISDOC (Occupational Safety and Health database.
CCOHS	Canadian Centre for Occupational Health and Safety portal to several OSH resources and databases
CDC	Centre for Disease Control and Prevention
	SafeWork Australia
	New Zealand Department of Labour Occupational Safety and Health
EUROSTAT	European Union Statistical Information Service

2.6.3. Professional Organisation websites

ISCP	Irish Society of Chartered Physiotherapists
CSP	Chartered Society of Physiotherapists (UK)
IPTAS	Institute of Physical Therapy and Applied Science
WCPT	World Confederation of Physical Therapy
	International Physiotherapy Associations

2.7. STEP 4: Specify search terms and carry out searches

Search terms for the identification of models of good practice and codes of practice for upper limb disorders included the following:

'Codes of practice', 'models of good practice', 'work related upper limb disorders'; 'safe work practice', 'physiotherapy practice', 'physical therapy practice', 'RSIs', 'ISO', 'CEN', , 'occupational health and safety in physiotherapy', 'EU legislation on MSDs', 'Ergonomics', 'International Standards' and combinations of these terms.

2.8. STEP 5: Refine inclusion and exclusion criteria and searches

After the initial searches, the inclusion criteria was broadened to include other occupational groups in healthcare and in particular sonographers as there is a specific "industry standard for the prevention of musculoskeletal disorders in sonography"(67).The search term 'sonographer practice' and sonography practice' in combination with the above search terms was added.

2.9. Review

The review identified a range of documents that fulfilled the inclusion criteria. Some of the documents address the prevention of musculoskeletal injuries in general, while others address upper limb disorders. Some of them were more general and addressed hand-intensive tasks or tasks affected by manual handling. A few were relevant only to physiotherapists/ physical therapists and sports/manual therapists. However, all were judged relevant in adding useful information to useful criteria for preventing upper limb injury.

The findings of the review are presented and organized into four categories according to:

a) what issues they address in relation to work related upper limb disorders;
b) their relevance to the assessment and prevention of upper limb disorders;

The classification of the findings is as follows:

- Professional Codes of Practice
- Guidance Documents
- International Organisation for Standardization (ISOs) and European Committee for Standardization (CEN) standards.
- Existing legislation to prevent MSDs.

2.10. Professional Codes of Practice

Codes of Practice provide practical guidance as to the observance of the provisions of Legislation relating to the protection of workers. They provide greater certainty about what constitutes compliance.

Table 2.1 summarises the professional Codes of Practice retrieved, the target group, guidelines for practice and occupational relevance.

2.10.1. National Code of Practice for Manual Handling –United States of America [NOHSC: 2005(1990](68)

The National Code of Practice for manual handling requires assessment and control of manual handling tasks to be carried out in consultation with employees. The code of practice requires the employer to take all workable steps to ensure the safety of employees while at work, in relation to manual handling.

Working postures and position - *Sect 4.11 - work activities should permit the employee to adopt several different, but equally healthy and safe, working postures. Any one posture should not be maintained for long periods without the opportunity to change posture through variation or activity or rest.*

The code of practice also refers to duration and frequency of manual handling tasks and is of particular importance to hand-intensive tasks as it states that "*manual handling operations involving the use of smaller muscle groups such as the hands (whether in sustained or repetitive static activity) should not be overlooked in assessing risks because these muscles fatigue quickly when overloaded".*

2.10.2. National Code of Practice for the Prevention of Occupational Overuse Syndrome Australia [NOHSC: 2013(1994)](69).

The purpose of this national code of practice is to provide practical guidance in meeting the requirements of the *National Standard for Manual Handling* [NOHSC: 1001(1990)] 2), with respect to the prevention of risks, and the identification, assessment and control of risks, arising from tasks undertaken in the workplace which involve:

(a) repetitive or forceful movement or both; and/or

(b) maintenance of constrained or awkward postures.

All workplaces may have tasks that involve the above activities, and therefore the risks of occupational overuse syndrome and other injuries that can arise must be considered. This document has been designed to be used in the consultative process in the workplace.

The code of practice outlines several risk factors for OOS and goes beyond "classical" risk factor lists, by addressing not just physical but also psychosocial risk factors e.g. awkward body postures; poorly designed tasks; work organisational factors; inappropriate job design i.e. repetitive movements; lack of job rotation; job satisfaction and control over work pace. Clear guidelines are given for risk identification, risk assessment and risk control.

Risk identification checklists, risk control forms and plans are provided and to be completed in consultation with the employees for the early detection and prevention of upper limb disorders.

2.10.3. National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007) Canberra Australia.(70)

The code of practice aims to reduce the number and severity of injuries to workers from manual tasks and is a user friendly code of practice that can be used in all occupations where there is a risk of ULDs. It is aimed at employers, designers, manufacturers and suppliers and workers.

The extensive code is based on the principles of safety management i.e. hazard identification, risk assessment, risk control and monitoring and review. Repetitive tasks, awkward postures, repetitive application of force, grip, duration, frequency, hard arm vibration and organisational risk factors are extensively covered in the code.

Hazard identification worksheets for the assessment of posture and movements, levels of force applied during manual tasks, work organisation and work practices, and a discomfort survey are included in the code of practice for use in the workplace.

The code of practice also provides further guidance and tools for assessing the risk of MSDs arising from manual tasks at work.

2.10.4. Manual tasks Code of Practice 2010. (Government of Western Australia)(71)

This new Code of Practice states ways to prevent or minimize exposure to risk factors that can contribute to, or aggravate work related musculoskeletal disorders, including disorders of the back and upper limbs.

Injuries to the upper limbs, (hand, wrist, elbow, arm, shoulder and neck), in this code of practice include: repeated or sustained exertions, including gripping, with or without high force; static postures involving the neck, shoulders and arms while using tools.

The Code of Practice provides extensive guidance on risk management and risk control including task analysis, checklists, and a discomfort survey for manual tasks as a result of force, repetition, static postures and organisational risk factors for example, work pace, task rotation and reporting of injuries.

Table 2.1: Professional Codes of Practice

Organisation	Title	Target Group	Guideline for practice	Relevance
NOHSC – National Occupational Health and Safety Commission United States of America	National Code of Practice for Manual Handling-United States of America **[NOHSC: 2005(1990]**	• Employers • Employees in general industry.	• Assessment and control of manual handling tasks. • Adoption of safe and health working postures. • Opportunity to change posture. • Variation in activity • Rest Breaks • Assessment of smaller muscle group (hands) • Avoidance of muscle overload	Relevant to all occupations where there is a risk of manual handling including physiotherapists and physical therapists.
NOHSC National Occupational Health and Safety Commission - Australia	National Code of Practice for the Prevention of Occupational Overuse Syndrome. **[NOHSC: 2013(1994)**	All occupations performing manual tasks that include repetitive tasks, awkward postures, repetitive application of force, grip, duration, frequency, hard arm vibration.	• Prevention of risk. • Assessment, surveillance and control of risk from repetitive or forceful movements and maintenance of constrained or awkward postures; work organisational and psychosocial risk factors.	Relevant to physiotherapists and physical therapists.

Organisation	Title	Target Group	Guideline for practice	Relevance
Australian Safety and Compensation Council, (ASCC). Canberra Australia.	National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007)	• Employers • Employees • Designers • Manufacturers and suppliers.	• Safety management • Hazard Identification, risk assessment and risk control measures. • Assessment of posture movements and applied force. • Assessment of work organisation and work practices. • Discomfort survey for employees	• All occupations where there is a risk of ULDs. • High relevance to physiotherapists and physical therapists although not specified.
Workplace Health and Safety Australia	Manual Tasks Code of Practice 2010	• All occupations where there is a risk of upper limb disorders.	• Assessment of physical, ergonomic, organisational and psychosocial risk factors. • Risk management • Task analysis • Work pace • Task rotation • Injury reporting	• Highly relevant to physiotherapists and physical therapists

2.11. Guidance Documents

2.11.1. Guidance on Manual Handling in Physiotherapy by The Chartered Society of Physiotherapists. (UK)(72)

The Guidance on Manual Handling in Physiotherapists provides guidance for physiotherapists on the risk associated with the practice of physiotherapy and states that physiotherapists must understand the importance of maintaining their own health and personal safety despite their knowledge of biomechanics. Risk assessment must be carried out as part of their work and must be specific to the task being undertaken by the physiotherapist, where there is a risk of injury. Job risk factors identified as contributing to musculoskeletal injury are: repetitive work, awkward static postures, treating a large number of patients, continuing to work when injured, performing manual therapy tasks. The guidance document provides information on special circumstances and various work settings for example, clinical settings, and community based rehabilitation and private practice. The importance of training and continuing education for all physiotherapists is clearly outlined, particularly for novice physiotherapists and graduate physiotherapists.

2.11.2. Prevention of Work-Related Musculoskeletal Disorders in Sonography- The Society of Radiographers (2007) (73)

This guidance document focuses on the prevention and control of work-related upper limb disorders in radiographers and other healthcare professionals engaged in sonography. This guide is aimed at senior management, department managers, specialist advisors such as risk managers, occupational health advisors and back care advisors, safety representatives and employees. The guidance is relevant to all facilities such as hospital-based care units, mobile units, and satellite units where ultrasound is used. The guidance clearly states the scale of the problem in sonography practice, and encourages best practice for the reduction and prevention of risk of injury from tasks at work.

Increasing volumes of work in demanding work environments, staff shortages leading to lack of rest breaks and reduced recovery time are highlighted as high risk factors for musculoskeletal symptoms. The seven stage framework for the management of work-related upper limb disorders, developed by the Health and Safety Executive (UK), is adopted in the guidance document to implement a risk management programme for MSDs in the sonography department and includes: the importance of management and workers

understanding the issues and ensuring commitment to an overall policy through strong leadership and "*appropriate balance between health and safety and production goals".*

Assessment of risk including ergonomic, psychosocial, organisational and physical risk factors is recommended. A particular emphasis is given to scheduling of work and scheduling of rest breaks, taking into account '*the experience of the sonographer, standards of equipment in use, type of scan being carried out, BMI of patient, need to plan for micro breaks and lunch breaks, the availability of an assistant, the use of new technology …'* (p. 21). Departmental managers, safety representatives and workers should work together to agree a safe work schedule over which the worker has a considerable degree of control.

The guidelines specifically point out awareness training and education in MSDs as a tool which assists in the identification of the early signs of musculoskeletal symptoms and finally, management of episodes of MSDs and health surveillance programmes.

The guide also provides recommendations for rest breaks in accordance with NIOSH recommendations for work scheduling (schedule different types of examinations to decrease strain on musculoskeletal tissues specific to one type of examination, consider maximum number of scheduled examinations taking several factors into account).

The guidance document features specific case studies, sample risk assessment forms and exercises for prevention and cure of upper limb disorders. Although, the guidance document is designed for sonographers, it could be adapted to other healthcare workers or workers in general performing hand-intensive tasks.

2.11.3. Occupational Overuse Syndrome- Guidelines for Prevention and Management by the Accident Compensation Corporation New Zealand(74).

The aim of these guidelines is to help in the prevention of occupational overuse syndrome and to provide information on rehabilitation and effective treatment for persons who do develop OOS. The guidelines address issues that go beyond simple manual handling recommendations such as the design of equipment and tasks; the organisation of work, the work environment, training and education and the development of policies for the prevention of OOS. Job rotation, work rates, social factors and reporting systems are identified as important factors for prevention. Guidance on training programmes, the value of early education on the risk factors for OOS and the importance of prevention policies to be incorporated into standard curriculum of education institutions are recognised as preventive strategies for OOS. A sample checklist for work organisation risk factors and a self-assessment discomfort survey for the early detection

of OOS are provided for both employers and employees. The guidance document recommends micro-pauses, typically for 5-10 seconds every three minutes, however unless the muscles relax fully, micro-pauses are of no value (74).

2.11.4. Upper limb disorders in the workplace- HSE Guide.UK 2002(75)

The guidance document is aimed at employers on the prevention and management of work-related upper limb disorders. It suggests that by following the guidance, one will normally be doing enough to comply with the law. It also suggests that experience has shown that ULDs are often directly linked to workplace activity, and if not related to the workplace, can be made worse at work. Although, the guidance document does not specifically address hand-intensive tasks, it is a useful document as it advocates a seven stage framework for the management of ULDs in the workplace which can be applied to healthcare workers with hand-intensive tasks namely;

1. management commitment
2. creation of a safe working environment
3. assessment of risks of ULDs in the workplace
4. risk reduction
5. education and training programmes for employees
6. management of identified episodes of ULDs
7. evaluation of the effectiveness of intervention strategies.

The guidance document also provides information on early rehabilitation and medical advice, risk assessment worksheets and suggestions for reducing the risk.

2.11.5. MSD Prevention Guideline for Ontario. OHSCO 2007.(76-78)

The MSD Prevention Guideline for Ontario is part of a three series guideline that provides Ontario's employers and employees with information and advice on a recommended generic framework for the prevention of musculoskeletal disorders in the workplace. The accompanying resource manual (part two of the guideline) provides guidance for risk assessment and selection and implementation of controls to minimize risk. A specific definition for repetition i.e. "*the number of times a task is performed in a given*

period of time (cycle time)" and what constitutes repetition are clearly outlined. The guideline also states how the risk associated with repetition increases in relation to; the number and speed of actions; the level of force exerted on muscles; the length of time a task is performed without a rest break and the distance of the joints from neutral position.

Part three of the guide *MSD Prevention Toolbox*, provides examples of worksheets, surveys and hazard identification tools that can be used in their efforts to prevent MSDs in the workplace.

2.11.6. Musculoskeletal Injuries? No Thanks! Swedish Work Environment Authority (2005)(79).

The purpose of the short guide is to clarify the responsibilities of the employer and employees for the prevention of injuries from incorrect handling of inappropriate loads. Job variation, job diversification, breaks or other measures are identified as risk resources. Basic rules for good ergonomic practice are outlined, for example, the design of work in terms of job content, variation of task, job rotation, working hours and job decision latitude. Although not directly related to ULDs, the short guide gives guidance on good ergonomic practice.

2.11.7. Californian Compensation Insurance Fund – Ergonomic Breaks, Rest periods and Stretches(80)

This guidance is aimed at employers and employees and provides information on ergonomic risk factors that include forceful movements, repetitive motions, awkward postures and lack of rest and gives information on maintaining overall health to reduce the risk of injury. It is a useful document as it gives specific recommendations for rest breaks. It recommends rest breaks to allow muscles to recover from tasks where there is a risk of injury- take micro-breaks lasting 10 – 15 seconds every 10 minutes and mini breaks lasting 3-5 minutes every thirty to sixty minutes. It also suggests work rotation, posture change and stretching exercises to limit the risk of injury at work.

2.11.8. Assessment of Repetitive Tasks of the Upper Limbs. (The ART Tool) 2010(3)

The Assessment of Repetitive Tasks (ART) tool is designed to help people with responsibility for the design; assessment, management and inspection of repetitive work to risk assess tasks that require repetitive

movements of the upper limbs (arms and hands). It provides guidance for the assessment of common risk factors in repetitive work that can contribute to the development of upper limb disorders.

The tool was included in this review because it can be also used as a guidance document on how to prevent upper limb injuries. The ART tool provides information on how to determine where the risks lie and what preventive measures can be taken by employers together with their employees to reduce the potential for injury. ART examines twelve risk factors that are grouped into four stages: frequency and repetition of movements; force; awkward postures (of neck, back, shoulders/arm, wrist and hand); and aspects of task duration, recovery, perceived work pace and work environment factors.

The ART provides risk categories for the frequency of shoulder and upper arm movements, for repetition of forearm, wrist and hand movement, awkward postures, breaks and work pace. From the perspective of using this tool as a guidance document for hand-intensive health care work, the risk categories for appropriate design of recovery and rest breaks in repetitive tasks are very interesting.

Breaks are defined as *"a significant change or pause in arm or hand activity (of at least 5 – 10 minutes)",* and include structured breaks and "*time spent performing other tasks that do not involve similar repetitive movements". For example, the risk category 'good' includes '... performing the task continuously without a break for less than 1 hours', and risk category 'poor: '... performs the task continuously without a break for 3 hours to less than 4 hours' (page 8).*

The ART tool also recommends job rotation to less demanding tasks. Although ART has not been validated yet as a predictor of WRULDs, and cannot be used to assess tasks that involve intense finger movements, it can be used to assess single tasks as are evident in healthcare workers performing hand-intensive tasks, namely; local contact stress for tissue massage; repetitive arm movements during manual therapy techniques for soft tissue damage or abduction of the shoulder while applying sustained pressure on the transducer in sonography tasks.

Table 2.2: Guidance Documents

Organisation	Title	Target Group	Guideline for practice	Relevance
The Chartered Society of Physiotherapists. (UK)	Guidance on Manual Handling in Physiotherapy	• Physiotherapists • Graduates • Students • Employers • Managers • Educators	• Assessment of risk in various clinical settings. • Self care maintenance • Task specific risk assessment • Injury reporting • Education • Training	• High significance for physiotherapists and physical therapists. • Can be adopted by other healthcare groups performing similar hand intensive tasks.
The Society of Radiographers UK	Prevention of Work-Related Musculoskeletal Disorders in Sonography	• Sonographers • Senior Managers • Department managers • Specialist advisors • Safety Representatives • Employees • Educators	• Framework for management of ULDs. • Risk assessment • Organisation of work • Scheduling • Rest Breaks • Awareness of risk factors • Training and education	• Although specific to sonographers, can be adopted by physiotherapists, physical therapist and all heath care workers performing hand intensive tasks.
The Accident Compensation Corporation New Zealand	Occupational Overuse Syndrome-Guidelines for Prevention and Management	• Safety managers • Employers • Employees in general industry. • Educators	• Management of OOS. • Job rotation • Work rates- specified micro pauses • Social factors • Injury reporting • Guidance on Training programmes, early education	• Specific to all occupations but can be adopted by physiotherapists, physical therapist and all heath care workers performing hand intensive tasks.

Organisation	Title	Target Group	Guideline for practice	Relevance
Health and Safety Executive Guide UK	Upper limb disorders in the workplace	• Employers • Managers • Employees • Health and safety managers	• Task specific analysis • Education and training • Evaluation of the effectiveness of interventions. • Rehabilitation • Early diagnosis	• Not specifically addressed to hand intensive tasks, but the guide can be applied to healthcare workers with hand intensive tasks
Occupational Health and Safety Commission Ontario	MSD Prevention Guideline for Ontario.	• Employers • Employees • Risk Managers Safety Managers	• Generic framework for prevention • Resource manual with guidance for task specific assessment • Prevention toolbox-assessment sheets, surveys.	Not specifically addressed to healthcare workers but can be applied to all workers at risk of ULDs.
Swedish Work Environment Authority	Musculoskeletal Injuries? No Thanks	• Employers • Employees	• Responsibilities for prevention • Job variation and job diversification. • Rest breaks • Scheduling • Good ergonomic practice	• Although not directly related to healthcare workers the short guide gives guidance on good ergonomic practice.
Californian Compensation Insurance Fund	Ergonomic Breaks, Rest periods and Stretches	• Employers • Employees	• Specific recommendations for rest breaks. • Ergonomic risk factors • Work rotation • Posture changes • Exercises	• Not specifically addressed to healthcare workers but can be applied to all workers at risk of ULDs.

Organisation	Title	Target Group	Guideline for practice	Relevance
Health and Safety Executive and Health and Safety Laboratory UK.	Assessment of Repetitive Tasks of the Upper Limbs. ART	• Inspectors • Employers • Managers • Health and safety Practitioners • Safety and Risk managers	• Risk factors • Risk categories • Rest breaks • Recovery periods • Job rotation • Assessment of Intense finger movements	• Although not directly related to healthcare workers the risk categories for appropriate design of recovery and rest breaks in repetitive tasks

2.12. Relevant ISO standards to prevent MSD's

In recent years, an increasing number of official ergonomic standards relevant to industry have become available worldwide. These can easily be used by non-experts for the design and evaluation of workplaces. The following are relevant standards related to the prevention of MSDs.

2.12.1. Industry Standards for the Prevention of Work-Related Musculoskeletal Disorders in Sonographers (2003)(67).

This industry standard developed by the Society of Diagnostic Medical Sonography (SDMS) addresses the role of employers, employees, educators, medical facilities and equipment manufacturers in reducing the incidence and impact of work-related injuries in sonographers, where sonographers are at risk of WRULDs due to hand-intensive tasks when performing ultrasound scans while using the transducer.

The standards provide for good practice in relation to equipment control measures that include: ultrasound system, control panels, monitors, transducers, work table, chair and accessories where there is a risk to sonographers performing ultrasound scans. Organisational factors are also addressed including duties of employers, workload and scheduling, dedicated examination areas, education and training. The standard provides information on "best practice" to reduce the risk of developing musculoskeletal disorders from sustained bending and twisting, awkward postures, sustained grip and ergonomics.

2.12.2. California State Standard – Repetitive motion injuries- Title 8 5110

The purpose of this regulation is the prevention of repetitive motion injuries with emphasis on employers' obligation, where there is a risk of repetitive motion in jobs undertaken by employees. The obligations apply to employers responsible for jobs *in which an injury has occurred* to more than one employee as a result of repetitive motion; where the employees are performing a job, process or operation that was repetitive in nature; the injuries sustained were musculoskeletal injuries and identified and diagnosed by a physician, and which the injuries were reported to the employer in the last 12 months. Employers are obliged to establish and implement programmes designed to minimize repetitive motion injuries including: worksite evaluations, implementation of controls and training of employees. Essentially, the Californian ergonomics regulations adapt some of the mandatory requirements in the OSHA ergonomic standards.

2.12.3. ISO 11226:2000 Ergonomics – Evaluation of static working postures.

The purpose of this standard is to determine if the working posture is acceptable. Accessibility is based on current ergonomic knowledge. The standard includes recommended limits for static working postures with varying amounts of external pressure and also gives protection to workers where their work involves static postures. The body areas assessed include the trunk, lumbar spine posture, neck, shoulder, forearm, hand and legs. However, no force measurements are made in this standard. The duration of time of static postures is evaluated and compared to the maximum holding time for a static working posture that can be held continuously from a resting state.

The duration of recovery time is also evaluated and includes the time that a body segment is maintained in a neutral position or is fully supported. The upper arm elevation is compared with acceptable holding time. A range of acceptable posture and duration times are given. Anything that falls outside of this range is considered unacceptable and action should be taken to improve either posture or holding time. The limitation of this standard is that the force applied during a given posture is not considered. This would affect the length of time a posture could be held for and is a necessary element of the analysis that is missing.

2.12.4. ISO/TS 20646-1

Ergonomic procedure for the improvement of local muscular workloads: Part 1: Guideline for reducing local muscular workloads. This standard includes a procedure for work-related musculoskeletal disorders including a risk assessment checklist for assessment of the lower back, lower limbs and upper limbs and neck.

The checklist considers tasks such as lifting, carrying, work requiring high physical force, awkward postures and repeated lifting extremes. Additionally, the checklist considers work hours, work using vibrating tools and precision work requiring high mental loads that can be attributed to WRULDs. The presence or absence of factors such as postures held for long durations and frequent changes to joint angles are also considered in the checklist. Constrained postures held for long durations are also considered. If risk factors for musculoskeletal disorders are noted to be present in the workplace, a risk assessment will determine what intervention is required.

Table 2.3: Relevant ISO Standards to prevent MSDs

Organisation	Title	Target Group	Guideline for practice	Relevance
The Society of Diagnostic Medical Sonography	Industry standards for the Prevention of Work-related Musculoskeletal Disorders in Sonographers.	• Sonographers • Managers • Employers • Educators. • Manufacturers of medical facilities and equipment	• Equipment control measures. • Assessment of Organisational risk factors. • Workload • Scheduling • Education and training • "best practice"	• Highly relevant to sonographers but guidance can be adapted to all hand intensive occupations.
California State Standard	Repetitive Motion Injuries – Title 8 5110	• Employers	• Guidance to employers where an injury has occurred and is musculoskeletal in nature and has been identified and diagnosed by a physician. • Programme for the control of risk factors. • Worksite evaluations • OSHA ergonomic Standards	• Not specific to healthcare however, programme for control could be adapted to all occupations at risk of ULDs.
International Organisation for Standardisation	ISO 11226:2000	• Employers • Health and Safety risk managers • Health and Safety Practitioners.	• Evaluation of static working postures. • Recommended limits for static working postures. • Evaluation of duration of static working postures • Evaluation of recovery time • Guidance on a range of acceptable posture and duration times.	• All occupations where there is a risk of MSDs from static postures, • High relevance to physiotherapists and physical therapists although not specified.

Organisation	Title	Target Group	Guideline for practice	Relevance
International Organisation for Standardisation	ISO/TS 20646-1	• Employers • Ergonomists • Health and Safety Practitioners	• Guidance for reducing local muscular workloads • Guidance on lifting, carrying, awkward posture, high physical force, repeated lifting extremes. • Risk Assessment	• All occupations where there is a risk of local muscular workloads. • Although not specific to healthcare occupations the industry standard could be adapted to healthcare workers.

2.13. Existing legislation to prevent MSDs.

Employers in Europe are required to comply with laws and regulations on working conditions and the workplace in their Member States. European legal requirements relating to musculoskeletal disorders (MDSs) include international conventions and standards, European Directives and European Standards.

The International Labour Organisation (ILO) has issued several conventions that relate to MDSs at an international level. However, before these conventions become legal obligations, they have to be ratified by a certain number of states.

At European level, several directives have been published relating directly or indirectly to MSDs. A directive fixes the agreed objectives to be pursued by the EU Member States and then each Member State is required to implement the directive into national law. These Directives are supplemented by a series of European standards (EN). The International Organisation of Standardisation (ISO) has also published international standards which deal with ergonomic requirements in relations to MSDs.

The following list is selective and includes the major pieces of legislation, however, is by no means complete.

2.13.1. Council Directive 93/104/EC

This Directive concerns the organisation of working time. Factors such as repetitive work, monotonous work and fatigue can increase the risk of MSDs and WRULDs. Requirements are set out relating to breaks, weekly rest, annual leave, night work and shift work and work patterns. This Directive was amended by Directive 2000/34/EC to cover sectors and activities excluded from that Directive.

Some jobs provide the opportunity for employees to take rest breaks, by doing other tasks away from repetitive work, however as rates of movement vary over a large range; no specific guidelines on duration or frequency of rest breaks exist.

2.13.2. Council Directive 90/ 270/EEC

This directive concerns the minimum health and safety requirements for work with display screen equipment. The Directive restricts surveillance to eye and eye sight tests but does not focus on other health hazards (especially MSDs). However, the Belgian and French transposing legislation obliges workers who use display screen equipment to undergo medical surveillance, but do not specifically identify the type of surveillance. In Finland, on the other hand, the task of health surveillance has been extended to general health and in Italy specifically requires surveillance for MSDs.

2.13.3. Council Directive 89/391/EEC

This directive focuses on the introduction of measures to encourage improvements in the safety and health of workers at work does not relate directly to MSDs. However, it does oblige employers to take the necessary measures to safeguard workers' safety and health in every aspect of their work.

2.13.4. Council Directive 90/269/EEC

This directive focuses on the minimum safety and health requirements for manual handling of loads, where there is a risk of back injury and concentrates on setting maximum loads. The Swedish regulations cover all work postures and movements including all repetitive work, work postures, ergonomic design of work equipment and areas; and the need for workers to vary work and take rest breaks when they feel the need.

2.14. Summary

This review set out to determine codes of practice and models of good practice for the prevention of upper limb disorders in hand-intensive work, specifically in health care professions. Interestingly, we did not find much guidance for the prevention of upper limb disorders that was specific to the above mentioned health care profession, despite their high prevalence of work-related upper limb disorders.

General legislation and industry standards not specific to health care or upper limb disorders were also reviewed with a view to identifying principles that could be applied to the professions of interest.

2.14.1. Summary and discussion of main findings:

- Most retrieved information was **not specific for manual tasks** but addressed the prevention of MSDs in general. **An exception are the codes of practice for manual tasks from Australia (81)** which specifically address injuries to the upper limb and manual tasks.
- The majority of the included guides are **not specific to health care workers** but refer more generally to manual handling tasks. Nevertheless, some of the principles we found in these documents may also be applied to hand-intensive tasks in health care.
- A large number of the codes of practice and models of good practice reflect an awareness of the importance of **physical and work organisational/psychosocial factors** that need to be addressed when preventing upper limb disorders, such as awkward body postures, repetitive movement, lack of job rotation, control over work pace and job satisfaction.
- In relation to work organisation, some guides specifically mention the need for **job rotation, variation of postures or job diversification.** These are important aspects of good ergonomic practice; however, they need to be translated specifically into the task design of health care jobs. The same is true for principles such as **job decision latitude and control over work**, which form important psychosocial aspects in the prevention of upper limb disorders.
- **The need for adequate rest breaks** is mentioned in a number of the guides, especially in the context of repetitive work. The New Zealand guidance document "Occupational Overuse Syndrome-Guidelines for Prevention and Management" recommends micro-pauses, typically for 5-10 seconds every three minutes, as unless the muscles relax fully, micro-pauses are of no value (69). Likewise, the other more specific information was found in the Californian guidance document on ergonomic breaks, rest periods and stretches, which specified micro breaks of 10-15 seconds every 10 minutes and mini breaks lasting 3-5 minutes every 30-60 minutes. Also, the ART tool (Assessment of Repetitive Tasks)

provides guidance on breaks in repetitive tasks by classifying risk categories for breaks into good, reasonable and poor. For example, risk category 'good' specifies that the repetitive task is continuously carried out without a break for less than 1 hour or with frequent mini breaks of less than 10 seconds every few minutes over the whole work period.

- Specific attention on **focused risk assessment** for manual handling tasks that involve **the use of smaller muscle groups** is pointed out in the NIOSH Code of Practice for manual handling. This provides a useful recommendation for this frequently overlooked area of risk assessment with often precedence of risk assessment for back injuries.
- An interesting issue is also raised by the specific application of the EU Directive on the minimum health and safety requirements for working with Visual Display Units (VDUs). Italy's strategy to specifically require **health surveillance for MSDs** in VDU workers may also prove useful for health care workers with hand-intensive tasks.

The review of the professional codes of practice for physiotherapist, physical therapist and sonographers provided the most specific recommendations and are as follows:

- The most specific recommendation for good practice in the **organisation of work** can be found in the guidance document on the prevention of work-related MSDs in sonographers developed by the Society of Sonographers. The outlined principles can be applied to physiotherapy/physical therapy, sports / manual therapy practice very easily. While applying the NIOSH recommendations on **work scheduling,** the recommendations for sonographers could be translated to physiotherapists/physical therapists, sports / manual therapists as follows: Different types of treatments per day should be scheduled to decrease strain on specific muscle groups. This obviously requires the input of the health care workers in appointment scheduling. Consideration should also be given to the maximum number of scheduled examinations per day which take into account ergonomic conditions and equipment, and the duration of the individual treatment. The guide also recommends review of the scheduling procedure (electronic versus personal scheduling) to provide more control over the schedule to each individual worker.
- The code of Practice for Physiotherapists recommends **risk assessment of each specific task** (i.e. the treatment of an individual patient) and recommends modification of the treatment plan as far as practicable to prevent MSDs in the physiotherapist. This recommendation is an interesting suggestion that would require some control over the planning of treatment plans and may prove very efficient, especially if considered together with recommendations on scheduling of treatments as discussed

above. An important aspect of any treatment planning or examination may be the BMI of a patient, as the body size determines the pressure force to be applied during treatment as well as it may require certain awkward positions. The recommendation to agree on a specific treatment protocol for obese patients may prove useful for other health care professionals as well.

- Another recommendation that could easily be applied to several health care occupations relates to implementing a clear **company policy** for the reduction of musculoskeletal hazards which should be endorsed at Board level (Sonographer guidance document). A sample policy can be found in the Sonographers guidance document.
- The sonographers' standard explicitly addresses **designers and manufacturers of equipment.** This principle could be extended to the other occupational groups in health care.
- **Training and education of the (health care) worker** is mentioned in several documents, some with specific reference to self care. It is recommended to provide regular staff training in risk assessment, control measures and the understanding of injury reporting mechanisms. Different types of self care addressed in the documents include aerobic exercises, body conditioning (such as Pilates or Yoga) and relaxation skills, but also education and training in the proper use of body mechanics. It is recommended that manual handling and self care training should be as specific to the task as possible. Furthermore, early education of students in self care and proper body mechanics early in their career is highlighted. These recommendations appear particularly important for counteracting the widely documented work culture of some health care workers that consider 'MSDs as part of the job'.

This list provides a range of general principles that need to be translated into hand-intensive health care jobs and also specific guidelines that can be easily applied to several hand-intensive health care jobs. Although not specifically drawn up for employed workers, these principles are applicable to self-employed health care workers as well. Self-employed workers in private practice usually have maximum influence on the ergonomic set up, patient scheduling and rest breaks. However, driven by economic constraints or lack of awareness, many may compromise principles of good ergonomics practice and work scheduling to the detriment of their own health. Although, studies have shown that practitioners with control over work schedules have lower rates of MSDs, under staffing in the face of current economic downturn, lack of funding for continued professional development and training, in addition to commitment to clients, may increase the risk of upper limb disorders in self employed practitioners. Therefore, targeting self-employed health care workers with hand-intensive tasks with specifically designed continuing education courses would be paramount.

2.14.2. Limitations

Limitations of this review are that it included publications in English only and may have missed important models of good practice published in other languages. In order to keep this review focused, we did not include issues relating to the management of upper limb disorders in an occupational health context but focused on the prevention aspect.

2.14.3. Conclusion

This review demonstrates that there is no specific guidance document for healthcare workers i.e. physiotherapists, physical therapists, sports / manual therapists, massage therapists, dentists, endoscopists, surgeons, sonographers and other healthcare professionals at risk of upper limb disorders from hand-intensive tasks. Such a guidance document targeting both employed and self-employed health care workers would be of great use in the prevention of WRULDs.

The information compiled in this systematic review could be useful for developing such a document that includes:

- guidance on task specific risk assessment;
- assessment of physical, ergonomic, organisational and psychosocial risk factors for upper limb disorders;
- guidance on the ergonomic set up of the workplace specific for each major group;
- specific guidance on rest breaks;
- concrete scenarios on providing input into work scheduling and control of the pace of work;
- explicit training and exercise programmes for self care maintenance; and
- the implementation of early and continued education.

Although most of the highlighted principles have immediate face value, their effectiveness in preventing WRULDs needs to be scientifically evidenced. Scientific ergonomic and epidemiological studies that clearly spell out the risk factors leading to WRULDs in hand-intensive health care occupations are rare and would greatly support the development of models of good practice for this population.

Many of the general principles for preventing WRULDs that were identified in this review were developed in the context of manufacturing work and VDU work. However, health care workers mainly ‘work on patients’ when they perform hand-intensive work with a lower level of standardization and these principles would require specific ‘translation’ to health care. Guidance on designing the machine/ VDU -interface has shown to be useful in the reduction of MSDs, therefore, guidance on “*human interface”* for people in direct contact with people, is also important, not only for the patient/ client but also for the healthcare practitioner.

3. Methods

3.1. Study Design

This study was a cross sectional study design which comprised of two studies.

3.2. Study Population

Currently practicing chartered physiotherapists (CPTs), physical therapists (PTs) and sports/athletic therapists (ATs) formed the study population for this study. In Ireland there is a distinct difference in the use of the terms *physiotherapist* and *physical therapist* and these professions have been historically organized as two separate professions. The differences between these professions have been discussed in the background section of this report.

3.3. Sample

The aim was to obtain representative samples of currently practicing Irish physical therapists, athletics therapists and chartered physiotherapists.

3.3.1. Physical Therapists and Sport/Athletic Therapists

The sampling of Physical Therapists and Sport/Athletic Therapists was completed through three data bases. Initially, the data base of the Institute of Physical Therapy and Applied Science (IPTAS), who represents all physical therapists that graduated from the Institute since 1990 (n=389), was used. As this database was in excess of twenty years old it was compared to a second database, the membership list of the Irish Association of Physical Therapists (I.A.P.T.), which is the professional body representing currently practicing physical therapists in Ireland and at the time of the study, had 189 registered members. From this database, 49 additional physical therapists were included in the study population. The third data base was the membership list of the newly established Athletic Rehabilitation Therapy Certified (A.R.T.C) organisation that specializes in the prevention and management of injuries associated with sporting, physical and occupational activity, in particular neuro-musculoskeletal injuries. This database had 29 members; however, contact details were only available for 18 members. Therefore, 18 athletic therapists (ATs) were included from the ARTC database. In total, 456 PTs and ATs were sampled. Each of these was sent an invitation

letter to participate in the study, an information sheet and a self-administered questionnaire along with a return stamp addressed envelope.

3.3.2. Chartered Physiotherapists

The chartered physiotherapists were sampled from two different populations: from the population of chartered physiotherapists in private practice and from the population of chartered physiotherapists employed in hospitals. The target was to obtain a sample with 40% of chartered physiotherapists working in private practice and 60% employed in public and private hospitals and various clinical settings. This represented oversampling of chartered physiotherapists in private practice in relation to the breakdown of self-employed versus employed physiotherapists in the population. Oversampling was necessary to obtain a large enough sample size of the chartered physiotherapists in private practice that gave sufficient statistical power for further sub-group analyses within this group.

Study participants working in private practice were randomly selected from Ireland's Chartered Physiotherapists Directory which was available on-line (82) and was cross-checked to a second database, the Chartered Physiotherapists in Private Practice (CPPP) database that was available on the Irish Society of Chartered Physiotherapists website. This resulted in a study population of three hundred and eighty three physiotherapists (n= 383). Two hundred and fifty (n=250) physiotherapists were randomly selected by developing a list and choosing every 10^{th}, 8^{th}, 6^{th}, 4^{th}, 5^{th} and 3^{rd} individual on the list, and excluded any participant already chosen in the previous selection.

For the second phase of the study on chartered physiotherapists in private and public hospitals, one-stage proportionate clustered sampling was used. Hospitals were selected based on bed capacity to ensure representation of physiotherapists working in different size hospitals reflecting approximately the proportionate distribution of different hospitals sizes in Ireland.

Table 3.1: Hospital Categories

Hospital Category	**Bed Capacity**	**No. of hospitals sampled from each category**
Acute Hospitals	0- 300 bed capacity	5
	301- 600 bed capacity	5
	600+ bed capacity	2
Specialist Orthopaedic	0 -300 bed capacity	4
Private Hospitals	0 - 100 bed capacity	4
	101– 200 bed capacity	3
	201 – 400 bed capacity	3

The physiotherapy manager in each chosen hospital was contacted by phone to explain the study, invite participation and get exact numbers of physiotherapists in each hospital. The study proposal and ethical approval documents were sent to managers that requested them prior to making a decision to take part in the study. Once each manager had decided to take part in the study the exact number of questionnaires was posted to the physiotherapy manager who then distributed them to the physiotherapists within their department. Each questionnaire was coded with a PT Number and a return stamped addressed envelope was attached to each questionnaire to allow the individual physiotherapists return the questionnaire to the research team should they choose to take part in the study.

The Irish Society of Chartered Physiotherapists (ISCP) was in favour of the aims of the study. However, due to intensified negotiations with the Irish Minister for Health in relation to the title of 'physiotherapist' and 'physical therapist', the ISCP felt that the timing of the study was not optimal and did not actively encourage their members to take part at this time. This may have been a contributing factor to the moderate response rate, only 14 of the 26 hospitals in the sample agreed to take part in the study. This corresponded to two hundred and twenty six (n=226) physiotherapists. Contacting the remaining initially selected 12 hospitals was not achievable due to the ongoing negotiations.

3.4. Questionnaire

The self-administered questionnaire (Appendix III) was derived from several standardized questionnaires developed for investigating musculoskeletal disorders in working populations. In order to reduce the "healthy worker effect" i.e. the sample may miss those who have left work as a result of musculoskeletal injury, our survey questionnaire was designed to allow those who had left work, either full time or part-time within the past 12 months, and who were still on the register of their professional body, to take part in the survey, thereby not excluding part-time or out-of-work individuals from the sample. In an attempt to curtail recall bias, we restricted our survey to 12 month prevalence and 7 day prevalence of musculoskeletal pain and discomfort for all six upper limb sites; as lifetime and career prevalence tend to task the participants memory and may result in either an over-estimation or under-estimation of symptoms.

The questionnaire was pilot tested for content validity and question clarity by physical therapists working in private practice and physiotherapists working in private practice, in a hospital based setting and a private clinical setting. Minor amendments were made to the questionnaire following the pilot test and on comments from reviewers from the Institution of Occupational Safety and Health (IOSH) UK.

The survey questionnaire contained fours sections:

The first section, **Section A**, was designed to elicit **general demographic information** such as age, height, weight and gender. Therapists were requested to provide occupational history including information on work status, area of practice, hobbies and sports, years of practice, hours of client contact, rest breaks, appointment schedules and work place risk assessments.

Section B was designed to measure **physical exposure factors** including; exposure to upper extremity risk factors using the questionnaire developed by Spieholz, Silverstein & Stuart (83). Questions were asked regarding the frequency and duration of potential physical job hazards such as force and repetition and measured on visual analogue scales that are used as components for deriving "cumulative exposure". This section also included questions that measure the worker's perceived physical effort associated with manual therapy practice. One of the most widely used psychophysical methods is the Borg Rating of Perceived Exertion Scale (RPE Scale, Borg, 1970) (84). The new RPE Scale developed in 1982 was used, with scale

values ranging from 0 *nothing at all* to 13 *maximal* which is especially suitable for subjective symptoms such as pain and workload.

Section C measured self-reported period prevalence of **upper limb symptoms** specified by 6 body parts over the past 12 months and period prevalence over the past 7 days using the upper limb questions from the Nordic Questionnaire that has been widely used to assess the nature and severity of self-rated musculoskeletal symptoms. Questions also addressed upper limb symptoms over the past 12 months that were so severe that they prevented the individual from carrying out normal activities during work, hobbies and housework ('incapacitating symptoms'). The following indicators were generated; binary (yes/no) for each body part, binary summary values (at least one body part affected versus none) for 12 months and 7 days prevalence and for incapacitating symptoms and number of affected body parts ('multisite symptoms'). Questions related to work-related musculoskeletal pain and discomfort that lasted longer than 3 days, medical help sought, clinical diagnoses of ULDs, intervention treatment, absenteeism at work due to related musculoskeletal pain or discomfort, injury prevention treatment and self care management were included in Section C as were questions about reporting and management of WRULDs.

Finally, **Section D** measured perceived **contribution of physical and psychosocial work factors** specific to physiotherapists/physical therapists, an instrument used in The Chartered Society of Physiotherapists (UK) study, which was originally developed by Bork et al (29). This section also comprised questions that measure wellbeing and psychosocial working conditions using the General Health Questionnaire GHQ12 (85) and selected scales from the Copenhagen Psychosocial Questionnaire (COPSOQ) (long version) (86). For self-employed PTs, the social support scales of the COPSOQ questionnaire were modified.

3.4.1. Psychosocial work characteristics: scale characteristics

Nine summary scales were created using the single items coded from 0 to 4. Table 3.2 shows the scale characteristics of the 9 different scales used to measure psychosocial work characteristics. In all scales, a high value represents a high level of the particular characteristic measured.

Table 3.2: Scale characteristics (Copenhagen Psychosocial Questionnaire)

Scale	Number of items	Mean	Min - max	Std	Cronbach's alpha
Quantitative work load (scale 0-16)	4	6.0	0-13	2.9	.64
Tempo (scale 0-12)	3	6.9	0-12	2.7	.84
Emotional demands (scale 0-16)	4	7.2	0-15	3.3	.77
Influence at work (scale 0-16)	4	11.5	0-16	4.3	.86
Predictability (scale 0-8)	2	6.1	0-8	1.9	.80
Peer support in employed (scale 0-12)	3	7.8	3-12	2.2	.72
Supervisory support in employed (scale 0-12)	3	6.5	0-12	3.0	.84
Peer support in self-employed (scale 0-12)	3	5.8	0-12	3.0	.83
Professional support in self-employed (scale 0-12)	3	4.9	0-12	3.1	.86

The scales measuring peer and supervisory support in employed practitioners were based on 119 individuals. The measures for either of the two social support scales addressed at self-employed individuals were based on the responses of 243 respondents, respectively. A number of respondents were both employed and self employed; therefore, they filled out both sections. All scales showed acceptable reliability measured as internal consistency (adjusted Cronbach's alpha).

Health care maintenance strategies to prevent or deal with musculoskeletal injury were also assessed and respondents were invited to make suggestions from their experience what they felt would help minimise the risk of sustaining a work-related musculoskeletal injury.

3.5. Maximising the response rate

The initial mailing to the Physical Therapists and Sport/Athletic Therapists occurred in June 2011 and several strategies were used to maximise the response rate. All cover letters were hand-signed and questionnaires were professionally printed in A4 booklet form, and stamped addressed envelopes were provided. The President of the Institute of Physical Therapy sent reminder emails to encourage registered physical therapists to take part in the study. Personal emails were sent to the newly established ARTC members indicating the support of their Senior Lecturer from Dublin City University. A follow up mailing occurred in July 2011, 3 weeks after the initial mailing to those who did not respond. A second questionnaire, cover letter and a stamped return envelope were sent. Any mailing that was returned with a change of address label from An Post (Irish Postal Service) was resent using a new address, if a new address was found. The addresses of non-respondents were checked against the current available addresses from the I.A.P.T database, the IPTAS database, the Yellow Pages and the current directory of physical therapists available on the website (87).

The initial mailing to the chartered physiotherapists in private practice occurred in October 2011 and several strategies were used to maximise the response rate. All cover letters were hand-signed and questionnaires were professionally printed in A4 booklet form, and stamped self addressed envelopes were provided. A follow up mailing occurred 3 weeks after the initial mailing to those who did not respond. A second questionnaire, cover letter and a stamped return envelope were sent that yielded additional responses. However this was not attainable with the hospital based physiotherapists. Consequently, selection bias of the sample of hospital based physiotherapist's needs to be considered when interpreting the results of this group.

3.6. Data treatment and data analysis

As the questionnaires were returned to the research office, each questionnaire was checked for missing data and pre-coded for entry into the already prepared data file. Data was analysed using the Statistical Package for Social Science SPSS Version 18.

Chi square analysis was used to determine significant differences in the prevalence of self-reported musculoskeletal symptoms with various job and personal characteristics. Yates Continuity Correction was used in 2x2 tables and Chi square test for linear trend, where appropriate.

To test whether upper limbs symptoms were associated with psychosocial and organisational work characteristics sets of logistic regression models were built using the scales of the Copenhagen Psychosocial Questionnaire as a predictor and 3 different indicators for upper limb symptoms as an outcome. The 3 indicators were (1) any upper limb disorders in the past 12 months (neck, shoulder, elbows, wrists, fingers or thumb), (2) any upper limbs disorder that prevented the respondent from normal daily activities in the past 12 months, and (3) any upper limb disorder in the past 7 days. The psychosocial work scales were entered as continuous variables into the regression models which were carried out in four steps. In the first step, the association between psychosocial work characteristic and ULDs was adjusted for demographics (age, gender). In the second step, work history variables (time working as PT, hours of manual work) and primary employment status (employed versus self-employed) were added. In the third step, the model controlled for demographics and physical health issues (body mass index, smoker versus non smoker, previous leisure time upper limb injury). In the fourth step, the model was also adjusted for mental health (GHQ).

3.7. Ethics

Ethical approval for the study was received from The Clinical Research Ethics Committee of the Cork Teaching Hospitals, Cork, Ireland. Informed consent was sought from all participants. The initial mailing included a cover letter and a participant information leaflet that stated the purpose of the study and assured the respondents that their questionnaire would remain anonymous and confidential. To follow up on non-respondents, each questionnaire was coded with a unique PT number that corresponded to a master roster of participant names. The master roster was kept in a safe place and only accessible to the research team. It was destroyed after all questionnaires were mailed.

4. Results

4.1. Response rate

4.1.1. Sample size

The final sample size was 347 after removal of currently non practicing therapists from the pool of completed questionnaires.

4.1.2. Physical Therapists / Athletic Therapists Response Rate

The response rate was excellent: 76% of currently practicing physical therapists and athletic therapists responded.

The population of currently practicing physical therapists / athletics therapists was 217. One hundred and ninety nine (n=199) questionnaires were returned. Of these 165 were completed, 3 were returned uncompleted and 31 letters and questionnaires were undelivered / not at this address. Of the 165 completed, 21 were returned as not currently working / on career break and 3 were returned as retired. The 31 undelivered were not defined as part of the study population as the letter of invitation and questionnaire did not reach them, despite sending them to a new address obtained for each of the 31 individuals.

As the study participants had been sampled from different sources, it was agreed to report separate response rates as follows:

$$\text{Combined Response Rate of PTs and ATs} = \frac{\text{Valid Responses PTs + Responses ATs}}{\text{Currently practicing PTs / ATs}} = \frac{165}{217} = 76\ \%$$

$$\text{Response Rate of PTs} = \frac{\text{Valid Responses PTs}}{\text{Currently Practicing PT's (IAPT)}} = \frac{152}{199} = 76\%$$

Response Rate of ATs = Responses Athletic Therapist = 13 = 72%

ARTC Database (2009-2010) 18

4.1.2.1 Non-responder analysis

In order to determine potential systematic selection bias by gender and province of residence/professional practice, gender and province specific response rates were generated. No systematic selection bias was detected in relation to the response from the 4 provinces with response rates ranging from 38% (Munster) to 42% (Ulster) hereby, providing a good cross-section of all areas in Ireland. Similarly, there was no systematic selection bias by gender (male 37%, female 41%).

Table 4.1: Responder / Non responder analysis by province

Province	Responder	Non Responder	Total
Munster	39	56	95
Leinster	107	168	275
Ulster	10	14	24
Connacht	11	18	29
Other	1	1	2
	168	257	425

Table 4.2: Responder / Non responder analysis by gender

Gender	Responder	Non Responder	Total
Male	74	124	198
Female	94	133	227
	168	257	425

4.1.3. Chartered Physiotherapists Response Rate

The chartered physiotherapists in private practice were sampled differently than the hospital based chartered physiotherapists; therefore, the response rate for each group was reported separately.

4.1.3.1. Chartered Physiotherapists in Private Practice

Questionnaires were sent out to two hundred and fifty (n=250) chartered physiotherapists in private practice. A total of one hundred and thirty five (n=135) questionnaires were returned. Of these, one hundred and thirty three (n=133) were completed and 2 were returned as undelivered, therefore, it was agreed that these could not be defined as part of the study population as the letter of invitation and questionnaire did not reach them. Therefore, the final study population for chartered physiotherapists in private practice was two hundred and forty eight (n=248).

Response Rate for Chartered Physiotherapists in Private Practice = All Responses / Entire sample population = 133 / 248 = 54%

4.1.3.2. Non-Responder Analysis for Chartered Physiotherapists in Private Practice

In order to determine potential systematic selection bias by gender and province of residence/professional practice, gender and province specific response rates were generated for Chartered Physiotherapists in Private Practice. No systematic selection bias was detected in relation to the response from Munster, Leinster and Connacht with response rates ranging from 55% (Munster) to 52% (Connacht), however, the response rate in Ulster (20%) shows there may have been systematic selection bias in the response from the provinces. There was no evidence of systematic selection bias by gender (male 51%, female 45%).

Table 4.3: Responder / Non responder analysis by province

Province	Responder	Non Responder	Total
Munster	40	33	73
Leinster	75	64	139
Ulster	1	4	5
Connacht	16	15	31
	132	116	248

Table 4.4: Responder / Non responder analysis by gender

Gender	Responder	Non Responder	Total
Male	31	32	63
Female	101	84	185
	132	116	248

It was not possible to complete a non-responder analysis based on gender or province of residence for the hospital based physiotherapists as this information was not available for this population.

4.1.3.3. Hospital Based Physiotherapists

The number of hospitals to be included in the sample was twenty six (n=26) hospitals. Of these 26, 14 hospitals agreed to accept questionnaires and the other 12 hospitals either actively refused to take part (n=2) or contact could not be made with the physiotherapy manager which may be interpreted as passive refusal (n=10).

A total of two hundred and twenty six (n=226) questionnaires were distributed to 14 hospitals based on the number of physiotherapists reported by the manager to be working in the department. A total of 11 hospitals

returned questionnaires, however no returns were received from the other 3 hospitals; therefore it was agreed to include them in the refusal rate as passive refusal. These 11 hospitals who responded were spread across all the acute hospital and private hospital groupings. In total, seventy one (n=71) questionnaires were returned.

Response Rate for Hospital Based Physiotherapists = All Responses / Entire sample population = 71 / 226 = 31%

Table 4.5: Response Rate by Hospital

Hospitals	**Total number of questionnaires sent out (n)**	**Total number of responders (n)**	**Response Rate percentage (%)**
Hospital 1	46	12	26
Hospital 2	11	5	45
Hospital 3	12	4	33
Hospital 4	20	8	40
Hospital 5	12	6	50
Hospital 6	2	2	100
Hospital 7	3	3	100
Hospital 8	50	14	28
Hospital 9	20	10	50
Hospital 10	5	4	80
Hospital 11	12	3	25

Note: Three hospitals had a further 33 questionnaires sent out to them but there were no returns.

4.1.3.4. Hospital Refusal Rate

In total, 15 of the 26 hospitals either actively or passively refused to take part in the study. Therefore, the overall hospital refusal rate was 58%.

In order to determine potential systematic selection bias, the refusal rate by hospital size was investigated. Considering the low response rate of hospital-based chartered physiotherapists and the large variation in the response rate by hospital systematic selection bias is likely. CPTs working in hospitals, especially those working in private hospitals, were definitely underrepresented in the overall study.

Table 4.6: Refusal Rate by cluster group

Cluster Groups	Number of hospitals which responded	Number of hospitals which refused	Total number of sampled hospitals
Acute Hospitals – 0-300 bed capacity	3	2	5
Acute Hospitals – 301-600 bed capacity	4	1	5
Acute Hospitals – +600 bed capacity	1	1	2
Acute Hospitals – Orthopaedic	2	2	4
Private Hospitals – 0-100 bed capacity	0	4	4
Private Hospitals – 101-200 bed capacity	0	3	3
Private Hospitals – 201-400 bed capacity	1	2	3

4.2. Descriptive results

Most of the descriptive results will be presented for the entire sample of currently working therapists (n=347) and separately for the 3 groups: Physical/Athletics Therapists (PTs/ATs) (n=141), Chartered Physiotherapists (CPTs) in private practice (n=135) and Chartered Physiotherapists in hospitals as these three groups were sampled from different study populations with differences in response rates. The results for PTs/ATs and CPTs in private practice can be regarded as fairly representative for the respective Irish populations.

4.2.1 Sample characteristics

The majority of the participants were female (67%) with an approximate equal gender balance in the group of physical therapists/athletics therapists (53% females/47% males). The mean age of all participants was 39 years with a range of 23 to 72 years (std. 8.82). CPTs in hospitals were generally younger than CPTs in private practice. The sample included highly experienced therapists as well as therapists at the beginning of their career. Therapists with shorter work experience were more frequent in the group of the PTs/ATs, whereas, CPTs in private practice tended to be more experienced (Table 4.7).

Table 4.7: Sample characteristics

	Entire sample N=347 % (n)	**PTs/Ats N=141 % (n)**	**CPTs in private practice N=135 % (n)**	**CPTs in hospitals N=71 % (n)**
Gender				
Males	33% (114)	47% (66)	24% (32)	23% (16)
Female	67% (233)	53% (75)	76% (103)	78% (55)
Age				
Younger than 30	18% (61)	16% (22)	10% (14)	36% (25)
31 - 40	43% (149)	42% (59)	43% (58)	46% (32)
41 - 50	27% (94)	35% (49)	27% (36)	13% (9)
51 - 60	11% (37)	65% (7)	19% (26)	6% (4)
61 and older	1% (4)	2% (3)	1% (1)	0 (0)
Years working as therapist				
<5 years	26% (88)	45% (62)	7% (10)	23% (16)
5- 10 years	27% (93)	31% (43)	15% (20)	42% (13)
11-15 years	19% (65)	18% (25)	21% (28)	17% (12)
16-20 years	9% (32)	5% (7)	16% (21)	6% (4)
> 20 years	19% (66)	1% (1)	42% 56)	13% (9)
Employment status in primary job				
Employed	146 (42%)	30% (42)	26% (35)	97% (69)
Self employed	201 (58%)	70% (99)	74% (100)	3% (2)
Secondary job	25% (86)	36% (51)	27% (36)	13% (9)
Tertiary job	5% (16)	6% (9)	4% (6)	1% (1)

	Entire sample N=347 % (n)	**PTs/Ats N=141 % (n)**	**CPTs in private practice N=135 % (n)**	**CPTs in hospitals N=71 % (n)**
Work hours per week as therapist (including overtime)				
<10hrs	6% (20)	13% (18)	2% (2)	0% (0)
10-19 hrs	13% (45)	24% (33)	7% (10)	3% (2)
20-29 hrs	20% (68)	28% (38)	18% (24)	9% (6)
30-39 hrs	31% (107)	19% (26)	20% (27)	76% (54)
40-49 hrs	17% (57)	10% (14)	26% (36)	11% (8)
50 hrs and more	14% (47)	7% (9)	27% (37)	1% (1)

There was good representation of both employed and self-employed therapists in the entire sample with slightly more respondents (58%) reporting self-employment as their primary employment status. Every fourth therapist worked in a secondary job either as a therapist or in a different profession. 5% of respondents were holding an additional tertiary job. The high percentage of therapists with additional jobs is reflective of a common situation among employed therapists who maintain a private practice parallel to their employment. Some self-employed therapists engaged in a job of a different nature parallel to their private practice.

The entire sample consisted of both full-time and part-time therapists and included also those practicing occasionally on an hourly basis. Some of the working hours were alarming. 34% of all therapists exceeded the 40 hours mark, of those 14% worked 50 hours per week and more. The average hours working as therapist including overtime was 31.2 hours per week (std. =14.6).

4.2.2. General health characteristics

Smoking, high body mass index (BMI) and psychiatric morbidity are well-known individual risk factors for musculoskeletal disorders and were therefore recorded. The prevalence of current smokers was low (8%) and compared very favourably with the national smoking prevalence of 23.6% in the General Irish adult population (88). The body mass index, indicative of normal weight, overweight and obesity showed considerable rates of overweight (29%) and obesity (6%), however, these rates were below the Irish rates of the general adult population with self-reported BMI overweight at 36% and obesity at 14% (89). 23% (almost one in four) of the therapists scored at a heightened risk for psychiatric morbidity as measured by the GHQ-12 questionnaire.

Table 4.8: Health characteristics

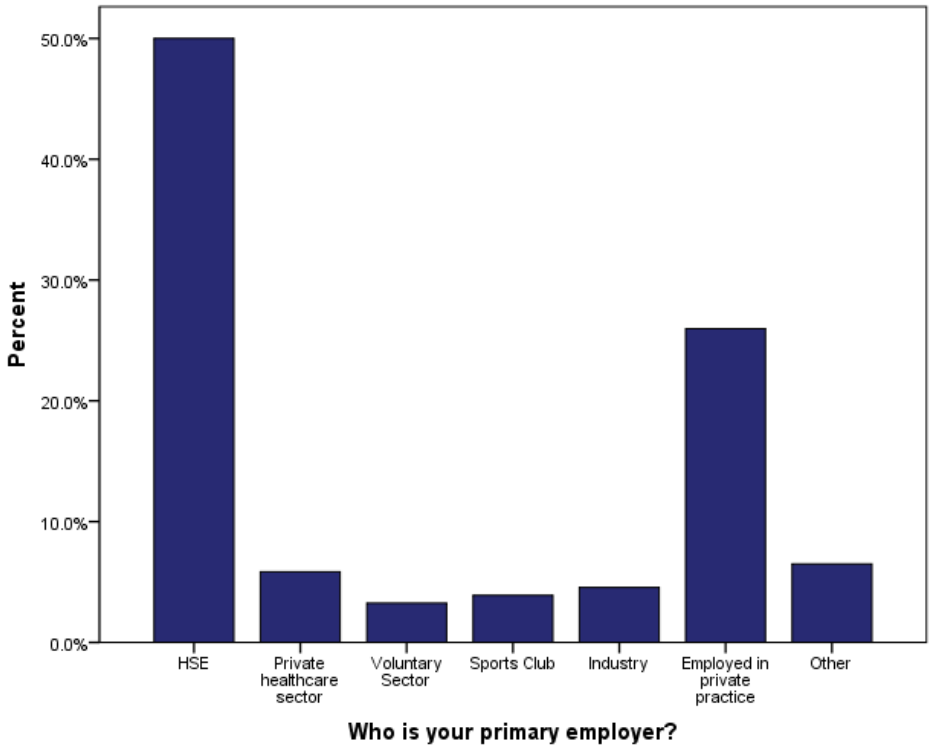
	Entire sample N=347 % (n)	**PTs/Ats N=141 % (n)**	**CPTs in private practice N=135 % (n)**	**CPTs in hospitals N=71 % (n)**
Smoking status				
Never smoker	75% (256)	65% (89)	81% (107)	85% (60)
Ex smoker	18% (60)	27 % (37)	11% (14)	13% (9)
Current smoker	8% (26)	9% (12)	9% (12)	3% (2)
Body mass index				
Normal weight (<=25)	65% (217)	53% (71)	70% (94)	78% (52)
Overweight (>25)	29% (98)	37% (50)	26% (35)	19% (13)
Obese (>= 30)	6% (20)	10% (13)	4% (5)	3% (2)
General health: Case (3 and above)	23% (80)	26% (36)	21% (28)	23% (16)

Note: Body mass index for entire sample based on n=335 due to missing data.

4.2.3 Employers and practice areas

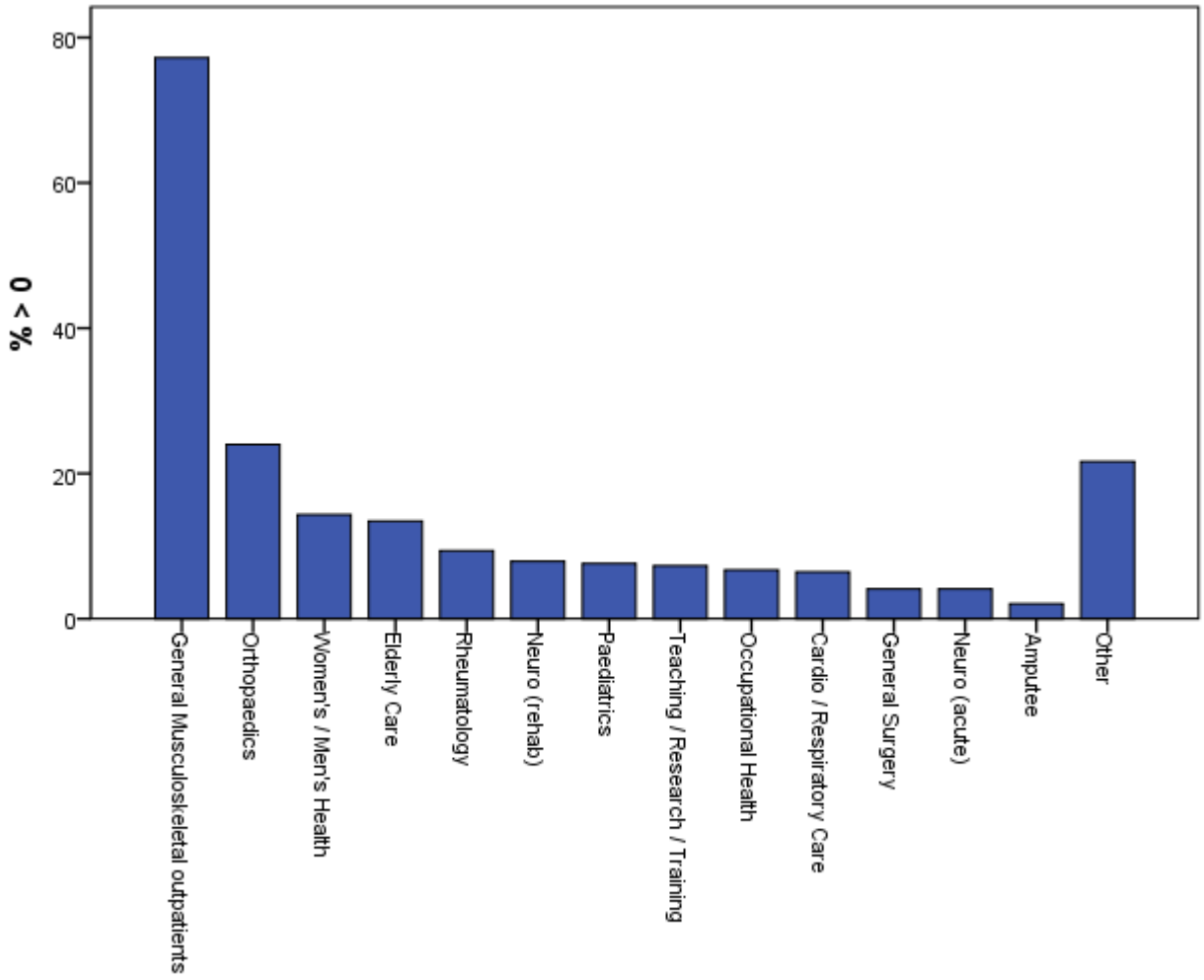
The main employers for employed therapists (n=152) were the Health Service Executive (HSE) (49%) and private practices (26%). Other employers were the private healthcare sector with settings in private health care centres and hospitals, industry and sports clubs. A small proportion (4%) contributed their work on a voluntary basis (Figure 4.1).

Figure 4.1: Employers of primary job (employed therapists only) (n=154)



Therapists worked in a range of practice areas which go beyond the 'classical' applications of manual therapies (Figure 4.2). Many of the respondents worked in more than one practice area indicative of the large scope of therapy applications practiced by the therapists. Almost 80% of all respondents reported working in musculoskeletal outpatient settings. These settings included treating patients/clients in a private practice setting, at home or in community care. Orthopaedics, women's and men's health and rheumatology were other major practice areas. The category 'other' consisted of specific applications, such as manual lymph drainage, acupuncture, pilates and cranio-sacral therapy, of applications within sports injuries and other speciality areas including oncology, palliative care and advanced rehabilitation.

Figure 4.2: Practice areas of all respondents (n= 347) (multiple responses were possible).



Most physical therapists/athletics therapists worked with musculoskeletal outpatients, whereas, CPTs reported a wider range of practice areas.

4.2.4 General work characteristics

As the study included full-time and part-time therapists working in a wide range of settings, general work characteristics varied considerably within and across the three groups.

Table 4.9: General work characteristics

	Entire sample N=347 % (n)	**PTs/Ats N=141 % (n)**	**CPTs in private practice N=135 % (n)**	**CPTs in hospitals N=71 % (n)**
Hours in direct patient contact per week				
10 and less hrs	13% (44)	28% (38)	2% (3)	4% (3)
11 -20 hrs	26% (88)	35% (48)	22% (30)	14% (10)
21-30 hrs	36% (123)	26% (35)	35% (47)	58% (41)
31 – 40 hrs	17% (59)	7% (10)	24% (33)	23% (16)
More than 40 hrs	9% (29)	4% (6)	16% (22)	1% (1)
Hours of manual therapy per week				
1 - 10 hrs	29% (98)	32% (43)	8% (10)	65% (45)
11 – 20 hrs	33% (110)	36% (48)	37% (49)	19% (13)
21 – 30 hrs	22% (74)	21% (28)	28% (37)	13% (9)
31 – 40 hrs	11% (38)	10% (13)	17% (23)	3% (2)
40+ hrs	5% (17)	2% (2)	11% (15)	0% (0)
Average time for individual treatment				
<15 min.	19% (65)	2% (3)	14% (19)	63% (43)
15 min – 29 min	37% (125)	13% (17)	65% (87)	31% (21)
30 min – 59 min	41% (140)	81% (110)	19% (26)	6% (4)
60 min and more	2% (8)	4% (6)	2% (2)	0% (0)
Number of clients/patients per day				
5 and less	25% (84)	54% (75)	5% (7)	3% (2)
6 – 10	46% (157)	40% (55)	54% (73)	41% (29)
11 and more	30% (102)	6% (8)	41% (55)	56% (39)

Therapists spent an average of 25.7 hrs per week (std. 12.4, range: 0-80) in direct patient/client contact. The majority of therapists (61%) performed manual therapy for 20 hours or less during the week. The average number of patients was 8.8 (std = 4.5) with a maximum of 29 patients/clients treated per day.

These general work characteristics are, to some degree, indicative of physical and mental workload, e.g. the duration engaged in manual therapy and the number of patients/clients per day determines time load and the physical and mental resources required to perform the task.

The three groups showed marked differences. Whereas PT/ATs constituted the group with the lowest hours in direct patient contact and manual therapy hours per week, their individual treatment sessions tended to be the longest.

4.3 Prevalence estimates of upper limbs symptoms

4.3.1 Prevalence estimates of symptoms (summary measures)

Table 4.10 displays the prevalence estimates of the summary indicators of musculoskeletal symptoms that specify whether somebody experienced any symptoms versus none.

Table 4.10: Prevalence estimates of self-reported musculoskeletal and UL symptoms (summary indicators) with 95% confidence intervals (95%CI)

	Any work-related musculoskeletal symptoms in last 12 months>3days (%, 95% CI)	**Any UL symptoms in last 12 months (%, 95% CI)**	**Any UL symptoms in last 7 days (%, 95% CI)**	**Any incapacitating UL symptoms in last 12 months (%, 95% CI)**
All respondents (n= 347)	55.4 (50.0-60.8)	82.5 (78.4-86.6)	53.3 (47.9-58.7)	25.6 (20.9-30.3)
Physical therapists/AT (n=141)	55.7 (47.2-64.3)	84.4 (78.4-90.4)	60.3 (52.1-68.4)	21.0 (14.2-27.9)
CPT private (n=135)	57.3 (48.7-65.8)	83.7 (77.4-90.0)	54.8 (46.4-63.3)	25.2 (17.8-32.6)
CPT public (n=71)	52.1 (40.4-63.9)	74.6 (64.4-84.9)	39.4 (27.9-50.9)	35.7 (24.4-47.1)

55.4% of all respondents reported that they had experienced work-related musculoskeletal pain or discomfort that lasted for more than 3 days in the past 12 months. This measure is not specific for upper limb symptoms but indicates general musculoskeletal problems. A very large proportion (82.5%) of therapists experienced symptoms (pain, aches, discomfort, numbness) in at least one upper limb body part during the last year. More than half of all therapists (53.9%) had upper limb symptoms during the past 7 days. One out of four therapists (25.7%) suffered from upper limb symptoms during the past 12 months that were so severe that they were incapacitating and interfered with normal activities at work, home or leisure time.

The three samples were similar in relation to any work-related musculoskeletal symptoms that lasted more than 3 days and to the 12-months prevalence of any UL symptoms. Current (7 day prevalence) varied considerably between the three groups and was highest in physical therapists and lowest in hospital-based chartered physiotherapists. Interestingly, hospital-based CPTs reported the lowest 12 month and 7 day prevalence rates of the three groups, however, exhibited the highest rate of incapacitating UL symptoms.

4.3.2 Prevalence estimates of upper limb symptoms by body parts

The most affected body parts accounting for the 12-month and 7 day-prevalence rates were shoulder, neck and thumbs (Figure 3). 53.2% of all respondents reported that they experienced shoulder symptoms (aches, pain, discomfort) during the past 12 months, followed by neck symptoms (49.4%). Neck (10.8%), shoulder (10.5%) and wrist (7.9%) symptoms accounted for most of the incapacitating conditions experienced in the past 12 months, i.e. symptoms that were so severe that they interfered with normal activities.

Figure 4.3: Prevalence estimates of upper limbs symptoms by body parts (entire sample) n=347.

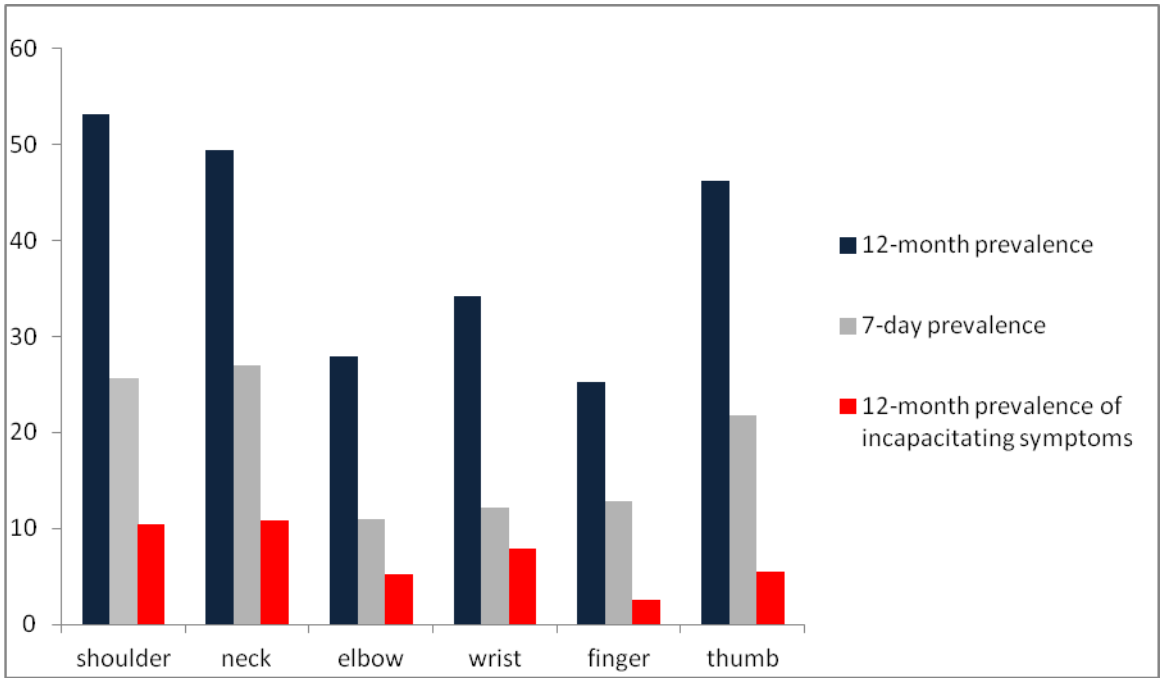


Table 4.11: 12-month prevalence estimates of upper limb symptoms by body parts for PTs/ATs, and CPTs

	Shoulder % (95% CI)	**Neck % (95% CI)**	**Elbow % (95% CI)**	**Wrist % (95% CI)**	**Finger % (95% CI)**	**Thumb % (95% CI)**
12-month prevalence of symptoms						
All respondents	53.2 (47.9-58.4)	49.4 (44.1-54.7)	28.2 (23.4-33.0)	34.2 (29.2-39.2)	25.3 (20.7-29.9)	46.2 (40.6-51.2)
PTs/ATs	57.2 (48.9-65.6)	51.4 (43.1-59.8)	32.6 (24.7-40.5)	41.2 (32.8-49.5)	29.0 (21.4-36.7)	44.9 (36.6-53.3)
CPT private	49.6 (41.1-58.1)	48.1 (39.7-56.6)	28.1 (20.5-35.8)	31.1 (23.2-39.0)	28.1 (20.5-35.8)	53.3 (44.9-61.8)
CPT public	52.1 (40.4-63.9)	47.9 (36.1-59.6)	19.7 (10.4-29.1)	26.8 (14.4-37.2)	12.7 (4.9-20.5)	33.8 (22.7-44.9)
7 – day prevalence of symptoms						
All respondents	25.9 (20.2-30.5)	27.0 (22.3-31.7)	11.0 (7.7-14.4)	12.2 (8.7-15.7)	12.8 (9.2-16.3)	21.8 (17.4-26.2)
PTs/ATs	30.4 (22.7-38.2)	29.0 (21.4-36.6)	17.4 (11.0-23.8)	14.5 (8.6-20.4)	15.2 (9.1-21.3)	18.8 (12.3-25.4)
CPT private	23.0 (15.8-30.1)	28.9 (21.2-36.6)	5.9 (1.9-10.0)	11.9 (6.4-17.3)	11.9 (6.3-17.3)	26.7 (19.2-34.2)
CPT public	22.5 (12.7-32.4)	19.7 (10.4-29.1)	8.5 (1.9-15.0)	8.5 (1.9-15.0)	9.9 (2.9-16.9)	18.3 (9.2-27.4)

	Shoulder % (95% CI)	**Neck % (95% CI)**	**Elbow % (95% CI)**	**Wrist % (95% CI)**	**Finger % (95% CI)**	**Thumb % (95% CI)**
12-months prevalence of incapacitating symptoms						
All respondents	10.5 (7.3-13.8)	10.8 (7.5-14.1)	5.2 (2.9-17.6)	7.9 (5.0-10.7)	2.6 (0.9-4.3)	5.5 (3.1-8.0)
PTs/ATs	10.2 (5.1-15.3)	7.3 (2.9-11.7)	6.6 (2.4-10.7)	10.2 (5.1-15.3)	2.9 (0.8-5.8)	5.1 (1.4-8.8)
CPT private	8.9 (4.1-13.7)	11.1 (5.8-16.5)	3.7 (0.5-6.9)	5.2 (1.4-9.0)	2.2 (-0.3-4.7)	7.4 (3.0-11.9)
CPT public	14.3 (6.0-22.6)	16.9 (8.1-25.7)	5.6 (0.2-11.1)	8.5 (1.9-15.0)	2.8 (-1.1-6.7)	2.8 (-1.1-6.7)

The interpretation of the confidence intervals (overlapping versus non-overlapping) allow for a comparison of the estimates between groups. There were no distinct patterns by group except in 2 cases: CPTs in private practice were suffering significantly more from thumb symptoms in the past 12 months than those CPTs working in hospitals. PTs/ATs reported with 41.2% the highest 12-month wrist prevalence. For all other body parts, there was no statistically significant difference between the groups.

In 2000 and 2001, the European Foundation for the Improvement of Living and Working Conditions completed a European wide survey which used a representative sample of working age adults within each country. The Irish data showed that 8.2% of Irish workers reported muscular pains in the shoulders and neck and less than 5% reported muscular pain in upper limbs (1). In comparison, the population of CPTs/PTs/ATs had a much high prevalence rate of muscular pain or discomfort in the shoulders and neck.

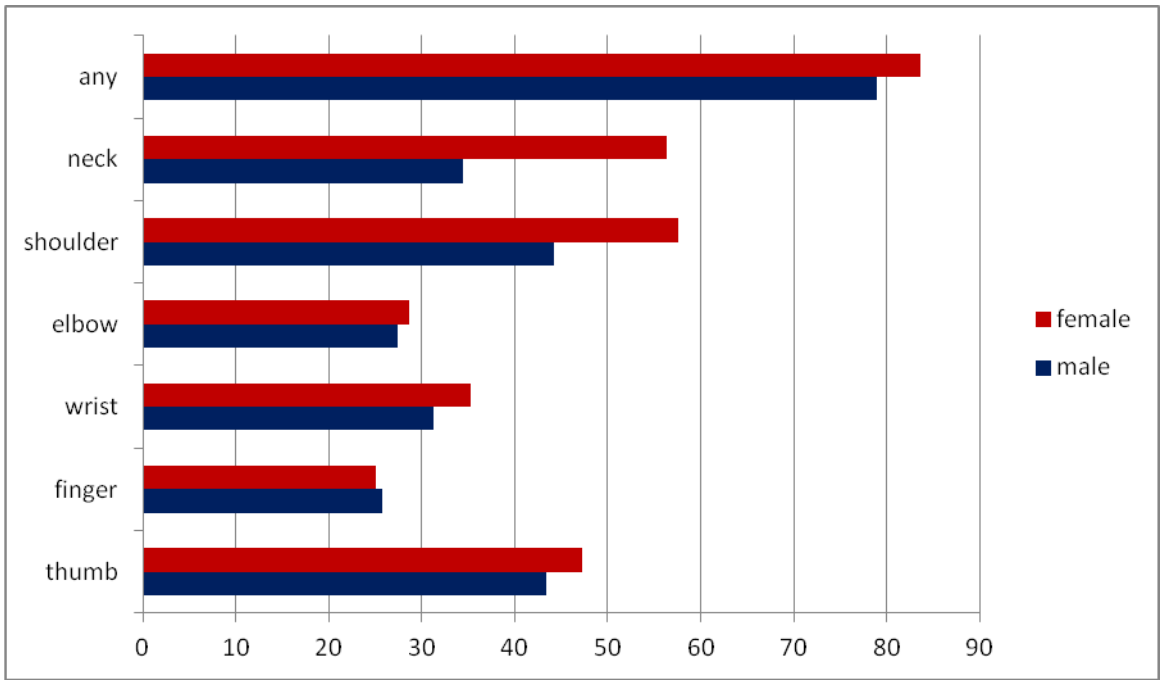
4.3.3. High risk groups for upper limb symptoms

4.3.3.1. Gender

The following analyses provide a break-down of prevalence by gender, age and years of experience as a therapist to determine potential high risk groups within the population of therapists.

Males and females were not significantly different in relation to symptoms in any body part during the past 12 months. Women were reporting significantly more neck and shoulder symptoms (56.3 % and 57.6% respectively) than their male counterparts (35.4%, 44.2 %).

Figure 4.4: 12 months prevalence of symptoms by gender in % (n=347)

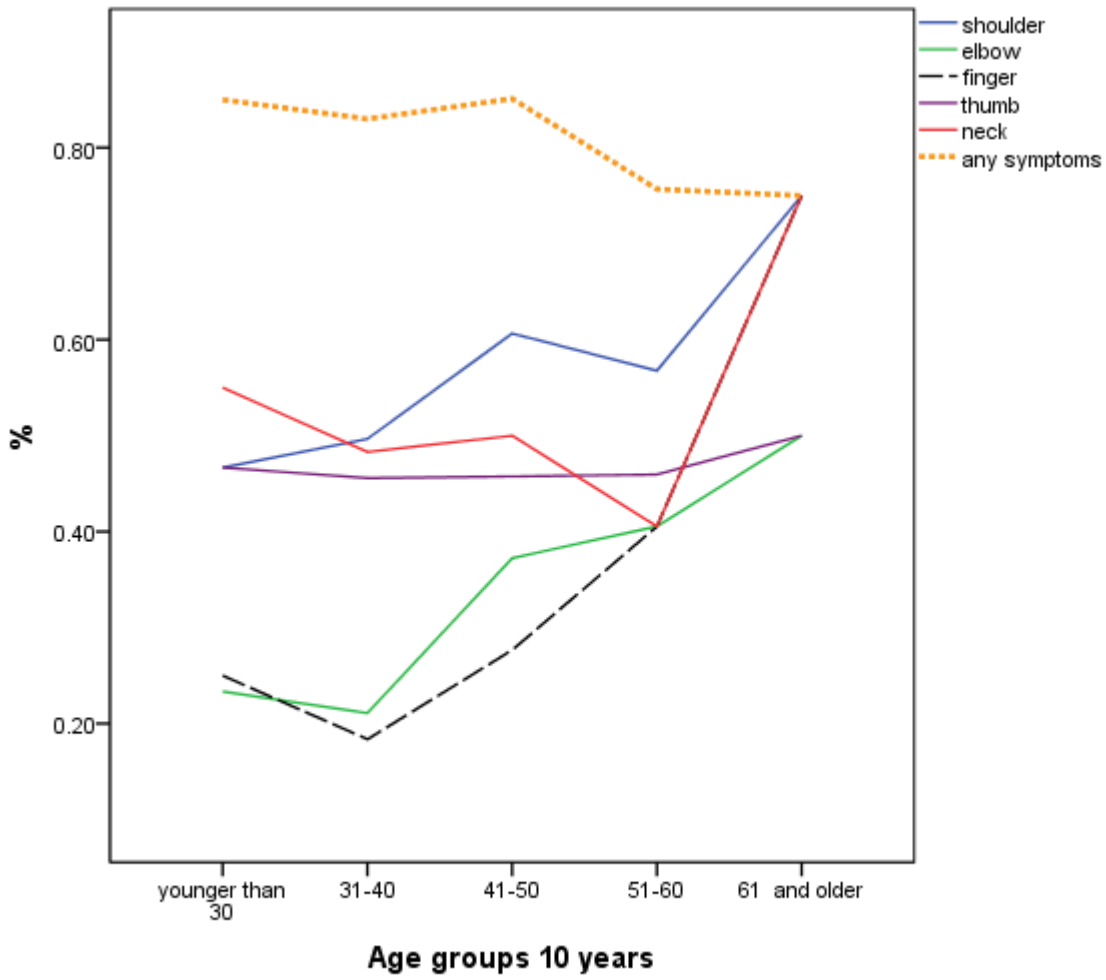


Results for the 7-day prevalence were similar with a significant difference between males and females in neck prevalence. There were no differences between the genders in relation to symptoms that were incapacitating (so severe that they interfered with normal daily activities) and work-related MSDs symptoms lasting longer than 3 days. Clinically diagnosed conditions were also fairly equally distributed between the genders.

4.3.3.2. Age

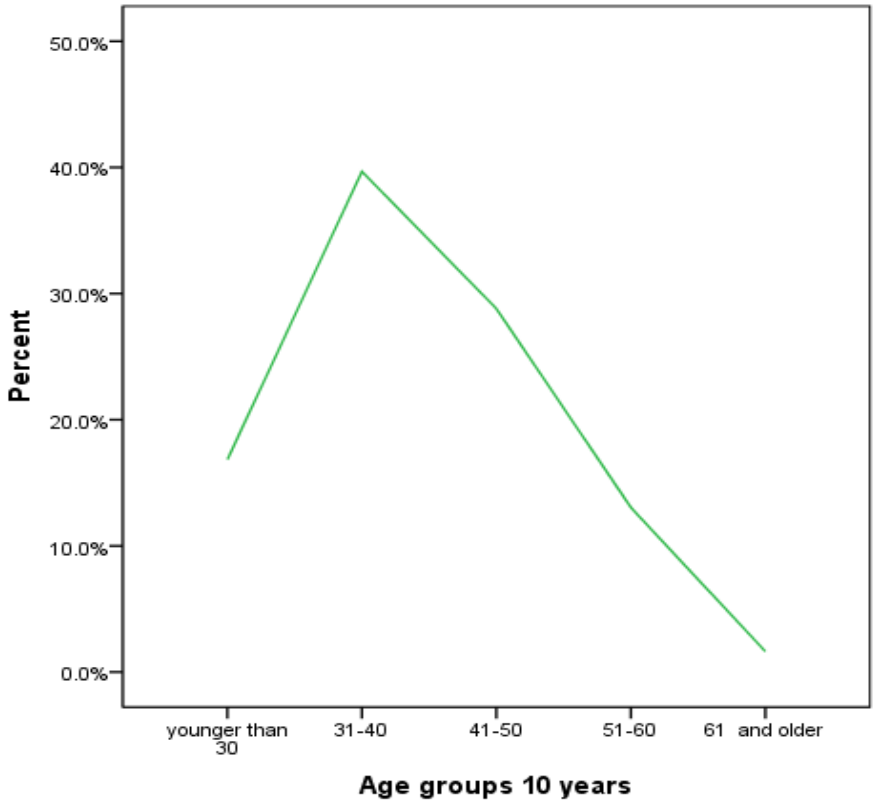
As expected, the 12-month UL symptom prevalence increased by age, specifically for shoulder, neck, elbows and fingers but not for thumbs. Interestingly prevalence of symptoms in at least one body part showed a tendency to decrease with age possibly indicative of the healthy worker effect.

Figure 4.5: 12 month symptom prevalence by age group (n=347)



The 7-day prevalence of UL symptoms and the 12-months prevalence rate of incapacitating symptoms did not show any conclusive trends by age group.

Figure 4.6: Self-reported work-related musculoskeletal symptoms that lasted longer than 3 days in past 12 months by age group



Report of work-related musculoskeletal symptoms was highest in the 31 to 40 age group and dropped steeply and steadily in the older age groups possibly indicative of a healthy worker effect.

4.3.3.3. Professional experience and employment status

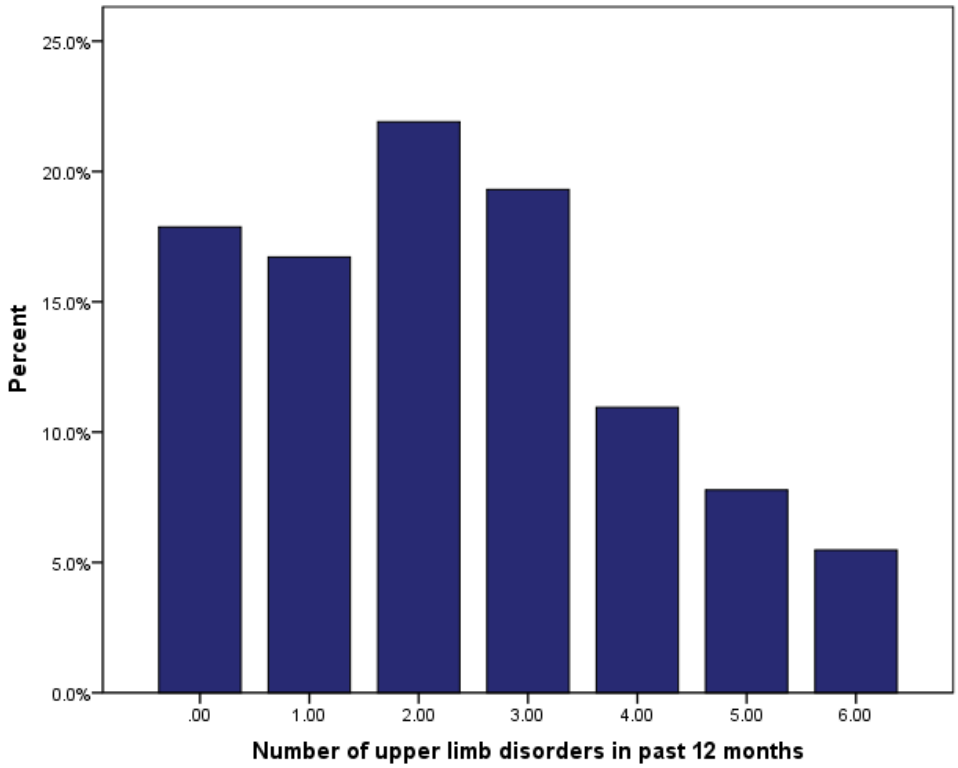
It was also investigated whether UL symptoms increase with years of working as a physical therapist. Whereas 7-day period prevalence of UL symptoms in any body site and WRMSDs lasting for longer than 3 days did not significantly vary by experience, the 12-month prevalence of any symptoms and of incapacitating symptoms did.

The proportion of those experiencing incapacitating symptoms increased significantly with years of working as a therapist in a linear fashion. 33.3% of therapists working for longer than 20 years reported incapacitating symptoms compared to 23% of therapists working shorter than 5 years (chi^2 test for trend, $chi^2 = 4.035$, $p = 0.045$). Incapacitating shoulder symptoms accounted for most of this trend (chi^2 test for trend, $chi^2 = 4.664$, $p = 0.031$). The 12 month prevalence of any UL symptoms also varied by years of

experience but not in a linear fashion (chi^2 = 10.577, p = .032). The lowest rate of UL symptoms (62.5%) was reported by therapists with a 16 to 20 years experience, the highest rate (87.9%) was in therapists working for longer than 20 years. Primarily self-employed therapists reported a higher 12 month prevalence of UL symptoms (86.4%) as compared to employed therapists (76.5%) (p=.026). Hospital-based therapists had a higher proportion of incapacitating symptoms (37.7%) in comparison to therapists in private practice (23.1%) (p=0.045).

4.4. Multisite symptoms

Figure 4.7: Number of body parts affected by upper limbs symptoms in the past 12 months (n= 347)



Many therapists reported ache, pain, discomfort or numbness in more than one body part with the majority having 2 or 3 upper limbs affected. Almost every fourth therapist (24.2%) reported symptoms in 3 or more body parts.

4.4.1. First occurrence of upper limb symptoms

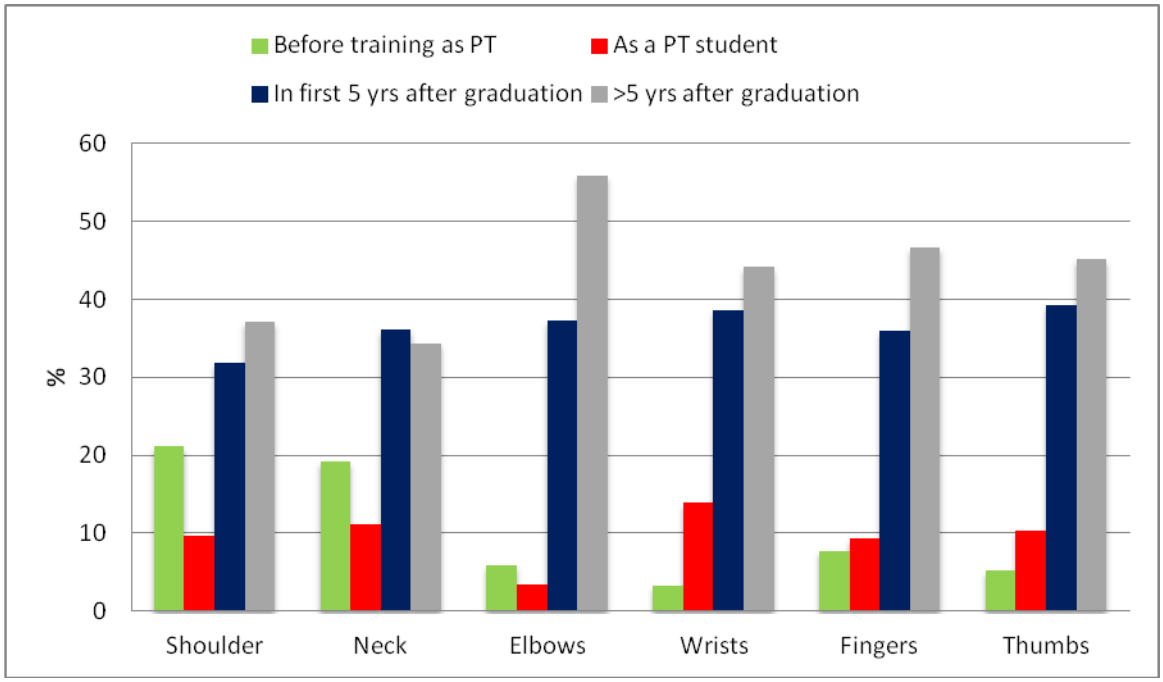
From a view of prevention of ULDs and early intervention the investigation of the first onset of symptoms is important. Information about the onset of symptoms may also provide evidence supporting the work-relatedness of ULDs.

Figure 4.8 shows the first occurrence of symptoms in those who reported symptoms in a particular body part. Whereas, for many therapists the first onset of symptoms was experienced late in their careers, a considerable proportion also reported early career onset in the first 5 years after graduation or even earlier while training. For example, 44% of those with thumb symptoms experienced these symptoms 5 years and later after graduation. However, 39% reported the first occurrence of thumb symptoms within the first 5 years of their career. The late onset was particularly pronounced in elbow symptoms.

Whereas, a considerable percentage of respondents reported that they had shoulder and neck symptoms before training as therapist (21% and 19%, respectively), the respective percentages were low for the other body parts, i.e. elbows (3.4%), wrists (3.3%), fingers (7.8%) and thumbs (5.2%) suggesting that onset of symptoms especially affecting the arms and fingers may be, at least partically, work-related.

A small percentage of therapists also reported that they developed upper limbs symptoms while training with proportions ranging from 3.4% in elbow symptoms to 14% in wrist symptoms.

Figure 4.8: Self-reported first onset of symptoms by body part of those with symptoms



Note: The table includes different sample sizes: Shoulder n=113, neck n=125, elbows n=59, wrists n=93, fingers n=75, thumbs n=135.

When interpreting these figures it needs to be taken into consideration that a quarter of the therapists (25.4%) had worked less than 5 years in practice. The proportion of late onset of symptoms is probably higher in relation to early onset than shown in this sample. It also needs to be taken into consideration that these reports may be subject to recall bias and present a rough estimate of the first occurrence .

4.4.2. Prevalence estimates of self-reported clinical diagnoses of ULDs

Another indicator of the prevalence of upper limb disorders were clinically diagnosed upper limbs disorders. Prevalence estimates were determined based mainly on the classification of work-related upper limb disorders provided by the consensus definition (Harrington et al., 1998) with a few additional common UL conditions added.

Table 4.12: Prevalence estimates of self-reported clinical diagnoses of ULDs

	Entire sample % (95% CI)	**PTs/ATs % (95% CI)**	**CPT private practice % (95% CI)**	**CPT hospitals % (95% CI)**
Overuse syndrome	11.8 (8.4-15.3)	14.1 (8.1-19.9)	8.4 (3.6-13.1)	14.1 (6.0-22.3)
Tendonitis	5.9 (3.4-8.4)	5.9 (2.0-9.9)	4.6 (0.9-8.2)	8.5 (2.0-15.0)
De Quervain disease of the wrist	1.8 (0.4-3.2)	3.7 (0.4-7.0)	0.8 (-0.7-2.3)	0.0
Shoulder capsulitis (frozen shoulder)	0.6 (-0.2-1.4)	0.7 (-0.7-2.2)	0.8 (-0.7-2.3)	0.0
Shoulder tendinitis	12.5 (8.9-16.0)	8.8 (4.1-13.7)	14.5 (8.4-20.5)	15.5 (7.0-24.0)
Lateral epicondylitis (tennis elbow)	9.8 (6.6-13.0)	10.4 (5.2-15.5)	10.7 (5.3-16.0)	7.0 (1.0-13.0)
Medial epicondylitis (golfer's elbow)	2.4 (0.7-4.0)	2.2 (0-4.7)	3.0 (0-6.0)	1.4 (-1.3-4.1)
De Quervain's thumb	3.3 (1.4-5.2)	5.2 (1.4-9.0)	3.0 (0-6.0)	0.0
Muscle tension	19.0 (14.8-23.2)	25.2 (17.8-32.6)	15.2 (9.1-21.5)	14.1 (6.0-22.2)
Other	12.0 (8.1-15.0)	6.6 (2.4-11.0)	16.0 (9.7-22.4)	12.7 (4.9-20.5)

A considerable percentage of therapists (37.5%) reported at least one clinical diagnosis.

The most common diagnoses made were muscle tension (19%), shoulder tendonitis (12.5%), overuse syndrome (11.8%) and lateral epicondylitis (9.7%). Considering the study population with professional knowledge and expertise in musculoskeletal conditions and understanding of the medical terminology used

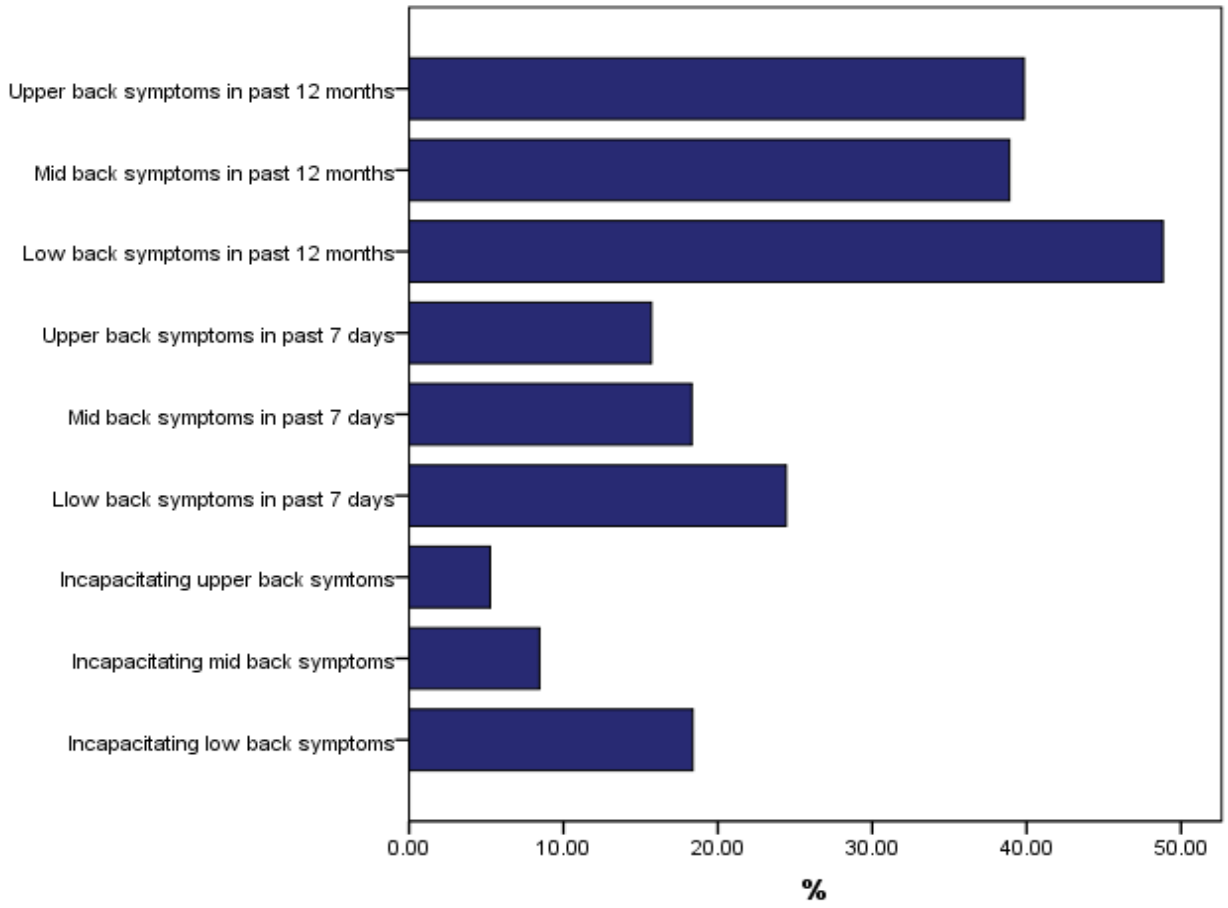
in the questionnaire, it can be assumed that the self-reported data form a fairly reliable estimate of clinically diagnosed conditions.

Self management was the most commonly used strategy to deal with the diagnosis (65%), followed by physiotherapy treatment (47%).

4.4.3. Prevalence of back symptoms

Although the focus of this research was on upper limb symptoms and disorders, symptoms of the lower back, the mid back and the upper back were also assessed. They are presented very briefly only.

Figure 4.9: Self-reported back symptoms



Generally the prevalence of back symptoms was high. Low back symptoms (pains, aches, discomfort, and numbness) accounted for the majority of back symptoms with a 12-month prevalence of 48.8%, a 7-day

prevalence of 24.4% and an 18.4% 12-months prevalence of incapacitating symptoms. Compared to the prevalence rates of UL symptoms, the back was one of the most commonly affected body sites.

4.4.4. Leisure time injuries

The aetiology of musculoskeletal disorders is multi-causal and caused or aggravated by a myriad of risk factors during work and leisure time. In order to be able to distinguish between work-related and non-work-related injuries in further statistical analyses, leisure time injuries were also assessed. Participants were asked if they had suffered an injury to their back, neck, arm or hand as a result of an accident during leisure time activities. A considerable number of therapists (n=106; 30.5%) reported a leisure time injury with 23.2% being fairly recent and occurring in 2011 or 2012.

4.4.5. Work time lost due to musculoskeletal injuries

In the sample of 341 therapists with complete data, a considerable total of 117 days were lost within the past 12 months due to work-related MS pain or discomfort. On average, therapists missed 0.35 days/annum (range 0-20 days) with a slightly higher statistically non-significant average of employed therapist (0.49 days/annum) compared to self-employed therapists (0.23 days per annum). The level of self-reported influence at work and predictability of work were also significantly associated with incapacitating symptoms after adjustment for the relevant confounders.

4.5. Work risk factors and their associations with Upper Limb Disorders

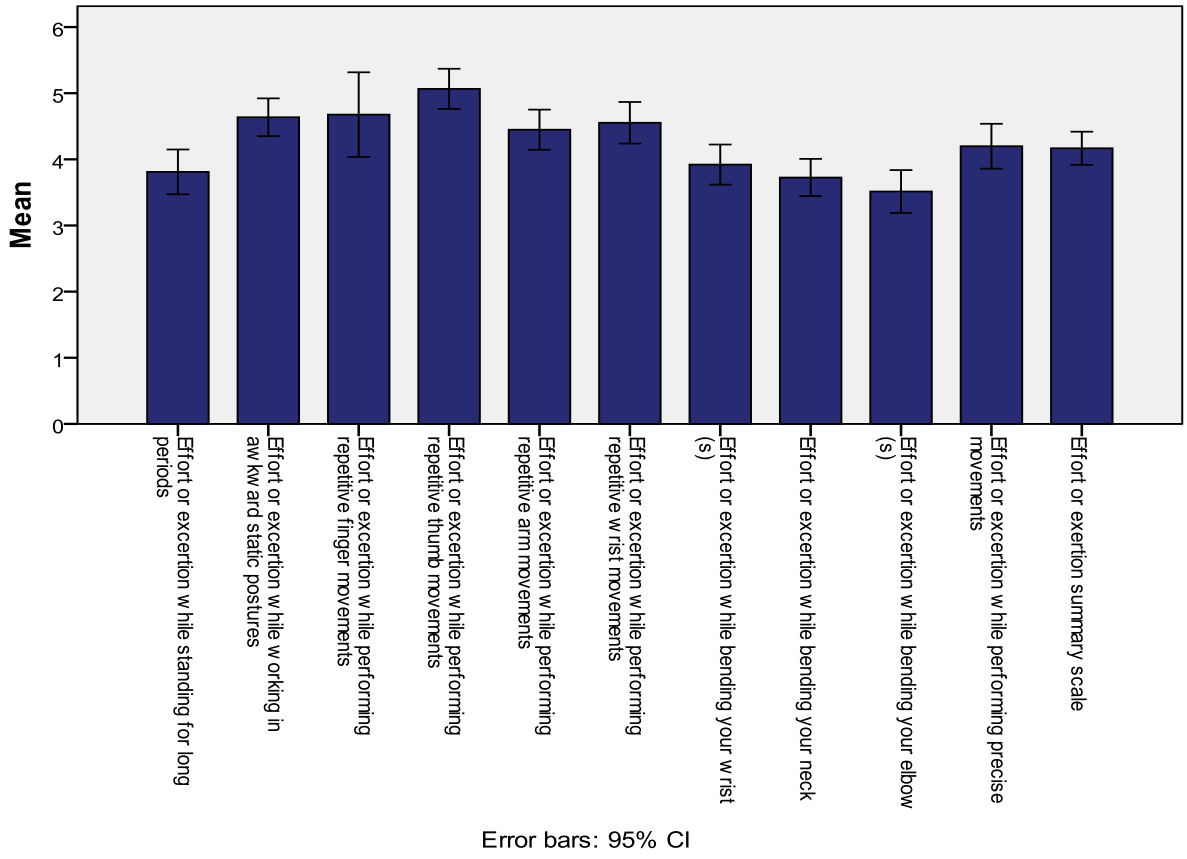
4.5.1. Physical work risk factors

Physical exposure factors are recognized as major contributing factors for WRULDs. The following analyses were conducted to determine whether therapists were at higher risk for upper limb symptoms when they reported a higher level of physical exertion.

Physical effort was measured using the Borg12 physical exertion visual analogue scale which describes the degree of muscle exertion which is perceived subjectively in a given part of the body related to dynamic and static action. Figure 4.10 shows the averages of perceived effort or exertion for typical dynamic or static actions involved in manual therapy. The average of the summary scale, a measure of general effort or exertion across all actions is also displayed.

The highest effort was perceived was for repetitive thumb movements (mean= 5.08) which corresponds to 'strong' exertion on the visual analogue scale. The lowest average effort was reported for bending the elbows (mean = 3.5), which would be 'moderate' exertion on the Borg Scale.

Figure 4.10: Perceived average effort or exertion and 95% confidence intervals



The overall perceived effort, as measured by the summary scale, significantly increased by age of the therapist, by hours of manual therapy and was significantly higher in self-employed therapists. Effort did not significantly increase by years of working as a therapist or by daily working hours. Effort increased by body mass index in a linear fashion, with overweight and obese therapists reporting a significantly higher level of effort. Those who screened positive for psychiatric morbidity on the General Health Questionnaire (GHQ) also perceived higher effort.

In order to test whether perceived effort or exertion was associated with UL problems a series of logistic regression models were built. As the aetiology of ULDs is multi-causal and includes several work-related and non-work related factors several models were developed to account for alternative explanations. In a step-wise approach, the most common alternative risk factors were included into the logistic regression

models, hereby, adjusting the associations between exertion and ULDs (expressed here as adjusted odds ratios). The models controlled for the following well-known risks factors for ULDs:

- Step 1: Demographics: age and gender (in both steps)
- Step 2: Life style related indicators: body mass index, smoking and previous musculoskeletal leisure time injuries and mental health issues, measured by the General Health Questionnaire that may influence the experience of UL pain and discomfort and the experience of effort and exertion.

Table 4.13 shows the adjusted odds ratios for the 2 steps in relation to 4 musculoskeletal health outcomes.

Table 4.13: Adjusted odds ratios for perceived effort or exertion and musculoskeletal health indicators

Outcome	**Step 1** **Odds ratio** **Adjusted for age and gender**	**Step 2:** **Odds ratio** **Adjusted for life style indicators and mental health**
12 month prevalence of UL symptoms in at least one body part	**1.2***	**1.3***
12 month prevalence of incapacitating symptoms in at least one body part	1.1	1.1
12 month prevalence of work-related MSD symptoms that lasted longer than 3 days	**1.2***	**1.2***
At least one clinical diagnosis of work-related UL disorder	**1.1***	**1.2***

* Significant at the 5% level.

Perceived effort and exertion was significantly associated with 3 of the 4 musculoskeletal outcomes, namely to the 12 month prevalence of UL symptoms in at least one body part, to work-related MSD symptoms in the last year that lasted longer than 3 days and to at least one clinical diagnosis of WRULDs. With increasing perceived physical effort, the likelihood of having musculoskeletal symptoms increased. These effects were independent of alternative, non work-related explanations such as body mass index, smoking, previous leisure time injury and mental health morbidity. Perceived effort was not significantly associated

with symptoms that were so severe that they interfered with normal daily activities (incapacitating symptoms).

4.5.2. Temporal and organisational work risk factors

Time factors constitute important potential risk factors for the onset or aggravation of WRULDs. The flexibility of timing of individuals work tasks, the availability, length and timing of rest breaks and the duration of specific physical and mentally demanding tasks are all likely to impact on the duration and intensity of physical and mental workload and the possibility to recover from demanding work tasks hereby impacting on musculoskeletal health.

For example, therapists' input into the scheduling of individual patients/clients can allow to vary between more or less physically demanding treatments, or to schedule longer breaks after challenging treatments.

The HITS Study addressed the following issues in relation to the temporal structure of the task

- Scheduling: Therapists were asked whether they usually schedule their appointments or the scheduling is done by a secretary/assistant or an electronic booking system.
- Rest breaks: Average duration of rest breaks after each client
- Hours engaged in manual therapy per day
- Average number of clients/patients per day
- Average duration of one individual treatment

As these time factors are intertwined, e.g. the average length of an individual treatment affects the number of patients/clients to be treated; all temporal variables were simultaneously entered into a logistic regression model. The aim was to determine the relative importance of each factor in relation to 12-month prevalence of ULD symptoms and incapacitating UL symptoms while adjusting for all other factors. The model was also controlled for age, gender and primary employment status.

Table 4.14: Descriptive results of work time factors by primary employment status

	Total sample N=347 %	**Self-employed therapists (primary job) N = 198 %**	**Employed therapists (primary job) N=149 %**	**P**
Scheduling				
Myself	65.7	69.5	60.0	.093
Rest breaks after each patient/client				
< 5 minutes	71.1	72.8	69.5	
5-10 min	19.9	18.5	21.3	
>10 min	9.0	8.7	9.2	.787
Hours of manual therapy per week				
1-10 hrs	29.1	16.8	46.1	
11-20 hrs	32.6	38.3	24.1	
>20 hrs	38.3	44.9	29.8	.000*
Average number of clients/patients per day				
5 or less	24.2	25.8	22.1	
6-10	25.8	51.0	38.6	
11 or more	30.0	23.2	39.3	.005*
Average length of individual treatment				
< 15 min	19.2	7.1	35.7	
15 min < 30 min	37.0	37.4	37.1	
30 min < 1 hr	41.4	52.0	26.4	
1 hour and more	2.4	3.5	.7	.000*

Most therapists scheduled their appointments themselves (65.7%), whereas 34.3% either used an assistant/secretary or an electronic booking system (Table 4.14). This difference was statistically not significant when comparing employed and self-employed therapists. Breaks after each client/patient were usually below 5 minutes, again without clear difference by employment status. Self-employed therapists engaged in more hours of manual therapy than employed therapists. This difference was probably driven by the group of employed physiotherapists working in hospitals whose work includes many other work activities outside manual therapy, whereas self-employed physical therapists mainly engaged in manual therapy. The average number of patients/clients per day was significantly higher for the employed therapists (9.5 per day) as compared to self-employed therapist (8.3 per day); however, employed therapist typically had a shorter length of treatment time per individual patient/client. There was no difference in total working hours between employed and self employed with both groups working approx. 31 hours on average per week.

Table 4.15: Adjusted odds ratios for work time factors in relation to 12-month prevalence of any UL symptoms (n=347)

	Adjusted Odds Ratio	P
Sex		
Male (reference)	1.0	-
Female	1.3	.432
Age	**.96**	**.018***
Employment status		
Employed (reference)	1	
Self employed	1.5	.248
Scheduling		
Therapist (reference)	1	-
Secretary/electronic booking	**2.3**	**.030***
Rest time after each client		
<5 min (reference)	**2.1**	
5 min and more	1	.070
Hrs of manual therapy per week		
1-10 hrs (reference)	1.0	
11-20 hrs	**4.1**	**.030***
21-30 hrs	1.3	.522
31 and more hrs	2.6	.134
Patients/clients per day		
5 or less (reference)	1	
6 – 10	.56	.221
11 or more	.96	.946

	Adjusted Odds Ratio	p
Length of individual treatment		
<15 min (reference)	1	
15 min < 30 min	.82	.686
30 min and more	.87	.802

* Statistically significant at 5% level
Note: Model fit: Chi square=21.427, df=12, p=.044

The most interesting result was that therapists who scheduled their own appointments were less likely to report any UL symptoms in the past 12 months as compared to those therapists whose appointments were scheduled by a secretary/assistant or an electronic booking system. The odds of UL symptoms more than doubled (OR=2.3) for those not booking their own appointments. This effect was independent of age, gender, employment status, the length of rest time, the hours of manual therapy, the number of clients/patients and the length of an individual treatment. The odds of UL symptoms also increased with hours of manual therapy practiced, however the odds ratio was only significantly elevated for the comparison between those who worked very minimal hours (1-10 per week) and 11-20 hours. Therapists with less than 5 minutes rest breaks after each treatment were more than twice as likely to report any symptoms, however this difference did not reach statistical significance (p=.07).

Table 4.16: Adjusted odds ratios for work time factors in relation to 12-month prevalence of any incapacitating UL symptoms (symptoms that prevented therapist from carrying out normal activities during work, hobbies or housework) (n=347)

	Adjusted Odds Ratio	P
Sex		
Male (reference)	1	
Female	1.5	.226
Age	**1.01**	**.557**
Employment status		
Employed (reference)	1	
Self employed	.51	.027*
Scheduling		
Therapist (reference)	1	
Secretary/electronic booking	**1.4**	**.297**
Rest time after each client		
<5 min (reference)	**2.3**	
5 min and more	1	.026*
Hrs of manual therapy per week		
1-10 hrs (reference)	1	
11-20 hrs	**1.3**	**.516**
21-30 hrs	1.3	.485
31 and more hrs	1.3	.626
Patients/clients per day		
5 or less (reference)	1	
6 – 10	.33	.004*
11 or more	.30	.007*

	Adjusted Odds Ratio	p
Length of individual treatment		
<15 min (reference)	1	
15 min < 30 min	1.4	.386
30 min and more	.95	.913

* Significant at the 5% level
Note: Model fit: Chi square = 1.179, df=8, p=.05

The most interesting result in relation to incapacitating UL symptoms was that therapists with less than 5 minutes of rest time after each patient/client were 2.3 times more likely to experience incapacitating symptoms when compared to those with 5 and more minutes of rest break. This effect was independent of all the other factors in the model, for example the number of patients treated or the hours of manual therapy.

Surprisingly, the more patients were treated per day the less incapacitating symptoms were reported. This unexpected association would need further investigation and can probably be attributed to a professional behaviour change of therapists after experiencing incapacitating symptoms resulting in treating fewer patients per day.

4.5.3. Associations between psychosocial/work organisational characteristics and upper limb symptoms

In the epidemiological literature, psychosocial work issues are now recognized as major contributing factors for MSDs. The following analyses were conducted to determine whether therapists were at higher risk for upper limb symptoms when they were working in an environment that exposed them to adverse psychosocial working conditions. It was also determined whether therapists were at lower risk for ULDs when they had resources in their work environment such as social support, influence at work or predictable work.

The psychosocial workplace factors, measured by the Copenhagen Psychosocial Questionnaire, include the following scales:

- *Quantitative demands* address the amount of work and its distribution over the course of the work day: How much needs to be done, how often does work pile up and how often does one get behind in work?

- *Emotional demands* address the demands on emotional involvement in work, for example when dealing with others peoples' emotional problems as part of the job.
- *Tempo* addresses intensive quantitative demands so that a work pace needs to be maintained throughout the day.
- *Influence* at work addresses the degree of influence on the amount of work and the specific work tasks assigned or taken on.
- *Predictability* addresses the availability of necessary information to carry out the job well including planned changes and decisions.
- *Peer support (employed therapists)* addresses the availability of help and support from colleagues including the willingness to listen to work problems.
- *Supervisory support (employed therapists)* addresses the degree of help and support of the nearest supervisor and the availability of feedback about work performance.
- *Peer support (self-employed therapists)* addresses the availability of other self-employed colleagues who help and support and listen to work problems and discuss how to carry out work well.
- *Professional support (self-employed therapists)* addresses support and help from other informed professionals in the field.

As the aetiology of ULDs is multi-causal and includes several work-related and non-work related factors several models were developed to account for alternative explanations. In a step-wise approach, the most common alternative risk factors were included into the logistic regression models, hereby, adjusting the associations between psychosocial risk factor and ULDs (expressed here as adjusted odds ratios). The models controlled for the following well-known risks factors for ULDs:

- Step 1: Demographics: age and gender (in all steps)
- Step 2: Life style related indicators: body mass index, smoking and previous musculoskeletal leisure time injuries
- Step 3: Physical work load: hours of manual therapy per week, years of working as PT and occupational group
- Step 4: Mental health issues, measured by the General Health Questionnaire that may influence the experience of UL pain and discomfort and/or the reporting of UL symptoms and psychosocial working conditions.

Table 4.17 shows the adjusted odds ratios for each of the seven psychosocial work characteristics. Different scales for social support were used for employed and self-employed therapists, respectively.

Table 4.17: Psychosocial work characteristics and upper limbs symptoms – Adjusted odds ratios, n=347

	Step 1 **Odds ratio Adjusted for demographics**	**Step 2** **Odds ratio** **Adjusted for demographics and work load**	**Step 3** **Odds ratio** **Adjusted for demographics and lifestyle**	**Step 4** **Odds ratio** **Adjusted for demographics and mental health**
Any upper limb symptoms in past 12 months				
Quantitative demands	1.04	1.02	1.02	1.02
Tempo	1.10	1.17*	1.12	1.09
Influence	1.01	.92	.93	1.01
Predictability	.88	.76*	.86	.90
Emotional demands	1.02	1.03	1.02	1.01
Peer support (self-employed only): n= 242	.84*	.81*	.82*	.84*
Professional support (self-employed only): n=242	.96	.91	.95	.96
Peer support (employed only): n=115[1]	.89	.88	.87	.94
Supervisor support (employed only): n=115[1]	.72*	.71*	.72*	.73*

	Step 1 **Odds ratio Adjusted for demographics**	**Step 2** **Odds ratio** **Adjusted for demographics and work load**	**Step 3** **Odds ratio** **Adjusted for demographics and lifestyle**	**Step 4** **Odds ratio** **Adjusted for demographics and mental health**
Any upper limbs symptoms that prevented normal activity in past 12 months (incapacitating symptoms)				
Quantitative demands	1.05	1.03	1.03	1.03
Tempo	1.02	.99	1.01	1.02
Influence	.92*	.91*	.92*	.93*
Predictability	.81*	.80*	.83*	.82*
Emotional demands	1.02	1.0	1.01	1.0
Peer support (self-employed only): n=242[1]	.85*	.85*	.86*	.86*
Professional support (self-employed only): n=242[1]	.91	.91	.90	.92
Peer support (employed only): n=115[1]	.82*	.77*	.80*	.82
Supervisor support (employed only): n=242[1]	.85*	.86*	.81*	.85*

Note: * Significant at 5% level.

[1]: Not adjusted for employment status in Step 2

Social support emerged as the single most important issue for both the 12-month prevalence of any UL symptom and the prevalence of incapacitating symptoms.

As indicated by the adjusted odds ratios below 1, with increasing level of social support by peers, supervisors and other professionals, the likelihoods of experiencing any UL symptoms and any incapacitating UL symptoms significantly decreased. For example, the odds of UL symptoms reported by self-employed therapists were reduced to between 84% to 81% with each unit increase on the peer support scale. This effect was even stronger in relation to supervisor support in employed therapists. With each unit

increase on the supervisory support scale the odds of UL symptoms decreased to between 73% to 71%. These associations could not be explained by a 'third' variable, such as demographics, physical work load, lifestyle or mental health due to the statistical adjustment for these factors.

The protective effect of social support was also significant in relation to incapacitating UL symptoms, especially for peer support in self-employed and employed therapists.

The level of self-reported influence at work and predictability of work were also significantly associated with incapacitating symptoms after adjustment for the relevant confounders.

4.5.4. Work factors attributed to personal work-related musculoskeletal injury or discomfort

Respondents with musculoskeletal problems were asked which job factors they thought contributed to their work-related injury or discomfort. The list provided potential work risk factors such as different aspects of repetitive work and postural work load, quantitative/organisational work load issues, training and ergonomic factors. Figure 4.11 shows the answers of those therapists who reported a clinically diagnosed upper limb disorder or work-related musculoskeletal pain/discomfort in the past 12 months that lasted for more than 3 days (n=215). Only the responses on the extreme category on each side of the 4-point answer scale are displayed in Figure 4.11 i.e. 'major significant' and 'irrelevant'.

Many affected therapists classified the repetitiveness of work motions (54.6%) and high quantitative workload due to treating many patients/clients (49.7%) as 'major significant' in negatively contributing to their musculoskeletal health. Also factors associated with posture workload, such as holding joints in fixed positions (33.1%) and working in the same position for long periods of time (29.9%) were considered as being of major significance by many therapists. The specific use of soft tissue and joint mobilisation was also attributed to personal MS injury by 30.9% of affected therapists.

The following issues were seen as 'irrelevant' to contributing to the personal injury or discomfort: work organisational issues such as irregular shifts (70.2%), not enough staff (63.5%) and overtime (54.1%). Also poor ergonomics (45.3%) and inadequate injury prevention training (53.9%) were seen as irrelevant by many therapists.

Figure 4.12 shows answers of those **employed** therapists who reported a clinically diagnosed upper limb disorder or work-related musculoskeletal pain/discomfort in the past 12 months that lasted for more than 3 days (n=90). Figure 4.13 shows answers of those **self-employed** therapists who reported a clinically

diagnosed upper limb disorder or work-related musculoskeletal pain/discomfort in the past 12 months that lasted for more than 3 days (n=125).

There were some significant differences in opinion between primarily self employed and employed therapists. Employed therapists attributed higher relevance to the following factors: not enough staff (U=2773, p=.000), poor ergonomics (U=3215, p=.010) and unsuitable equipment (U=3204, p=.007). With self-employed therapists attributing higher relevance to the following factors: same tasks over and over (U=2953, p=.000), same motion every few seconds (U=3236, p=.027), same motions sequence more than 50% of cycle time (U=2848, p=.002) and same motion sequence more than twice/min (U=3144, p=.026).

Figure 4.11: Work risk factors attributed to personal work-related injury or discomfort by therapists with musculoskeletal problems (n=215)

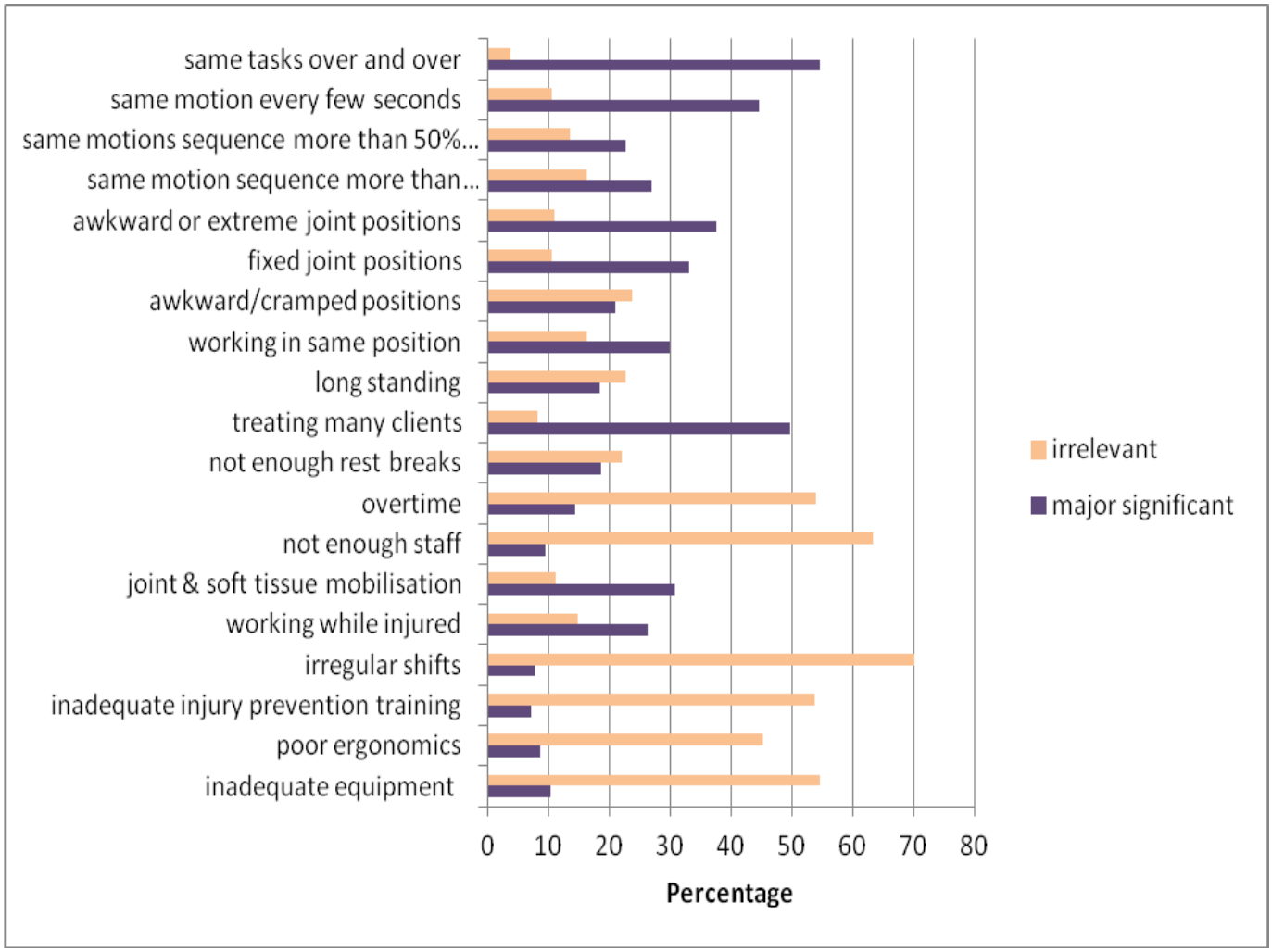


Figure 4.12: Work risk factors attributed to personal work-related injury or discomfort by employed therapists with musculoskeletal problems (n=90)

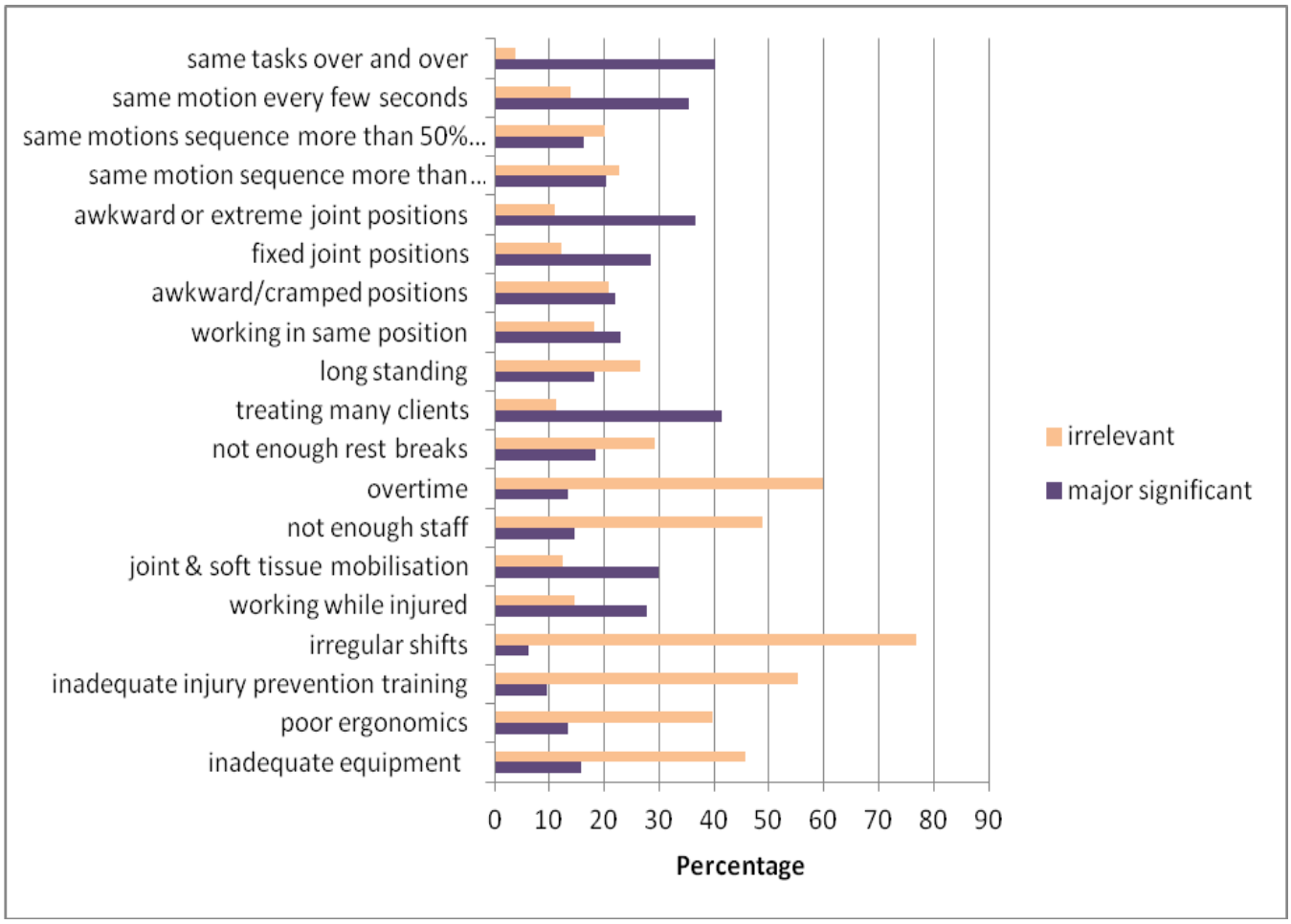
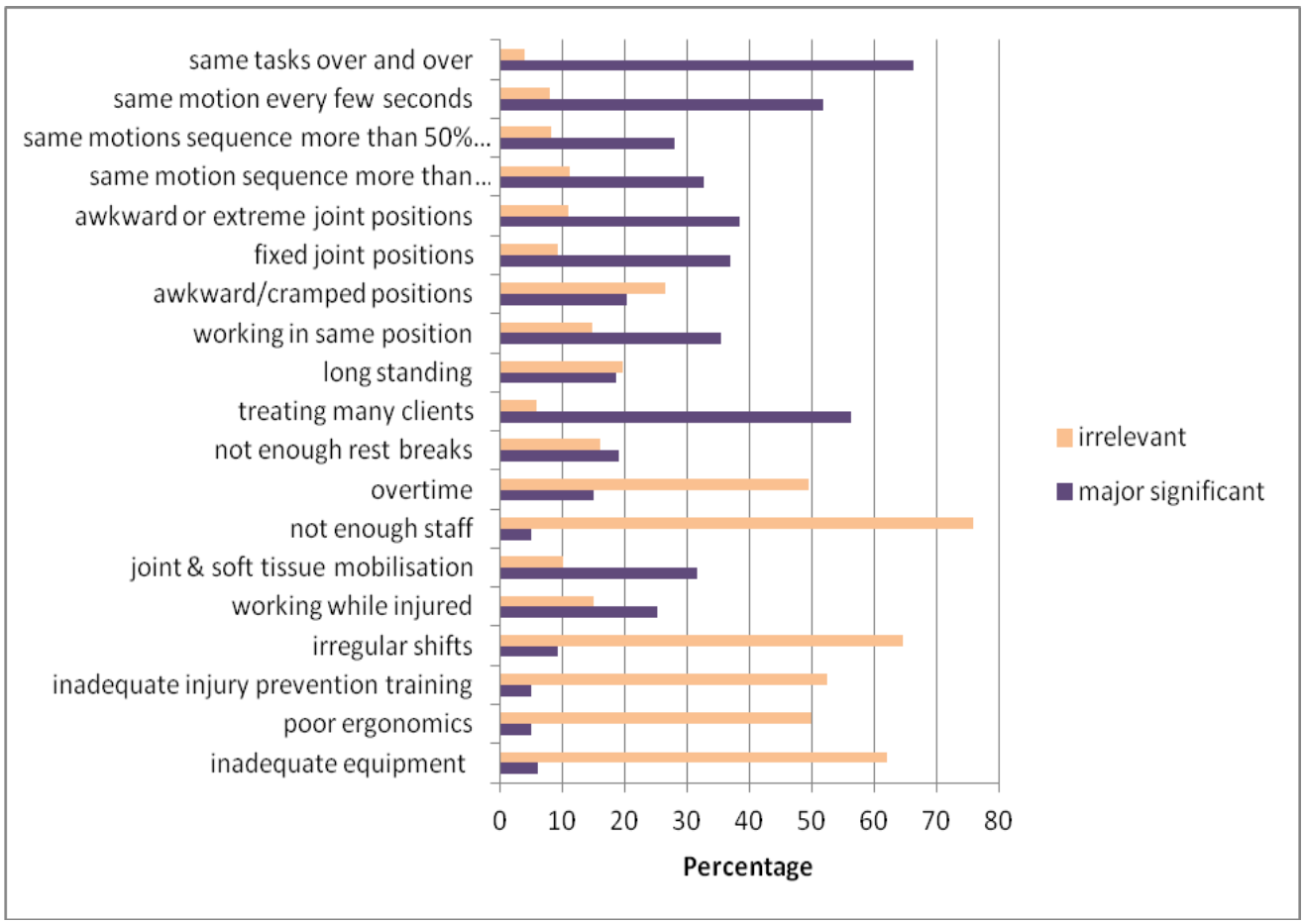


Figure 4.13: Work risk factors attributed to personal work-related injury or discomfort by self employed therapists with musculoskeletal problems (n=125)



4.6. Prevention and self care maintenance

4.6.1. Risk assessment

All respondents were asked if a risk assessment had been carried out at their place of work to protect their health and safety.

Almost seventy six percent (75.7%) of respondents had no risk assessment of their work completed to ensure their own personal health and safety. Employed therapists were more likely to have a risk assessment completed in their workplace (37.2% versus 14.7%, p=.000).

Table 4.18: Risk assessment of the work completed to ensure CPT/PT/ATs health and safety

Risk assessment completed?	No. of respondents	%
YES: Regularly (annually)	42	12.3
YES: Irregularly (less than once a year)	24	7.0
YES: Once in the last 5 years	17	5.0
NO	259	75.7
Total	342	100

Of the eighty three (n=83) respondents who indicated that a risk assessment had been completed on their work, 52 (62.6%) reported that changes were made based on risk assessment. Of these fifty two (n=52) respondents, 41 (78.8%) reported that in their opinion the changes made following the risk assessment were adequate to put them at less risk.

Only 73.5% of respondents who have had a risk assessment completed on their work have had any pain or discomfort in the past 12 months compared to 85.7% of respondents who have not had a risk assessment. This difference was statistically significant (p=.017).

4.6.2. Injury Prevention Training

Respondents were asked what they do regularly to protect their own health and about receiving injury prevention training in relation to their job.

Respondents were asked what self care maintenance strategies they used to protect their own health. The most popular strategy was stretching (72.6%), followed by aerobic exercise (65.1%) and strength building exercises (60.5%). Self massage and receiving massage were the least popular strategies used by therapists at 34.4% and 30.3% respectively.

Only 55.8% of respondents had received injury prevention training (Table 4.19). Therapists with training experience were generally less likely to have had any pain or discomfort in the past 12 months, although this difference missed statistical significance (p=.057). The difference was not specific to any specific body site except shoulder (p=.007), where individuals who received training were less likely to have had any pain or discomfort in the past 12 months.

Table 4.19: Training and ULDs - 12 month prevalence

	Any ULD symptoms	**Neck**	**Shoulders**	**Elbows**	**Wrists**	**Fingers**	**Thumbs**
Training received	78.8%	46.6%	46.0%	27.0%	36.7%	22.8%	44.4%
No training received	87.3%	51.3%	61.3%	29.3%	30.9%	27.3%	47.3%
	p=.057	p=.445	**p=.007***	p=.721	p=.315	p=.399	p=.674

*Statistically significant at the 5% level

There was no marked difference between CPT/PT/ATs who had received training and those that did not, in relation to any incapacitating UL symptoms or discomfort in the past 12 months in all upper limb sites except wrists (Table 4.20). CPT/PT/ATs who received training were generally more likely to have had any incapacitating wrist symptoms or discomfort in the past 12 months, although this difference missed statistical significance (p=.07).

Table 4.20: Training and Incapacitating ULD symptoms-12 month prevalence

	Any ULD symptoms	**Neck**	**Shoulders**	**Elbows**	**Wrists**	**Fingers**	**Thumbs**
Training received	26.3%	9.6%	8.6%	4.8%	10.6%	3.7%	5.9%
No training received	25.5%	12.0%	13.3%	6.0%	4.7%	1.3%	5.3%
	p=.961	p=.589	P=.217	p=.803	**p=.07**	p=.310	p=1.000

4.6.3. Best practice strategies to reduce physical strain during manual therapy

What do therapists actually do in practice to reduce the strain on their body or arms when working?

Respondents were asked to rate 13 best practice strategies using a five point scale, ranging from a strategy that was "never / hardly ever" used to "always" used. Strategies referred to the use of alternative treatments that put less strain on the body, increased recuperation periods and improved body mechanics.

The most commonly used strategy employed by respondents (always or often**)** was "I adjust plinth/bed height before treating a patient/client" (83.3%) (Figure 4.14). Other best practice strategies used by respondents on a regular basis were "modifying their own position" (76.3%) and "the position of the client/patient" (65.1%) and "select a technique that will not aggravate or provoke discomfort" (54%).

On the contrary, a large number of respondents reported never/hardly ever or seldom warming up or stretching before treating a client (80.2%), seeking assistance from other personnel (78.1%), taking more rest breaks (63.6%), pause regularly to stretch and change position (50.1%), and doing fewer manual techniques (50.4%).

When interpreting these results, it needs to be considered that not every best practice strategy was available to every therapist at each time; especially seeking assistance from others may not have been an option for many self-employed therapists working alone. Another plausible explanation for the difference in the use of best practice strategies may be that these strategies were learned and reinforced in injury prevention training.

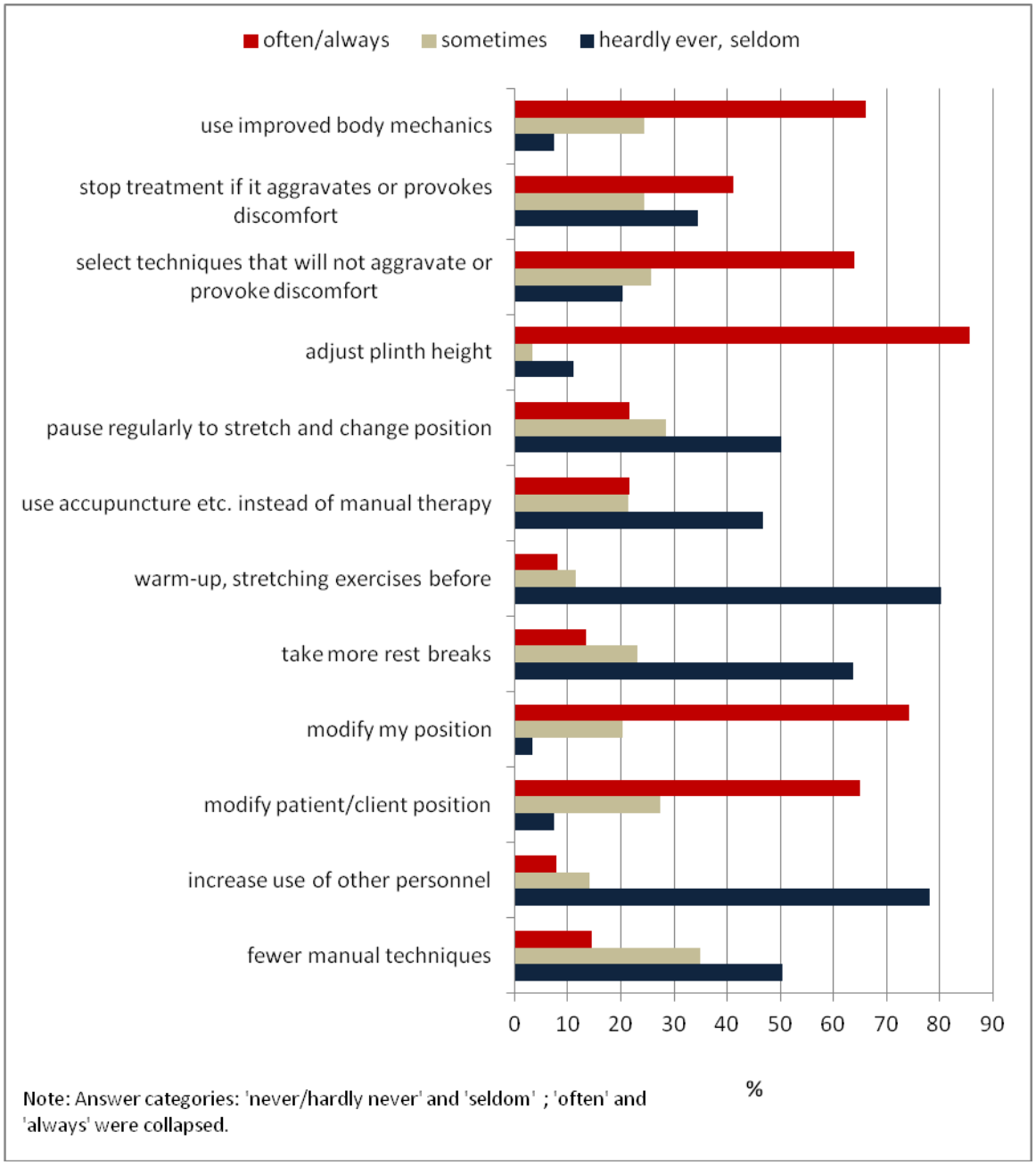
A comparison of therapists who had received injury prevention training as compared to those who had never received injury prevention training provided evidence for this hypothesis:

Therapists with history of injury prevention training engaged in the following strategies more frequently as determined by the Chi^2 Test for trend:

- Modify own position ($Chi^2 = 9.732$, $p = .002$)
- Modify client/patient position ($Chi^2 = 7.494$, $p = .006$)
- Increased use of other personnel ($Chi^2 = 5.603$, $p = .0018$)
- Used fewer manual techniques ($Chi^2 = 4.729$, $p = .030$)
- Stop doing a treatment if it aggravates or provokes discomfort ($Chi^2 = 3.794$, $p = .005$)
- Improve body mechanics ($Chi^2 = 4.367$, $p = 0.032$)

Another strategy to cope with the strain on the job could be to consider changing the job because of fear of suffering from long-term musculoskeletal injury as suggested by findings from Cromie et al (28). In the present study, only 7.4% of respondents stated that they would often or always consider changing their job, a considerable 15.9% reported sometimes thinking about this option and the remainder never or seldom considered this option.

Figure 4.14: Strategies to reduce physical strain (n=347)



4.7. Discussion

The purpose of the study on chartered physiotherapists (CPTs), physical therapists (PTs) and sports/athletic therapists (ATs) working in hand-intensive occupations was (1) to provide representative prevalence estimates of WRULDs among health care professionals performing hand-intensive tasks, (2) to determine high risk groups, (3) to investigate potential determinants of WRULDs in the workplace including both physical/ergonomic and organisational/psychosocial workplace factors and their synergistic effects in different practice & organisational settings and (4) to detail self-care behaviour of therapists and the role of self care and self care training in the prevention of WRULDs.

Study objective 1: Prevalence

The study found evidence for high upper limb prevalence rates for all indicators of musculoskeletal health used. Work-related musculoskeletal symptoms that lasted for more than 3 days provided the most general indicator of general musculoskeletal health; however, not specific to upper limb disorders. A more specific indicator for upper limb disorders was the 12-month prevalence. 12 month prevalence of upper limb symptoms in at least one body part amounted to 82.5%, which is an alarming figure. The 7-day prevalence provided information about the present health situation and was possibly less affected by recall bias than the 12-months prevalence. Also this indicator showed a relatively high rate of current injury (53.9%). As the self-reported symptoms discussed above were likely to include minor symptoms, another indicator was added that measured incapacitating UL symptoms in the past 12 months, i.e. symptoms that were so severe that they prevented respondents from completing daily activities. This measure was used as an indicator of the seriousness of the disorders and amounted to 26%.

The comparison of the HITS study results with other similar studies (Tables 1.1 – 1.4) in relation to the 12 month prevalence of affected UL body parts (while taking the 95% confidence intervals into account) shows that the Irish estimates (Table 4.11) tended to be slightly higher for the symptoms of wrist, neck and shoulder, symptoms of the thumbs tended to be slightly lower than those estimates found in other studies.

In addition to subjective self reports of participants, clinical diagnoses by a physician, where also documented, the probably ‘hardest’ indicator, which showed a sizable prevalence of 37.5% of therapists being diagnosed with at least one condition.

Although symptoms to the back were also highly prevalent in these therapists, the high occurrence of UL problems and their significant effects on daily life, including work activities, warrants further specific attention by the health and safety academic and practitioner community

Unfortunately we reached our goal to generate representative prevalence estimates for the group of currently practicing Irish PT/ATs only. The response rate (76%) of this group was excellent with no apparent systematic selection bias. The response rate of the CPTs in private practice was acceptable at 54%, however moderate selection bias was likely. The representativeness of the prevalence estimates for the hospital-based CPTs, especially private hospital settings, was questionable, as private hospitals were underrepresented in the sample and the response rate was very moderate. The high refusal rate, possibly due to the ongoing discussion of the title of 'physiotherapist' and 'physical therapist', may have resulted in systematic selection bias, although it is not clear whether this potential bias led to an over- or underestimation of the estimates. Nevertheless, the relatively large sample of 347 therapists working in different organisational and practice settings allowed for meaningful analyses, especially the analysis of associations between work factors and ULDs.

Study objective 2: Determine high and low risk groups

A breakdown of the 12 month prevalence by relevant sub-groups showed that especially female therapists were at significantly higher risk for neck and shoulder symptoms than male therapists. Therapists had an increased risk by age specifically, for the shoulder, neck, elbows and finger symptoms. Also self-employed therapists emerged as a potential high risk group.

Study objective 3: Work factors and ULDs

We found evidence for the importance of both organisational/psychosocial and physical/ergonomic factors for UL health.

In relation to work organisation factors, duration of rest breaks and input into scheduling of clients/patients emerged as important issues. The striking finding of a more than double likelihood of UL symptoms in therapists who did not schedule their own appointments, (with most likely alternative explanations for this association being statistically adjusted for), is of high relevance to practice. Likewise the finding of

associations between UL symptoms and duration of rest breaks after each client is of high practical significance.

This study showed that therapists with 5 minutes or more rest breaks after each treatment increased their odds of incapacitating UL symptoms by the factor of 2.3. Unfortunately, no further dose-response relationship between increasing duration of rest breaks and odds of UL symptoms could be established. To date experts have not come up with a consensus about the most suitable duration of rest breaks for specific tasks. However considering that many therapists in our sample took only very short breaks (5 minutes or less), simple practical guidelines for the regular scheduling of rest breaks would be beneficial in any case.

In relation to work stressors and work resources and UL health, significant association between work resources (social support, influence, predictability) and upper limb symptoms could be shown, but not between work stressors and ULs (work demands, emotional demands and tempo). In line with many other studies, the most consistent associations were found for social support in both self-employed and employed therapists. These associations remained stable when adjusted for other potential explanations and were not attributable to life style-related issues, such as previous leisure time injuries, smoking or body mass index nor could they be explained by physical work load. They were also independent of mental health, a well-known risk factor for MSDs.

Unlike most other research that is limited to the study of employed workers, the HITS study was able to establish associations between social support and UL symptoms also for self-employed therapists. For CPTs/PTs/ATs working in private practice, specifically for those who work alone, social support provided either by peers or other informed professionals may be an important key to prevention of ULDs. Further research is required to determine the specific forms of social support most beneficial to self-employed populations. Social support for self-employed therapists most likely takes other forms than in employed workers.

In relation to physical work factors, perceived effort or exertion while performing repetitive thumb movements was highest. This finding was in line with other research addressing the particular relevance of thumb injuries in therapists performing hand-intensive treatment and the potential use of alternative manipulation techniques to reduce the strain on thumbs while performing manual therapy (52, 53). Perceived effort, due to repetitive motions and postural load, was also significantly associated to UL symptoms pointing towards the importance of physical work factors in relation to upper limb symptoms.

Study objective 4: Health care maintenance and injury prevention

It is positive to note that many therapists actively engaged in self care maintenance. The most popular strategy was stretching, followed by aerobic exercise and strength building exercises. However, integration of the self care maintenance practice may be an issue as 50.1% of therapists reported that they never stretch and change position when performing manual therapy.

The proportion of those with regular (annual) risk assessments of their work place was strikingly low (12.3%) and points towards the need of further training for health and safety issues.

CPT/PT/ATs who received injury prevention training were generally less likely to have had UL symptoms and UL incapacitating symptoms in the past 12 months, although this difference just missed statistical significance. Although a causal relationship between injury prevention training and UL health could not be established in this study due to its cross-sectional study design it is plausible that injury prevention training had an effect. This is further underlined by our result that therapists with injury prevention training experience significantly engaged in more best practice prevention strategies. Interestingly, CPT/PT/ATs who received training were generally more likely to have had any incapacitating wrist symptoms or discomfort in the past 12 months, although this difference was not significant (p=.07). This may lean towards a need for injury prevention training to focus on the wrists.

It is interesting to note that, in contrast, most CPTs/PTs/ATs attributed their injury to the repetitiveness of work motions and the high quantitative work load due to treating many patient/clients. Most CPTs/PTs/ATs reported lack of training or work organisational issues such as irregular shifts, not enough staff and overtime as having lower importance in attributing to their injury.

Limitations of the study

A few methodological limitations of this research need to be taken into consideration when interpreting the results. The cross-sectional design of the study did not allow establishing a causal relationship between work factors and ULDs and the work-relatedness of reported UL symptoms could not established. However there were several lines of evidence in the findings that support the hypothesis of work-relatedness of UL symptoms in therapists. First, all associations between psychosocial and physical work factors and UL symptoms were adjusted for previous non-work-related injuries reported by the respondents, one of the major alternative non-work-related explanation for the aetiology of ULDs. Although previous leisure time injuries were strongly correlated to currently experienced upper limb symptoms their inclusion into the

regression models did not change the magnitude of the odds ratios dramatically, indicating no major confounding by leisure time injuries. Second, the significant associations were also adjusted for other non-work related explanatory variables such as demographics, mental health and lifestyle factors. Third, a considerable proportion of therapists reported first onset of symptoms, especially neck and shoulder symptoms, before starting training as therapist. These symptoms may have been aggravated later by work, hereby establishing work-relatedness of the onset of serious symptoms. The increase of incapacitating symptoms with years of working as a PT supported this hypothesis.

Another limitation of the study needs be taken into account. Work factors and ULDs were both self-reported. The use of the same method for measuring the dependent and independent variable may have inflated the associations due to common methods variance, although this effect was potentially mitigated by the use of self-reported clinical diagnoses. The use of more objective measures, either using expert assessments for evaluating work conditions or physiological indicators of UL health would have been desirable but not possible in this study.

5. LONGITUDINAL STUDENT STUDY

5.1. Introduction

A growing body of research (28-31, 41-43), suggests that healthcare professionals including physiotherapists (CPT) / physical therapists (PT), sports / manual therapists (MT) first experience injury or musculoskeletal symptoms as undergraduate students or early career graduates. Glover (31) reported that 32% of CPTs experienced first symptoms of injury within 5 years of graduating with 12% sustaining symptoms while training. He suggested that newly qualified CPTs do not appear to be putting their training into practice. Similarly, Graham(90) reported that CPTs believed "*their knowledge and skills would serve to reduce the risk of serious WRMSDs"*. However, studies by Bork (29), and Scholey(91) reported that despite their knowledge and expertise, CPTs and PTs were developing symptoms of WRULDs and injury early in their careers. Cromie (28), suggested that work organisation amongst various clinical settings in addition to practice rotation within the first few years as graduates, is an important issue that needs to be addressed, as injuries sustained early in their career can have an effect on their future work practices. As students undertake both theory and clinical practice as part of their training and can spend up to fifty percent of their time in year three and year four on clinical placement, they are exposed to the same risk factors for musculoskeletal disorders as graduates or experienced therapists.

Exposure to work risk factors, specific clinical settings and patient care activities have indicated increased risk of symptoms of upper limb disorders. Activities, including the application of high levels of force through the hands, working in awkward postures, patient handling and transferring have been associated with increased risk of sustaining early symptoms of injury (92). Working in specific clinical settings, including musculoskeletal out-patients and rehabilitation can increase the risk of injury (42, 44, 46), while failure to take rest breaks, high clinical workload due to understaffing, poor working conditions, treating a large number of patients per day are also reported as risk factors for injury (3, 31, 42, 44-46).

Studies to date for CPT/PT and MT students training for hand-intensive occupations are limited. The objective of this study was: (1) to determine the prevalence of ULDs in CPT/PT and MT students in their final year of training / education, and (2) to determine 1 year incidence / onset of new symptoms in CPT/PT and MT graduates and after having started working as therapists.

5.2. Methods

5.2.1. Study Design

The study was a prospective cohort study with 1-year follow up. Data was gathered using a self-report questionnaire at baseline and at follow- up.

Throughout this report, *baseline* refers to the final months of study and *follow-up* represents when graduates started working as therapists.

5.2.2. Sample

Study participants included all students in their final year of study in physiotherapy, physical therapy, athletic therapy and training and sports therapy/physiotherapy assistant from four colleges in Ireland. For the purpose of anonymity, the colleges are referred to as College 1, College 2, College 3 and College 4 throughout the study. With permission from College 1 and 2, the baseline questionnaire was distributed by hand to the students who completed the questionnaire and returned it immediately on completion. As it was not feasible to distribute the baseline questionnaires in College 3 and 4, the Senior Lecturer from each college agreed to distribute the questionnaire to the students during class and allowed sufficient time for completion. The completed questionnaires were then returned by post to the research office.

One year later, the follow-up questionnaire was mailed to every student who responded to the baseline questionnaire.

5.2.3. Inclusion and exclusion criteria

The study included students in their final year of study and who were involved in clinical practice/placement as students.

For the follow-up study, only graduates who were working exclusively as a CPT/PT or MT and graduates who were working part-time as a CPT/PT or MT and who also had other work were included in the follow up study. Graduates who worked in other work but not as a CPT/PT or MT were excluded from the follow – up study.

5.2.4. Questionnaire

The self-administered questionnaire (Appendix IV) was derived from several standardized questionnaires developed for investigating musculoskeletal disorders in working populations. The student baseline questionnaire contained four sections:

In **Section A,** student contact details, including student name, email address and telephone/ mobile contact details were included to facilitate follow-up. Students were assured their personal contact details were separated from their questionnaire and stored electronically in a password protected database for follow-up.

Background and demographic information including, sex, age, college attended, smoking status, hours in direct client/patient care as a student, hours of manual therapy per week as a student, and holding a second job were included in the baseline questionnaire. Exposure to specific tasks as a student were assessed including patient repositioning, and number of patients / clients on whom students performed joint mobilisation and soft tissue work was assessed based on previous studies on task specific risk factors for PT practice.

In **Section B** exposure to physical risk factors was assessed using the questionnaire developed by Spieholz, Silverstein & Stuart (83), regarding the frequency and duration of potential physical job hazards such as force and repetition and measured on visual analogue scales that are used as components for deriving "cumulative exposure".

This section also included questions that measure the student's perceived physical effort associated with manual therapy practice as a student. One of the most widely used psychophysical methods is the Borg Rating of Perceived Exertion Scale (RPE Scale, Borg, 1970 (84). The new RPE Scale developed in 1982 was used, with scale values ranging from 0 *nothing at all* to 13 *maximal* which is especially suitable for subjective symptoms such as pain and workload.

Section C measured prevalence of upper limb symptoms including ache, pain, discomfort or numbness over the past 12 months using the upper limb questions from the Nordic Questionnaire that has been widely used to assess the nature and severity of self-rated musculoskeletal symptoms. A question relating to ache, pain, discomfort or numbness during the past 8 weeks was used to establish who was free from upper limb symptoms for 8 weeks prior to baseline. Duration of pain or discomfort and episodes of symptoms was also assessed, and students were also asked if they were prevented from carrying out normal activities (job, housework, hobbies) as a result of pain or discomfort.

Questions related to onset of first symptoms of pain or discomfort, medical help sought, clinical diagnoses of ULDs, intervention treatment, absenteeism at work in the past 4 weeks and 12 months and episodes of absenteeism related musculoskeletal pain or discomfort, and injury related to leisure time activity were also included in Section C.

Section D measured perceived contribution of physical and psychosocial work factors specific to CPTs/PTs and MTs using an instrument previously used in The Chartered Society of Physiotherapists (UK) study, that was originally developed by Bork et al(29). This section also comprised questions that measure wellbeing and psychosocial working conditions using the General Health Questionnaire GHQ12 (85). Students were also asked what they do to reduce the strain on their body and arms as a clinical practice student.

The questionnaire was given to practicing physical therapists and educators for content validity and question clarity to ensure it was suitable for final year students. Minor amendments were made to the questionnaire following the pilot test.

5.2.5. Follow-up questionnaire

The same questions as at baseline were included in the follow-up questionnaire (Appendix V) with the addition of questions related to; current employment status, month/year of commencement of work as a CPT/PT or MT, current area of practice, number of days per week including overtime worked as a CPT/PT or MT and time giving manual therapy to a client/patient.

Questions in relation to injury prevention/self care education as a student, type of training received and its usefulness at work were assessed. As some graduates had the opportunity to set up their own practice, all graduates were asked if they had received or undertaken injury prevention/self-care training since entering the workplace and what they do to protect their own health.

Symptoms of musculoskeletal disorders i.e. ache, pain discomfort or numbness, duration of symptoms, episodes of symptoms and onset of symptoms were assessed since graduation.

Psychosocial risk factors were assessed with selected scales from the Copenhagen Psychosocial Questionnaire (COPSOQ) (long version) (86). For graduates who became self-employed, the social support scales of the COPSOQ questionnaire were modified.

In relation to coping strategies to prevent or deal with musculoskeletal injury, graduates were asked to make suggestions from their experience since they started work, any approaches to their work as a CPT/PT, sports rehabilitation therapist or physiotherapy assistant they think would help minimise the risk of sustaining a work-related injury.

At the time of the pilot testing for the follow up questionnaire the sample of student respondents was small , therefore, it was agreed that the follow-up questionnaire would be pilot tested with graduates from the previous year (2010). The questionnaire was emailed to 3 graduates and a face to face discussion was undertaken with other PTs currently working in private practice. On receipt of comments, several changes were made to the follow-up questionnaire that included; including number of days worked per week as some graduates may not be working full-time; training received in college and training undertaken since starting work; episodes of absenteeism since graduation and response categories to barriers to applying training since entering the workplace.

5.2.6. Data Collection

The baseline questionnaire with a unique PTS Number was distributed to the final year students in College 1 and 2 in April / early May 2011. Of the 22 final year students in College 1, 15 students completed the questionnaire during our visit. The remaining 7 questionnaires were distributed by the Senior Lecturer to the students who were absent on the day. A return, stamped, addressed envelope was supplied to the remaining 7 students to facilitate return of the questionnaire on completion.

In College 2, the questionnaire was distributed to a total of 42 students. Thirty six students agreed to complete the questionnaire and they were collected and returned to the research office.

As it was not feasible to meet with the students in College 3 and 4, as they were undertaking clinical practical exams at the time, the lecturers from the respective colleges agreed to distribute the questionnaires to the students. Twenty five baseline questionnaires with a unique PTS numbers, return stamped addressed envelopes and cover letters explaining the study were posted to the lecturer in College 3. A similar package containing 20 questionnaires, cover letters and return envelopes were posted to the lecturer in College 4. In total, 109 baseline questionnaires were distributed to final year students between April 2011 and May 2011.

In September 2011, an email was sent to all graduates to maintain contact and obtain a preferred email address if the original email address provided at baseline was no longer in use.

In February 2012, all graduates were contacted to obtain a postal address for the follow-up questionnaire. By the end of March 2012, 18 of the 74 graduates had replied with a postal address. It was then decided to send a web text or text message to the remaining 56 graduates and within 2 weeks a total of 38 graduates had provided postal addresses. A further 36 follow-up text messages and emails were sent to non-responders two weeks later, and the option of completing the questionnaire on–line was also given to graduates. Four graduates agreed to complete the follow-up questionnaire on line. The lecturers from Colleges 1, 2 and 3 also emailed the graduates to encourage participation in the follow-up study.

Follow-up mailing occurred in May 2012. Thirty eight follow-up questionnaires were posted to the graduates who had provided a postal address using the same PTS number from baseline, 4 were completed on-line and the lecturers from Colleges 2 and 3 offered to send the follow-up questionnaires to the remaining 32 graduates for whom we had no postal address.

After 2 weeks a reminder text message and email was sent to the graduates reminding them of the importance of the study and to encourage participation. Responses were accepted until July 2012.

5.2.7. Data treatment and data analysis

As the baseline questionnaires were returned to the research office, each questionnaire was checked for missing data and pre-coded for entry into the already prepared baseline data file.

Similarly, as the follow-up questionnaires were returned, each questionnaire was checked for missing data and pre-coded for entry into the follow-up data file.

Data was analysed using the statistical package for social science SPSS Version 18. An accuracy check of both the baseline and follow-up questionnaires yielded no errors after data checking and cleaning.

Exposure and demographic data were taken from the baseline questionnaire. Descriptive statistics were produced for student clinical practice hours for manual therapy, exposure factors and 12 month prevalence of work-related musculoskeletal symptoms by body area with associated 95% confidence intervals.

Chi- square for within subjects, McNemar's chi-square was used to determine the difference in the proportions of students (Time 1) and graduates (Time 2) for upper limb symptoms.

From a view of prevention and early intervention of ULDs the investigation of the first onset of symptoms as students and after graduation were assessed.

The primary outcome variable was a 1- year cumulative incidence of newly occurring WRULD. A *case* was defined as a report of ache, pain, discomfort or numbness. An *incident case* was considered to be when a respondent met the case definition during the follow-up period. Incidence for each upper limb site was calculated by taking the number of cases in that upper limb site and dividing it by the number of students who did not have any symptoms in the same upper limb site prior to baseline.

5.2.8. Ethics

The questionnaires and protocol for this study were approved by The Clinical Research Ethics Committee of the Cork Teaching Hospitals, Cork, Ireland. Informed consent was sought from all participants.

The initial distribution and subsequent mailing included a cover letter and a participant information leaflet that stated the purpose of the study and assured the respondents that their questionnaire would remain confidential. To follow up on non-respondents and for the subsequent follow-up study, each questionnaire was coded with a unique PTS number that corresponded to a master roster of student names. The master roster was kept in a safe place and only accessible to the research team. It was destroyed after all questionnaires were mailed.

5.3. Results for longitudinal study

5.3.1. Response Rate

Seventy four (n=74) students responded to the baseline questionnaire with a response rate of 68%. The follow-up questionnaire was either mailed or made available on line to the 74 students who responded to the baseline questionnaire. Responses to the follow-up questionnaire were received from 26 graduates with a response rate of 35%. Four graduates were not included in the study as they were not working as a CPT/PT or MT. The overall follow-up rate was 30% (22/74).

Table 5.1: Responder / Non-responder analysis by College at Baseline

College	Responder	Non-responder	Total
College 1	68% (15)	32% (7)	22
College 2	86% (36)	14% (6)	42
College 3	76% (19)	24% (6)	25
College 4	20% (4)	80% (16)	20
Total	68% (74)	32% (35)	109

Table 5.2: Responder / Non-responder analysis by College at Follow-up

College	Responder	Non-Responder	Total
College 1 Graduates	60% (9)	40% (6)	15
College 2 Graduates	25% (9)	75% (27)	36
College 3 Graduates	26% (5)	74% (14)	19
College 4 Graduates	75% (3)	25% (1)	4
Total	35% (26)	65% (48)	74

As only four training institutions were represented in the study and the response rates are different by selected college, the sample is not representative of the entire student population in Ireland undertaking training/education as CPTs/PTs, sports therapists and physiotherapy assistants. Therefore, systematic selection bias is likely as a representative sample of students/graduates was not achieved and may therefore affect the results.

5.3.2. Demographics

The gender breakdown of respondents at baseline, 55.4% male (41) and 44.6% female (33) reflects the accessibility of both male and female students to the professions of chartered physiotherapy/physical therapy, sports therapy and physiotherapy assistant.

The average age of respondents was 28.41 (Standard Deviation = 7.17, range 19 to 48 years. Age distribution of students and graduates under the age of 25 years was 47.3% at baseline and 34.6% at follow-up. Over 36% of graduates were over the age of 30 years which reflects the accessibility of mature students to this profession.

5.3.3. Work Status

The majority of graduates (80%) commenced work during their year of graduation (2011) with 38.9% starting work in the second quarter of the year. Twenty five percent (25%) of graduates worked exclusively as a physiotherapist/physical therapist (PT) or sports / manual therapist (MT), whereas 75.0% worked in a part-time capacity as a PT or MT while holding another job. Over 50% (52.6%) worked in self- employed practice, followed by sports facility and private healthcare 31.6% and 15.8% respectively.

General musculoskeletal practice was the area of practice that the highest number of graduates (95.0%) worked in, while 90% worked in sports conditioning / rehabilitation, followed by occupational injury (25%), neuro- rehabilitation (10%), teaching / tutoring (10%), women's / men's health (5.0%), amputee (5.0%), and cardio-respiratory care (5.0%).

There was a clear increase in hours spent doing manual therapy since starting work as opposed to being students in clinical practice as shown in Table 5.3.

Table 5.3: Hrs per week doing manual therapy techniques as students in clinical practice and after starting work as therapists

Hrs per week doing manual therapy	**Students in clinical practice- (21/22)**	**Graduates after starting work – 19/22**
1-5 hrs	57.1% (12)	42.1% (8)
6-10 hrs	19.0% (4)	21.1% (4)
>11 hrs per week	23.8% (5)	36.8% (7)
Total	100% (21)	100% (19)

5.3.4. Musculoskeletal symptoms

At baseline

Previous 12 month prevalence for musculoskeletal pain that lasted more than 3 days was 56.8% (42) at baseline (n=74), with no significant difference between male (57.6%) and female (56.1%) students.

Table 5.4: The prevalence at baseline of work related musculoskeletal pain or discomfort (regardless of its duration) in the past 12 months by body area, with associated 95% confidence intervals (95%CI) by gender.

Body Area	Prevalence (entire sample) N=74	95%CI	Male students	Female Students	P< .05
All ULD sites	78.4%	68.7 - 87.9	81.8%	75.6%	-
Shoulders	51.4%	39.6 - 63.0	51.5%	51.2%	-
Thumbs	47.3%	35.6 - 58.9	48.5%	46.3%	-
Neck	40.5%	29.0 - 51.9	42.4%	39.0%	-
Wrists	39.2%	27.8 - 50.5	36.4%	41.5%	-
Fingers	20.3%	10.8 - 29.6	27.3%	14.6%	-
Elbows	12.2%	4.5 - 19.7	9.1%	14.6%	-

78.4% of students at baseline had experienced UL symptoms in at least one body part in the past 12 months. This measure represents general musculoskeletal problems experienced by students in their final year of study and incidentally was similar to a large proportion of experienced therapists in the main HITS survey (82.5%) who reported symptoms (pain, ache, discomfort, numbness) in at least one upper limb body part in the previous 12 months. There was no significant difference between male and female students. The prevalence of incapacitating UL symptoms was below 5%.

At follow-up

There was a clear increase in the twelve month prevalence of work-related musculoskeletal pain lasting longer than 3 days that respondents believed to be associated with work from baseline to follow-up. At baseline the proportion was 54.5% (n=22) and at follow-up after having started work 72.7% of the 22 graduates reported work-related musculoskeletal pain they believed to be associated with work.

The 1-year incidence rate in the 22 students who were followed-up was 40.0%. In total, 15 incident cases were reported. Table 6.5 lists the proportion of incident cases for the follow-up year.

Table 5.5: 1 –Year Incidence of work-related upper limb symptoms

Upper limb site	No of graduates with incident cases	1-year incidence rate (%)
Shoulder	2	16.6%
Neck	4	23.5%
Elbow	2	9.5%
Wrists	2	12.5%
Fingers	1	6.2%
Thumbs	4	33.3%

The greatest number of incident cases was seen in the thumbs and neck, followed by the shoulders, elbows, wrists and fingers. The difference in the proportions of ULD symptoms from baseline (Time 1) to follow-up (Time 2) was not statistically significant as determined by McNemar's chi-square analysis.

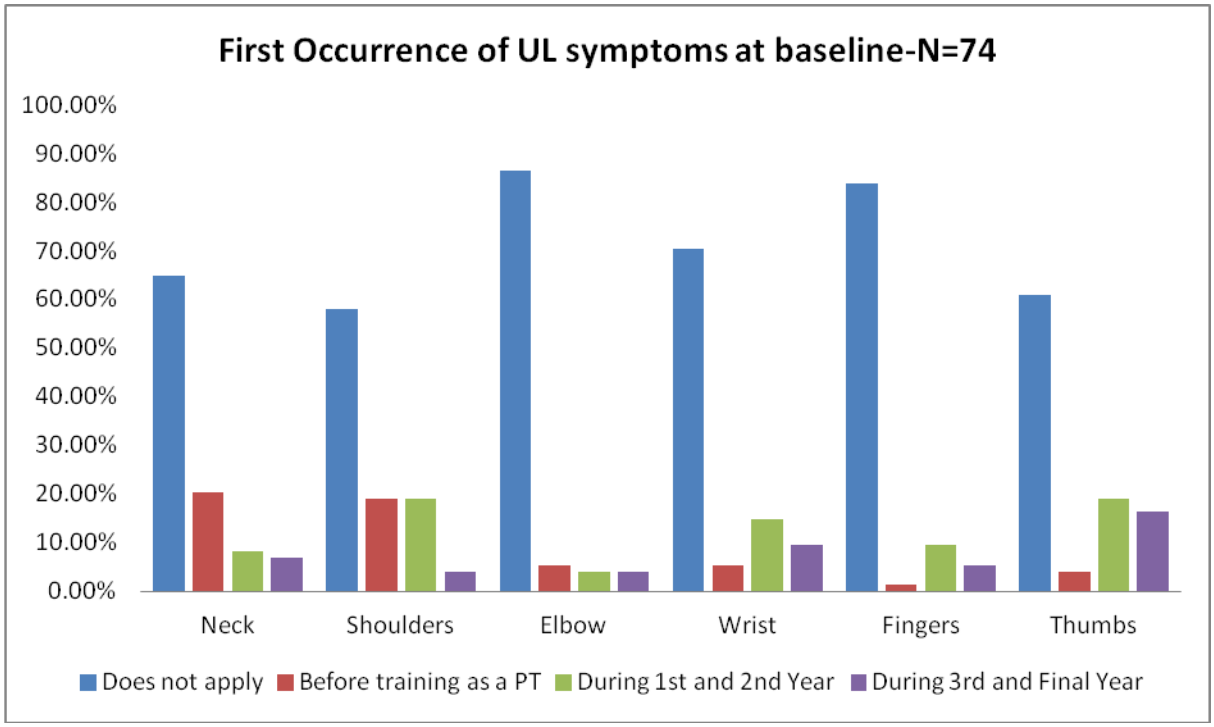
Table 5.6: The difference in percentages with 95% CI, associated with the changes in proportions / percentages Time 1 and Time 2.

UL Site	Percent Time 1 n=22	Percent Time 2 n=22	Difference	Lower CI	Upper CI	p<.05*
Shoulder	45.5%	54.5%	-9.09%	-35.19%	18.91%	.527
Neck	22.7%	40.9%	-19.18%	-38.40%	4.31%	.102
Elbow	4.5%	13.6%	-9.09	-28.27%	8.39%	.157
Wrists	27.3%	36.4%	-9.09%	-34.58%	18.10%	.527
Fingers	22.7%	27.3%	-4.55%	-25.74%	17.05%	.654
Thumbs	45.5%	63.6%	-18.18%	-40.25%	7.23%	.157

5.3.5. First Occurrence of symptoms

From a view of prevention and early intervention of ULDs, the investigation of first onset of symptoms is important. Students at baseline (n=74) were asked to remember retrospectively "if you experience work-related musculoskeletal pain or discomfort, when did it first occur?" Optional answers included; 'before training as a PT', 'during each year of PT training' or as an option for those who did not have the particular symptoms 'does not apply'. Students reported the highest first occurrence for shoulders (18.9%) and thumbs (18.9%) during 1st and 2nd year, thumbs (16.2%) as the most significant site of first occurrence in their 3rd and final year. Over 80% of students reported the onset of symptoms as gradual, yet only 20% saw a physician. Neck (20.3%) and shoulder (18.9%) symptoms were the most commonly reported symptoms already present before training as PTs.

Figure 5.1: First occurrence of upper limb symptoms at baseline



Graduates at follow-up (n=22) in response to a similar question reported newly developed conditions after they started working that were not present at baseline for thumbs (38.1%), wrists (23.8%) and fingers (14.3%).

When interpreting these results it needs to be taken into consideration that almost 40% (39.4%) reported a back, neck, arm or hand injury as a result of an accident that occurred before commencement of training prior to 2007.

5.3.6. Multisite symptoms at baseline and follow-up

Analysis of multisite symptoms showed that more than 66% of students at baseline reported upper limb symptoms in two or more upper limb sites. Almost 30% of students reported symptoms in 3 upper limb sites.

After starting work as therapists, graduates who responded to the follow-up questionnaire were also asked about multisite symptoms. Analysis of the same students at baseline and follow-up (n=22) showed an increase for 2 (27.3%-baseline / 36.4% follow-up) and 3 (18.2% baseline / 27.3% follow-up) upper limb sites after starting work, possibly due to an increase in hours of manual therapy practiced since starting work.

5.3.7. Self Care Education and Training

Data on self care education and training was available at follow-up only. Graduates were asked questions about training they received as students, training received since starting work and how this training impacted on their work.

All graduates (100%, n = 22) reported having received injury prevention/self care education as a student. Over 55% (57.1%) reported that the training they received was useful in work and they were able to apply that training in their current workplace (57.1%). However, 75% of graduates reported lack of equipment as a barrier to applying training in the workplace. No other significant barriers were reported.

Graduates were also asked if, since entering the workplace, they had received or undertaken any further self care training. All students, (100%, n = 22), reported having received or undertaken manual handling training since entering the work place, however, only 33.3% received or attended people moving and handling training that is applicable to their tasks when assisting patients and repositioning patients for treatments. No further training or education was given to graduates or undertaken by self-employed therapists in work scheduling, workplace ergonomics or stress/burnout awareness.

5.3.8. Multisite symptoms and leisure time injuries at baseline and follow-up

Analysis of multisite symptoms showed that more than 66% of students at baseline reported upper limb symptoms in two or more upper limb sites. Almost 30% of students reported symptoms in 3 upper limb sites. Almost 40% (39.4%) reported a back, neck, arm or hand injury as a result of an accident that occurred before commencement of training prior to 2007.

After starting work as therapists, graduates who responded to the follow-up questionnaire were also asked about multisite symptoms. Although the response rate is not representative of all students at baseline, analysis of the same students at baseline and follow-up (n=22) showed an increase for 2 (27.3%-baseline / 36.4% follow-up) and 3 (18.2% baseline / 27.3% follow-up) upper limb sites after starting work, possibly due to an increase in hours of manual therapy practiced since starting work.

5.4. Discussion

The purpose of the study on final year CPT/PT and MT students training for hand-intensive occupations was (1) to determine the prevalence of ULDs in CPT/PT and MT students in their final year of training/education and (2) to determine 1 year cumulative incidence / onset of new symptoms in CPT/PT and MT graduates and after having started working as therapists.

The baseline study had an excellent response rate of 68%; however, the response rate of the follow-up study was disappointing despite our best efforts to encourage participation with the assistance of the educators in the relevant training institutions. Therefore, systematic selection bias is likely and a representative sample of Irish students and graduates was not achieved. However the baseline and follow-up findings did allow a first indication of the prevalence and incidence of UL symptoms in students and early career graduates in hand-intensive occupations in Ireland.

Study objective 1: Prevalence

The findings suggest that CPT/PT and MT students are at risk of symptoms of ULDs during training and also early in their careers with an alarming 12 month prevalence at baseline of 78.4% of symptoms in at least one body part. Specifically shoulders and thumbs were the body sites which showed the highest 12 month prevalence of ULDs in students (51.4% and 47.3% respectively). Other research (29, 31, 90, 91) suggested that despite their knowledge and expertise CPTs/PTs and MTs were developing symptoms of ULDs and injury early in their careers and that this issues needs to be addressed as injuries sustained early in their careers can have an effect on future work practices and career development.

The 12 month prevalence of 82.5% found in the experienced therapists reported in the cross-sectional HITS study is very similar which is surprising. One would expect it to be higher in experienced therapists. However, in contrast to the sizable proportion (25.7%) of experienced therapists reporting incapacitating symptoms in the cross-sectional HITS study, only a small percentage of students, not even 5 %, at baseline reported any incapacitating UL symptoms. This finding suggests that symptoms may aggravate with years of working as a therapist.

Study objective 2: Incidence and onset of new symptoms

The 1-year incidence rate of newly developed symptoms after graduation was 40.0% with 15 incidences.

The greatest number of incident cases was seen in the thumbs (33.3%) and neck (23.5%), followed by the shoulders (16.6%), elbows (9.5%), wrists (12.5%) and fingers (5.2%). The difference in the proportions of ULD symptoms from baseline (Time 1) to follow-up (Time 2) was not statistically significant; however, statistical power was limited due to small numbers. These results can be interpreted as first indication that thumb and neck incidences may be an issue early in career.

From a view of prevention and early intervention of ULDs, the investigation of first onset of symptoms is important. Some students retrospectively reported they already had neck (20.3%) and shoulder (18.9%) symptoms before training as PTs, however, highest first occurrence for shoulders (18.9%) and thumbs (18.9%) symptoms occurred during 1st and 2nd year of training whereas students reported thumbs (16.2%) as the most significant site of first occurrence in their 3rd and final year. Multisite symptom analysis of the same students at baseline and follow-up (n=22), showed an increase for two and three upper limb sites after starting work, possibly due to an increase in hours of manual therapy practiced since starting work.

It was positive to note that all graduates, (100%, n = 22), reported having received injury prevention / self care education as a student that was useful in work, however, no further training or education was given to graduates or undertaken by self-employed therapists in work scheduling, workplace ergonomics or stress/burnout awareness.

Early onset of work-related musculoskeletal symptoms tends to be an issue and early intervention to recognize the risk factors associated with the development of upper limb symptoms, early modification of techniques and task specific risk assessments may reduce stress on the upper limbs and reduce the risk of musculoskeletal injury development.

6. IMPLICATIONS FOR PRACTICE & CONCLUSION

Based on the study results two practical outcomes were developed: A self care training programme and a self assessment checklist.

6.1 Self care training programme

As our study reported that almost 80% (78.4%) of students in their final year of training had experienced a ULD in at least one body part in the previous 12 months, this Self- Care Training Programme For Hand-Intensive Occupations in Healthcare Workers was developed with the aim of increasing awareness of work-related upper limb disorders associated with hand-intensive tasks at work and to promote the health, safety and well-being of workers performing hand-intensive tasks. Despite the limited research in early career development of upper limb symptoms in hand-intensive healthcare workers, Cromie (28) and Jang (25) proposed that "early intervention to recognise the point at which fatigue starts to affect work, and early modification of techniques, may reduce stress on the upper limbs and reduce the risk of musculoskeletal injury development".

The self-care training programme is designed for final year students in physical therapy, physiotherapy, sports therapy and similar hand-intensive disciplines and provides participants with the information and training necessary to increase health and safety competency and awareness within their practice. The course is highly participative and practical and a range of learning methods are used which are designed to combine theory and practice.

At the end of the training programme participants will:

- Be familiar with the basic principles of health and safety in the workplace.
- Know the main duties of the employer and employee in relation to health and safety.
- Be able to identify risk factors at work to include:
  - Workplace Hazards.
  - Ergonomic Hazards.
  - Organisation of work hazards.

- Be aware of the major upper limb injuries affecting manual therapists.
- Be able to carry out a risk assessment with a particular focus on hand-intensive tasks.
- Be able to identify preventive strategies that can be incorporated into your daily work practices

The Self- Care Training Pack includes:

- Teacher Resource Manual
- Student Resource Manual
- Work Sheets for interactive learning:
    - Identification of hazards- workplace, ergonomic and organisational.
    - Work injury prevention at workplace and individual levels.
    - Risk Assessment work sheets.
- A self-assessment screening tool that can be used by students, early career graduates and therapists to help them identify if a more detailed, professional assessment is required.
- A short answer questionnaire to assess learning.
- A course evaluation to evaluate the training programme for future development of the programme

6.2 Self assessment tool

A self assessment checklist (Appendix VII) was developed that can be used by therapists to help identify early signs of work-related upper limb disorders and/or their possible determinants at work. The checklist is suitable for the assessment of working conditions of all therapists performing manual therapy on a daily basis. No previous ergonomics or risk assessment training or knowledge is required in the application of this checklist.

Its design is simple so that it can be applied without prior preparation and additional equipment and forms part of the self care training module to inform participants of the importance of health surveillance as part of health and safety management in the work place.

Unlike other self assessment tools or checklists, used mainly in industry, that have been developed and validated for assessment of upper limb disorders, this self assessment checklist is not scientifically validated as the opportunity to have it tested by manual therapists, their opinion on usability and meaningfulness and

the estimation of reliability has not been possible. However, Table 6.1 shows the preliminary evaluation for use by 55 practicing therapists with generally positive results.

Table 6.1 Preliminary Evaluation for use of Self Assessment Checklist.

N=55	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
The self-assessment checklist is easy to understand	47% (26)	45%(25)	5% (3)	0%	1%(1)
The self assessment checklist is relevant to my workplace	45%(25)	40%(22)	13%(7)	1%(1)	1%(1)
The self assessment is an important tool to identify work risk factors that are associated with hand-intensive tasks	60%(33)	31%(17)	7%(4)	1%(1)	0%
I would consider using the self assessment checklist in my workplace for the early identification of symptoms of ULDs	34.5%(19)	44%(24)	22%(12)	0%	0%
The self assessment checklist should form part of health and safety management in my workplace	45%(25)	40%(22)	13%(7)	1%(1)	0%

6.3 Further practical implications

One clear element that has been identified from the HITS study is that CPTs/PTs, ATs and manual / manipulative therapists performing hand-intensive tasks as part of their daily work are at risk of upper limb disorders. Raising awareness in students and early career graduates of the risk associated with hand intensive tasks is most likely beneficial so that their health will be protected from existing or emerging work risk factors through early assessment and safe work practices.

Surprisingly only 55.8% of therapists reported having received injury prevention training, while 33.3% of graduates received or attended people moving and handling training that is applicable to their tasks when assisting patients and repositioning patients for treatments on entering the workplace.

However, as many therapists finished their training several years ago when modern curricula were not established and the introduction and use of handling aids were not recognised, adequate continuing professional education and the provision of refresher training is pertinent.

As the application of pressure for manual techniques requires the therapists' hands, wrists and thumbs to be in potential detrimental positions for sustained periods of time, there is possibly a need for further research and evidence-based training in alternative techniques leading possibly to variation in techniques. It may be also useful to incorporate the aspects further into education curricula with the goal of increasing therapists awareness of the risks associated with excessive manual techniques.

As summarised in the systematic report of models of good practice, a specific guidance document for hand-intensive health care occupations does not exist. Such a document may have the following general elements:
Guidance on

- task specific risk assessment;
- assessment of physical, ergonomic, organisational and psychosocial risk factors for upper limb disorders;
- ergonomic set up of the workplace specific for each major group;
- rest breaks;
- concrete scenarios on providing input into work scheduling and control of the pace of work;
- explicit training and exercise programmes for self care maintenance including the use of less straining techniques; and
- the implementation of early and continued education.

In detail:

Individual case risk assessment is an important factor that needs to be considered by therapists. The specific aspect of therapists having input into work scheduling may require more detail specific to the situation of therapists. Specific guidelines have been developed for sonographers and may be translated into the work settings of therapists where therapists schedule different types of examinations to decrease strain on musculoskeletal tissue specific to one type of treatment. As the number of treatments is influenced by the number of clients a therapists treats and the frequency of appointments is in turn influenced by the number of working hours a therapists works, guidelines that stipulate a specific workload that is appropriate for therapists and rest breaks when performing manual therapy may be warranted. Similarly, as many therapists work in a self-employed capacity and feel more economic pressure and uncertainty in the current economic climate, specific workload guidelines could also possibly address the problem of work scheduling in this high risk group.

The maintenance of good psychosocial work environments and the utilization of supervisory support for employed therapists and social support through the professional bodies for self-employed therapists are issues that need to be addressed as social support emerged as the single most important issue for both the 12-month prevalence of any UL symptom and the prevalence of incapacitating symptoms.

In conclusion, a few words from the CPTs/PTs/ATs who participated in this study:

- "More education on injury prevention. Better self care. Use of hoists in clinic etc"
- "Early recognition of symptoms, then immediate care/management of the injury. Prevention through posture awareness, regular exercise and self-treatment."
- "Adjusting plinth height/patient positioning or my own posture before or when treating. Keeping generally fit / flexible. Self massage as needed or the odd time treatment by colleague if unable to self treat niggles."
- "Maintain flexibility, strength and aerobic capacity along with core strengthening. It is easier to stay strong and healthy if you start strong & healthy."

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Appendices

Appendix I – Definitions, signs and symptoms and risk factors for selected case definitions for work related upper limb disorders.

Appendix II – Documents excluded from systematic review

Appendix III – Questionnaire for physical therapists & physiotherapists

Appendix IV – Baseline questionnaire for use in longitudinal study

Appendix V – Follow up questionnaire for use in longitudinal study

Appendix VI – IPTAS Conference Presentation

Appendix VII – Self assessment risk assessment tool