THE GENDER DIFFERENCES IN UPPER-EXTREMITY OCCUPATIONAL REPETITIVE STRAIN INJURIES IN MANITOBA

By Janet Sprout

A Thesis submitted to
the Faculty of Graduate Studies
in Partial Fulfilment of the Requirements

MASTERS OF SCIENCE

Department of Community Health Sciences
University of Manitoba
Winnipeg, Manitoba

0-612-23505-X

THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES

COPYRIGHT PERMISSION

THE GENDER DIFFERENCES IN UPPER-EXTREMITY OCCUPATIONAL REPETITIVE STRAIN INJURIES IN MANITOBA

BY

JANET SPROUT

A Thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE

TABLE OF CONTENTS

ACKNOWLEDGMENTS v

A ABSTRACT 1

I INTRODUCTION 3

II BACKGROUND 7
II.1 Overview 7
II.1.1 Classification 7
II.1.2 Historical Perspective 9
II.1.3 Nature of the Problem 11
(a) Incidence and Prevalence of Occupational RSI 11
(b) Cost of Occupational RSI 12
II.2 Gender Differences 14
II.2.1 Incidence and Prevalence 14
II.2.2 Disability 15
II.2.3 Explanations for Gender Differences 16
(a) The Debate 16
(b) Job "Ghettos" 19
(c) Disability/Recovery Process 21
II.3 Etiological Factors for RSI 21
II.3.1 Nonoccupational Factors 21
II.3.2 Occupational Factors 22
(a) The Debate 22
(b) Evidence for Work Relatedness 24
II.3.3 Methodological Difficulties in the Literature 27
(a) Difficulties in Defining Cases and Determining Risk Factors 27

III RESEARCH DESIGN AND METHOD 30
III.1 Target Population and Sample 30
III.2 Data Collection 31
III.3 Case Definition 33
III.4 Statistical Methods 34
III.4.1 Denominators 35
III.4.2 Industry Specific Occupational RSI Rates 36
III.5 Workers Compensation Data Source 37
III.5.1 Validity and Reliability 39
(a) Under-Ascertainment of Cases 40
(b) Inaccurate and Incomplete Data 41

IV RESULTS . . . 44
IV.1 Nature and Extent of Occupational RSI Claims . . . 44
IV.2 Incidence Rates . . . 45
IV.2.1 Industrial Rates . . . 45
IV.2.2 Occupational Rates . . . 48
IV.3. Demographic Profile of RSI Claimants . . . 51
IV.3.2 Age . . . 51
IV.3.3 Body part Injured . . . 51
IV.4 Diagnosis and Treatment . . . 53
IV.4.1 Diagnoses . . . 53
IV.4.2 Medical Treatment Received . . . 55
IV.5 Severity and Cost of Claims . . . 56
IV.5.1 Claim Duration . . . 56
IV.5.2 Claim Cost . . . 60
IV.5.3 Claim Outcome . . . 61
IV.5.4 Workers Compensation Involvement . . . 62

V DISCUSSION . . . 64
V.1 Incidence Rates . . . 64
V.2 Other Gender Differences . . . 67
V.2.1 Body Part . . . 67
V.2.2 Injury Severity . . . 68
V.2.3 Diagnosis . . . 71
V.3 Limitations of This Study . . . 72
V.4 Implications . . . 74

VI BIBLIOGRAPHY . . . 76

APPENDICES

1 SUMMARY OF EPIDEMIOLOGIC STUDIES . . . 96
2 CLAIMS DATA RECORD SHEET . . . 104
3 CODES . . . 107

TABLES

1 EXAMPLES OF STUDIES REPORTING THE PREVALENCE OF REPETITIVE STRAIN INJURIES IN INDUSTRY . . . 12
2 WORKERS COMPENSATION CLAIM CODES BY LIKELIHOOD OF CONTAINING UPPER LIMB RSI CLAIMS . . . 32
3 REASSIGNMENT OF WCB RATE CODES TO SIC CODES . . . 38
4 NUMBER AND RATE OF UPPER LIMB RSI CLAIMS . . . 46
5 NUMBER AND RATE OF UPPER LIMB RSI CLAIMS BY OCCUPATION AND GENDER . . . 49
6 NUMBER AND RATE OF UPPER LIMB RSI CLAIMS BY AGE AND GENDER 51

7 NUMBER AND PERCENT OF RSI CLAIMS BY GENDER AND PART OF BODY INJURED 52
8 FIRST, SECOND AND THIRD DIAGNOSIS OF RSI CLAIMS BY GENDER . 54
9 MEDICAL TREATMENT RECEIVED BY GENDER 55
10 DIAGNOSIS OF CLAIMANTS RECEIVING SURGERY BY GENDER 57
11 AVERAGE TIME LOSS BY GENDER 58
12 SAMPLE WEIGHT GROUPING MEAN TIME LOSS BY GENDER 58
13 TIME LOSS BY GENDER 59
14 AVERAGE CLAIM COST BY GENDER 60
15 MEAN CLAIMS COSTS OF SAMPLE WEIGHT GROUP BY GENDER 60
16 TOTAL CLAIMS COST BY GENDER 61
17 RETURN TO WORK STATUS BY GENDER 62
18 TYPE OF WCB BENEFIT RECEIVED BY GENDER 63
19 OVERALL MALE AND FEMALE INCIDENCE RATES FOR VARIOUS RSI STUDIES 64
A1.1 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING CARPAL TUNNEL SYNDROME 96
A1.2 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING TENDINITIS, TENOSYNOVITIS AND OTHER TENDON DISORDERS 100
A1.3 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING EPICONDYLITIS 101
A1.4 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING SHOULDER DISORDERS 102

GRAPHS

1 INDUSTRY RSI RATE BY GENDER 47
2 OCCUPATION RSI REATES BY GENDER 50
3 BODY PART INJURED BY GENDER 52
4 TIME LOSS BY GENDER 59

ACKNOWLEDGMENTS

Rarely does one complete as large a project as a Master's thesis and degree without the assistance, support and encouragement from others along the way, and I am no exception.

I want to express my appreciation to my thesis advisor, Dr. Annalee Yassi, for her sound advice and continuous encouragement throughout the lengthy course of my master's program. Without her encouragement I would never have begun the process towards my degree. Without her confidence in me, I would not have received the opportunity to work with her on various projects related to my field. I am also grateful to my committee members, Dr. Cam Mustard and Dr. Allen Kraut, for their comments and input on the various drafts of my thesis.

I want to thank my employer, the Workplace Safety and Health Division of Manitoba Labour and, in particular, Tom Farrell, Geoff Bawden and Garry Hildebrand, for agreeing to maintain my salary while I attended classes and allowing me the use of office equipment and supplies to produce my thesis. Without this support I would not have been able to meet the requirements of my Master's program. I would also like to thank my coworkers Barry Warrack, Norma Alberg, Donna Johannson, and Dennis Nikkel who assisted me with their knowledge and expertise on the various computer software programs.

A special thanks must be extended to my colleague and friend, Bob Tate, for his advice on statistical matters. Not only did he assist me with his knowledge and statistical expertise but also his calm, reassuring manner helped at critical moments.

Special appreciation is finally extended to my friends for listening to me while I whined about "having to do my thesis". In particular, I wish to thank Gail Marchessault, Joy Goertzen and Nancy Anderson for their words of encouragement, support and reassurance during difficult times, and to David Patton for his help with editing.

Lastly, I wish to extend my love to my children, Jennifer and Nelson, who were with me throughout this process. When I began, I was pregnant with Nelson. He is now nearly eight years of age.

A. ABSTRACT

There is growing evidence to indicate that women's experience with occupational repetitive strain injuries (RSI) is different from that of men. Women are reported to experience higher rates of occupational RSI and have more widespread and diverse RSI symptoms and longer time loss due to occupational RSI than men. The purpose of this study was to describe and compare the frequency of occupational RSI in Manitoba, Canada by gender in terms of age, industry, occupation, diagnosis, body part affected, severity of injury, disability outcome, medical treatment and compensation assistance received.

A manual file review of a stratified sample of time loss upper limb workers compensation injury claims settled in 1991 was undertaken to identify occupational RSIs. Information was obtained on age, gender, occupation, industry, time loss, claims cost, diagnosis, medical management and workers compensation board (WCB) intervention. Incidence rates were generated by extrapolating the number of found RSI WCB claims to the entire claims population and using the employed labour force of Manitoba for 1991 as the population at risk.

Contrary to the findings of other studies using compensation claims data, there was no significant difference in the overall occupational RSI rate for women and men (0.76/1000 female workers vs. 0.73/1000 male workers). Greater variation was observed among the industrial and occupational categories than between men and

women within an occupation or industry group. Women had significantly higher occupational RSI rates than men for the meat & poultry (38.66/1000 female workers vs. 17.69/1000 male workers) and government service industries (1/1000 vs. 0.34/1000) and for the processing (19.80/1000 vs. 8.47/1000) and construction trades (5.33/1000 vs. 0.82/1000) occupations. Men had significantly higher rates in the assembling and repairing occupations (5.22/1000) than women (3.32/1000).

Women remained on workers compensation benefits for longer periods of time than did men (on average 76.8 days vs. 66.5 days); this difference was observed only in the first two months of time loss after which men and women were equally represented in time loss greater than 40 days. Proportionately more men than women experienced occupational RSI to their shoulders (26.4% vs. 11%) and elbows (21.5% vs. 9%); while more women than men suffered occupational RSI injuries to their wrists (39.7% vs. 25%).

The greater variation in rates found among industries and occupations than between genders within occupation or industry suggest that the type of work one performs has a greater influence on the likelihood of developing an occupational RSI than does one's gender. Significant differences found in the body part injured likely reflect the different type of work men and women perform. The gender difference found in length of time loss could be a result of a number of factors including injury severity, work availability, or psychosocial factors.

I INTRODUCTION

Occupationally related repetitive strain injuries (RSIs) have become an increasing concern in Canada, as in other countries. In Ontario, the incidence and frequency of occupational RSI claims allowed by the Ontario Workers Compensation Board nearly doubled from 1986 to 1991 (Ashbury 1995). The average occupational RSI compensation claim is more costly and the amount of time lost from work is longer than that for other traumatic musculoskeletal injury claims (Yassi et al 1996; Brogmus et al 1996; Cheadle et al 1994; Webster and Snook 1994). In British Columbia, the long term cost of occupational RSI claims is estimated to be in excess of $31,000,000 (Workers Compensation Board of British Columbia, unpublished data).

There are a growing number of studies suggesting that women experience both higher rates of occupational RSI than men and that these rates are increasing faster for women (Ashbury 1995; Franklin et al 1991; Tanaka et al 1988; Gun 1990).

There is also evidence to suggest that women's experience with RSIs is different from that of men. For example, women have been reported to suffer longer time loss attributable to RSIs (Ashbury 1995), and to experience more widespread and diverse RSI symptoms (Champion et al 1986) than do men. Women also report to experience proportionately more occupational RSIs to neck and shoulders (Viikari-Juntura 1979) than men; while men proportionately are more likely to develop occupational RSIs to the elbow in the form of epicondylitis (Champion et al 1986).

Hypotheses to explain gender differences can be divided into those that emphasize biological causes and those that emphasis environmental effects. One category of hypotheses is that the biological differences between men and women, such as differences in hormonal factors, the ratio of body fat to muscle, or body size, cause men and women to react differently to similar working conditions (Nathan et al 1996; Dimberg et al 1989; Cannon et al 1981; Dekel et al 1980; Oldberg 1973; Leach and Odom 1968; Phalen 1966). The competing explanation is that environmental differences in working conditions between women and men account for the differences in occupational RSI (Messing 1991; Dimberg et al 1989; Mergler et al 1987).

These two sets of explanations have different implications for prevention strategies and public policy. If the gender difference is thought to be primarily environmental in origin, then workplace-based prevention measures are more likely to be undertaken which would include work station redesign, work reorganization, and worker training. If, however, the differences are thought to be biological in origin, then prevention measures could include selection of specific types of workers for specific tasks, resulting in the possible exclusion of women or men from certain jobs.

Few studies have specifically examined the gender differences in occupational RSI beyond comparing occupational RSI rates in various occupations or industries. As such, comprehensive analyses of gender differences with respect to specific body part injured, diagnosis, severity of injury, medical treatment received and disability outcomes are lacking. The purpose of this study was to conduct an analysis of gender differences with respect to the incidence, distribution, determinants and outcome of occupational RSI in Manitoba.

To accomplish this, Manitoba Workers Compensation Board (WCB) claim data were used. WCB databases constitute the single most comprehensive source of occupational injury data (Spiegel and Yassi 1991). The specific objectives of the present study were:

1) to describe and compare the frequency of upper-extremity occupational RSI in Manitoba by gender in terms of age, industry, occupation, diagnosis, body part affected, length of time loss, medical treatment, compensation assistance received, and disability outcomes;

2) to develop and compare gender upper-extremity occupational RSI rates within industry and occupational groups; and

3) to determine whether the gender differences that do exist are greater than the differences between the various industrial and occupational groups.

To meet these objectives, the following hypotheses were tested:

1) that women will experience more ORSI than men,

2) that the higher rates in women are due to environmental factors (the nature of their work), and

3) that there will be significant differences between the genders for: diagnoses

of RSI, anatomical location, length of time loss, medical treatment received, compensation assistance received, and return to work status.

II BACKGROUND

This literature review is divided into three parts:

1. The first part provides an overview and explanation of repetitive strain injury and a description of the extent of the problem.
2. Next, the gender differences in occupational RSI and the various theories to account for these differences are examined.
3. Last, various controversies surrounding repetitive strain injury are presented.

II.1 Overview

The term "Repetitive Strain Injuries" (RSI) is not a medical diagnosis, but an umbrella term used to describe a variety of well-defined soft tissue disorders in which discomfort, pain, and functional impairments are caused, precipitated, or aggravated by highly repetitive work functions, constrained postures and/or forceful movements (Guidotti 1992; Gerr 1991; Chaterjee; Silverstein et al 1986). RSI may be seen in workers, athletes (Herring and Nilson 1987), homemakers (Delgrosso and Boillat 1991; Birkbeck and Beer 1975), and musicians (Fry 1986a; Hochberg 1983).

II.1.1 Classification

Several specific disorders fall within the general term of "repetitive strain injury". They include disorders of the musculoskeletal or peripheral nervous system. Some are well-defined medical diagnoses such as carpal tunnel syndrome (CTS), epicondylitis, bicipital tenosynovitis, rotator cuff or supraspinatus tendonitis, De Quervain's disease, trigger finger/thumb, and thoracic outlet syndrome (Armstrong et al 1982; Cannon et al 1981; Kurppa et al 1979; Luopajarvi et al 1979; Chatterjee, 1987). Other RSI disorders are more diffuse syndromes such as myofascial disorders, fibromyalgia, and chronic pain syndrome (Miller and Topliss 1988).

Although the term repetitive strain injury was first suggested in Australia in 1984, it has been argued that the term "repetitive strain injury" is unsatisfactory because it implies that a strain type of injury has been caused by repetitive movement. In fact RSI can be caused by many ergonomic factors (including force, awkward posture and vibration). In some cases no strain injury can be detected (McDermott 1986).

Other common terms used for RSI include cumulative trauma disorder (Armstrong et al 1982), which is mostly used in the USA; occupational cervicobrachial disorder (Maeda et al 1982) mostly used in Japan; work-related upper limb disorder used in the UK (Reilly 1995), occupational overuse syndrome (Ferguson 1984); industrial orthopaedics and occupational rheumatic diseases (Sikorshi 1988; Kuorinka and Koskinen 1979) or disorders associated with repeated trauma (Tanaka et al 1995). Other terms such as regional musculoskeletal disorder, musculoskeletal disorders of occupational origin, soft tissue disorders of occupational origin and workplace upper limb disorders have been suggested (Gerr et al 1991; Chatterjee 1992). It has been proposed that the well-defined entities such as CTS and tendinitis be used instead when attempting to relate occupational factors to musculoskeletal health outcomes (Gerr et al 1991). Nevertheless, RSI continues to be used within the Canadian occupational health setting because there is general recognition that it refers to soft tissue conditions which develop over time due to repeated exertions and movements of the body or work in a fixed position. In this paper the term occupational repetitive strain injuries or occupational RSI will be used to cover injuries and diseases of the musculoskeletal system (mainly upper limbs, shoulders and neck) which have a proven or likely work-related causal component.

II.1.2 Historical Perspective

Medical diagnoses of occupational RSI have existed for over 250 years. Ramazzini, in 1717, first described health problems appearing in workers who did "certain violent and irregular motions and unnatural postures of the body . . ." (Ramazzini 1717 cited in Armstrong 1986). In 1893, Gray's *Anatomy* gave a description of a condition called washerwoman's strain, later to be known as De Quervain's disease (Armstrong et al 1987). Clinical conditions remarkably similar to present day RSIs were reported in the medical literature as early as 1830 (Fry 1986b). Accounts of work-related tenosynovitis had been reported by the middle of this century (Conn 1931; Howard 1937; Pozner 1942; Flowerdew and Bode 1942; Thompson et al 1951). A common cause often cited was unaccustomed or resumption of work tasks involving highly repetitive or intense muscular action. Tenosynovitis arising from frequent repetitive motions or vibrations was being recognized as a compensable condition as early as

1929 (Conn 1931). Conn (1931) estimated that tenosynovitis accounted for 1% of the total days lost from all causes in 1930, which was an increase from 0.15% in 1929, a year of full employment. Pozner (1942) noted that at least 10% of soldiers became disabled from tenosynovitis while harvesting. Reed and Harcourt (1943) reported 70 cases of tenosynovitis, accounting for 0.54% of all visits to an industrial clinic. Strains, contusions and repeated motions were thought to be the causal factors. Thompson and others (1951) reported that 40 cases of tendinitis and tenosynovitis occurred annually in a motor factory, with an average of 21 lost work days per case.

By the 1960's the literature began de-emphasizing unaccustomed or change in working conditions as a major etiological factor and began focusing on the repetitive nature of the work (Hymovich and Lindholm 1966; Ferguson 1971; Maeda 1977). Other etiological factors were postulated such as tool design, static working posture and social and organizational factors. Higher rates of the disorders among women were beginning to be noted, most likely reflecting the increased entry of women into the processing occupations and the increased mechanization of work. Preventive measures were also proposed during this time (Hymovich and Lindholm 1966; Tichauer and Lubbock 1966; Ferguson 1971).

II.1.3 Nature of the Problem

(a) Incidence and Prevalence of Occupational RSI

The overall prevalence and incidence rate of occupational RSI is unknown, however reports from studies of individual work sites suggest that occupational RSIs are increasing and are a major cause of lost work days. For example, occupational RSIs of the upper limb have been estimated to be between 2% and 4% of all compensation claims (Yassi et al 1996; Brogmus 1996). The Bureau of Labor Statistics (BLS) reported that injuries and illnesses resulting from repetitive motion accounted for 4.2% of all lost time cases in the United States in 1993 (Bureau of Labor Statistics 1995). Although most workplace injuries and illnesses have been declining, the total number of repetitive motion claims increased by 10% from 1993 to 1994 (Bureau of Labor Statistics 1995). The proportion of occupational RSI cases and claims increased from less than 1% in 1986 to 4% in 1993 (Brogmus et al 1996).

Studies of the incidence and prevalence of occupational RSIs suggest that they are extraordinarily high in some industries and occupations (Table 1). For example, one recent study at a large California supermarket where a CTS cluster had been reported revealed the CTS prevalence to be 23% (Osorio et al 1994). An earlier study showed that the incidence of all RSIs in a poultry processing plant was 12.8 per 200,000 hours, and for one job, thigh skinning, the rate was an average of 1.3 RSI cases per worker per year (Armstrong et al 1982).

TABLE 1 EXAMPLES OF STUDIES REPORTING THE PREVALENCE OF REPETITIVE STRAIN INJURIES IN INDUSTRY

STUDY	INDUSTRY/ OCCUPATION	INCIDENCE/ PREVALENCE
Osorio et al 1994	sample of 56 from 69 employees at a grocery store	CTS prevalence was 23% (determined from medical questionnaire and median sensory nerve conduction)
Chiang et al 1993	8 fish processing plants in Taiwan (total 207 employees)	14.5% clinically diagnosed with CTS, 15% epicondylitis and 30.9% shoulder pain.
Liss et al 1992	150 ice cream novelties machine operators	11.3% CTS, 5.3% CTS surgery
Conrad et al 1990	58 dental hygienist	25% reported symptoms of CTS and 12% tested positive for mild nerve dysfunction
Punnett 1987	76 female hospital workers	32% reported musculoskeletal pain in upper limb during the preceding year.
Margolis and Kraus 1987	supermarket checkers	62.5% self-reported CTS symptoms
Viikari-Juntura 1983	117 slaughter house workers in Finland	60% reported arm or hand symptoms in the previous year. There were 15.9% cases of tenosynovitis, 3.5% cases of epicondylitis diagnosed by physician in the previous year.
Herberts et al 1981	131 welders from Sweden	18% of welders had supraspinatus tendinitis

It is difficult to compare incidence or prevalence of occupational RSIs from one study to another. Uniformity of classifying, identifying and measuring cases is lacking, symptoms may be very diffuse and the consequences for different workers vary depending upon the worker's physical job demands. Methodological difficulties are discussed in greater detail in section II.3.3.

(b) Cost of Occupational RSI

Occupational repetitive strain injuries can be particularly disabling and costly compared to non-RSI claims. Various analyses of workers compensation claims have shown that occupational RSIs are more costly, and require more time loss than other similar claims of traumatic origin (Yassi et al 1996; Brogmus et al 1996; Cheadle et al 1994; Webster and Snook 1994). Utilizing Manitoba compensation claim data, the average number of days off work was 71 days for occupational RSI claims compared to 34 days for non-RSI musculoskeletal claims with similar WCB coding (Yassi et al 1996). The average cost of an RSI claim was just over $5500 (Cdn) compare to nearly $2500 (Cdn) for non-RSI musculoskeletal claims (ibid). American occupational RSI compensation claims costs are also higher, with an average cost per occupational RSI claim of $8070 (US), almost twice the amount of the average workers compensation claim at $4075 (US) (Webster and Snook 1994).

Plant-specific studies demonstrate the personal impact of occupational RSIs. For example, workers in an Illinois meat packing plant who had undergone carpal tunnel release lost an average of 53.6 days from work per hand and were left with up to an average 18% impairment rating of a hand (Masear et al 1986). The cost of time-loss compensation claims amounted to an average of $1848(US)/hand and an average permanent disability cost of $8073(US)/hand.

Although most occupational RSIs are self-limiting, with most cases improving within four months (Yassi et al 1996; Miller et al 1994; Adams et al 1994), many continue to have lingering problems affecting work and daily activities (Blader et al 1991; Miller et al 1994). As much as half of all occupational RSI sufferers required medical work restrictions preventing them from returning to their usual work tasks (Chaterjee 1992). Adams and colleagues' (1994) study of occupational CTS surgical cases found that the mean duration of time loss postoperatively was nearly four months with 8% exceeding one year, although 75% had time loss of no more than 90 days postoperatively. Only 67% of occupational CTS surgical cases could return to their previous job (ibid). When compared to other workers with similar musculoskeletal injuries of traumatic origin, occupational RSI claimants were found to be less likely to be able to return to their same job (67.3% vs. 81.0%) and more likely not to be able to return to work at all due to their injury (2.9% vs. 0.5%) (Yassi et al 1996). Those occupational RSI claimants who did return to work were more likely to experience a recurrence of the injury upon returning to work (8.5% vs. 0.4%) when compared to those with similar non-RSI claims.

II.2 Gender Differences

It is reported that women experience more occupational RSI than men (Jensen et al 1983; Franklin et al 1991; Tanaka et al 1988; Gun 1990, Ashbury 1995) and take longer to recover from occupational RSI than men (Ashbury 1995; Cheadle et al 1994).

II.2.1 Incidence and Prevalence

Incidence and prevalence rates of occupational RSI are reported to be higher in women than men (Tanaka 1988; Gun 1990, Ashbury 1995; Jensen et al 1983; Franklin et al

1991). For example, the incidence rate in women was almost double that of men (with a female to male rate ratio of 1.85) and after an adjustment for the actual hours worked an even higher relative risk was observed (rate ratio 2.5) (Gun 1990). In Ontario, the female to male claim frequency rate ratio of lost time occupational RSI claims varied from 1.3 to 1.6 from 1986 to 1991 (Ashbury 1995). Occupational RSI is increasing at a greater rate in women than in men (Franklin et al 1991; Tanaka et al 1988), although one study has shown a reverse of this trend in recent years (Ashbury 1995).

II.2.2 Disability

Occupational RSI appears to affect women more than men. Women receive compensation benefits due to occupational RSIs for longer periods of time than their male counterparts (Ashbury 1995; Gun 1990). Except for women working in construction, this gender difference was observed even when the data were examined by selected occupations. Although Ashbury (1995) based this observation on compensation benefit data within 90 days of the accident date, other studies examining factors affecting all WCB disability claims revealed similar gender differences (Cheadle et al 1994; Cornes 1990). For example, Cheadle and others (1994) found that women were only 84% as likely as men to return to work at any given point in time. Crook and Moldofsky (1994) found that, among those who had sustained a musculoskeletal soft tissue injury, men were more likely to return to work than women, but once returned to work, women were more likely to remain at work than men. Baldwin and colleagues (1996) found that married men had shorter work absences while married women had longer absences, compared to their single counterparts.

Very little research has examined whether gender differences in anatomical location, diagnosis or manifestation of occupational RSI exist. One study of slaughterhouse workers found that women experienced more neck and shoulder occupational RSI problems than did men, but no gender differences were found for the arms or hands (Viikari-Juntura 1983).

A review of 100 consecutive occupational RSI upper-limb cases with more than six months pain found gender differences in type and nature of the occupational RSIs (Champion et al 1986). For example, men tended to show more restricted patterns of involvement which were predominantly musculoskeletal, whereas women had more widespread neck and arm pain with neurological features. Proportionately more men had epicondylitis than women. Significantly more women gave a history of paraesthesia extending to the fingers and had been previously referred for neurological studies, primarily for the diagnosis of carpal tunnel syndrome.

II.2.3 Explanations for Gender Differences

(a) The Debate

There are different theories to explain the gender differences associated with occupational RSI. First, there is the argument that women are not at increased risk for occupational RSIs but are just more likely to report occupational injuries than men. In support of this argument are studies demonstrating that women generally utilize medical services more often than men (Kandrack et al 1991; Adelman and Koch 1991). Coupled with this, is the suggestion that the increase in occupational RSIs reflects redefining the common "aches and pains" which most people experience in life as an "injury" (Ferguson 1987; Hall and Morrow 1988; Hadler 1986). However, other studies have demonstrated that women's excess utilization of health services and experienced disability days is primarily observed in milder conditions (see Kandrack et al 1991). Given that occupational RSIs result in an average of 71 days time loss (Yassi et al 1996), many occupational RSIs would not be considered a minor injury and should not be more under-reported by men than other injuries. Furthermore, a study examining gender and medical utilization among injured workers found no difference in utilization patterns (Worral et al 1987). It is unlikely that the gender difference in occupational RSI rates is due primarily to reporting differences.

Another set of theories to explain potential gender differences focuses on biological versus environmental factors. Some investigators have argued that women are more predisposed to some RSI conditions such as carpal tunnel syndrome (CTS) than men because of their smaller and weaker physical stature and/or hormonal factors (Nathan et al 1996a; de Krom et al 1990; Bjorkqvist et al 1977; Oldberg 1973). For example, women may be exposed to greater stresses because the average dimensions of the female hand are less than those of the male hand. Studies have demonstrated that smaller carpal canal size increases the risk for CTS (Bleecher 1987; Johnson et al 1983). The risk for CTS increases in pregnancy and with hormonal changes such as menopause, use of oral contraceptives or estrogen replacement (de Krom et al 1990; Dieck and Kelsey 1985; Massey 1978; Bjorkqvist et al 1977; Sabour and Fadel 1970; Phalen 1966; Wilkinson 1960). However, these arguments are based primarily from clinical series.

An alternative hypothesis is that men and women experience different working conditions, which accounts for women's higher occupational RSI risk factor. For example, Gun's (1990) analysis of South Australia's industrial injury data revealed that the female to male incidence rate ratios varied widely among the various occupations and industries, suggesting that the differing incidences between sexes are largely due to differences between work assigned to male and female workers rather than to any biological differences. Several studies have shown that some of the occupations traditionally held by women, such as garment workers (Blader et al 1987 & 1991, Punnett et al 1985, Armstrong & Chaffin 1979), VDT operators (Knave et al 1985, Rossignol et al 1987) grocery store cashiers (Orgel et al 1992; Harber et al 1992b, Baron and Habes 1992, Morgenstern et al 1991, Osorio et al 1994, Margolis and Kraus 1987), hospital workers (Punnett 1987), and dental hygienists (Conrad et al 1990) are at high risk for repetitive strain injuries.

(b) Job "Ghettos"

Men and women often hold very different jobs within the same industry or occupation category. Several studies have demonstrated that women are employed in jobs which often involve lifting of small weights at high frequency, repetitive hand and wrist movements, and static positions, while those performed by men more often involve heavy physical demands with frequent rest periods and more varied tasks (Vezina and Courville 1992; Mergler et al 1987a,b; Messing and Reveret 1983). For example, Vezina and Courville (1992) conducted an ergonomic analysis of sex-typed jobs in a clothing factory and in a plastics factory. They found that the typical male labourer's job in these industries required a diversity of activities, sporadic, heavy lifting, and frequent rest breaks; while typical women's jobs required moderate, but continuous exertion at a repetitive, nonstop pace.

Even within the same job title men and women may have different responsibilities and task assignments (Messing et al 1994, 1993; Lamson 1986; Messing and Reveret 1983). For instance, an analysis of task assignments among male and female gardners of a large Quebec municipality revealed that 44% reported a division of tasks by gender (Messing et al 1994). Women were more likely to do weeding and planting and pruning of bushes, while men were more likely to do "heavier" tasks such as pushing loaded wheelbarrows uphill, pruning trees and using forks and picks.

Women's and men's differing body size, proportion, shape and strength result in men and women using different methods to do the same task. Tools and equipment that were designed for men become sources of biomechanical stress for women (Messing et al 1994; Stellman et al 1984). Women often have to work in a different posture than do their male counterparts, exposing women to different stresses than men (Chatigny et al 1995; Messing et al 1994; Courville et al 1992; Armstrong et al 1986). An ergonomic analysis demonstrated that the design of the paint mixing and oven attendant process within a light bulb manufacturing plant gave an advantage to taller workers with larger hands (Chatigny et al 1995). Thus women working in this traditionally male job assignment had a greater strain placed on their elbow joint when performing the task assignments. Paul and Frings-Dresen (1991) studied the influence of changing body dimensions during pregnancy on the interaction with the workplace in an assembly line process. They found that there was enhanced risk of musculoskeletal disorders due to posture changes produced by pregnancy.

These differences in work activities and body/task interaction for men and women likely account for some of the gender differences observed with occupational RSIs. Many of these tasks in which women predominate, such as a fast work speed and repetitive hand movements, are noted for increasing a worker's risk for occupational RSIs (see section II.3.2). For example, Feldman and associates (1987) in their on-site risk assessment of an electronic assembly plant found that more women were more likely to be employed in jobs that were high risk for CTS than in low risk jobs. Silverstein and colleagues (1987a) found that men and women were not evenly distributed in exposure categories. For example, males tended to predominate in the high force/low repetition category, while females tended to predominate in the low force/high repetition category. Highly repetitious work has been shown to be a greater risk factor for CTS than high force (ibid).

(c) Disability/Recovery Process

There needs to be an examination of women's dual role of paid work and unpaid work in the home, and how this relates to recovery rates. Meekosha and Jakubwicz (1986) argued that occupational RSI is more difficult for women than for men because of a number of factors, including the gender division of labour at work and in the home, the historically patronizing and oppressive relationship of the medical profession to women, the greater restricted access to vocational rehabilitation, and the disregard for women's occupational health and safety needs. Kvarnstrom (1983) found that workers with shoulder disorders more often reported having children at home, having ill spouses and working alternate shifts than did workers without shoulder disorders. In this study, women were 10 times more likely to experience shoulder disorders than were the men, even though 80% of the workers were men.

II.3 Etiological Factors for RSI

II.3.1 Nonoccupational Factors

The etiology of occupational RSIs is often multifactorial and in many cases is still obscure. It is generally recognized that some individuals may be predisposed to some

RSIs, notably carpal tunnel syndrome. For instance non work-related factors such as age, small stature, obesity, small carpal canal size, pregnancy, use of oral contraceptives, menopause, gynecological surgery (specifically hysterectomy with bilateral oophorectomy), arthritis, diabetes, renal failure, previous acute trauma, and endocrinological disorders have been associated with one or more RSIs (de Krom et al 1990; Dimberg et al 1989; Bleecker 1987; Turner and Buckle 1987; Dieck and Kelsey 1985; Sabour and Fadel 1970; Bjorkqvist et al 1977; Cannon et al 1981; McCann and Davis 1978; Jung et al 1971; Gould and Wissinger 1978; Massey 1978; Wilkinson and Oxom 1960; Johnson et al 1983; Brown and Snyder 1975; Leach and Odom 1968; Phalen 1972, 1966; Mulder et al 1961). Lifestyle factors, such as alcohol abuse, tobacco use, or caffeine consumption, have also been associated with greater risk for the development of CTS (Nathan et al 1996a,b; 1994). It is also thought that psychosocial factors may contribute to the development of RSIs (Himmelstein et al 1995; Heliwell et al 1992; Bernard et al 1994; Hopkins 1990a; Dimberg et al 1989; Linton and Kamwendo 1989; Ryan and Bampton 1988; Wallace and Buckle 1987; Bergenudd et al 1988).

II.3.2 Occupational Factors

(a) The Debate

The role of occupational factors in the development of RSI conditions has been hotly debated, even as early as the 1930's (Conn 1931). The 1980's RSI "epidemic" in Australia generated much of the controversy over occupational factors and brought the debate to prominence. Similar controversy is now occurring in both Britain (Reilly 1995) and North America (Hadler 1996). Some experts have argued that occupational RSI is a work-related organic injury and that the sudden rise beginning in the early 1980's was due to changed industrial processes (eg., Novek et al 1990; Putz-Anderson 1988; Morse 1986) or increased awareness and reporting of occupational RSI conditions (Hopkins 1990a). Others have argued that the recent increase is due to nonorganic factors such as psychological mechanisms or conversion disorders (Lucire 1988; Bloch 1984; Rush 1984; Black 1987; Cleland 1987; Ireland 1986), social iatrogenesis caused by psychosocial or economic incentives (Lam 1995; Hadler 1990; Bell 1989; Deves and Spillane 1987), or the transformation of everyday aches and pains into long-term complaints of upper extremity pain and disability (Hadler 1992, 1989, 1986, 1985). Hadler argues (1992, 1990) that the body with "usage within reason" should not lead to repetitive injuries and that the medical, legal and compensation system has encouraged the reporting of normal aches and pains experienced by most people into occupational RSI. While Hadler's comments are provocative, they have been criticized for lacking scientific support (Silverstein et al 1996).

The critics of the existence of occupational RSI argue that often there are no clinical signs or identifiable underlying pathologies, no reliable patterns of symptoms, unclear causal links to work, and unsuccessful preventive strategies (Lam 1995; Cleland 1987. Hadler 1986; Ireland 1986). It is widely acknowledged that the epidemiologic evidence linking occupational RSI to specific risk factors is generally of very poor quality (Stock 1991; Gerr et al 1991; Moore 1992a; Wallace and Buckle 1987).

(b) Evidence for Work Relatedness

The predominant position taken in the recent literature is, however, that occupational activities can indeed place workers at increased risk for the development of RSIs (Silverstein et al 1996; Viikari-Juntura 1995; Kroemer 1992; Gerr et al 1991; Stock 1991; Wallace and Buckle 1987). There is scientific evidence showing an association between a variety of RSI disorders and work-related factors such as repetitive action (Silverstein et al 1987a, 1986; Barnhart 1991), high hand force (Silverstein et al 1986), awkward joint postures (English et al 1995; Feldman et al 1983; Armstrong et al 1982), a pinched grip (English et al 1995), and exposure to vibration (Farkkila et al (1988). Psychosocial factors such as control over work tasks and social supports have also been shown to influence RSI rates (Skov et al 1996; Marcus and Gerr 1996; Bernard et al 1994; Gerr et al 1991; Wallersteiner 1985; Isernhagen 1992; Arndt 1987).

Tables A1.1 to A1.4 (Appendix 1) list several of the epidemiologic studies assessing work-relatedness for four RSI diagnoses - CTS, tendonitis and other tendon disorders, epicondylitis, and shoulder disorders. Many of these studies controlled for nonoccupational factors either through experimental design or by control of confounders in the analysis. In some of these studies the work-related risk factors are stronger predictors of an adverse outcome than the nonwork factors (Barnhart et al 1991; Wieslander et al 1989). For example, when Barnhart and others compared the prevalence of CTS among workers in repetitive jobs to controls, the age and sex adjusted prevalence ratios varied from 1.63 to 5.18 depending upon the case definition of CTS. There was no difference between the two groups for thyroid disease, arthritis, use of oral contraceptives, gynecological surgery, or menopause. Morgenstern and others (1991) estimated that 60% of the CTS found among grocery checkers was attributable to exposures related to work.

Some of the evidence of work relatedness comes from prospective studies (Kurppa et al 1991; Jonsson et al 1988; Feldman et al 1987). These studies demonstrated a deterioration of the RSI condition after one year in high risk jobs (Feldman et al 1987; Jonsson et al 1988). Those workers with RSIs who were able to relocate to lower risk positions experienced an improvement (Jonsson et al 1988).

A dose-response relationship has been shown in several studies (de Krom et al 1990; Wieslander et al 1989; Moore and Garg 1994; English et al 1995; Osorio et al 1994; Chiang et al 1993). For example, in a case-control study, Wieslander and others (1989) found increasing odds ratios with increasing exposure time for use of hand held vibrating tools (Odds ratios: 1, 2.7 and 4.8 for <1yr, 1-20 yrs and >20 yrs exposure respectively) and for repetitive movements of the wrist (Odds Ratios: 1, 1.5, 4.6 for <1yr, 1-20 yrs and > 20 yrs exposure). A clear dose-response relation was shown for duration of activities with a flexed or an extended wrist, with the risk ratio increasing at least four to five times for people engaged in these activities for more than 20 hours per week (De Krom et al 1990).

There is good strength of association between work-related factors and some RSI conditions (see Tables A1.1 to A1.4 in Appendix 1). For example, well designed studies have a greater than fourfold difference in rates with high force/high repetition tasks, vibration, or prolonged wrist flexion/extension (Osorio et al 1994; Weislander et al 1989; de Krom et al 1990; Chiang et al 1993; Barnhart et al 1991; Silverstein et al 1987a; Cannon et al 1981). The prevalence of CTS was found to be at least twice that of the general population in certain work sites such as electronic manufacturing plant (Feldman et al 1987) and packing houses (Masear et al 1986; Falck & Aarnio 1983). Similarly strong association has been shown for high repetition/high force work and tendon disorders (OR 29.4) (Silverstein et al 1986; Armstrong et al 1987). However, the evidence of an occupational association for epicondylitis and for shoulder disorders is equivocal (Table A1.3 and A1.4).

In addition to the epidemiology, there are several laboratory studies which demonstrate biological plausibility that combinations of forceful, repetitive and stressful positions contribute to musculoskeletal dysfunction (Moore 1992b; Moore et al 1991; Sundelin and Hagberg 1992; Szabo and Chidgey 1989; Dennett and Fry 1988; Goldstein et al 1987; Aaras et al 1988; Arndt 1987; Goldstein et al 1987). As well, conceptual models for the pathogenesis of work-related RSIs have been developed (Armstrong et al 1993; Mackinnon et al 1994; Moore et al 1991).

II.3.3 Methodological Difficulties in the Literature

(a) Difficulties in Defining Cases and Determining Risk Factors

While the preponderance of studies demonstrates a correlation between certain occupational activities and RSIs, there are, nevertheless, several major impediments to obtaining etiological clarity for upper extremity RSIs. First, these disorders are multifactorial. Occupational and non occupational factors may interact in such a way that one factor may cause one type of disorder for one person and another type for someone else. Second, there is no uniformity in identifying and classifying cases among the various RSI studies. The existing disease classification systems are inadequate for RSIs and the criteria used to classify cases varies between studies (Sommerich et al 1993).

The measurement tools used for identification of cases, such as questionnaires, physical examinations, nerve conduction studies, time loss or some combination, also vary across studies. Consequently, the prevalence of an occupational RSI condition will depend on how the condition is identified. For example, the prevalence of a disorder is higher when the reported complaints consistent with the disorder are used to define a case than when symptoms plus a physical examination are used. Many prevalence studies rely on self-reported histories by patients or the qualitative impressions of the physician.

Measurement and classification of exposure variables vary across studies (Sommerich et al 1993, Hagberg 1992, Viikari-Juntura 1995, 1984). A job title or occupational group is usually used as a measure of exposure. However, a job title such as "office worker" describes a potentially large variety of occupational tasks. The more precisely measured the risk factors, the more potentially meaningful and generalizable the results (Sommerich et al 1993, Hagberg and Wegman 1987). Classifying by job title does express some qualitative combination of physical exposures and is useful primarily to identify problems and generate hypotheses regarding risk factors.

In addition to problems related to identifying cases and describing risk factors, there are other difficulties with the epidemiological research in this area. Most studies have utilized a cross-sectional design in small samples of population. Appropriate control groups are often lacking (Wallace and Buckle 1987). The case-control design is used very little and prospective longitudinal studies are almost nonexistent (Viikari-Juntura 1995). Most case-control studies have been carried out among "survivor" populations, which is among those workers who have withstood the effects of long-term exposure, thus introducing a possible selection bias.

Hagberg (1992) argues that the ergonomic field is rather new to epidemiology and ergonomists often lack adequate knowledge of epidemiology. Although measurement techniques for systematically describing manual work have been developed, the analysis of work methods is difficult and labourious. Work movements are many and complex, even in apparently monotonous tasks. Much work is needed to know more details of the quantity and quality of the work movements that place individuals at increased risk of occupational RSI (Viikari-Juntura 1984). Viikari-Juntura (1995) argues that the interaction between physical and psychosocial factors are not well understood because epidemiologic studies have put an emphasis on the assessment of physical work factors over psychosocial factors.

Evidence for both the paucity of rigorous epidemiologic studies on occupational RSI and of the lack of reliability of a large number of occupational RSI studies is Stock's (1991) evaluation of 49 relevant studies. Nearly all of these studies reported a positive relationship between exposure and outcome, but only three, according to Stock, merited careful consideration on the basis of criteria that emphasized adequate definitions of populations, exposures, and outcomes. This lack of rigorous epidemiological evidence has led some authors to question the validity of occupationally related RSI. However, it should be noted that studies often cited to refute the association of RSI with work have similar deficiencies (Moore 1992a).

III. RESEARCH DESIGN AND METHOD

A cross-sectional file review of Manitoba occupational RSI workers compensation time loss claims settled in 1991 was undertaken. The objective was to describe and compare the occupational RSI incidence, distribution, determinates and outcomes by gender.

Data collected from an earlier Manitoba occupational RSI study (Yassi et al 1996) were reanalysed for this study. The method used to obtain the occupational RSI data is described in section III.2 below.

III.1 Target Population and Sample

Since the Workers Compensation Board (WCB) is the best source of occupational injury and illness data, the sample population was workers covered by the Manitoba WCB. The target population was the employed people with workers compensation coverage within the province of Manitoba in 1991. The total number of full time equivalency employees covered by WCB in 1991 was 371,492. However, the total number of workers in Manitoba who are covered by compensation insurance is not known, but it has been estimated to be approximately 70% of all employed Manitobans. Canada's 1991 census survey has placed Manitoba's employed labour force (those who were employed at some time in the week prior to the June 4, 1991 census) at 515,985. This includes full time, part time and temporary workers.

III.2 Data Collection

As there was no "RSI" coding field, nor diagnostic coding field within the Manitoba Workers Compensation Board coding system, it was necessary to determine which combination of coding fields of body part injured, nature of injury, source of injury and type of accident would contain upper limb RSIs. These four coding fields were each classified into three categories (identified as probable, possible and unlikely) of finding RSI claims with those codes as shown in Table 2.

All combinations for the three categories of the four coding fields result in 81 (3^4) groups. Those claims which did not have an upper limb body part code were not reviewed, nor were those claims where the nature or type of injury code fell into the "unlikely" category (such as burns, fractures etc.). This resulted in 12 groups thought likely or "possibly" to contain RSI claims.

A stratified sampling design was used. The 12 remaining groups contained 1431 claims. Since the objective was to review as many actual RSI claims as possible, all claims in those groups whose coding combination was thought most likely or "probable" to contain RSI files were reviewed. As well, all claims in those groups which contained a small number of claims were reviewed. This resulted in all 60 claims from the six groups with nature of injury codes categorized as "possible" and all 360 claims from those groups where both the nature and source of injury categorized as "probable" being reviewed.

TABLE 2 WORKERS COMPENSATION CLAIM CODES BY LIKELIHOOD OF CONTAINING UPPER LIMB RSI CLAIMS

CODING FIELD	LIKELIHOOD OF CONTAINING UPPER LIMB RSI CLAIMS		
	PROBABLE	POSSIBLE	UNLIKELY
Nature of Injury	sprains/strains (code 188), or inflammation/irritation (260)	diseases of the nervous system including carpal tunnel syndrome (560) or occupational illness including Raynaud's not elsewhere classified (399)	All others
Source of Injury	bodily motion due to repetitive motion (0401) or due to twisting, bending etc. (0409) or unspecified (0400)	persons (0280), boxes etc. (0600-0699), conveyors (1300, 1301, 1350, 1399), switchboard (1520), food products (1800, 1816-1890), hand tools - not powered (2200-2299) hand tools - powered (2300-2399) hoisting (2600-2699) machines (3000-3999) mechanical power transmission apparatus (4000-4099) metal items (4100, 4110-4140, 4150, 4155), paper and pulp items (4500).	All others
Type of Injury	involuntary motions (101) or voluntary motions (102) or overexertion in lifting (121) or overexertion in pushing, pulling (122)	bodily reaction UNS, NEC (100,109), overexertion UNS, NEC (120,129), overexertion in welding or throwing (123). leaning, kneeling etc. (080-089)	All others
Body Part Affected	Upper limb (300-399) or shoulder (450)	Lower limb or spine	All others

From the remaining four groups (claims with source codes categorized as "possible" or "unlikely" and the nature code categorized as "probable") random samples of claims were selected. The sample size was sufficiently large enough to ensure that the estimate of the proportion of RSIs found in each group would be accurate to within 10%. Only three out of the four groups needed to be sampled, since the one group was small enough that all claims needed to be sampled. All subsequent analyses were reweighed by the inverse of the sampling fraction from each group.

The selected claim files were reviewed by the author to determine whether the claim was indeed an occupational RSI, and to obtain information on demographic factors, risk factors, medical management and WCB intervention (see Appendices 2 and 3 for information obtained). The occupational and non occupational risk factors assessed were determined in accordance with the risk factors outlined by Wallersteiner (1985) and Isernhagen (1992).

Upon file review it was found that a small number of files with the body part coded as multiple (700) contained upper limb occupational RSIs. These claims were also included in the analysis.

III.3 Case Definition

A case for the purposes of this project was defined as an occupational RSI only if:

1. there was no specific accident or incident which caused the injury/disablement from work,
2. the occurrence of the injury was over a period of time of at least one day and
3. the nature of the injury was musculoskeletal.

This was the same definition used by Yassi and colleagues in the earlier study (Yassi et al 1996) and similar to the definition used by Tanaka (1988), except for the criteria that the injury period had to have occurred over one week. The injury period of one day was used in this study to increase the likelihood that all RSI claims were captured.

Although vibration white finger disease is not considered a musculoskeletal injury, if the claim met the other two criteria, it was also coded as an RSI. Claims where only one of the three accident description reports by either the employer, worker, or doctor met all the criteria requirements, or claims in which there was not enough information to definitely determine whether it was or was not an RSI claim, were not included in this analysis.

III.4 Statistical Methods

Since a stratified sampling design was used, the true number of occupational RSIs for each variable had to be estimated by extrapolating the actual number of occupational RSI claims found to the entire claims population. This was done by multiplying each identified occupational RSI claim by a weight equivalent to the inverse of the sampling fraction from each group.

Incidence rates by gender for industry, occupation and age groupings were expressed by the numbers of estimated occupational RSI per 1000 workers (ORSIs/1000) within each industry, occupation or age grouping. Statistical probabilities were calculated using Chi-square test.

Since time loss and compensation costs are not normally distributed, the Mann-Whitney U test was used to calculate statistical significance between groups on median time loss and cost of occupational RSI claims (Hassard 1991). To account for individuals with different sampling weights a stratified analysis was undertaken. The sample was divided into four categories of sampling weights (1, 2.48, 3.34, and 3.58) and the male and female medians were compared within each sampling weight group.

The Epi Info (version 6) microcomputer program was used for database management and statistical analysis.

III.4.1 Denominators

Although the Manitoba WCB maintains the number of full time equivalent workers per firm and industry group, information by gender, age and occupation of the workers is not recorded. Furthermore, Statistics Canada labour force employment data do not distinguish those industries or occupations covered by workers compensation legislation. Therefore, the employed labour force in Manitoba for 1991, as reported by Statistics Canada (Statistics Canada 1993) for each occupation, industry and age groups was used. The major limitation with using Statistics Canada's employed labour force as the denominator is that it includes full time, part time and temporary employees and people not covered by WCB. Nevertheless, the employed labour force provides an approximate indication of the population at risk for the purposes of comparison. Using this denominator results in an underestimation of the actual occupational RSI claim rates for two reasons. First, the employed labour force will always be greater than the WCB insured workforce. Second, and of more concern, there is the problem of differential underestimation. There are more female part time workers than male part time workers resulting in a greater underestimation of occupational RSI rates for women. Also, some industry and occupational groups are less completely insured by the WCB than other groups. This does not easily allow for a correction factor to be used to estimate the portion of WCB insured labour force in each group. The estimated proportion of each group not covered cannot be estimated with any reasonable accuracy because the WCB allows for voluntary coverage for some industry grouping and because the Standard Industry Codes (SIC) used by Statistics Canada and the WCB industry codes are not easily matched. As well, there would be no way of determining the proportion of uninsured by occupation.

III.4.2 Industry Specific Occupational RSI Rates

As stated above, the industry codes used by the WCB (assessment rate codes) are different from the Standard Industry Codes used by Statistics Canada. In order to reduce disparities as much as possible WCB assessment rate codes were rearranged to meet SIC definitions and the SIC industry categories were used to analyse industry rates.

Although there are many rate codes which were mismatched to SIC code, only those rate codes which contained an occupational RSI claim were individually reviewed and assigned a SIC industry division. For the most part, the WCB industrial categories (rate codes) with RSI claims corresponded appropriately with the SIC industry division codes (i.e., manufacturing WCB rate codes fell within the SIC manufacturing division, construction rate codes within the SIC construction division, and so on). However, there were 19 occupational RSI claims which needed to be reassigned a SIC code. These mismatched rate codes/SIC codes occurred mainly in the WCB coded Self Assurers, Voluntary, and Service Industry rate codes. Table 2 outlines those WCB rate codes which needed to be reassigned to a SIC industry division.

III.5 Workers Compensation Data Source

Research was conducted utilizing the Manitoba Workers Compensation Board (WCB) database. The Workers Compensation Board data system provides the most comprehensive single source of occupational injury data in Canada (Spiegel and Yassi 1991). Most provincially and federally regulated employers in the province of Manitoba are legally required to obtain occupational injury and illness insurance with the Manitoba WCB. The WCB estimates that approximately 30% of Manitoba workers are not covered; many of these would be farmers, teachers, professional office employees and bank and insurance industry workers. Nevertheless, many noncompulsory employers voluntarily obtain WCB coverage for their employees. These employers are classified as "Voluntary" by the WCB for the purposes of assessment coding. The WCB has estimated that the total number of full time equivalency employees covered by WCB in 1991 was 371,492.

TABLE 3 REASSIGNMENT OF WCB RATE CODES TO SIC CODES

WCB RATE CODES & DESCRIPTION	ASSIGNED TO SIC CODE & DIVISION
Voluntary	
90103 - Operation of Buildings	751 - Operators of Business, Division L - Real Estate Operator & Insurance Agent
90207 - Landscaping	429 - Other Trade Work, Division F - Construction
90211 - Provincial Govt. Agencies	Division N - Government Services
90306 - Social Services	864 - Non-Institutional Social Services, Division P - Health and Social Service
90310 - Taxidermy	999 - Other Services NEC, Division R - Other Services
90404 - Stock Farm, Feed lot	011 - Livestock Farms, Division A - Agriculture
90702 - Survey, Exploration, Prospecting	775 - Architectural, Engineering and Other Scientific and Technical Services, Division M - Business Service
92102 - Operation of Schools	851 - Elementary and Secondary Education, Division O - Educational Service
92202 - Federal Employment Program	813 - Labour, Employment and Immigration Services N - Government
Self Assurers	
Canadian Pacific Railway	453 - Railway Transport and Related Services G - Transportation and Storage
Canadian National Railways	453 - Railway Transport and Related G - Transportation and Storage
Workers Compensation Board	Division N - Government Services
City of Winnipeg	83 - Local Government Service Division N - Government Services
Manitoba Telephone System	480 - Communication Industries UNS, Division H - Communication and Other Utilities
Government of Canada	81 - Federal Government Service, Division N - Government Service
Province of Manitoba	82 - Provincial & Territorial Government Service Government N - Government Service
Canada Post Corporation	484 - Postal and Courier Service Division H - Communication & Other Utilities
Manitoba Hydro	491 - Electric Power Systems Division H - Communication & Other Utilities
Manufacturing	
30103 - Wholesale meat products	Division I - Wholesale Trade

The WCB databases contain data information necessary for the administration of claims. Individual claims are coded with a three or four digit coding system using three standards: Canadian Work Injuries Standard 1990 (for nature of injury, part of body injured, source of injury and type of accident); Occupational Classification Manual 1971 (for occupational codes); and Manitoba's WCB assessment rate codes for industries. In addition, the databases contain the following information on each accepted claim: claim ID, gender, age, date of injury, firm, time loss on claims and rehabilitation, cost of claim, medical aid, and rehabilitation.

III.5.1 Validity and Reliability

Workers compensation records from a variety of countries have been used as the primary source for the documentation or surveillance of occupational RSIs and occupationally related carpal tunnel syndrome (Yassi et al 1996; Frazier and Loomis 1996; Ashbury 1995; Franklin et al 1991; Gun 1990; Hanrahan and Moll 1989; Tanaka 1988). The advantages of WCB data include availability and ease of analysis of the data (Frazier and Loomis 1996; Spiegel and Yassi 1991). WCB data are a good, comprehensive source for making comparative assessments of occupational injuries or illnesses across industries and occupations, and for the development of prevention intervention strategies.

Nevertheless, it is recognized that WCB data have limitations (Korrick et al 1994).

(a) Under-Ascertainment of Cases

Most important among the limitations of WCB data is an underestimate of the prevalence of occupational RSI conditions. There are several reasons for this, including incomplete coverage of all workers, under-reporting and under-recognition of the condition. Not all employers are registered with WCB, hence not all workers who sustain a bonafide occupational injury or illness can receive coverage from the board. Secondly, there is growing evidence that many entitled workers never apply for compensation benefits (Fine et al 1984; Armstrong 1986; Seligman et al 1986). In a non-random survey of unionized workers in Manitoba (Buekert and Weninger unpublished), only 47% of those workers who had an RSI disorder diagnosed as work-related by a doctor filed a WCB claim. However, results from the Workers Compensation Board of Ontario (1992) study on workplace accident reporting practices found only a very small number of underreported or misreported workplace injuries. Based on a random sample of covered employees within the general population, under-reporting rate of about 1% was found. The same study found that possibly 20% of all workplace accidents are not reported. The Ontario Board also found that among a randomly selected sample of lost time claimants with the WCB, nearly 3% had other workplace accidents which were not reported to the Board but only 1% could possibly have resulted in a WCB claim. Since the sample size was small for the number of workplace non-reporting incidents found, the generalizability of these findings must be viewed with caution.

Thirdly, the use of WCB data is limited by the administrative criteria governing acceptance of claims. Workers Compensation is an insurance system and criteria governing acceptability of a claim is set by legislation and policies. For example, in B.C., a change in the normal work activities needs to have occurred prior to the onset of the RSI condition in order for an RSI claim to be accepted. The RSI survey of unionized Manitoba workers found that 17% of RSI disorders diagnosed as work-related were rejected at some point by the Manitoba WCB (Buekert and Weninger's unpublished). Furthermore, occupational RSI usually develops gradually without a single insult, thus recognition of its work-relatedness can be delayed or absent, which may hinder the reporting of the condition to the WCB.

(b) Inaccurate and Incomplete Data

WCB data may also contain incomplete and inaccurate information (Korrick et al 1994). Studies have shown that misclassification and coding errors are serious problems. One study found that only 88% of compensation cases coded as carpal tunnel syndrome actually had a physician's diagnosis of CTS. Twenty-four percent of claims coded as sprains and strains, inflammations or nervous system conditions that involved at least one body part from the upper extremities, wrist, hand or fingers had a physician diagnosis of CTS (ibid). Another study of occupationally related carpal tunnel syndrome using Washington State workers compensation claims (Franklin et al 1991) found that only 82% of coded CTS incident claims were true cases of carpal tunnel syndrome by documented physician diagnosis. It was also found that only 72%

of claims that were associated with carpal tunnel surgery had a code compatible with CTS. Twenty-five percent had either some nonspecific diagnosis or erroneous diagnostic codes.

Studies which have assessed the completeness of WCB data, have revealed that workers compensation systems may not be the most comprehensive or reliable source for some work-related injuries (Russell and Conroy 1991; Stout and Bell 1991; Korrick et al 1994). For example, workers compensation data have been shown to capture, on average, only 57% of all fatal occupational injuries in the U.S. (Stout and Bell 1991; Russell and Conroy 1991). These studies revealed that for occupational fatalities, WCB data in the U.S. constitute the third most complete database. Death certificates and medical examiner records were more complete. As well, other occupational RSI studies have found that anywhere from one half to one tenth of occupational RSIs were identified from workers compensation records (Fine et al 1984; Cannon et al 1981;).

In spite of these weaknesses within the database, workers compensation data remains the best source of occupational injury and illness data in Canada. Canadian WCB data remains a good source for enumerating the occurrences of work-related injuries, obtaining the relative frequencies of these injuries within groups, and identifying important trends and patterns concerning risk factors and occupational injury and illness characteristics. Workers compensation data are useful for undertaking descriptive epidemiology and for generating hypotheses. They are also useful for comparing incidence rates across groupings. Since this study's objective was to explore gender differences in occupationally related RSIs and given the ease of accessibility of the WCB data, the Manitoba WCB database was utilized for the purposes of this study.

IV RESULTS

IV.1 Nature and Extent of Occupational RSI Claims

During 1991, 18,826 time loss claims were settled[1], of which 5605 were upper limb claims. Of these, 763 claims were selected for manual review, 295 were determined to be occupational RSIs (as defined in III.3), of which 149 were in women and 144 in men. As the sizes of the population of claims from which the samples were drawn were not identical, nor were the sizes of the samples, weighting factors of the inverse of the sampling fraction were applied to reflect the proportion of all occupational RSI claims. Extrapolating these figures to the total population of claims indicates that there were an estimated 381.81 (382) upper limb occupational RSI workers compensation claims accepted in 1991, of which 184.1 (184) were estimated to be from women and 197.71 (198) were estimated to be from men. This amounts to 6.8% of all accepted upper limb claims and 2.1% of total claims accepted by the Manitoba WCB in 1991.

RSI claims accounted for a higher proportion of all female upper limb claims (12.3%)

---

[1] Settled claims means those claims closed and not rejected during 1991 whether the accident occurred in 1991 or in a prior year. In 1991 there were 44,588 accidents reported to the WCB and 31,143 accidents settled during that year. Of those settled claims 12,317 were for medical aid only and 18,826 were total time loss claims which included fatalities, and temporary and permanent disabilities.

than men's upper limb claims (4.8%). Yet the occupational RSI claim rates were similar for women and men (0.79/1000 female workers vs. 0.73/1000 male workers, Chi squared = 0.5, p>0.25). Overall, the average WCB occupational RSI claim rate for Manitoba workers was 0.76/1000 workers.

IV.2 Incidence Rates

IV.2.1 Industrial Rates

Table 4 shows the occupational RSI claim rates for the various industry sectors. Occupational RSI rates varied significantly among the various industries (Chi squared = 975.62; p<0.001). There was greater variation among the industries than between the genders within industry (Graph 1), suggesting that the type of work performed influences the occupational RSI claim rate to a greater extent than gender differences.

The overall highest risk industry sector was manufacturing, with a collective rate of 4.87 per 1000 workers (4.75/1000 female workers and 5.00/1000 male workers). When the industry sectors were analysed further by subdivision and rates calculated, greater gender differences were seen. As can also be seen in Graph 1, the meat and poultry manufacturing sector had the highest occupational RSI claim rate with 38.66/1000 female workers, and 17.69/1000 male workers. This gender difference was statistically significant (X^2 = 10.31 p<.01). Significant gender differences were also found for the Government Services sector (1/1000 female workers vs. 0.34/1000 male workers, $X^2 = 7.46, p<.01$).

TABLE 4. NUMBER AND RATE OF UPPER LIMB RSI CLAIMS BY INDUSTRY AND GENDER

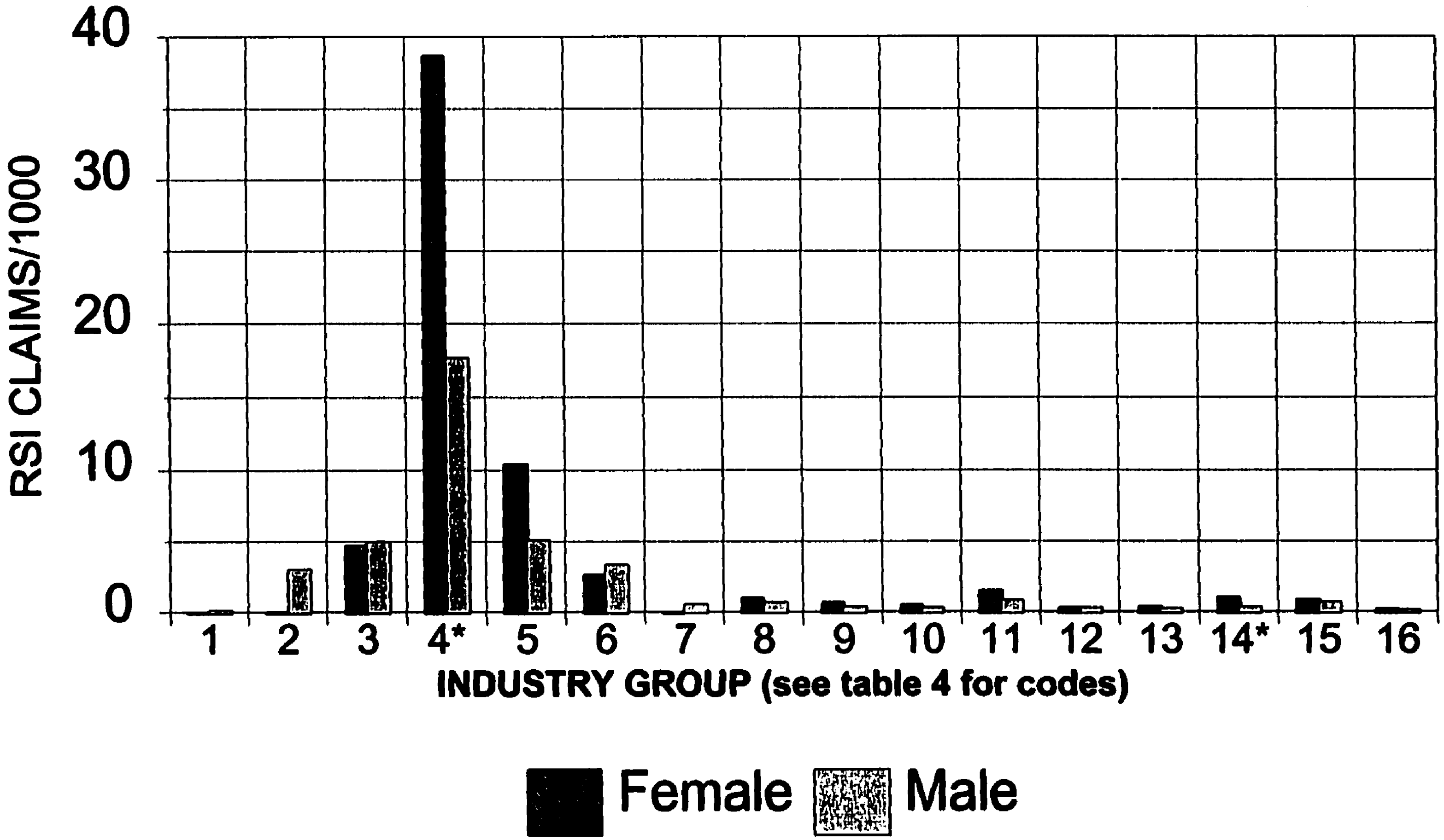
INDUSTRY GROUP	# ESTIMATED RSI		# MANITOBA WORKERS[1]		RSI RATE (/1000 workers)	
	F	M	F	M	F	M
1 Forestry & Agriculture	0	3	13,455	32,925	-	0.10
2 Mines	0	17	540	5,600	-	3.06
3 Manufacturing Total	92	101	19,360	20,220	4.75	5.00
4 - Meat & Poultry	34	33	880	1,890	38.66 **	17.69 **
5 - Aircraft	11	17	1,100	3,235	10.44	5.14
6 - All Other	47	51	17,380	15,095	2.67	3.37
7 Construction	0	14	2,935	26,665	-	0.53
8 Transportation, Communication, Storage	9	24	10,080	37,690	0.93	0.63
9 Trade - Total	26	17	40,615	50,715	0.65	0.34
10 - Retail Stores	10	3	20,970	11,690	0.48	0.26
11 - Grocery Stores	13	5	8,775	6,815	1.52	0.78
12 - All Other	3	9	10,870	32,210	0.28	0.28
13 Service- Total	57	21	145,690	96,045	0.39	0.22
14 - Govt. Services	21	10	20,920	29,120	1.0 **	0.34 **
15 - Hospitals	17	3	20,535	4,465	0.81	0.67
16 - All Other	19	8	104,235	62,460	0.18	0.13
TOTAL	184	198	232,675	269,860	0.79	0.73

** P<.001

[1] Data obtained from Statistics Canada Catalogue No. 93-326 includes persons over 15 years of age who were employed or unemployed during the week prior to June 4, 1991, but who had worked since January 1, 1990.

GRAPH 1

INDUSTRY RSI RATE BY GENDER



* gender difference significant $p<0.05$

Although the rates for women were nearly twice the rates for men in the aircraft manufacturing trade, grocery and retail trade sectors, these differences were not statistically significant due to the small numbers.

IV.2.2 Occupational Rates

Table 5 shows the occupational RSI claim rates in the various occupational categories. As with industries, the occupational RSI rates varied significantly among the various occupations (Graph 2, $X^2 = 2.29$, $p<0.001$). The processing occupations had the highest overall rates with 19.80 and 8.47 occupational RSIs per 1000 female and male workers respectively. This gender difference in the rates is statistically significant ($X^2 = 23.69$, $p<.001$). Product fabricating, assembling and repairing occupations followed with 3.32/1000 female workers and 5.22/1000 male workers ($X^2 = 9.46$, $p<.01$). The gender difference for the construction trades (women 5.33/1000 vs. men 0.82/1000; $X^2 = 11.48$, $p<.001$) was also statistically significant. Although large rate differences were noted for men and women in other occupations, these differences were not statistically significant, again due to small numbers.

TABLE 5 NUMBER AND RATE OF UPPER LIMB RSI CLAIMS BY OCCUPATION AND GENDER

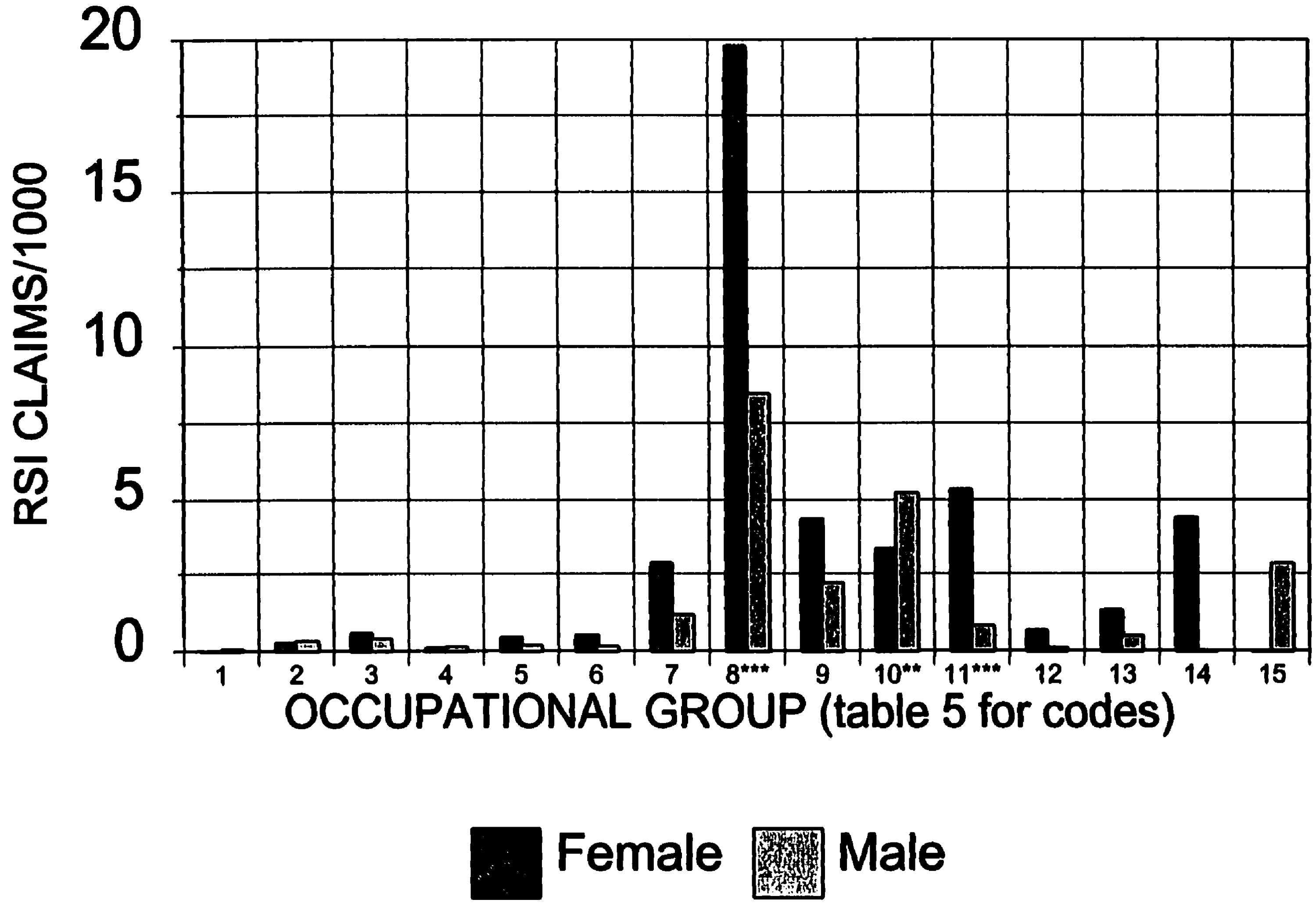
OCCUPATIONS	# ESTIMATED RSI		# MANITOBA WORKERS[2]		RATE (/1000 workers)	
	F	M	F	M	F	M
1. Admin. Teaching, Engineering, & Natural & Social Sciences	0	3	30,720	54,685	-	0.052
2. Medicine & Health	7	2	26,430	6,190	0.26	0.32
3. Clerical	44	8	75,700	21,150	0.58	0.39
4. Sales	2	3	22,440	27,765	0.09	0.13
5. Service	22	6	46,775	31,730	0.46	0.19
6. Farming	6	4	10,415	30,480	0.54	0.15
7. Fishing, Forestry & Mining	1	6	350	5100	2.86	1.18
8. Processing	60	68	3,040	8,015	19.80 ***	8.47 ***
9. Machining	2	20	460	9,040	4.35	2.21
10. Product Fabricating, Assembling & Repairing	27	42	8,055	27,510	3.32 **	5.22 **
11. Construction Trades	4	25	750	30,975	5.33 ***	0.82 ***
12. Transport Equip. Operating	1	2	1,525	19,440	0.66	0.10
13. Materials Handling	2	3	1,530	6,095	1.31	0.49
14. Other Craft & Equip Operating	7	0	1,675	4,630	4.38	-
15. Not Elsewhere Classified	0	4	1,405	8,650	-	2.85
TOTAL	185	196	231,270	291,455	0.80	0.68

** $P < 0.01$
*** $p < 0.001$

2 Data obtained from Statistics Canada <u>Occupation</u> Catalogue No. 93-327; includes persons 15 years and older who were employed or unemployed during the week prior to June 4, 1991, but who had worked since January 1, 1990.

GRAPH 2

OCCUPATION RSI RATES BY GENDER



** p< 0.01
*** p< 0.001

IV.3. Demographic Profile of RSI Claimants

IV.3.2 Age

Table 6 shows the occupational RSI claim rates for the various age categories. Although the occupational RSI claim rate variation among the age categories was significant ($X^2 = 39.04$, $p < 0.001$), there were no significant differences found between male and female occupational RSI rates within any age group.

TABLE 6 NUMBER AND RATE OF UPPER LIMB RSI CLAIMS BY AGE AND GENDER

AGE	# RSI		# WRKRS IN MB.[3]		RSI RATE (/1000 workers)	
	F	M	F	M	F	M
0-19	6	3	17,105	18,575	0.38	0.16
20-24	17	29	27,525	29,830	0.63	0.96
25-34	53	62	65,325	78,190	0.81	0.79
35-44	59	63	63,200	71770	0.93	0.88
45-54	37	27	39,080	47,865	0.94	0.56
55 +	9	10	24,465	38,560	0.35	0.26
Not Stated	3	4	-	-	-	-
TOTAL	184	198	236,705	284,790	0.78	0.69

[3] Data obtained from Statistics Canada Labour Force Activity Catalogue No. 93-324; includes persons 15 years and over who were employed.

IV.3.3 Body part Injured

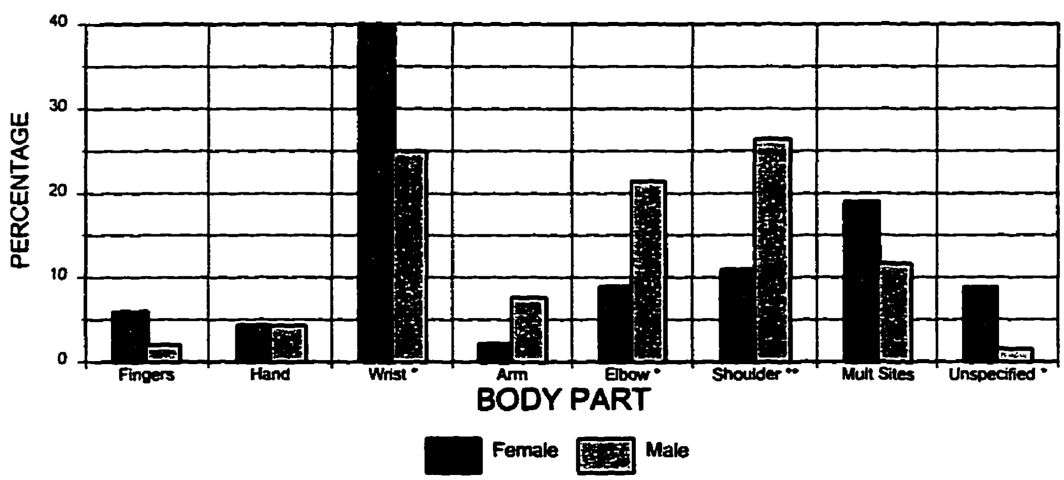
Table 7 shows the upper limb body part injured. The most common body part sustaining an occupational RSI injury was the wrist (32.1% of all RSI claims) followed by the shoulder (19.0%), elbow (15.4%) and multiple sites (15.2%).

TABLE 7 NUMBER AND PERCENT OF RSI CLAIMS BY GENDER AND PART OF BODY INJURED

Body part	# ESTIMATED RSI F	# ESTIMATED RSI M	PERCENTAGE F	PERCENTAGE M
Fingers	11	4	6.0	2.0
Hand (not fingers or wrist)	8	8	4.4	4.3
Wrist	73	49	39.7 **	25.0 **
Arm (not wrist or elbow)	4	15	2.2	7.6
Elbow	16	42	9.0 **	21.5 **
Shoulder	20	52	11.0 ***	26.4 ***
Multiple Upper Extremities/Arms	35	23	19.0	11.6
Upper Extremities/ Arms Unspecified	16	3	8.9 **	1.5 **
TOTAL	183	196	100.2	99.9

** p< 0.01
*** p< 0.001

GRAPH 3
BODY PART INJURED BY GENDER



* P<0.025
** P<0.01

Men and women were likely to sustain occupational RSI injuries to different parts of their body (Chi square = 66.42 $p < 0.001$). Statistically more men than women experienced occupational RSI injuries to their shoulder (26.44% of male RSI claimants vs. 10.95% of female RSI claimants) and elbow (21.45% vs. 8.95%), whereas statistically more women than men suffer from an occupational RSI injury to their wrist (39.73% vs. 25.03%). While more women than men also experienced occupational RSI injuries to their fingers (5.96% vs. 2.02%) or multiple sites (19.03% vs. 11.63%) and more men experienced RSI injuries to their arm (7.6% vs. 2.17), these differences did not reach statistical significance.

IV.4 Diagnosis and Treatment

IV.4.1 Diagnoses

The diagnoses obtained from the claim files were recorded exactly as stated on the file. Up to a maximum of three diagnoses were recorded for each occupational RSI claim. No attempt was made to determine whether the medical diagnosis was accurate based upon the recorded medical information on file. Table 8 shows the recorded diagnoses of occupational RSI claims. Using the first medical diagnosis recorded on the claim file, the five most common occupational RSI diagnoses were tendonitis (27.5%), CTS (19.3%), epicondylitis (15.3%), strain/sprains (15.8%) and tenosynovitis (8.2%). Including later diagnoses did not change these rankings.

The pattern of diagnoses between the genders was similar. Although more women

TABLE 8 FIRST, SECOND AND THIRD DIAGNOSIS OF RSI CLAIMS BY GENDER

DIAGNOSIS	ESTIMATED RSIs					
	First Report No. (%)		2nd & 3rd Report No. (%)		Total No. All Reports (% in Dx in 1st report)	
	F	M	F	M	F	M
De Quervain	1 (0.5)	2 (1.0)	5 (2.7)	3 (1.6)	6 (16.7%)	5 (40%)
Trigger Finger	4 (1.9)	2 (1.0)	1 (0.5)	4 (2.5)	4 (77.7)	6 (30.9)
Ganglion	0	0	4 (2.2)	1 (1.6)	4 (0)	1 (0)
Carpal Tunnel Syndrome	37 (20.4)	36 (18.2)	7 (4.0)	3 (1.6)	45 (83.6)	38 (93.6)
Epicondylitis	23 (12.4)	35 (17.9)	5 (2.7)	7 (3.5)	28 (82.0)	42 (83.5)
Tendonitis	60 (32.4)	45 (23.0)	9 (4.9)	13 (6.3)	69 (86.9)	58 (78.3)
Tenosynovitis	16 (8.7)	15 (7.7)	11 (6.3)	5 (2.5)	28 (58.3)	20 (75.3)
Rotator Cuff/ Supraspinatus Tendinitis	1 (0.5)	7 (3.7)	5 (3.0)	3 (1.8)	6 (15.4)	11 (67.8)
Strain/Sprain	25 (13.9)	35 (17.7)	8 (4.3)	4 (2.3)	33 (76.3)	39 (88.6)
Myofascial/ Fibromyalgia disorders	3 (1.6)	0	9 (4.9)	10 (5.0)	12 (27.1)	10 (0)
Bursitis	1 (0.5)	5 (2.5)	3 (1.9)	4 (2.3)	4 (22.3)	8 (59.0)
Other	1 (0.5)	2 (1.0)	13 (7.3)	1 (0.5)		
Vibration White Finger Disease	0	4				
Over Use Syndrome	4 (2.4)	0				
Not Stated	3 (1.6)	3 (2.0)	-	-	-	-
Soft Tissue Injury	1 (0.5)	1 (0.5)				
Neuropathy/ Impingement Syndrome/ Neuritis/ Nerve Entrapment	3 (1.8)	4 (2.0)				
TOTAL	182	198				

than men were diagnosed with tendonitis, CTS and myofascial or fibromyalgia disorders, and proportionately more men than women had the diagnosis of epicondylitis and strain or sprain, these gender differences were not statistically significant.

IV.4.2 Medical Treatment Received

Table 9 shows the medical services received by occupational RSI claimants. There were no

TABLE 9 MEDICAL TREATMENT RECEIVED BY GENDER

MEDICAL TREATMENT RECEIVED		ESTIMATED RSI CLAIMS RECEIVING TREATMENT No. (%) F	M
G.P.	- yes	172 (93)	185 (94)
	- no	12 (7)	13 (6)
Neurologist	- yes	32 (17)	32 (16)
	- no	152 (83)	166 (84)
Physical Medicine Specialist	- Yes	16 (9)	10 (5)
	- No	168 (91)	188 (95)
Orthopaedic	- Yes	55 (30)	54 (27)
	- No	129 (70)	144 (73)
Other Specialist	- Yes	30 (16)	22 (11)
	- No	154 (84)	175 (78)
Surgery	- Yes	44 (24)	42 (21)
	- No	140 (76)	155 (79)
Physiotherapy	- Yes	102 (56)	124 (63)
	- No	82 (44)	73 (37)
Other	- Yes	17 (9)	18 (9)
	- No	167 (91)	180 (91)

significant differences observed between the genders. More than 93% of all occupational RSI claimants attended general physicians for their treatment. Over half received physiotherapy and 22.6% underwent surgery. Of those undergoing surgery (Table 9), approximately 79% (61.1% of female RSI surgery claimants and 65.2% of male RSI surgery claimants) had been diagnosed with carpal tunnel syndrome at some point during their claim.

IV.5 Severity and Cost of Claims

IV.5.1 Claim Duration

Overall, women had more time loss than men (average of 76.76 days vs. 66.49 days) (Table 11). While this difference was observed for all but one group, when analysed by sample weight groups (Table 12), the only significant difference occurred within one sample group ($U = -2.16$, $p < 0.05$). That group contained 85% of identified RSI claims. This suggests that statistically significant differences were not found within the other sample groups due to the small number of RSI claims within these sample groups.

When the claim time loss was examined in greater detail, some interesting differences were found. Table 13 shows the distribution of time loss for occupational RSI claims by gender. The gender differences with respect to time loss were primarily observed in the earlier weeks of time loss - up to 2 months (40 working days). Nearly half

TABLE 10

DIAGNOSIS OF CLAIMANTS RECEIVING SURGERY BY GENDER

Diagnosis at some point during claim[1]	No. (%) of Claimants who had Surgery F	M	Total
De Quervain	3 (5)	0	3 (34)
Carpal Tunnel	36 (61)	32 (65)	68 (79)
Ganglion	0	1 (2)	1 (1)
Trigger Finger	3 (4)	3 (6)	6 (6.5
Epicondylitis	0	6 (13)	6 (6.5
Tendonitis	6 (9)	1 (2)	7 (8)
Tenosynovitis	3 (5)	0	3 (4)
Rotator Cuff/Supraspinatous Tendinitis	0	1 (2)	1 (1)
Myofascial/ Fibromyalgia Disorders	1 (2)	0	1 (1)
Other	5 (8)	2 (4)	7 (8)
Neuropathy/ Impingement Syndrome/ Neuritis/ Nerve Entrapment	3 (6)	3 (6)	7 (8)
Total Claimants Who Underwent Surgery[2]	44 (24)	42 (21)	86 (23)

[1] Diagnosis noted on file either on 1st, 2nd or 3rd medical report.
[2] Number obtained from Table 8. Numbers in this row are not a total of the numbers in the columns due to the possibility that one claimant could have more than one diagnosis recorded on their file.

(48.8%) of all male occupational RSI claimants had recovered within the first 4 weeks of the claim compared with a third (34.8%) of all female occupational RSI claimants. During the second month of time loss (21 - 40 working days), 22.9% of women compared with 12.8% of men returned to work during this time. After the second month of time loss (41 + working days), men and women were equally represented (38.4% of male occupational RSI claimants vs. 42.3% of female occupational RSI claimants). This overall pattern of gender differences in time loss was significant ($X^2 = 19.62$, $p < .05$).

TABLE 11 AVERAGE TIME LOSS BY GENDER

AVERAGE TIME LOSS (Working Days)	FEMALE	MALE
Total Time Loss	76.8	66.5
Time on Claims[1]	71.3	62.6
Time on Rehabilitation - All Claims	5.5	3.9
- Only Claims with Rehab Time[2]	114.4	138.7

1 Time on claims benefit would include surgery.
2 There were only 9 RSI claims with rehabilitation costs

TABLE 12 SAMPLE WEIGHT GROUPING MEAN TIME LOSS BY GENDER

SAMPLE WEIGHT GROUP (# of claims)	MEAN TIME LOSS (days)	
	Female	Male
1 (251) *	71.0	65.2
2.48 (21)	103.6	99.3
3.34 (15)	104.7	62.4
3.58 (8)	39.0	27.2

* p< 0.05

GRAPH 4

TIME LOSS BY GENDER

* p<0.025

** p<0.01

TABLE 13 TIME LOSS BY GENDER

TIME LOSS Working Days	ESTIMATED # RSI CLAIMS		ESTIMATED % RSI CLAIMS	
	F	M	F	M
0 - 5 **	18	41	9.9	20.8
6 - 10	24	17	13.2	8.8
11 - 15	11	24	5.9	12.1
16 - 20	11	14	5.9	7.1
21 - 40 *	42	25	22.9	12.8
41 - 60	16	15	9.0	7.8
61 - 120	28	23	15.0	11.6
121 +	34	38	18.4	19.0
TOTAL	184	197	100.2	100.0

* p <.025

** p <.01

IV.5.2 Claim Cost

Tables 14, 15 and 16 examine the claim costs by gender. While the average men's occupational RSI claim cost appears to be higher than women's ($6028.55 vs. $5075.17), the difference was not statistically significant.

TABLE 14 AVERAGE CLAIM COST BY GENDER

TYPE OF COST	AVERAGE DOLLAR COST	
	FEMALE	MALE
Total Cost	5075.17	6028.55
Medical Costs	760.00	546.57
Wage Loss Recovery Costs	3998.14	4898.55
Rehabilitation Costs - All Claims	317.03	583.43
- Only Claims with Rehab Costs[1]	6618.60	21038.48

[1] There were only 9 RSI claims with rehabilitation costs

The distribution of total claims costs (Table 15) when examined by gender was also not statistically significant.

TABLE 15
MEAN CLAIMS COSTS OF SAMPLE WEIGHT GROUP BY GENDER

SAMPLE WEIGHT GROUP (# of claims)	MEAN DOLLAR COST	
	Female	Male
1 (251)	4694.17	5309.76
2.28 (21)	8465.78	9999.92
3.34 (15)	5754.17	6839.44
3.58 (8)	1402.67	2877.20

TABLE 16 TOTAL CLAIMS COST BY GENDER

TOTAL COST OF CLAIM (Dollars)	ESTIMATED # RSI		PERCENTAGE	
	F	M	F	M
0 - 500	36	36	19.5	18.4
501 - 1000	20	28	10.9	14.0
1001 - 2000	29	33	15.7	16.6
2001 - 3000	26	12	14.3	5.9
3001 - 4000	10	14	5.4	7.3
4001 - 5000	13	7	7.1	3.5
5001 - 6000	9	10	4.9	5.2
6001 - 10,000	19	24	10.6	12.1
10,001 - 20,000	9	18	4.9	9.3
20,001 +	12	15	6.7	7.7
TOTAL	183	197	100	100

IV.5.3 Claim Outcome

Another measure of injury severity is the final outcome of the injury claim. Table 17 shows the return to work status for each gender. Although more men than women had returned to some form of employment at the time of the file review (86.8% vs. 79.5%), the difference was not significant. Of these, all except one returned to work with their preaccident employer. Of the 21 occupational RSI claimants who could not return to work, thirteen (4% of all female and 2% of all male RSI claimants) could not return due to their disability arising from their injuries. Due to the small numbers, the difference was not significant.

TABLE 17 RETURN TO WORK STATUS BY GENDER

RETURN TO WORK STATUS	ESTIMATED # OF RSI		ESTIMATED % OF RSI	
	F	M	F	M
Return to Work - total	145	172	79.5	86.8
- Same Job	123	133	67.0	67.5
- Modified job	20	31	11.1	15.5
- Different job	2	7	2.1	3.3
- Different Employer	0	1	-	0.5
Not Return to Work - Total	13	10	7.3	4.8
- Due to injury	7	4	3.8	2.0
- Due to Economy	6	4	3.5	2.3
- Voluntary Retirement	0	1	-	0.5
Still on Benefits/ Other	7	4	3.8	2.0
Can't Determine	17	13	9.4	6.4
TOTAL	182	198	100.00	99.99

IV.5.4 Workers Compensation Involvement

Table 18 examines the type of compensation benefits provided to the RSI claimants by the Workers Compensation Board. Again, no significant differences were observed between the genders. Small proportions of male and female occupational RSI claimants received rehabilitation benefits and assistance, in addition to wage loss recovery and medical aid benefits.

TABLE 18 TYPE OF WCB BENEFIT RECEIVED BY GENDER

TYPE OF WCB INVOLVEMENT	# ESTIMATED RSI		PERCENTAGE	
	F	M	F	M
Wage Loss Recovery and/or Medical Aid Only	168	184	91.4	93
Additional Involvement- total	16	14	8.6	7
- Rehab	15	11	8.1	5
- Pension	1	2	0.5	1
- Other	0	1	-	1
TOTAL	184	198	100.00	100.00

V. DISCUSSION

This cross-sectional study, using data obtained from a manual file review of 1991 workers compensation claims, described and compared the occurrence of occupational RSI in Manitoba with respect to gender. This research found very few differences between the genders.

V.1 Incidence Rates

Contrary to the findings from a number of recent workers compensation-based studies (Table 19) there were no significant differences found in the overall provincial

TABLE 19
OVERALL MALE AND FEMALE INCIDENCE RATES FOR VARIOUS RSI STUDIES

Authors	Data source	Incidence Rates (/10,000) F	M	Female/Male Rate Ratio
Franklin et al, 1991 (CTS only)	Washington State WCB claim data	19.6	15.8	1.24
Peipins, 1996 (CTS only)	BLS 1992 Annual Survey of Occupational Injury and Illnesses	7.7	3.0	2.03
Tanaka et al, 1988	Ohio state WCB data 1980-84	4.1	2.3	1.78
Frazier & Loomis, 1996	North Carolina WCB data		0.88	N.A.
Ashbury, 1995	Ontario WCB data 1986-1991	6.7	4.6	1.46
Gun, 1990	Australia Bureau of Statistics 1980/81 to 1986/87.	2.6	1.4	1.86
Present	Manitoba 1991 WCB data	7.9	7.3	1.04

occupational RSI rates between men and women. However, the magnitude of the incidence rates were within similar range of other studies' findings.

Only in a limited number of industry and occupation categories did the occupational RSI rates differ significantly between the genders. Significant gender differences in occupational RSI claim rates were found within only two industry groupings (meat & poultry industry and government service industry) and within only three occupational groupings (the processing occupations; the product fabrication, assembling and repairing occupations; and the construction trade).

There are several possible explanations for the failure to find differences in occupational RSI rates between the genders. The power of the study may not have been sufficient to detect small differences, due to the small number of 1991 RSI claims (384). Alternatively, Manitoba may have a different gender employment pattern compared to elsewhere. Men and women in this province may be more equally employed in those jobs which are at higher risk for occupational RSIs. Or, proportionately more Manitoba men than women may be covered by workers compensation or may be reporting their occupational RSI conditions.

Within most industrial or occupational groupings, women had higher occupational RSI rates than men. Only in the product fabricating, assembling and repairing occupations were men found to have a statistically significant higher rate of occupational RSIs than women. Again, most likely due to the small number of RSI claims in many of the industry and occupational categories, most gender differences did not reach statistical significance.

Although this study did not find the expected gender differences in occupational RSI rates, Manitoba industries and occupations with elevated rates for occupational RSI claims mirrored those high risk industries and occupations found in other studies. People working in the manufacturing industries and occupations, specifically process, fabricating and assembling subclassifications, reported the highest rates of occupational RSIs for both men and women (Jensen et al 1983, Ross 1985, Tanaka et al 1988; Gun 1990; Franklin et al 1991; Ashbury 1995; Frazier and Loomis 1996).

Although some of the industries and occupations known to employ large numbers of women, such as nursing homes, retail grocery stores, restaurants and offices, are thought to be associated with RSI, this study found very low rates of occupational RSI. This may be reflective of the wide diversity of occupations and task assignments within these classifications. As well, these industries and occupations generate high numbers of occupational RSI claims as the number of workers employed in these industries is large, thus producing a false impression of a strong association.

The rates varied across the various industries and occupations. In fact, greater variations in occupational RSI rates were found among the various industries and occupations than between genders within occupation or industry. Consistent with Gun (1990), the female to male incidence rate ratios varied widely between the different occupations and industries. These results support the hypothesis that the working environment has a greater influence than gender in precipitating occupational RSI disorders. However, studies which examine greater details of the work activities are needed to test this hypothesis further.

V.2 Other Gender Differences

It was hypothesized that men's and women's experience with occupational RSI would be different. This study found that, overall, men's and women's experiences with occupational RSI were remarkably similar, with significant differences being found only for the body part injured and time loss.

V.2.1 Body Part

Men were more likely than women to sustain an occupational RSI injury to the shoulder, elbow, or arm, while more women than men experienced injuries to the wrist. These differences most likely reflect the different type of work men and women perform. Men are more likely to be working in positions where upper arms are raised above shoulder height or repetitively lifting weights in movements which place stress on the elbows.

Champion and other (1986) also found that more men than women had epicondylitis, supporting this finding of this study. However, in contrast with the present study, Viikari-Juntura's (1983) found that women experienced more shoulder problems than did men. Viikari-Juntura's study was of one workplace, a slaughter house, and the work required there may require fewer task activities, thus explaining the different findings.

V.2.2 Injury Severity

In this study time loss and return to work status were used as a measure of injury severity. Women were more likely to experience longer time loss due to their RSIs than were men. This difference was observed for all sample groups when analysed to account for sample weight, with the difference in the largest sample group reaching statistical significance. The other three groups constituted only a very small number of the total identified RSI claims (15% of the identified RSI claims or a total 44 claims) resulting in sample sizes too small to detect small gender differences.

The gender difference found in 85% of the claims confirmed the findings of others which indicate that women experience longer time loss for occupational RSI claims than men (Ashbury 1995, Crook and Moldofsky 1994, Cheadle 1993). However, this study found that the greater time loss in women only occurred in the first eight weeks of recovery. Significantly more men returned to work within the first week of the injury, but by the end of the second month the proportion of male and female occupational RSI claimants recovered were similar. Men and women were equally represented in the longer term time loss occupational RSI claims.

While time loss has commonly been used as an indicator for injury severity, there are a number of problems with this. First, many workers who return to work after an initial occupational RSI injury frequently require further work absences (Yassi et al 1996; Baldwin et al 1996; Oleinick et al 1993). Short term follow-ups may be underestimating the true time loss. In this study, however, the file review was conducted in 1993, increasing the chances of capturing subsequent time loss recurrences. Any recurrence of a previously accepted WCB injury is compensated and recorded on the initial claim file.

A more serious problem with using time loss as a measure of injury severity is that there are many factors not related to physical recovery which influence the length of time a person receives compensation benefits. Several studies have found that other non medical factors such as availability of work, employers' willingness to accommodate a recovering worker, and the education, income and marital status of the injured worker, have an impact on disability and recovery time (Baldwin et al 1996; Cunningham and Kelsey 1984). Married men have been found to return to work sooner, and married women later, than their single counterparts; and injured workers with lower income and education have been found to take longer to return to work (Baldwin et al 1996).

It is possible that more household and child rearing responsibilities at home could be delaying the recovery time for women in this study. While women generally have lower earnings than men, the lack of financial resources available to deal with the injury and disability should not be a factor in this study, as the WCB pays all expenses arising from compensable injuries. It may be that unknown socioeconomic factors may be operating here. Women's longer time loss may be due to the types of jobs women have. For example, they may have fewer accommodating employers or less task flexibility to accommodate the recovering worker. Qualitative methods, such as obtaining the worker's account of the impact of their injury on their lives, would provide an alternative measure of injury severity and may assist in explaining women's longer recovery time.

As reported previously (Yassi et al 1996), the majority of all occupational RSI claimants recovered sufficiently to return to work. While more men (87%) than women (79%) were able to return to work, these differences were not statistically significant.

The return to work status was determined by the last written notation on the file regarding work status. It was assumed that the work or disability state remained the same between the last file notation and the time of review. While this method may be more reliable than using cessation of claim benefits as a proxy for return to work, which is often used in studies using insurance data, chances of error still exist. The longer the time period between last notation on file and the assessment date, the greater the chance of work status change. A more accurate measure would have been to contact all claimants directly, but this would be costly.

V.2.3 Diagnosis

While previous studies (Champion et al 1986) found differences in RSI medical diagnosis between men and women, no differences were found in this study. However, some of the gender differences found in these earlier studies are diagnoses which relate to specific body parts such as the elbow, wrist, and shoulder. These are the same body parts found in this study to sustain RSIs at different frequencies by men and women.

For instance, Champion and colleagues' (1986) case study of long standing occupational RSIs found that proportionally more men had epicondylitis than women, while this study found proportionately more men experienced RSIs to their elbow.

Carpal tunnel syndrome, a condition known to affect women in greater numbers than men (Armstrong and Chaffin 1979, Stevens et al 1988, Delgrosso and Boillat 1991, Miller et al 1994) was found to affect both men and women in equal proportions in this study. This unusual finding lends support to the position that environmental factors, rather than biological factors, play a large role in the development of occupational RSI gender differences.

Studies comparing the medical treatment received by men and women for other conditions demonstrated differing and less aggressive treatment for women (Chiriboga et al 1993; Young and Kahana 1993; Steingart et al 1991; Ayanian and Epstein 1991). Yet this study found no difference in the treatment received for their occupational RSI compensation conditions. Men and women attended specialists, received surgery and physiotherapy in proportionately the same numbers. Since compensation board physicians periodically review longer duration or more difficult cases to ensure that appropriate medical treatment is being provided, this routine review could be assisting in preventing any gender differences in medical treatment.

V.3 Limitations of This Study

The implications of this study are constrained by some of the data limitations. Workers compensation data represent only those individuals who have successfully established a claim. Employers have incentives to reduce workers compensation claims and workers may obtain benefits under other sickness and disability insurance. Workers compensation data are collected for insurance purposes, not for research or occupational health surveillance. Thus, recorded information is limited to codes relevant to a claim[2]. The number of workers employed with registered firms is not reported by age nor gender.

---

[2] Since this study was conducted advances have been made to the WCB coding system. Diagnositic codes are now being included.

As noted earlier, the calculated rates are likely an underestimation of the true occupational RSI rates in the population. Statistics Canada labour force employment data include full time, part time and temporary employees in addition to people not covered by the WCB. Furthermore, other studies (Fine et al 1984, Bueckert and Weninger unpublished) have demonstrated more occupational RSI disorders in the general working population than those reported to the WCB. It has been argued that using WCB occupational RSI data as a measure of injury rates is more a reflection of likelihood of a worker formally registering a claim (Hadler 1989). Further research to assess the extent of under-reporting of occupational RSIs in Manitoba is warranted[3].

Complete and accurate data, directed by the researcher's hypotheses on the populations at risk, are required. In order to appropriately compare gender differences,

---

[3] A study to assess the amount of under-reporting to the WCB of occupational RSI was initially proposed as part of this thesis. It was proposed that using CTS as a proxy for all occupational RSIs, CTS rates by gender in the general population of Manitoba could be obtained from the Manitoba Health Services Insurance Plan database and compared to WCB based CTS rates. Using results from a survey reported in MMWR 1989 of the estimated rate of CTS which are of occupational origin (between 31% and 55% with an overall average of 47%), Manitoba's estimated number of CTS of occupational origin for 1991 could be derived from the general population rates. This number could then be compared to the actual number of CTS found in order to make some comments on the accuracy and completeness of the Manitoba WCB data. However, since CTS is a four digit code in the Manitoba Health Insurance Plan, but physician claims are coded to the third digit only, this portion of the research could not be undertaken without additional research to estimate the number of CTS in treatment in the Manitoba health care system.

complete and accurate numbers in the populations at risk are required. The precise number of employees, subdivided by job classification and by gender, is required. Moreover, there is significant diversity in the number of hours worked by gender and occupations. Women tend to work more part time than do men and this variation needs to be identified to calculate exposure accurately (Messing et al 1994).

Given the unexpected findings of very few occupational RSI rate differences between the genders, caution must be exercised in extrapolating the results of this study to other geographic areas outside Manitoba. Manitoba has a labour force population base of just over half a million workers. The manufacturing industry, the highest risk industry for occupational RSI, employs a proportionately small number of workers in Manitoba. Farming and related agriculture industry is a major industry in this province. Manitoba also has a very small number of large employers, the majority of which are public sector employers.

V.4 Implications

Knowing the demographic characteristics of persons with occupational RSI is useful for developing prevention strategies and in assessing future health care needs. The variations seen in rates among industries and occupations as well as between genders indicates that preventive intervention programs in equipment and/or work processes are needed. Occupations in which women have historically had lower participation rates, such as construction trades, and perhaps a poorer fit between the worker and tools, will likely require tool modification to reduce the larger gender disparity in occupational RSI rates (Peipins et al unpublished). Changes in employment patterns in high risk industries and occupations could impact on future health care utilization, the number of RSI compensation claims and compensation costs to employers.

This study also suggests the need for compensation policies which encourage task flexibility to accommodate recovering workers or provide incentives to employers to modify tools, equipment and work processes. The WCB databases and coding systems are designed for administrative purposes and the board's coding system was not amenable to the easy identification of RSIs. In response to repeated requests for the compensation boards to upgrade its occupational surveillance, the Manitoba WCB began coding diagnoses in 1996. While this coding addition should assist in identifying RSI claims, it will not identify all RSIs. The diagnosis code records the first diagnosis on file and many RSIs have the diagnosis of strain or sprain. A unique RSI code would facilitate tracking RSI claims.

The findings of this study are also useful in suggesting and evaluating etiologic hypotheses. However, to gain more insights into the factors responsible for the occupational RSI and the gender differences in incidence rates and experiences, additional gender specific research is required, including qualitative approaches (Messing 1992). Thus, while this research has added to the world of knowledge, as is always the case, much is left to be discovered in this area.

VI. BIBLIOGRAPHY

Aaras. A., R.H. Westgaard and E. Stranden. 1988. Postural angles as an indicator of postural load and muscular injury in occupational work situations. Ergonomics 31:6:915-933.

Adams, Michael, Gary Franklin, and Scott Barnhart. 1994. Outcome of carpal tunnel surgery in Washington State Workers Compensation. American Journal of Industrial Medicine; 25:4:527-536.

Adelman, A.M., and H. Koch. 1991. New visits for abdominal pain in the primary care setting. Family Medicine, 23:2: 122-126.

Armstrong Thomas J. 1986. Ergonomics and cumulative trauma disorders. Hand Clinics 2:3:553-565.

Armstrong, T.J. and D.B. Chaffin. 1979. Carpal tunnel syndrome and selected personal attributes. Journal of Occupational Medicine, 21:7:481-486.

Armstrong, Thomas J., and Barbara A Silverstein. 1987. Upper-Extremity Pain in the Workplace - Role of Usage in Causality. Clinical Concepts in Regional Musculoskeletal Illness, ed. Norton M. Hadler; Orlando:Grune & Stratton, Inc.: 333-354.

Armstrong, Thomas J., Peter Buckle, Lawrence J. Fine, Mats Hagberg, Bengt Jonsson, Asa Kilbom, Ilkka A.A. Kuorinka, Barbara A. Silverstein, Gisela Sjogaard, and Eira Viikari-Juntura. 1993. A conceptual model for work-related neck and upper-limb musculoskeletal disorders. Scandinavian Journal of Work, Environment and Health, 19:73-84.

Armstrong, Thomas J., Lawrence J. Fine, Steven A Goldstein, Yair R. Lifshitz and Barbara Silverstein. 1987. Ergonomics considerations in hand and wrist tendinitis. The Journal of Hand Surgery 12A: 5 (September): 830-837.

Armstrong, Thomas J., Robert G. Radwin, and Doan J. Hansen. 1986. Repetitive trauma disorders: Job Evaluation and Design. Human Factors 28:3:325-336.

Armstrong, Thomas J., James A. Foulke, Bradley S. Joseph, and Steven A Goldstein. 1982. Investigation of cumulative trauma disorders in a poultry processing plant. American Industrial Hygiene Association Journal, 43:2:103-116.

Arndt, Robert. 1987. Workplace, stress and cumulative trauma disorders. Journal of Hand Surgery, 12A:2:866-869.

Ashbury, Fredrick D. 1995. Occupational strain injuries and gender in Ontario, 1986 to 1991. Journal of Occupational and Environmental Medicine, 37:4:479-485.

Ayanian, John Z., and Arnold M. Epstein. 1991. Differences in the use of procedures between women and men hospitalized for coronary heart disease. The New England Journal of Medicine, 325:4:221-225.

Baldwin, Marjorie, William G. Johnson, and Richard J. Butler. 1996. The error of using returns-to-work to measure the outcomes of health care. American Journal of Industrial Medicine, 29:632-641.

Baron, S.L. and D. Habes. 1992. Occupational musculoskeletal disorders among supermarket cashiers. Scandinavian Journal of Work, Environment and Health, 18:Suppl 2:127-129.

Barnhart, Scott, Paul A. Demers, Mary Miller, W.T. Longstreth, Jr., and Linda Rosenstock. 1991. Carpal tunnel syndrome among ski manufacturing workers. Scandinavian Journal of Work, Environment and Health 17:46-52.

Beaton, Dorcas E., Claire Bonbardier, and Sheilah A Hogg-Johnson. 1996. Measuring health in injured workers: A cross-sectional comparison of five generic health status Instruments in workers with musculoskeletal injuries. American Journal of Industrial Medicine, 29:618-631.

Bell, David S. 1989. "Repetition strain injury": an iatrogenic epidemic of simulated injury. The Medical Journal of Australia, 151:280-283.

Bergenudd, Hans, Folke Lindgards, Bo Nilsson, and Claes J. Petersson. 1988. Shoulder pain in middle age. A study of prevalence and relation to occupational work load and psychosocial factors. Clinical Orthopaedics and Related Research, 231:234-238.

Bernard, Bruce, Steve Sauter, Lawrence Fine, Marin Petersen and Thomas Hales. 1994. Job task and psychosocial risk factors for work-related musculoskeletal disorders among newspaper employees. Scandinavian Journal of Work, Environment and Health, 20:417-426.

Birkbeck, M.Q. and T.C. Beer. 1975. Occupation in Relation to the Carpal Tunnel Syndrome. Rheumatology and Rehabilitation, 14:218-221.

Bjorkqvist, S.-E., A.H. Lang, R. Punnonen, and L. Rauramo. 1977. Carpal tunnel syndrome in ovariectomized women. Aeta Obstet Gynecol Scand, 56:127-130.

Black, Peter. 1987. Psychiatric aspects of regional pain syndrome. The Medical Journal of Australia, 147:257.

Blader, S., U. Barch-Holst, S. Danielsson, E. Ferhm, M. Kalpamaa, Leijon, M. Lindh, G Markhede, and B. Mikaelsson. 1987. Neck and shoulder complaints among sewing-machine operators. In Musculoskeletal Disorders at Work Proceedings of a conference held at The University of Surrey, Guildford 13-15 April 1987. Peter Buckle (ed), New York: Taylor & Francis. pp 110-111.

Blader, S., U. Barch-Holst, S. Danielsson, E. Ferhm, M. Kalpamaa, Leijon, M. Lindh, and G Markhede. 1991. Neck and shoulder complaints among sewing-machine operators. A study concerning frequency, symptomatology and dysfunction. Applied Ergonomics, 22:4:251-257.

Bleecker, Margit L. 1987. Medical surveillance for carpal tunnel syndrome in workers. The Journal of Hand Surgery, 12A:5, Pt 2:845-848.

Bloch, Bernard. 1984. Repetition strain injuries. Medical Journal of Australia, 147:257.

Brismar, Tom and Lean Ekenvall. 1992. Nerve conduction in the hands of vibration exposed workers. Electroencephalography and Clinical Neurophysiology, 85:173-176.

Brogmus, George E., Garry S. Sorock, and Barbara S. Webster. 1996. Recent trends in work-related cumulative trauma disorders of the upper extremities in the United States: An evaluation of possible reasons. Journal of Occupational and Environmental Medicine, 38:4:401-411.

Browne, Earl Z. and Clifford C. Snyder. 1975. Carpal tunnel syndrome caused by hand injuries. Plastic and Reconstructive Surgery, 56:41-43.

Bueckert, Lynn and Lois Weninger. Unpublished. Manitoba Repetitive Strain Injury Questionnaire Report. Women and work Research and Education Society, Vancouver, B.C., Canada. April, 1993.

Bureau of Labor Statistics. 1995. News. United States Department of Labor: Washington, D.C. USDL-95-142.

Cannon, Lawrence J. Edward J. Bernacki, and Stephen D. Walker. 1981. Personal and occupational factors associated with carpal tunnel syndrome. Journal of Occupational Medicine, 23:4:255-258.

Champion, G.D., J. Cornell, C.D. Browne, R. Garrick, T.J. Herbert. 1986. Clinical observations in patients with the syndrome"repetition strain injury. Journal of Occupational Health and Safety - Australia and New Zealand, 2:107-113.

Chatigny, Celine, Ana Maria Seifert, Karen Messing. 1995. Repetitive strain in nonrepetitive work: A case study. International Journal of Occupational Safety and Ergonomics, 1:1:42-51.

Chatterjee, D.S. 1987. Repetition strain injury - a recent review. Journal of Social Occupational Medicine 37:100-105.

Chatterjee, D.S. 1992. Workplace upper limb disorders: A prospective study with intervention. Occupational Medicine 42:129-136.

Cheadle, Allen, Gary Franklin, Carl Wolfagen, James Savarino, P.Y. Liu, Charles Salley, Marcia Weaver. 1994. Factors influencing the duration of work-related disability: A population based study of Washington State Workers Compensation. American Journal of Public Health; 84:2:190-196.

Chiang, Horn-Che, Yin-Ching Ko, Shun-Shen Chen, Hsin-Su Yu, Trong-Neng Wu, and Po-Ya Chang. 1993. Prevalence of shoulder and upper-limb disorders among workers in the fish-processing industry. Scandinavian Journal of Work Environment and Health, 19:126-131.

Chiriboga, D.E., J. Yarzebski, R.J. Goldber, A. Chen, J. Gurwitz, J.S. Alpert and J.E. Dalen. 1993. A community-wide perspective of gender differences and temporal trends in the use of diagnostic and revascularization procedures for acute myocardial infarction. The American Journal of Cardiology, 71: 4 (February 1): 268-273.

Cleland, Leslie G. 1987. "RSI": a model of social iatrogenesis. The Medical Journal of Australia 147:236-239.

Conn, Harold R. 1931. Tenosynovitis. Ohio State Medical Journal, 27:713-716.

Conrad, John C., Joy B. Osborn, Kathy J. Conrad, and Thomas C. Jetzer. 1990. Peripheral nerve dysfunction in practising dental hygienists. Journal of Dental Hygiene 64 (October):382-387.

Cornes, p. 1990. The vocational rehabilitation index: a guide to accident victims' requirement for return-to-work assistance. Int. Disability Stud., 12:32-36.

Courville, J., N. Vezina and K. Messing. 1992. Analyse des facteurs pouvant entrainer l'exclusion des femmes du tri des colis postaux. Le Travail humain 55:2:119-134.

Crook, J. and H. Moldofsky. 1994. The probability of recovery and return to work from work disability as a function of time. Quality of Life Research, 3: Suppl 1: S97-S108.

Cunningham, Linda S. and Jennifer L. Kelsey. 1984. Epidemiology of musculoskeletal impairments and associated disability. American Journal of Public Health 74:6:574-579.

Deaton, Dorcas E., Claire Bonbardier, and Sheilah A Hogg-Johnson. 1996. Measuring health in injured workers: A cross-sectional comparison of five generic health status Instruments in workers with musculoskeletal injuries. American Journal of Industrial Medicine, 29:618-631.

Dekel, S., T. Papaioannou, G. Rushworth, and R. Coates. 1980. Idiopathic carpal tunnel syndrome caused by carpal stenosis. British Medical Journal, 280: 6227 (May 31):1297- 1299.

de Krom, M.C.T.F.M., A.D.M. Kester, P.G. Knipschild and F. Spaans. 1990. Risk factors for carpal tunnel syndrome. American Journal of Epidemiology, 132:1102-1110.

Delgrosso, Ivano and Marcel-Andre Boillat. 1991. Carpal tunnel syndrome: role of occupation. International Archives of Occupational and Environmental Health 63:267-270.

Dennet, Xenia and Hunter John Hall Fry. 1988. Overuse syndrome: A muscle biopsy study. The Lancet, 1:905-908

Deves, Leigh and Robert Spillane. 1989. Occupational Health, stress, and work organization in Australia. International Journal of Health Services 19:2:351-363.

Dieck, G.S., and J.L. Kelsey. 1985. An epidemiologic study of the carpal tunnel syndrome in an adult female population. Preventive Medicine, 14:63-69.

Dimberg, Lennart. 1987. The prevalence and causation of tennis elbow (lateral humeral epicondylitis) in a population of workers in an engineering industry. Ergonomics, 30:3:573-580.

Dimberg, Lennart, Ari Olafsson, Eythor Stefansson, Hans Aagaard, Anders Oden et al. 1989. The Correlation between Work Environment and the Occurrence of Cervicobrachial Symptoms. Journal of Occupational Medicine, 31:5:447-453.

English, C.J., W.M. Maclaren, C. Court-Brown, S.P.F. Hughes, R.W. Porter, W.A. Wallace, R.J. Graves, A.J. Pethick and C.A. Soutar. 1995. Relations between upper limb soft tissue disorders and repetitive movements at work. American Journal of Industrial Medicine, 27:75-90.

Falck, Bjorn and Perttl Aarnio. 1983. Left-sided carpal tunnel syndrome in butchers. Scandinavian Journal of Work Environment and Health, 9:291-297.

Farkkila, M., I. Pykko, V. Jantti, S. Aatola, J. Starck, and O. Korhonen. 1988. Forestry workers exposed to vibration: A neurological study. British Journal of Industrial Medicine, 45:188-192.

Feldman, Robert G., Rose Golman, and W. Monroe Keyserling. 1983. Peripheral nerve entrapment syndromes and ergonomic factors. American Journal of Industrial Medicine 4:661-681.

Feldman, Robert G., Patrician Hyland Travers, Jeannette Chirico-post, and W. Monroe Keyserling. 1987. Risk assessment in electronic assembly workers: Carpal tunnel syndrome. Journal of Hand Surgery, 12A:2 Pt 2:849-855.

Ferguson, David A. 1987. "RSI": putting the epidemic to rest. The Medical Journal of Australia 147:213-214.

Ferguson, David. 1984. The "new" industrial epidemic. The Medical Journal of Australia (March 17):318-319.

Ferguson. David. 1971. Repetition injuries in process workers. The Medical Journal of Australia, 2:408-412.

Fine L.G., L. Punnet, and W.M. Keyserling. 1987. An epidemiologic study of postural risk factors for shoulder disorders in industry. In Musculoskeletal Disorders at Work Proceedings of a conference held at The University of Saurrey, Guildford 13-15 April 1987. Peter Buckle (ed), New York: Taylor & Francis. pp 108-109.

Fine, Lawrence J., Barbara A Silverstein, Thomas J. Armstrong and Charles A Anderson. 1984. An alternative way of detecting cumulative trauma disorders of the upper extremities in the workplace. In Proceedings of the 1984 International Conference on Occupational Ergonomics, Human Factors Association, Attwood, D.A. and C. McCann (eds), International Conference on Occupational Ergonomics: Toronto: Ontario.pp 425-429.

Flowedrew, R.E. and O.B. Bode. 1942. Tenosynovitis in Untrained Farm-workers. British Medical Journal, 2:367.

Franklin, Gary M., Joanna Haug, Nicholas Heyer, Harvey Checkoway, and Neil Peck. 1991. Occupational carpal tunnel syndrome in Washington State, 1984-1988. American Journal of Public Health 81:6:741-746.

Fry, Hunter J. H. 1986a. Overuse syndrome in musicians: Prevention and management. The Lancet (September 27):728-731.

Fry, Hunter J.H. 1986b. Overuse syndrome in musicians - 100 years ago. An historical review. The Medical Journal of Australia, 145:620-625.

Gerr, Fredric, Richard Letx, and Philip J. Landrigan. 1991. Upper-extremity musculoskeletal disorders of occupational origin. Annual Review of Public Health 12:543-566.

Goldstein, Steven A., Thomas J. Armstrong, Don B. Chaffin, and Larry S. Matthews. 1987. Analysis of cumulative strain in tendons and tendon sheaths. Journal of Biomechanics, 20:1:1-6.

Gould, John S. and H. Andrew Wissinger. 1978. Carpal tunnel syndrome in pregnancy. Southern Medical Journal, 71:2:144-145.

Green, Rodney A., and Christopher A. Briggs. 1989. Effect of overuse injury and the importance of training on the use of adjustable workstations by keyboard operators. Journal of Occupational Medicine, 31:6:557-562.

Guidotti, Tee L. 1992. Occupational repetitive strain injury. American Family Physician 45:2:585-592.

Gun, Richard T. 1990. The incidence and distribution of RSI in South Australia 1980-81 to 1986-87. The Medical Journal of Australia 153:(October 1):376-380.

Hadler, Nortin M. 1990. Cumulative trauma disorders. An iatrogenic concept. Journal of Occupational Medicine 32:1:38-41.

Hadler, Nortin M. 1985. Illness in the workplace: The challenge of musculoskeletal symptoms. The Journal of Hand Surgery, 10A:4:451-456.

Hadler, Nortin. 1996. A keyboard for "Daubert". Journal of Occupational and Environmental Medicine. 38:5:469-476.

Hadler, Nortin. 1993. Arm pain in the workplace. Bulletin on the Rheumatic Diseases; 42:8:6-8.

Hadler, Nortin. 1992. Arm pain in the workplace. A small area analysis. Journal of Medicine (February): 113-119.

Hadler, Nortin M. 1989. The roles of work and of working in disorders of the upper extremity. Bailliere's Clinical Rheumatology, 3:1:121-141.

Hadler, Nortin M. 1986. Industrial rheumatology. The Australian and New Zealand experiences with arm pain and backache in the workplace. The Medical Journal of Australia 144:191-195.

Hagberg, Mats. 1992. Exposure variables in ergonomic epidemiology. American Journal of Industrial Medicine 21:91-100.

Hagberg, Mats, B. Silverstein, R. Wells, M.J. Smith, H. W. Hendrick, P. Carayon, M. Perusse. 1995. In Work Related Musculoskeletal Disorders (WRMSDs): A Reference Book for Prevention. Ilkka Kuorinka and Lina Forcier Eds. London: Taylor & Francis: 5-184.

Hagberg, Mats, Hal Morgenstern and Michael Kelsh. 1992. Impact of occupations and job tasks on the prevalence of carpal tunnel syndrome. Scandinavian Journal of Work, Environment and Health, 18:337-345.

Hagberg, M. and D.H. Wegman. 1987. Prevalence rates and odds ratios of shoulder-neck diseases in different occupational groups. British Journal of Industrial Medicine 44:602-610.

Hall, Wayne, and Louise Morrow. 1988. Repetition strain injury: an Australian epidemic of upper limb pain. Social Science and Medicine, 27:6:645-649.

Hanrahan, Lawrence P. and Michael B. Moll. 1989. Injury surveillance. American Journal of Public Health 79:Supplement:38-45.

Harber, Philip, Laura Pena, Gerard Bland and Hohn Back. 1992b. Upper extremity symptoms in supermarket workers. American Journal of Industrial Medicine 22:873-884.

Hassard, Thomas H. 1991. Understanding Biostatistics. Mosby Year Book:Toronto.

Helliwell, P.S., D.B. Mumford, J.E. Smeathers, and V. Wright. 1992. Work related upper limb disorder: the relationship between pain, cumulative load, disability, and psychological factors. Annals of the Rheumatic Diseases, 51:1325-1329.

Herberts, P. F. Kadefors, C. Hogfors and G. Sigholm. 1984. Shoulder pain and heavy manual labor. Clinical Orthopaedics and Related Research, 191:166-178.

Herberts, Peter, Roland Kadefors, Gun Andersson and Ingemar Petersen. 1981.

Shoulder pain in industry: An epidemiological study on welders. Acta Orthopeapica Scandinavica; 52:299-306.

Herring, Stanley A. and Karen L. Nilson. 1987. Introduction to overuse injuries. Clinics in sports Medicine, 6:2:255-239.

Himmelstein, J.S., M.Feuerstein, E.J. Stanek III, K. Koyanatsu, G.S. Pransky, W. Morgan, K.O. Anderson. 1995. Work-related upper-extremity disorders and work disability: Clinical and psychosocial presentation. Journal of Occupational and Environmental Medicine, 37:11:1278-1286.

Hochberg, Fred H. Robert D Leffert, Matthew D Heller and Lisle Merriman. 1983. Hand difficulties among musicians. Journal of American Medical Association, 249:14:1869-1872.

Hopkins, Andrew. 1990a. The social recognition of repetition strain injuries: An Australian/American comparison. Social Science and Medicine, 30:3:365-372.

Hopkins, Andrew. 1990b. Stress, the quality of work, and repetition strain injury in Australia. Work and Stress , 4:2:129-138.

Howard, Nelson J. 1937. Peritendinitis crepitans. The Journal of Bone and Joint Surgery, XIX:2:447-459.

Hymovich, Leo and Miriam Lindholm. 1966. Hand, srist, and forearm injuries. The result of repetitive motions. Journal of Occupational Medicine, 8:11:573-577.

Ireland, Damlan C.R. 1986. Repetitive strain injury. Australian Family Physician, 15:4:415418.

Isernhagen, Susan J. 1992. Principles of prevention for cumulative trauma. Occupational Medicine: State of the Art Reviews 7:1:147-153.

Jensen, Roger C., Bruce P. Klein, and Lee M. Sanderson. 1983. Motion-related wrist disorders traced to industries, occupational groups. Monthly Labor Review,106:13-16.

Johnson, Ernest W., Timothy Gatens, David Poindexter, and David Bowers. 1983. Wrist dimensions: Correlation with median sensory latencies. Archives of Physical Medicine Rehabilitation, 64:556-557.

Jonsson, B.G., J. Persson and A. Kilbom. 1988. Disorders of the cervicobrachial region among female workers in the electronics industry. A two-year follow up. International Journal of Industrial Ergonomics, 3:1-12.

Jung, Y. T.C. Hohmann, J.A. Gerneth, J. Novak, R.C. Wasserman, B.J. D'Andrea, R.H. Newton, and T.S. Danowski. 1971. Diabetic hand syndrome. Metabolism, 20:11:1008-1015.

Kandrack, Mary-Anne, Karen R. Grant, and Alexander Desgall. 1991. Gender differences in health related behaviour: Some unanswered questions, Social Science and Medicine, 32:5: 579-590.

Kivi, Pertti. 1982. The etiology and conservative treatment of humeral epicondylitis. Scandinavian Journal of Rehabilitation Medicine, 15:37-41.

Knave, Bengt G., Roger I. Wibom, Margaretha Voss, Lards D. Hedstrom and Ulf O.V. Bergquist. 1985. Work with video display terminals among office employees. 1. Subjective symptoms and discomfort. Scandinavian Journal of Work, Environment and Health 11:457-466.

Korrick, Susan, Kathleen Rest, Letitia Davis, and David Christiani. 1994. Use of state Workers Compensation data for occupational carpal tunnel syndrome surveillance: A feasibility study in Massachusetts. American Journal of Industrial Medicine; 25:6:837-850.

Kroemer, K.H.E. 1992. Avoiding cumulative trauma disorders in shops and offices. American Industrial Hygiene Association Journal 53:596-604.

Kuorinka, Ilkka, and Paavo Koskinen. 1979. Occupational rheumatic diseases and upper limb strain in manual jobs in a light mechanical industry. Scandinavian Journal of Work, Environment and Health, 5:suppl 3:39-47.

Kurppa, Kari, Pekka Waris, and Pentti Rokkanen. 1979. Peritendinitis and tenosynovitis. A review. Scandinavian Journal of Work, Environment and Health, 5:suppl. 3:19-24.

Kurppa, Kari, Eira Viikari-Juntura, Eeva Kuosma, Matti Huuskonen and Pertti Kivi. 1991. Incidence of tenosynovitis or peritendinitis and epicondylitis in a meat-processing factory. Scandinavian Journal Work, Environment and Health 17:32-37.

Kvarnstrom, Sven. 1983. Occurrence of musculoskeletal disorders in a manufacturing industry with special attention to occupational shoulder disorders. Scandinavian Journal Rehabilitation Medicine, Supp. 8:2-35.

Lam, S,J,S. 1995. Repetitive strain injury (RSI) or cumulative trauma disorder (CTD) as legal and clinical entities. The need for a total reappraisal of this concept as being occupationally caused and therefore compensatable. Medical Science Law, 35:4:279-

286.

Lamson, C. 1986. On the line: Women and fish plant jobs in Atlantic Canada. Relations Industrielles, 41:145-157.

Leach, Robert E., and John A. Odom. 1968. Systemic causes of carpal tunnel syndrome. Postgraduate Medicine , 44:127-131.

Linton, Steven, and Kitty Kamwendo. 1989. Risk factors in the psychosocial work environment for neck and shoulder pain in secretaries. Journal of Occupational Medicine 31:7 (July): 609-613.

Liss, Gary M., Crystal Armstrong, Robert A. Kusiak, and Maris M. Gailitis. Use of provincial health insurance plan billing data to estimate carpal tunnel syndrome morbidity and surgery rates. American Journal of Industrial Medicine 22:395-409.

Littlejohn, Geoffrey O. and Marian H. Miller. 1986. Repetitive strain injury: divide and conquer. Australian Family Physician, 15:4:409-413.

Lucire, Yolande. 1986. Neurosis in the workplace. The Medical Journal of Australia, 145:323-327.

Luopajarvi, Tuulikki, Ilkka Kuorinka, Markku Virolainen, and Mia Holmberg. 1979. Prevalence of tenosynovitis and other injuries of the upper extremities in repetitive work. Scandinavian Journal of Work, Environment and Health, 5: suppl 3:48-55.

Mackinnon, Susan E. and Christine B. Novak. 1994. Clinical commentary: Pathogenesis of cumulative trauma disorder. The Journal of Hand Surgery, 19A:5:873-883.

Maeda, Katsuyoshi, Shun'ichi Horiguchi, and Migiwa Hosokawa. 1982. History of the studies on occupational cervicobrachial disorder in Japan and remaining problems. Journal of Human Ergology, 11:17-29.

Maeda Katsuyoshi. 1977. Occupational cervicobrachial disorder and its causative factors. Journal of Human Ergology, 6:193-202.

Margolis, Wendy and Jess F. Kraus. 1987. The prevalence of carpal tunnel syndrome symptoms in female supermarket checkers. Journal of Occupational Medicine, 29:12:953-956.

Marcus, Michele, and Fredric Gerr. 1996. Upper extremity musculoskeletal symptoms among female office workers: Associations with video display terminal use and occupational psychosocial stressors. American Journal of Industrial Medicine, 29:161-170.

Masear, Victoria R., James M. Hayes, and Arthur G. Hyde. 1986. An industrial cause of carpal tunnel syndrome. The Journal of Hand Surgery, 11A:2:222-227.

Massey, E. Wayne. 1978. Carpal tunnel syndrome in pregnancy. Obstetrical and Gynaecological Survey, 33:3: 145-148.

McCann, V.J. and R.E. Davis. 1978. Carpal tunnel syndrome, diabetes and pyridoxal. Australian and New Zealand Journal of Medicine, 8:638-640.

McDermott, Francis. 1986. Repetition strain injury: a review of current understanding. The Medical Journal of Australia 144: (February 17): 196-200.

Meekosha, H. and A. Jakubowicz. 1986. Women suffering RSI: the hidden relations of gender, the labour process and medicine. Journal of Occupational Health and Safety - Australia and New Zealand, 2:390-401.

Mergler, Donna, Carole Brabant, Nicole Vezina, and Karen Messing. 1987a. The weaker sex? Men in women's working conditions report similar health symptoms. Journal of Occupational Medicine, 29:5:417-421.

Mergler, Donna, Nicole Vezina, and Carole Brabant. 1987b. An analysis of women and men's reported work activity in poultry slaughterhouses and health outcomes. Proceedings of the Annual Conference of the Human Factors association of Canada/Comptes-renus du congres annuel de l'association candienne d'ergonomie. p19-22.

Messing, Karen 1992. Introduction: Research directed to improving women's occupational health. Women and Health, 18:3:1-9.

Messing, Karen. 1991. Occupational Safety and Health Concerns of Canadian Women: A Background Paper, Ottawa: Minister of Supply and Services Canada. Labour Canada Catalogue Number: L016-1748/91E.

Messing, Karen, Julie Courville, Micheline Boucher, Lucie Dumais, Ana Maria Seifert. 1994. Can safety risks of blue-collar jobs be compared by gender? Safety Science, 18:95-112.

Messing, Karen, Ghislaine Doniol-Shaw, and Chantal Haentjens. 1993. Sugar and spice and everything nice: Health effects of the sexual division of labor among train cleaners. International Journal of Health Services, 23:1:133-146.

Messing, Karen and Jean-Pierre Reveret. 1983. Are women in female jobs for their health? A study of working conditions and health effects in the fish-processing industry in Quebec. International Journal of Health Service, 13:4:635-647.

Miller, Marian H. and Duncan J. Topliss. 1988. Chronic upper limb pain syndrome (repetitive strain injury) in the Australian workforce: A systematic cross sectional rheumatological study of 229 patients. The Journal of Rheumatology 15:11: 1705-1712.

Miller, R.S., D.C. Iverson, R.A. Fried, L.A. Green and P.A. Nutting. 1994. Carpal tunnel syndrome in primary care: A report from ASPN. The Journal of Family Practice, 38:4:337-344.

Moore, A., R. Wells, and D. Ranney. 1991. Quantifying exposure in occupational manual tasks with cumulative trauma disorder potential. Ergonomics 34:12:1433-1453.

Moore, J. Steven. 1992a. Carpal tunnel syndrome. Occupational Medicine: State of the Art Reviews 7:4:741-763.

Moore, J. Steven. 1992b. Function, structure, and responses of Components of the Muscle-Tendon Unit. Occupational Medicine: State of the Art Reviews 7:4:713-740.

Moore, J. Steven and Arun Garg. 1994. Upper extremity disorders in a pork processing plant: Relationships between job risk factors and morbidity. American Industrial Hygiene Association Journal, 55:8:703-715.

Morgenstern, Hal, Michael Kelsh, Jess Kraus, and Wndy Margolis. 1991. A cross-sectional study of hand/wrist symptoms in female grocery checkers. American Journal of Industrial Medicine 20:209-218.

Mulder, Donald W., Edward H. Lamber, James A Bastron, and Randall G. Sprague. 1961. The neuropathies associated with diabetes mellitus. Neurology, 11:4:275-284.

Nathan, P.A., R.C. Keniston, K.D. Meadows, and R.S. Lockwood. 1996a. Re: prevalence and work relatedness of self-reported carpal runnel syndrome among U.S. workers. American Journal of Industrial Medicine. 30:500-501.

Nathan, Peter A., Richard C. Keniston, Richard S. Lockwood, and Kenneth D. Meadows. 1996b. Tobacco, caffeine, alcohol, and carpal tunnel syndrome in American industry. Journal of Occupational and Environmental Medicine, 38:3:290-298.

Nathan, P.A., K. Talogawa. R.C. Keniston, K.D. Meadows, and R.S. Lockwood. 1994.

Slowing of sensory conduction of the median nerve and carpal tunnel syndrome in Japanese and American industrial workers. The Journal of Hand Surgery, 19B:1:30-34.

Nathan, Peter A., Richard C. Keniston, Kenneth D. Meadow, and Richard S Lockwood. 1993. Validation of occupational hand use categories. Journal of Occupational Medicine, 35:10:1034-1042.

Nathan, Peter A., Richard C. Keniston, Lee D Myers, and Kenneth D. Meadows. 1992. Longitudinal study of median nerve sensory conduction in industry: Relationship to age, gender, hand dominance, occupational hand use, and clinical diagnosis. The Journal of Hand Surgery, 17A:5:850-857.

Nathan, P.A., K.D. Meadows and Linda S. Doyle. 1988. Occupational as a risk factor for impaired sensory conduction of the median nerve at the carpal tunnel. The Journal of Hand Surgery 13B[2 Pt 2]:167-170.

Nilsson, T., M. Hagberg. L. Burstrom, and S. Kihlberg. 1994. Impaired nerve conduction in the carpal tunnel of platers and truck assemblers exposed to hand-arm vibration. Scandinavian Journal of Work, Environment and Health, 20:189-199.

Novek, Joel, Annalee Yassi and Jerry Spiegel. 1990. Mechanization, the labour process, and injury risks in the Canadian meat packing industry. International Journal of Health Services, 20:2:281-296.

O'Dwyer, K.J. and C.R. Howie. 1995. Medial epicondylitis of the elbow. International Orthopaedics (SICOT), 19:69-71.

Ohlsson, K., R.G. Attewell, B. Palsson, B. Karlsson, I. Balogh, B. Johnsson, A. Ahim, and S. Skerfving. 1995. Repetitive industrial work and neck and upper limb disorders in females. American Journal of Industrial Medicine, 27:731-747.

Oldberg, Sten. 1973. A new factor in the etiology of chronic nonspecific tendovaginitis in the wrist. Upsala Journal of Medical Science, 78: 160-5

Oleinick, A. K.E. Guire, V.M. Hawthorne, A. Schork, J.V. Gluck, B. Lee and S. La. 1993. American Journal of Industrial Medicine, 23:231-252.

Orgel, David L. Monica J. Milliron, and Linda J. Frederick. 1992 Musculoskeletal discomfort in grocery express checkstand workers. Journal of Occupational Medicine 34:8:815-818.

Osorio, A.M., R.G. Ames, J. Jone, J. Castorina, D. Rempel, W. Estrin, and D.

Thompson. 1994. Carpal tunnel syndrome among grocery store workers. American Journal of Industrial Medicine, 25:229-245.

Paul, J.A. and M.H.W. Frings-Dresen. 1991. Changes in working posture and perceived effcrt due to pregnancy. In Designing for Everyone. Proceedings of the Eleventh Congress of the International Ergonomics Associations, Y. Queinnec and F. Caniellou (eds). London:Talyor & Francis: 1562-1564.

Peipins, Lucy, Barry E. Flanagan, Walter L. Calmbach, David A Katerndahl. Unpublished. Carpal Tunnel Syndrome: Gender and Occupation. Presented at the American Public Health Association Conference; New York; November 18 - 21.68

Phalen, George S. 1972. The carpal-tunnel syndrome. Clinical evaluation of 598 hands. Clinical Orthopaedics and Related Research, 83:29-40.

Phalen, George S. 1966. The carpal-tunnel syndrome. Seventeen years' experience in diagnosis and treatment of six hundred fifty-four hands. The Journal of Bone and Joint Surgery, 48A:2:211-228.

Pozner, H. 1942. A report on a series of cases of simple acute tenosynovitis. Journal of the Royal Army Medical Corps, 78:142-144.

Punnett, Laura, James M. Robins, David H. Wegman and W.Monroe Keyserling. 1985. Soft tissue disorders in the upper limbs of female garment workers. Scand J Work Environ Health, 11:417-425.

Punnett, Laura. 1987. Upper extremity musculoskeletal disorders in hospital workers. Journal of Hand Surgery, 12A:2 Pt 2:858-862.

Putz-Anderson, Vern. 1988. Prevention strategies adopted by select countries for work-related musculoskeletal disorders from repetitive trauma. Trends in Ergonomics/Human Factors V, 5: 601-611.

Reed, Jewett V. and Allan K. Harcourt. 1943. Tenosynovitis. An industrial disability. American Journal of Surgery, LXII:3:392-396.

Reilly, Paul A. 1995. 'Repetitive strain injury': From Australia to the UK. Journal of Psychosomatic Research, 39:6:783-788.

Ross, I.J.K. 1985. Trends in repetition strain injury statistics in New South Wales. Journal of Occupational Health and Safety - Australia and New-Zealand, 1:2:96-101.

Rossignol, Annette Mackay, Elise Pechter Morse, Virginia M. Summers, and Leonard

D. Pagnotto. 1987. Video display terminal use and reported health symptoms among Massachusetts clerical workers. Journal of Occupational Medicine, 29:2:112-118.

Roto, Pekka, and Pertti Kivi. 1984. Prevalence of epicondylitis and tenosynovitis among meatcutters. Scandinavian Journal of Work, Environment and Health, 10:203-205.

Rush, Jonathan. 1984. The overuse of tenosynovitis. Medical Journal of Australia, 145:614-615.

Russell, Julie and Carol Conroy. 1991. Representativeness of deaths identified through the injury-at-work item on the death certificate: Implications for surveillance. American Journal of Public Health, 81:12:1613-1618.

Ryan, G. Anthony and Margo Bampton. 1988. Comparison of data process operators with and without upper limb symptoms.Community Health Studies, 12:1:63-68.

Sabour, M.S., and H. E. Fadel. 1970. The carpal tunnel syndrome - a new complication ascribed to the "Pill". American Journal of Obstetrics and Gynaecology, 107:8:1265-1267.

Salengro and F. Commandre. 1987. Musculoskeletal disorders at work in building constructions: Epicondylitis and low back pains. In Musculoskeletal Disorders at Work Proceedings of a conference held at The University of Saurrey, Guildford 13-15 April 1987. Peter Buckle (ed), New York: Taylor & Francis. pp 254-258.

Schottland, John R., Gordon J. Kirschberg, Roger Fillingim, Voris P. Davis, and Fran Hogg. 1991. Median nerve latencies in poultry processing workers: An approach to resolving the role of industrial "cumulative trauma" in the development of carpal tunnel syndrome. Journal of Occupational Medicine, 33:5:627-631.

Seligman Paul J., William E. Halperin, Robert J. Mullan and Todd M. Farzier. 1986. Occupational lead poisoning in Ohio: Surveillance using Workers Compensation data. American Journal of Public Health, 76:11:1299-1302.

Sikorski, J.M. 1988. The orthopaedic basis for repetitive strain injury. Australian Family Physician 17:2:81-83.

Silverstein, Michael A., Barbara A. Silverstein, and Gary M. Franklin. 1996. Evidence for work-related musculoskeletal sisorders: A scientific counter argument. Journal of Occupational and Environmental Medicine, 38:5:477-484.

Silverstein, Barbara A., Lawrence J. Fine and Thomas J. Armstrong. 1986. Hand wrist cumulative trauma disorders in industry. British Journal of Industrial Medicine 43:779-784.

Silverstein, Barbara A., Lawrence J. Fine and Thomas J. Armstrong. 1987a. Occupational factors and carpal tunnel syndrome. American Journal of Industrial Medicine 11:343-358.

Silverstein, Barbara, Lawrence Fine, and Diana Stetson. 1987b. Hand-wrist disorders among investment casting plant workers. The Journal of Hand Surgery,12A:5, Pt. 2:838-844.

Skov, Torsten, Vilhelm Borg, and Elsa Orhede. 1996. Psychosocial and physical risk factors for musculoskeletal disorders of the neck, shoulders and lower back in salespeople. Occupational and Environmental Medicine, 53:5:351-356.

Sommerich, Carolyn M., James D. McGlothlin, and William S. Marras. 1993. Occupational risk factors associated with soft tissue disorders of the shoulder: a review of recent investigations in the literature. Ergonomics, 36:6:697-717.

Spiegel, Jerry and Annalee Yassi. 1991. Occupational disease surveillance in Canada: A framework for considering options and opportunities. Canadian Journal of Public Health, 82:294-299.

Statistics Canada. 1993. The Nation. Catalogue Nos. 93-324, 93-326, 93-327.

Steingart, R.M., M. Packer, P. Hamm, M.E. Coglianese, B.Gersh, E.M. Geltman, J.Sollano, S. Katz, L. Moye, L.L. Bast, S.J. Lewsi, S.S. Gottlieb, V. Bernstein, P. McEwan, K. Jacobson, E.J. Brown, M.L. Kukin, N.E. Kantrowitz, and M.A. Pfeffer. 1991. Sex differences in the management of coronary artery disease. The New England Journal of Medicine, 325:4:226-230.

Stenlund, Berndt, Ian Goldie, Mats Hagberg, and Christer Hogstedt. 1993. Shoulder tendinitis and its relation to heavy manual work and exposure to vibration. Scandinavian Journal of Work Environment and Health, 19:43-49.

Stevens, J.C., S. Sun, C.M. Beard, W.M. O'Fallon, and L.T. Kurland. 1988. Carpal tunnel syndrome in Rochester, Minnesota, 1961 to 1980. Neurology 38:134-148.

Stock, Susan R. 1991. Workplace ergonomic factors and the development of musculoskeletal disorders of the neck and upper limbs: A meta-analysis. American Jomrnal of Industrial Medicine 19:87-107.

Stout, Nancy and Catherine Bell. 1991. Effectiveness of source documents for identifying fatal occupational injuries: A synthesis of studies. American Journal of Public Health, 81:6:725-728.

Sundelin, Gunnevi and Mats Hagberg. 1992. Electromyographic signs of shoulder muscle fatigue in repetitive arm work paced by the Methods-Time Measurement system. Scand J Work Environ Health 18:262-268.

Szabo, Robert M. and Larry K. Chidgey. 1989. Stress carpal tunnel pressures in patients with carpal tunnel syndrome and normal patients. The Journal of Hand Surgery, 14A:4:624-627.

Tanaka, Shiro, D. K. Wild, P.J. Seligman, W.E. Halperin, V.J. Behrens and V. Putz-Anderson. 1995. Prevalence and work-relatedness of self-reported carpal tunnel syndrome among U.S. workers: Analysis of the Occupational Health Supplement data of 1988 National Health Interview survey. American Journal of Industrial Medicine, 27:451-470.

Tanaka, Shiro, Paul Seligman, William Halperin, Michael Thun, Clifton L. Timbrook and James J. Wasil. 1988. Use of workers compensation claims data for surveillance of cumulative trauma disorders. Journal of Occupational Medicine 30:6:488-492.

Thompson, A.R., L.W. Plewes, and E.G. shaw. 1951. Peritendinitis crepitans and simple tenosynovitis: a clinical study of 544 cases in industry. British Journal of Industrial Medicine, 8:150-160.

Tichauer, E.R. and P.E. Lubbock. 1966. Some aspects of stress on forearm and hand in industry. Journal of Occupational Medicine, 8:2:63-71.

Turner, James P. and Peter W. Buckle. 1987. Carpal tunnel syndrome and associated risk factors - A review. In Musculoskeletal Disorders at Work Proceedings of a conference held at The University of Saurrey, Guildford 13-15 April 1987. Peter Buckle (ed), New York: Taylor & Francis. pp 124-132.

Vezina, Nicole and Julie Courville. 1992. Integration of women into traditionally masculine jobs. Women and Health, 18:3:97-118.

Viikari-Juntura, Eira, Kari Kurppa, Eeva Kusoma, Matti Huuskonen Ikka Kuorinka, Ritva Ketola and Ulla Konni. 1991. Prevalence of epicondylitis and elbow pain in the meat-processing industry. Scandinavian Journal of Work, Environment and Health 17:38-45.

Viikari-Juntura, Eira. 1983. Neck and upper limb disorders among slaughterhouse workers; an epidemiologic and clinical study. Scandinavian Journal of Work, Environment and Health, 9:283-290.

Viikari-Juntura, Eira. 1984. Tenosynovitis, peritendinitis and the tennis elbow syndrome. Scandinavian Journal of Work, Environment and Health, 10:443-449.

Viikari-Juntura, Eira. 1995. The role of physical stressors in the development of hand/wrist and elbow disorders. In Repetitive Motion Disorders of the Upper Extremity. S.L. Gordon, S.J. Blair, L.J. Fine eds. Rosemont, Il: American Academy of Orthopedic Surgeons; 7-30.

Wallace, Meredith, and Peter Buckle. 1987. Ergonomic aspects of neck and upper limb disorder. International Reviews of Ergonomics,1:173-200.

Wallersteiner, Ulrika C. 1985. "An ergonomic analysis of upper limb cumulative trauma disorders". Canadian Occupational Safety 23:3:8-9,18-19.

Webster, Barbara S. and Stover H. Snook. 1994. The cost of compensable upper extremity cumulative trauma disorders. Journal of Occupational Medicine, 36:7:713-717.

Wells, J.A., J.F. Zipp, P.T. Schuette, and J. McEleney. 1983. Musculoskeletal disorders among letter carriers. Journal of Occupational Medicine, 25:11:814-820.

Wieslander, Gunilla, D. Norback, C-J Gothe, and L. Juhlin. 1989. Carpal tunnel syndrome (CTS) and exposure to vibration, repetitive wrist movements, and heavy manual work: a case-referent study. British Journal of Industrial Medicine, 46:43-47.

Wilkinson, Marcia. 1960. The carpal-tunnel syndrome in pregnancy. The Lancet, Feb.27:453-454.

Williams, R. and M. Westmorland. 1994. Occupational cumulative trauma disorders of the upper extremity. The American Journal of Occupational Therapy,48:5:411-420.

Workers Compensation Board of Ontario. August, 1992. Workplace Accident Reporting Practices. Research and Evaluation Branch: Toronto, Ontario.

Workers Compensation Board of British Columbia. Unpublished. Senior Executive Committee Presentation, May 2, 1995. RSI Early Intervention Pilot Project Final Report. Rehabilitation Centre.

Worrall, J.P., D. Appel, and R.J. Butler. 1987. Sex, marital status and medical utilization by injured workers. Journal of Risk Insurance, 54:27-44.

Yassi, Annalee, Janet Sprout and Bob Tate. 1996. Upper limb repetitive strain injuries in Manitoba. American Journal of Industrial Medicine. 30:461-472.

Young, R.F., and E. Kahana. 1993. Gender, recovery from late life heart attack, and medical care. Women and Health, 20:1:11-31.

APPENDIX 1 SUMMARY OF EPIDEMIOLOGIC STUDIES

TABLE A1.1 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING CARPAL TUNNEL SYNDROME

AUTHORS	STUDY DESIGN	METHOD OF DATA COLLECTION	FINDINGS
Osorio et al 1994	CTS prevalence study 56 supermarket wrkrs assessed for CTS - Work classified as low, mod. or high exp. to repetitive & forceful wrist motion	- physical exam - questionnaire - median nerve conduction test	- no sig. difference between exp. grps and decrease in sensory median nerve velocity and amplitude (was a non sig decrease as work exp increased) - Prevalence of CTS-like symptoms increased as exp. to rep. and forceful wrist motion increased (RR 8.3)
Nilsson et al 1994	cross-sectional study of 179 wrkrs - 89 platers, 70 truck assembly wrkrs vs. 61 office wrkrs.	- sensory nerve conduction of carpal tunnel - clinical exam. - questionnaire by Dr. - Ergonomic assessment to vibration, forceful gripping, and hand/wrist positions	Increased risk of prolonged latency time was found for: - platers and assemblers (exp to vibration and forced grip) compared with office wrkrs, and - vibration exp. wrkrs contrasted to non vibration exp. wrkrs, irrespective of job title
Nathan et al 1994	cross-sectional 101 Japanese furniture workers and 316 American wrkrs from 4 industries	- bilateral nerve conduction studies - physical exam - questionnaire	- Abnormal slowing were similar in Japanese and American wrkrs (17% vs 22%), - Japanese wrkrs significantly less likely to report CTS symptoms (2.5% vs 15.1%) and less likely to have a Dx of CTS (2% vs 8.3%) than American wrkrs. - Body mass most important predictor of Max. latency difference. - Job related factors (key board use, repetition, occupational hand use, heavy lifting and duration of employment) were found to explain 56% of the variation, but 40% was protective (keyboard use and duration of employment).
Chiang et al 1993	Cross-sectional prevalence survey - 207 fish processing wrkrs in Taiwan - 61 grp 1 (low force & low rep), - 118 grp 2 (high rep or high force), - 28 grp 3 (high rep & high force).	- Ergonomic assessment - questionnaire - clinical exam	- 15% Dx with CTS - increasing trend of CTS from grp 1 to grp 3, but when gender taken into account trend was not observed. - However, for short term employees (<12 mnths) sig, increasing trend in the ratio of CTS was observed between grps. - Forceful movements and gender were found to be sig. predictors of CTS, - Not predictors for CTS were interaction of rep. and force. - 2.0 OR found for use of oral contraceptives.
Brismar and Ekenvall 1992	cross-sectional survey - 17 men exp to vib tools -10 constr worker unexp to vib. - 11 CTS patients (3 men, 8 women) - 9 healthy male divers unexp to vib. or heavy manual work	- motor and sensory nerve conduction of median and ulnar nerves	Vib exp subj. with symptoms demonstrated decrease in median nerve conduction similar to, but less pronounced than, CTS patients. No other sig. diff. found between grps.

AUTHORS	STUDY DESIGN	METHOD OF DATA COLLECTION	FINDINGS
Nathan et al 1992	Longitudinal & cross-sectional study - 429 workers	- Nerve conduction tests in 1984 and 1989.	- highly sig +ve correlation between weight and slowing and between BMI and slowing - no increase in prevalence of slowing between 1984 and 1989. - Non of the job-related factors (occup hand use, duration of employment nor industry was a predictor of 1989 slowing. 1989 Predictors were 1984 BMI, age and wrist/width ratio, exercise level and weight.
Morgenstern et al 1991	cross sectional prevalence survey of 1,058 female grocery checkers	Self admin. Questionnaire	- 12% Dx CTS (based upon reported symptoms) which is higher than gen. pop. - +ve assoc. found for: age, ave. hrs/wk, yrs worked, use of diuretics. - Attributable risk est. 60% of all CTS due to work. - No assoc. found for use of scanners, unloading baskets, use of oral contraceptive, exogenous estragon, pregnancy or history of broken wrist.
Delgrosso and Boillat 1991	case-control - using Swiss sentinel physician network for 1 yr, CTS patients were identified, controls were next patient of same age and sex (resulting in 65 case-control pairs). - 21 CTS surgery patients, compared to general pop.	Questionnaires completed by Drs.	? sig. assoc. - Repetitive movements, extensions, flexion, use of vibrating tools and wrist movements necessitating force were mentioned more often by subjects than by controls. - development of CTS in women was assoc. with pregnancy.
Barnhart et al 1991	cross-sectional survey of ski assembly plant 152 wrkrs with rep jobs 105 wrkrs with nonrep.	- Questionnaire, - Physical exams and EMG	- +ve assoc. with rep job - +ve assoc. with diabetes mellitus but not thyroid disease, arthritis, use of oral contraceptives, gynaecological surgery, or menopause.
Schottland et al 1991	cross sectional survey - 93 subjs. randomly selected workers (27 men and 66 women) at a poultry processing plant - 93 controls (44 men and 41 women) applicants	EMG - median nerve motor and sensory latencies measured.	No assoc. between median motor latency slowing and employment. - Small but +ve assoc for sensory latency in right hands of females (equal to risk associated with age).
De Krom et al 1990	Case-control in general pop. in The Netherlands - 156 CTS cases - 473 controls	- questionnaire about general health and health care - interview & neurophysiologic testing to identify CTS.	- Risk of CTS increased with duration of activities with flexed or extended wrist over past 5 yrs. (ex. RR: 1, 1.5, 3.0, 8.7 for exp. of 0, 1-7, 8-19, 20-40 hrs/wk for flexed wrist). - not sig. was working with pinch grasp, typing or combination of flexed and extended wrist. - Sig. non-occup. factors were: hysterectomy without oophorectomy (RR 2.0), first menopausal year (RR 6.5), dieting (2.1), short stature, varicosis in men (RR 12.0). - Not sig. non-occup. factors were: age at menopause, age at menarche, number of pregnancies, diabetes during pregnancy, weight, wrist fractures, thyroid diseases, rheumatism and diabetes

AUTHORS	STUDY DESIGN	METHOD OF DATA COLLECTION	FINDINGS
Wieslander et al 1989	case-control -38 cases (CTR bet. 1974-80) - 76 controls (gall bladder and varicose vein surgery) - 76 from gen. pop.	Telephone Interviews	- +ve assoc. with vibrating hand tools (OR 3.3), rep movement of wrist (OR 2.7). - Dose-response gradient with increasing yrs of exp. for both types of exposure. - No sig. assoc. with work load on wrist, although OR increased with increasing yrs of exp. - Increased prevalence of obesity, rheumatoid disease, diabetes and thyroid disease among cases with CTS.
Nathan et al 1988	cross sectional survey among gen. working pop. (Oregon & Washington States) - 471 wrkrs 27 occupations from four industries - grouped into 5 occup. grps. from very light to very heavy force and rep. using occup. title	- median nerve sensory latency measured of both hands. - self admin. questionnaire	- No assoc with hand force, rep. or yrs at work - Grp 1 had sig lower proportion with slowing than grp 5, but when hands instead of persons were examined the only significant inter grp difference was between grp 1 and 3. - slowing not assoc. with bimanual occup hand activity or length of employment.
Farkkila et al 1988	case-control 217 forestry workers in Finland - 186 exp. to vibration - 30 not exp.	- Questionnaire - Neurological exam & 79 randomly given EMG	+ve assoc. with: - CTS (26%) - white finger (22%) Among CTS grp, correlation between numbness of hand and history of hand muscle fatigue and VWF.
Silverstein et al 1987a	Cross-sectional survey - 652 workers from 7 ind. plants, 39 jobs divided into 4 exp grp. (combinations of high & low force with high & low rep)	Interviews, Physical exam, Ergonomic assessment - videotaped - EMG recordings	Highly +ve assoc between CTS and - high force/high rep (OR 15) compared to low force/low rep. - vibration (OR 5.3) - high rep. > risk factor than high force. - no sig. assoc. with posture.
Feldman et al 1987	Prospective cross-sectional survey - 586 employees in an electronics plant - Assessed high risk wrkrs 1 yr. later.	Questionnaire, Clinical exam high risk work areas ID (based upon freq. of complaints & observed work tasks involving rep. flexion, extension, pinching and deviated wrist postures). -biomechanical assessment of & EMG on wrkrs randomly selected from high risk work areas.	Higher prev of symptoms (17.9% vs 8.7%), and +ve neurological findings (26.2% vs 11.5%) among wrkrs from high risk work areas than from rest of work pop. - increased abnormalities in median nerve EMG tests 1 yr later among wrkrs in high risk areas, although most not sig. - More women than men in high risk grps. compared to low risk grps
Masear et al 1986	Retrospective of 117 packing plant employees who had CTR from 1967 - 1983	Reviewed plant records, Interviews & Clinical exams	Prevalence of CTR greater than gen. pop (1%). - 20% in females - 14.5% in males Age much younger than gen. pop. -35 yrs vs 49.8 for men and 51 for women
Falck & Aarnio 1983	Prevalence study of 17 butchers	Interviews, Clinical exams EMG	Higher Prevalence & unusual pattern of CTS than gen. pop. - 53% CTS (subj. symptoms & electrophsy. evidence) - 18% subclinical signs - Nondominant hand affected in all

AUTHORS	STUDY DESIGN	METHOD OF DATA COLLECTION	FINDINGS
Cannon et al 1981	Case-Control 30 cases 90 controls aircraft manf. plant	Self admin. questionnaires & interviews - didn't report criteria used to assign erg exp.	+ve assoc. between CTS and - hand held vibrating tools (OR 7.0) - genealogical surgery (OR 3.7) - rep. motion task (OR 2.1) - Yrs. on job (OR 0.9)
Armstrong & Chaffin 1979	Case-Control 18 female pairs from sewing production jobs -cases had history of CTS	- Chart review - Ergonomic assessment using videotapes and EMG	+ve assoc (small) between CTS and use of forceful exertions, deviated wrist and pinch hand position - No assoc found for size or shape of hands of wrist

TABLE A1.2 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING TENDINITIS, TENOSYNOVITIS AND OTHER TENDON DISORDERS

AUTHORS	STUDY DESIGN	METHOD OF DATA COLLECTION	FINDINGS
Luopajarvi et al 1979	cross-sectional survey - 152 female assembly line packers in a food processing plant - 133 female department store workers (excluding cashiers) - Wrkrs with preexisting risk factors were excluded	Interviews, Clinical exam, Ergonomic assessment - videotaped	- Sig. higher prevalence of tenosynovitis and tendinitis and conditions more severe in the assembly-line packers than store clerks. - Work of assembly line packers required more repetitive motion at high speeds, extreme work positions of hand/wrists, & static muscle work than shop workers. - No sig diff. in # of cases of tension neck, cervical syndrome, scalenus syndrome and epicondylitis.
Kuorinka & Koskinen 1979	Cross-sectional survey scissor making process - 93 manual wrkrs - work analysis assessed task char. cycle time, wrist joint deviations and total work load.	Clinical exam Interviews Job & erg. analysis - videotape - production data - empl/Co records	Total work load (# of pieces handled) correlated to: - # of symptoms, & - # of cases of tendinitis. - No sig. assoc with work factors such as fast, rep movements, wrist deviation or work loads.
Viikari-Juntura 1983	Prevalence study (1 yr.) - 117 slaughterhouse workers	Physical exam, Interviews	- 15.9% with tenosynovitis or peritendinitis. - All cases were among cutters and butchers and predominantly among young workers.
Roto and Kivi's (1984)	Cross-sectional survey - 90 male meatcutters - 77 construction foremen	- Self admin. Questionnaires- Physical exam	Increased prevalence of tenosynovitis among meatcutters compared to foremen (4.5% vs 0%), but not significant
Silverstein et al 1986; Armstrong et al 1987	cross- sectional survey -652 workers from 7 ind. plants, 39 jobs divided into 4 exp grp. comb of H & L rep; H & L force	Interviews, Physical exam, Ergonomic assessment - videotaped - EMG recordings	Highly +ve assoc between tendinitis and high rep/high force work (OR 29.4) than low rep/low force work. - Gender a sig. factor (OR 4.3) - No other sig. personal factors (age, oral contraceptives, hysterectomy, oophorectomy, recreational activities). - No other sig. work factors (vib. or work posture).
Kurppa et al 1991	Prospective Cohort study of a meat processing plant and followed for 31 mnths for incidence of clinically Dx tenosynovitis, peritendinitis and epicondylitis. - 377 wrkrs in strenuous jobs - 338 wrkrs in nonstrenuous jobs	- Co medical health care records & sick-leave certificates	Annual incidence of tenosynovitis or peritendinitis was 25.3% for female packers, 16.8% for female sausage makers and 12.5% for male meatcutters compared to less than 1% for wrks in nonstrenuous jobs. - Authors noted employees from nonstrenuous jobs rarely sought medical treatment for tenosynovitis or peritendinitis. Thus the differences may be due to the under reporting of the true morbidity in nonstrenuous workers.
Stenlund et al 1993	clinical cross-sectional survey - 54 bricklayers, - 55 rockblaster - 98 foremen	Clinical exam, X-rays Exposure assessment	- +ve assoc for shldr tendinitis with bricklayers and vib. exp Bricklayers had OR 3.33 and 1.21 for the left & right side when compared with foremen. - Exp to vib. tools increased risk by 2.49 and 1.86 for the left & right.

TABLE A1.3 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING EPICONDYLITIS

AUTHORS	STUDY METHOD	METHOD OF DATA COLLECTION	RESULTS
O'Dwyer and Howie 1995	Retrospective case review of 83 medial epicondyl patients	Case review	- 90% of cases were thought to be related to work. - Of these 45% were classified as light manual work
Kurppa et al 1991	Prospective cohort cross sectional study of a meat processing plant and followed for 31 mnths. -377 wrkrs in strenuous jobs -338 wrkrs in nonstrenuous jobs	Co medical health care records & sick-leave certificates	+ve assoc with strenuous jobs - annual incidence of epicondylitis was about 1% for employees in nonstrenuous jobs, 11.3% for female sausage makers, 7% for female packers and 6.4% for male meatcutters. - differences between the exposed and nonexposed wrkrs may be due to under reporting, since employees from nonstrenuous jobs rarely sought medical treatment for epicondylitis.
Viikari-Juntura et al 1991	Clinical cross-section study - 102 meatcutters, - 125 sausage makers, - 150 packers and - 332 workers in nonstrenuous jobs Followed for 31 mnths.	- 3 clinical exams, Questionnaire	No sig assoc. with work factors - workers in strenuous jobs reported symptoms 1.6-1.8 times more often, but no sig. diff. between the grps. for clinical epicondylitis - women reported symptoms sig. more than men.
Salengro & Commandre 1987	Retrospective prevalence study - 4065 construction workers in Nice - used records from 1977 to 1982	Review of medical records of compulsory medical exams	Uneven dist. of epicondylitis. - Of those dx with epicondylitis, 33.7% were brick-layers and 10.3% front house's builders, although they represented only 14.6% and 0.1% of the workers respectively. In comparison, only 1.1% of steel workers had Dx. - 57% of all front house builders had epicondylitis
Dimberg 1987	cross-sectional survey of a aircraft engine manufacturing plant - 540 workers	Questionnaire Clinical exam	No sig diff in prevalence between blue and white collar wrkrs. (11.0% vs 5.3% respectively). - Age +ve assoc with epicondylitis. - sex, job category, and degree of elbow stress were not sig. - tendency to seek medical advice increased with work stress.
Roto and Kivi 1984	clinical cross-sectional - 90 male meatcutters - 77 construction foremen	Physical exam Questionnaires	- Sig. increased prev in meatcutters (9% vs 1%) - est. risk 6.4 - age and number of year exposed were +ve assoc. with epicondylitis. - difference may be due partly to an over representation of older workers among the meatcutters.
Kivi 1982	Case series - 50 males & 38 females	Clinical exam Interviews	- 73% of cases were judged to have an occupational origin. - Of these 60% were determined to be due to continuously monotonous over-exertion of the forearm. - Highly significant difference in the daily number of working movements between the cases judged occupational and other cases.
Luopajarvi et al 1979	cross-sectional survey - 152 female assembly line packers in a food processing plant - 133 female department store workers (excluding cashiers)	Interview Clinical exam Ergonomic assessment - videotapes	No sig diff of prevalence between assembly line workers and shop assistant (3% and 2% respectively)

TABLE A1.4 SUMMARY OF EPIDEMIOLOGIC STUDIES REGARDING SHOULDER DISORDERS

AUTHORS	STUDY METHOD	DATA COLLECTION	RESULTS
Ohlsson et al 1995	Cross sectional - 82 female assembly workers - 64 female controls	- questionnaire - physical exam - ergonomic assessment	- higher prev of neck/shoulder complaints and diagnosis (OR 4.6) among those who performed repetitive tasks. - sig. assoc. between time spent with neck in flexion position >15 degrees and time spent with upper arm abducted >60 degrees - small sig assoc between and muscular tension neck & shoulder Dx and personality tendencies to stress/worry,lower muscular strength, lower emotional well-being, and higher prev. of psychosomatic symptoms.
Chiang et al 1993	Cross-sectional - 207 wrkrs from 8 fish processing plants in Taiwan	- interview - clinical exam - job analysis using high-low rep. and force	+ve assoc between shoulder pain and rep. (OR 1.6) and forceful movements (OR 1.8). - increasing trend observed for shoulder pain as ergonomic risk factors increased in severity. - Wrkrs with short term exp. (< 12 mnths) showed sig increasing trend in the ratio of shoulder pain.
Blader et al 1991; 1987	Prevalence study - 224 sewing machine operators from 4 factories in Sweden	- questionnaire (199) - clinical exam (131) - smaller grp interviewed by psychologist (	- +ve correlation between yrs employed and hrs worked to symptoms - +ve correlation between working hrs >30 hrs/wk and tension neck syndrome - 1 yr. 75% prev. rate for symptoms. - 51% prev. for previous 7 days
Jonsson et al 1988	Prospective Cohort study - 96 female assembly wrkrs from 2 electronic manuf. firms - followed for 2 yrs.	- 3 medical exams (by physiotherapist), 1 each year - individual ergonomic evaluations assessed for work tasks, and technique, physical work capacity, productivity, psychological stress	- Increase in prevalence of cervicobrachial symptoms (11% to 24% after 1st yr.) - Decrease in prev. of symptoms among those whose job tasks were modified (16%) compared to those whose tasks remained unchanged (26%).
Bergenudd et al 1988	Prevalence, cohort study - 319 men, 255 women, Sweden - assessed relationship between work load (light, mod, or heavy physical demands) determined by job title and psychosocial factors (education, intelligence, income, job satisfaction social network).	- Interviews - secondary data from other data sources, such as elementary school records (1938 onward), Malmo Longitudinal Study followed since 1942 and a social questionnaire (1983). - medical exam	- No difference in physical job load among subj with or without shoulder pain, but women with signs of supraspinatus tendinitis more often had jobs with physical demands. - sig. diff. between women subj with shoulder pain and low job satisfaction and between men with shoulder pain and low intelligence scores.
Fine et al 1987	Case-Control - 93 cases of shoulder pain and 259 controls in an automobile plant	-interviewed - examined - ergonomic job assessment to characterize postural and peak force req. on shoulder.	- sig. assoc between shoulder pain and elevated shoulders above 90 degrees (OR 3.2, 2.3, and 4.0 for left, right and both shoulders respectively). - Increasing proportion of job cycle in shoulder elevation resulting in sign increase in odds ratio. - no sig assoc for peak forces and shoulder pain.
Hagberg and Wegman 1987	meta-analysis of 21 published studies. - Prevalence, odds ratio and etiological fraction of shoulder neck disorders in diff. occup. calculated.	- Task exposure was assumed based on job title.	- a +ve assoc between thoracic outlet syndrome and high rep arm movement for pooled data (OR 4.0, etiological fraction 0.75). None of the studies indiv. showed a sig. OR. - +ve assoc. between work at shoulder level and rotator cuff tendinitis OR 11 and etiological fraction 0.91 (pooled data from two studies). - a poled grp of keyboard operators (4 studies) showed a +ve assoc with tension neck syndrome (OR 3, etiological fraction 0.67). - individual studies demonstrated OR sig exceeding 1 in specific occupations for: cervical spondylosis (meat carriers, dentists, miners and heavy workers); cervical syndrome (civil servants); tension neck syndrome (data entry workers, typists, assembly line packers, scissors makers, lamp assemblers and film rolling workers). - women had higher rates of tension neck syndrome than men (OR 5.9). osteoarthrosis compared with office workers and farmers.

AUTHORS	STUDY METHOD	DATA COLLECTION	RESULTS
Punnet et al 1985	cross-sectional - 162 female garment wrkrs - 76 female hospital wrkrs	- self admin. questionnaire - physical exam - cases defined as experiencing pain for most days of a month or more within 1 yr prior to study	- 19.6% of garment wrkrs and 8.8% of hospital wrkrs had persistent pain in shoulders. - Finisher & stitchers had sig rate ratios for shoulder pain (4.0, 2.0) when compared with hospital wrkrs.
Herberts et al 1984	Follow-up of 1981 study (see below) - 188 plate wrkrs compared to - 131 welders and 57 office clerks	- self admin questionnaire - clinical exam and interview by physiotherapist	- Sig. diff. in prevalence of supraspinatus tendinitis between office workers (0%) and welders (18.3%) and plate-workers (16.2%). - Welders with disorder were 6 yrs. younger than plate-workers, yet age distribution of pop. were similar. - Welders work was classified almost exclusively static while plate-working was classified as dynamic.
Kvarnstrom 1983	Case-control in a large Swedish electronic man. firm -112 cases of long term (> 4 wks) shoulder pain - 112 matched controls randomly selected from same co.	- interviewed - work task graded for degree of monotony, rep. and total work load on shoulder	- grp piece rate, shift work, repetitive and monotonous tasks were sig. more frequent among cases - sig more cases considered their work heavy, monotonous and stressful and required heavy lifting. - cases reported sig. more social factors such as poor relationship with supervisors, having children at home, having ill spouses and working alternate shifts. - Immigrants had a sig. higher risk of being a cases (RR 6.7) and the disorders were more frequent within certain occupations - shoulder disorders were 10 times more frequent in women, even though 80% of factory wrkrs were men.
Wells et al 1983	prevalence cross-sectional -196 male letter carriers - compared with gas meter readers and postal clerk control.	- interviews - severe shoulder pain was defined objectively by a scoring system which required a sig. amount of distress in terms of onset, frequency and duration of pain, and impact on activities.	- prev. of severe shoulder pain among meter readers, postal clerks and letter carriers was 7%, 5% and 13% respectively - a 4.3 kg.increase in bag wt for letter carriers elevated prev. to 23%.
Herberts et al 1981	prevalence cross-sectional of a Swedish shipyard - 131 welders - 56 male office clerks	- questionnaire - clinical exam by physiotherapist - interviews	- sig diff. in prev. ratio of 9.0 for supraspinatus tendinitis between welder and clerks. - neither the # of welding yrs not the level of shoulder muscle load were found not to be sig.

APPENDIX 2 **CLAIMS DATA RECORD SHEET**

WCB CLAIM # __ __ __ __ __ __ __ __

Is this a RSI claim? __

Date of Claim/first application __ __/__ __/__ __

Date of injury/lay off __ __/__ __/__ __

Prior RSI claim? __

Recurrence occurred on the claim? __

FACTORS CONTRIBUTING TO CUMULATIVE TRAUMA DISORDER

Worker Characteristics

Pre-existing info __ __ __ __ __ __

If other specify ____________

- seniority in industry (yrs) __ __.__ __
- in firm (yrs) __ __.__ __
- in job (yrs) __ __.__ __

Occupational Risk Factors

1. Task Activities

- awkward joint posture/hand positions deviating from the anatomical neutral __
- pinch grip __
- change of routine/return from leave __
- forceful exertion __
- low temperature __
- repetitive action __
- use of hand tools/ill fitting gloves/ill fitting handle shapes __
- vibration/impact __

2. Work Station Layout

- static loading/prolonged constrained posture __
- above elbow height work __
- excessive reaches __

3. Psycho-social Climate
- incentive pay system ___
- no job rotation/inadequate rest period ___
- overtime/long hours ___
- increased stress levels ___
- don't know/not stated ___
- other (specify)____________ ___

MEDICAL INFORMATION

Diagnosis __ __ __ __ __ __
If other specify _______________

Stage of Disease
- How long since 1st exposed (yrs) __ __.__ __
- How long since 1st symptoms (yrs) __ __.__ __
- Stage of severity at time of claim ___

Medical Intervention
- family physician/GP ___
- phys. med. specialist ___
- orthopaedic specialist ___
- neurologist/neurosurgeon ___
- other specialist (specify) ___________ ___
- surgery? ___
- physiotherapy? ___
- other (specify) _______________ ___

STATUS OF CLAIM AT LAST WCB ENTRY
Date of last entry __ __/__ __/__ __
- still receiving WCB payment? ___
- worker still in communication with WCB? ___

- type of WCB involvement ___

- type of RTW activity ___ ___

APPENDIX 3 CODES

No 0 Yes 1 2 Don't know/maybe/not enough info

PRE-EXISTING INFO

0 No pre-existing - evidence they looked for pre-existing conditions.
1 Endocrinological - diabetes, hypothyroidism, obesity
2 Gynaecological conditions (hysterectomy, menopause, oophorectomy, pregnancy)
3 Rheumatoid, gout, and other arthritis/degenerative changes
4 Sports or hobby activity
5 Previous trauma or congenital abnormality
6 Don't Know/Not Stated/not investigated
7 Other

DIAGNOSIS

Hand and Wrist
1 De Quervain
2 Carpal Tunnel Syndrome
3 Ganglion
4 Trigger finger

Forearm and Elbow
5 Epicondylitis

Any Location
6 Tendonitis
7 Tenosynovitis
8 Peritendinitis

Shoulder and Neck
9 Cervicobrachial Disorders/Syndrome
10 Neck Torsion Syndrome/Tension Neck Syndrome
11 Rotator Cuff/Supraspinatous Tendinitis
12 Thoracic Outlet Syndrome

13 Non specific - Strain/Sprain
14 Myofacial/Fibromyalgia disorders
15 Bursitis
16 Other
17 Vibration White Finger Disease
18 Over use syndrome
19 don't know/not stated
20 Soft Tissue Injury
21 Neuropathy/ Impingement Syndrome/Neuritis/Nerve Entrapment

JOB RISK FACTORS - as stated on file only

0 no activity/low risk
1 some activity/medium risk
2 frequent/high activity/high risk

STAGE OF DISEASE

1 Stage 1 - Pain, discomfort at work but resolved when not working. There is no significant reduction in work performance nor any physical signs.

2 Stage 2 - Symptoms start early and persist longer in the work shift. They do not settle overnight and cause disturbance of sleep. There is reduced capacity for repetitive work and physical signs may be present.

3 Stage 3 - Symptoms persist at rest, pain occurs with non-repetitive movements and cause disturbance of sleep. Unable to perform light duties, experiences difficulties in non-occupational tasks and physical signs are present.

4 Don't know/not stated

STATUS OF CLAIM AT LAST WCB ENTRY

Type of WCB Involvement

1 only claims/medical aid involvement

Rehabilitation services
2 Job search/job club/vocational assessment
3 training/education
4 wage top up/Special Additional Compensation

5 Other

6 Pension

Type of Rehabilitative/RTW activity - as last noted on file

0 Not yet attempted to RTW
1 Attempted to RTW but unsuccessful
2 RTW-same employer, same job
3 RTW-same employer, modified job
4 RTW-same employer, entirely diff job
5 RTW-diff. employer, same type of job
6 RTW-diff. employer, entirely diff job
7 Not RTW - because of injury/condition/restrictions
8 Not RTW - no work available due to economy/lay offs/ bankruptcy of Co.
9 Not RTW - voluntary i.e. retired/ pensioned off/ quit
10 Don't know/not stated
11 Other