BIOPSYCHOSOCIAL RISK FACTORS IN OFFICE WORKERS WITH NON-SPECIFIC NECK PAIN: A CROSS-SECTIONAL ANALYSIS

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Thesis presented for the degree of

Master of Research

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24th of April, 2017

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Candidate's statement of originality

I hereby declare that this submission is my own work and that, to the best of my knowledge, it contains no material previously published nor written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or other institute of higher learning, except where due acknowledgment is made in the thesis. Any contribution made to the research by others, with whom I have worked at Macquarie University or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

The research presented in this thesis was approved by the Macquarie University Ethics Review Committee, reference number: 5201600261 on 11April 2016.

Signed ________________________

Martin Frutiger (SID: 42142458)

Date 24 / 04 / 2017

Supervisor's statement

As supervisors of Martin Frutiger's Master of Research work, we certify that we consider his thesis "Biopsychosocial risk factors in office workers with neck pain: a cross-sectional analysis" to be suitable for examination.

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Publications and presentations

Some of the work presented in this thesis has been published, drafted for publication or presented in the following forums:

Publications

Frutiger M, Tuchin PJ. Chiropractic curriculum mapping and congruence of the evidence for workplace interventions in work-related neck pain. *Journal of Chiropractic Education*. 2017;31(2):115-124. See Appendix I.

Article in review for publication

Frutiger M, Tuchin PJ, Borotkanics RJ. Systematic review and meta-analysis suggests strength training and stretching may reduce neck pain in office workers. *International Archives of Occupational and Environmental Health*. 2017; *in review*. See Appendix J.

Presentations

Frutiger M, Tuchin PJ, Borotkanics RJ. The efficacy of workplace interventions for physical factors in office workers with neck pain: a systematic review, a presentation of methodology. 2017 World Federation of Chiropractic Conference. Washington D.C., United States of America, 15-18 March 2017.

Acknowledgements

I acknowledge my academic supervisors A/Prof Peter Tuchin and Dr Robert Borotkanics. You have guided and supported me throughout this candidature. Your knowledge, patience and understanding were significant elements in the successful completion of this candidate. I extend my sincerest gratitude for your mentorship and support.

I acknowledge all the staff from the included workplaces for their willing participation in this project.

I would like to mention my mentors at Macquarie University, namely Mrs Hazel Jenkins, Dr Benjamin Brown, Dr Stephney Whillier, Mr Michael Swain, Dr Roger Engel and Mr Aaron Downie. These individuals have contributed to providing me with a productive research environment. Their advice and critique provided me a better understanding of conducting quality research.

I thank my fellow Master of Research candidates, Mr Curtis Thor Rigney, Mr Christopher Burrell, Mr Stephen Sharp and Mrs Anneliese Hulme. Their support and friendship provided me with the motivation and enthusiasm required to complete my candidature.

Lastly, I wholeheartedly thank my family for supporting throughout this candidature, which would have not been possible without their unconditional love and support and for this I am forever grateful.

Responsibility and tasks

The chief investigator

The role and responsibilities of the chief investigator constituted the largest proportion of duties in this research project. The chief investigator, guided by the supervisors, conceived the study and was partly responsible for participant recruitment (which includes initial contact with workplaces). Conducting the questionnaire was the responsibility of the chief investigator. The chief investigator compiled the data and both electronically and manually entered the data. The chief investigator was responsible for correspondence with the biostatistician, which involved communicating the primary and secondary objectives of the study and communicating the research questions. The chief investigator is responsible for storage of collected data and for submitting papers for journal publication and was the primary writer of this thesis. The chief investigator was responsible for quality assurance through compliance with protocol, problem identification, distribution and maintenance of material. The chief investigator did not receive monetary reward for responsibilities and tasks in this study.

The primary supervisor

The role and responsibility of the primary supervisor was to oversee the conduct of the research project and provide troubleshooting for problems that may have arisen. The primary supervisor contributed to the conception of the research project and evaluated the rigour of the methodological construct. The primary supervisor was responsible for ethical issues considered in this project. The primary supervisor monitored study progress in the context of the primary and secondary objectives. The primary supervisor was the overseer of results dissemination and edited the thesis. The primary supervisor monitored project quality assurance and assisted in the recruitment and follow up of participants. The primary supervisor did not receive monetary reward for responsibilities and tasks in this study.

The secondary supervisor

The role and responsibility of the secondary supervisor was to troubleshoot problems that may have arisen. The secondary supervisor provided advice and assistance with the statistical analysis of this project. The secondary supervisor edited the thesis. The secondary supervisor did not receive monetary reward for responsibilities and tasks in this study.

Resources

A research budget of $2,000 was available from the Department of Chiropractic's higher degree research fund at Macquarie University. No other sources of funding were requested. Of the $2,000 budget, $278 was utilised in this research project to purchase statistical software, *Stata 14* (StataCorp, College Station, TX).

Abstract

Background: Non-specific neck pain (NSNP) is a highly prevalent and burdensome musculoskeletal disorder. Several biopsychosocial risk factors for NSNP exist in the literature. However, the use of standardised, research-validated self-reporting instruments for measuring the multidimensional nature of risk factors in NSNP is lacking in the literature.

Objectives: Describe a population of office workers with NSNP with respect to biopsychosocial risk factors; and, find the prevalence of NSNP in an office worker population.

Methods: 119 office workers were studied. Data were collected using an online questionnaire comprising six standardised self-reporting instruments to measure biopsychosocial risk factors.

Results: The prevalence of self-reported NSNP in the study population was 73.10%. NSNP was associated with manner of self-reported NSNP, gender, employment, education, workplace, marital status and sickness absence by some of the self-reporting instruments. Preliminary evidence suggests psychosocial parameters have significant effects on self-reported NSNP. The instruments were also highly correlated to one another.

Conclusions: Several biospychosocial risk factors for NSNP in office workers exist. Future studies should examine the correlations between each of the six instrument items to one another and by self-reported NSNP to ascertain the effect of specific risk factors in NSNP and disability.

CHAPTER ONE

INTRODUCTION

Executive summary

The topic of this dissertation is the examination of biopsychosocial and demographic risk factors in a sample of Australian office workers and their relationship with self–reported non-specific neck pain (NSNP).

NSNP is broadly defined as pain experienced in the posterior neck or shoulders, caused by abnormal stress and strain on cervical musculoskeletal structures in the absence of serious pathology (*e.g.*, radiculopathy, tumour, fracture, infection *etc.*)[1, 2]. However, NSNP is a complex and multifactorial healthcare problem and can also be defined based on anatomical location[1, 5], aetiology[5-7], severity[5-7], and duration of symptoms[8]. Work-related NSNP is synonymous to cumulative trauma disorders, repetitive strain injuries[9], or overuse injuries[10] pertaining to the neck and is associated with workplace risk factors[11].

NSNP is highly prevalent in office workers and is associated with a substantial burden to the healthcare system and the individual[12-17]. Several risk factors, particularly physical and demographic factors, for work–related NSNP have been proposed in the literature[13, 18]. However, a combination of research–validated, self–reporting instruments with sound reliability and validity and which items are inclusive to varying aspects of NSNP and disability is lacking in the literature. In addition, assessing workplace factors in the development of NSNP requires the inclusion of psychosocial and psychosomatic parameters and classification of subgroups along with physical and demographic parameters[19].

Aims and objectives of the thesis

Primary objective:

Describe a population of office workers with NSNP with respect to biopsychosocial and demographic risk factors.

Secondary objective:

Identify the prevalence (given as a percentage) of NSNP in a population of Australian office workers.

The null hypothesis of the secondary objective is:

In Australian office workers with NSNP, there is no association between either prevalence or severity of NSNP and the potential risk factors.

This thesis will also:

- Provide a review of the literature on workplace risk factors in office workers and their relationships with NSNP.
- Discuss the development of a new, combined, online self–reporting instrument, which was based on previously published standardised instruments[20-22]. This combined instrument was used to survey demographic and biopsychosocial risk factors and their relationship with NSNP in Australia office workers.
- Detail the results and summarise the findings of a cross–sectional study that assessed biopsychosocial and demographic risk factors in Australian office workers, using the above, combined self–reporting instrument.
- Present a study that assessed curriculum mapping of workplace risk factors in the Master of Chiropractic program at Macquarie University.
- Present a study that conducted a systematic review and meta-analysis of randomised controlled trials on workplace interventions for NSNP in office workers.

CHAPTER TWO

LITERATURE REVIEW

Introduction

Defining the problem

Non-specific neck pain (NSNP) was defined in Chapter 1. Figure 2.1 gives an illustrative representation of the anatomic region of the neck[5]. Our understanding of NSNP and its associated risk factors have seen a change in the conceptual framework in which it is researched[5, 19, 23]. Our concept of pain and its definition has also evolved over the past two decades with the inclusion of psychosocial and psychosomatic parameters and classification of subgroups along with physical parameters[19]

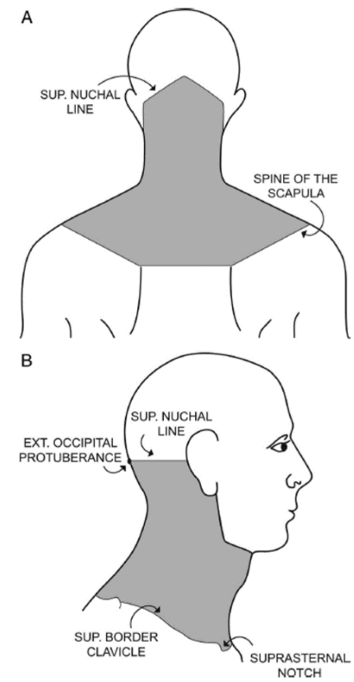


Figure 2.1. The anatomic region of the neck posteriorly (A) and laterally (B) as defined by The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and its Associated Disorders[1, 2].

Epidemiology

After low back pain, nonspecific or NSNP, is the second-most point prevalent and burdensome of the musculoskeletal disorders (MSD), accounting for the majority of workplace disability and absenteeism in developed countries[13, 15, 24]. In this context, point prevalence is the proportion of ongoing cases of NSNP at any one point in time, and differs from incidence, which conveys information about the risk of developing a new case of NSNP per unit of time[12]. Since the 1980s there has been an increase in attention paid to the issues surrounding NSNP in the population. The escalating burden on disability and costs associated with work-related NSNP sparked interest in the academic community. Until the mid-1990s, few reports on epidemiological factors of NSNP were available in the literature and little was known about the true incidence rate. Scandinavian studies reported that the lifetime prevalence of NSNP was 71% and that between 12% and 34% of adults experienced NSNP annually[25, 26] It is generally accepted that approximately two-thirds of the global population will experience at least one episode of NSNP in their lifetime and lifetime prevalence is highest in the middle-aged[27]. A systematic analysis for the global burden of disease study 2010 by Murray *et al.*[16] found MSD to have a mean annual incidence of 488 per 100,000 in 2010, which was an 8.5% increase from 1990. In 1990, MSD ranked 25th on the global disability-adjusted life year and climbed to 21st in 2010[16]. Global NSNP figures are predicted to account for the next largest number of years lived with disability when compared to other MSD[16].

Certain occupations are associated with a higher lifetime prevalence of NSNP: dentists, nurses and office workers have a lifetime prevalence of NSNP of more than 50%, and the point prevalence of annual absenteeism due to NSNP varies from 5-10%[13]. Incidence differs from prevalence in that it conveys information about the risk of developing NSNP, whereas prevalence indicates how widespread NSNP is in a population. Sedentary behaviours are prevalent in office and computer workers[28] who also have the highest incidence of NSNP[13] when compared to the general population[29].

Today, many people use computers at their workplace and recreationally, taking up a great deal of their day. While the increase in usage is partly due to cultural adaptations to the convenience and availability of technologies, it is also attributable to an industrial shift to a service-orientated economy[13], which brings with it more sedentary jobs[28]. Furthermore, corporate downsizing as a means to minimise losses in profits, often forces an increase in productivity for those workers who remain[30]. This is associated with an increase in absenteeism for MSD complaints[30]. Office computer use streamlines what would otherwise be timely tasks such as retrieving mail, copying files or leaving the desk[31]. The increase in productivity and elimination of time-consuming tasks also reduces the number of restorative work breaks available to workers from repetitive or static tasks[30]. Indeed, the lifetime prevalence of MSD observed in computer users has increased in recent years[32, 33].

MSD have a significant economic burden on healthcare systems. The total economic burden of MSD in Australia was estimated at AUD$55.1 billion in 2012[140].Direct economic costs include investigations and treatments such as radiography, medications and physical therapy, which accounted for approximately AUD$9 billion of total costs. Indirect costs include lost income, reduced work productivity and absence, which accounted for approximately AUD$7 billion in productivity losses and AUD$34 billion from loss of quality of life[140]. These Australian findings complement results from the 2010 Global Burden of Disease Study by Murray *et al.*[16]and Vos *et al.*[17].

Summary of the literature on risk factors for neck pain

NSNP is assumed to be a multifactorial problem: there are several risk factors contributing to its development. The relationship between risk factors and NSNP is a complex one, because NSNP is likely to be caused by multiple repeat exposures rather than by the direct effect of a single exposure[7, 13]. Analytical cross-sectional studies may be used to investigate the association between a putative risk factor and a health outcome. However, this type of study is limited in its ability to draw valid conclusions about any association or possible causality because the presence of risk factors and outcomes are measured simultaneously. It may therefore be difficult to work out whether the disease or the exposure came first, so causation should always be confirmed by more rigorous studies[7, 13].Risk factors can be work-related, as well as non-work-related, and can be divided into three groups, *i.e.*, physical, psychosocial, and demographic risk factors.

Potential studies were identified with computer-aided searches (to March 2016) in the following electronic databases: CENTRAL (Cochrane Library), PubMed, EMBASE (Excerpta Medica Database), CINAHL (Cumulative Index to Nursing and Allied Health Literature), and Web of Science.The search strategy for CENTRAL included MeSH and descriptor terms such as ‘neck pain’, ‘risk factors’ and ‘cross-sectional study’, which were also expanded to include all trees. PubMed search strategy included articles with ‘neck pain’ and the prefix ‘work’ and ‘office’. EMBASE search strategy expanded and prefixed ‘neck’, ‘office’ and ‘work’ terms and only included articles with these terms. ‘Treatment outcomes’, ‘questionnaires’ and ‘health-promotion’ and their synonyms were also expanded and articles with all possible terms were included. CINAHL search strategy included terms such as ‘neck’, ‘risk factor’, ‘observational study’ and ‘musculoskeletal disorder’, in which ‘neck’ was prefixed. Web of Science searches included ‘neck’ and ‘work’ as prefixes and ‘office’.

Reporting bias was reduced using the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) cohort study checklist (Appendix D)[141]. STROBE is a 22-point checklist which recommends the reporting of key methodological issues for greater transparency and standardisation of observational studies in epidemiology[141].

The literature search revealed twelve pertinent cross-sectional studies and one longitudinal study focusing on risk factors for NSNP in workers that were published within the last decade[16, 34-44]. The thirteen observational studies have been summarised in Appendix E. The overall consensus from the thirteen observational studies for risk factors affecting NSNP appears to be a strong association between female gender, older age, previous history of neck complaints and decreased physical exercise; and limited evidence for pain starting after an accident, poor posture, duration of employment in same job for less than one year, poor computer skills, workstation ergonomics, high task difficulty and low influence at work for initial onset of NSNP in office workers[16, 34-44].The majority of studies report significant differences in age groups and NSNP[34, 39, 45]; however, some did not[35-38, 41, 42]. In most studies, the effect of age peaks in the fourth and fifth decades of life and remains stable thereafter[34, 39, 40, 46-48].The prospective cohort study by Hush *et al.*[49] examined NSNP in office workers and gender was the only factor to show statistical significance. However, the precision of the point estimates was most likely compromised by dichotomizing the continuous variables and further loss of statistical power results from the small sample size[49]. For these reasons, the results should be considered tentative. Many other observational studies in the literature appear to focus on only one or a few risk factors or on one particular category of risk factors and examine non-specific groups of populations[50-53].

The ability to reduce the impact of NSNP on the public healthcare system and strengthen our understanding of its concepts is dependent on vital research through basic, clinical, and translational research; epidemiologic studies; and analysis of care patterns and costs[54]. To effectively achieve the study objectives, it is important to distinguish between the strengths and weakness in observational studies: here, cohort and cross-sectional study design are most common. Cohort studies are undertaken to ascertain a causal relationship between a given exposure and disease. Causality can be established because the study is undertaken over time and so a temporal relationship can be established between exposure and disease. A population of subjects who do not have the disease are followed for a period of time, and those who develop the disease (new incidence) are examined. Prospective cohort study design determines risk factors for contracting a new disease because it is a longitudinal observation of the individual through time, and the collection of data at regular intervals, so recall error is reduced[55, 56]. More importantly, exposure is defined and measured prior to onset of a disease, therefore causality can be ascertained. Examining changes over a longer timeframe is particularly significant, because NSNP occurs along a continuum in which worker's pain fluctuates over the course of their pain episode[5, 57]. However, due to time-constraints and limited resources, collecting data over a longer time period is occasionally not feasible. Cross-sectional methodology is therefore a practical alternative. Cross-sectional studies identify prevalence, severity and disability of a particular disease and its associated risk factors at a single time point. However, an important weakness in cross-sectional design is that routinely collected data does not normally describe which variable is the cause and which the effect, thus precluding conclusions regarding causation[7].

A systematic review of five high-quality and two low-quality prospective cohort studies by Paksaichol *et al.*[18] found strong evidence that female gender and previous history of neck complaints were significant risk factors in NSNP; indeed, this gender pattern is seen in most types of body pain and several sociological, cultural and physical differences have been proposed as explanations, but these hypotheses have not been shown to be satisfactory[58-60]. Some explanations for the increased risk of NSNP in females include repetitive work with less physical rest, increased contact with causes and gender imbalance in domestic work[61], smaller stature and lower strength of shoulder musculature[45], higher musculoskeletal loading when using computers and reporting of symptoms more frequently than males[62]. Interestingly, inconclusive results were found for factors, such as low levels of exercise, low social support and high psychosocial stress, which have been mentioned as pertinent risk factors for NSNP in office workers (Appendix E)[34, 36, 37, 49]. However, the review demonstrated substantial heterogeneity (*i.e.,* significant variation in outcome variables, timeframes *etc.*) among studies mainly regarding case definition, risk factors, self-reporting instruments and follow-up duration[18]. For instance, included studies that used non-standardised methods had issues with test—retest reliability, which may have led to a poor validity of exposures, and thus inconclusive results. Data collected was at various follow-up periods and a longer recall period in studies, particularly those that examine detailed NSNP information, increased recall bias[63]. Furthermore, short follow-up periods result in fewer cases, which decreases the power of statistical analysis and therefore the internal validity of the study[63, 64].

Physical risk factors

The relationship between risk factors and NSNP is complex: it is unlikely that a single comprehensive pathophysiological mechanism is responsible for tissue damage alone[65], and indeed several mechanisms have been proposed in the literature[12, 29, 34]. NSNP is likely to be caused by multiple ongoing exposures rather than by the direct effect of a single exposure[7, 13]. Physical factors that have been shown to increase the risk of NSNP include: physical exposure such as high levels of sedentary behaviour, prolonged static muscular contraction and cervical loading particularly in cervical flexion, prolonged sitting, extreme working postures, poor workstation ergonomics and repetitive tasks[13, 66-68]. Ariens *et al.*[50] found that office workers who were seated for more than 95% of their working day were at twice the risk of developing NSNP compared to workers who spent less time seated at work. Indeed, several observational studies found a significant increase in risk of developing NSNP in office workers with prolonged seated positions at work[29, 36, 38, 39, 69, 70]. Janwantanakul *et al.*[37] also found that repetitive tasks at work were associated with an increased risk of developing NSNP in office workers. However, Erikson *et al.*[71] did not find relationships between NSNP and prolonged sitting or computer work and Wu *et al.*[72] did not find relationships between NSNP and personal use of a computer in spare time.

Psychosocial risk factors

Much of the earlier work from Vasseljen *et al.*[73-75] acknowledged and focused on identifying biopsychosocial risk factors in neck and upper limb pain, and indeed found that psychosocial and psychosomatic risk factors were related to NSNP. Vlaeyen *et al.*[4] performed a cross-sectional study that examined the relationship between fear of movement (using the Dutch version of the Tampa Scale for Kinesiophobia), biographical variables (age, pain duration, gender *etc.*), pain-related variables (pain intensity, cognitions and coping) and affective distress (fear and depression) in 103 chronic low back pain patients. The study suggested that patients receiving disability compensation report more fear of movement/re-injury than those who do not receive any compensation, and that fear of movement/re-injury occurred independently from current pain experiences. Therefore, feeding into a patient's negative perception of pain and disability will only further lead to pain and disability. However, the study adopted cross-sectional methodology, which precludes definitive results for causation and the outcome measures used were not research-validated or standardised in the literature[4].

A study by Bongers *et al.*[7] found that job stress is consistently associated with work-related MSD, more specifically neck and upper extremity symptoms, in a general working population; however, the cross-sectional design of the included studies precludes definitive conclusions regarding causation[7]. Indeed, a longitudinal study by Hush *et al.*[49] found that offers workers with stress levels above 5 on the Depression Anxiety Stress Scale-21 (DASS-21) may have a 1.6-fold higher risk of developing NSNP. This is particularly interesting because a stress score of 5 (on a 0-21 scale) is relatively low, which suggests that even slightly elevated stress levels may impact on the risk of NSNP. A systematic review of prospective studies reported clear associations between stress, distress or anxiety and back or NSNP in workers; however, the methodologic quality of the included studies varied considerably and therefore definitive results cannot be ascertained[76].

Demographic risk factors

Demographic factors also contribute to the prevalence of NSNP[13, 34, 51]. Findings from cross-sectional studies suggest middle-aged female workers who are not physically active who work more than 8 hours a day with pre-existing NSNP have an increased risk of developing NSNP[13, 34, 35, 38]. Although, some demographic risk factors such as marital status, formal education, and sleeping hours were not linked to the risk of developing NSNP[34]. Work-related risk factors may include aspects of the work content, organization, interpersonal relationships at work, finances and economics[12, 29, 34]. The current literature suggests that work exposure such as work-related stress and job strain, monotonous tasks, low co-worker support, shortage of personnel, mental tiredness, low job control and decreased job security increases the risk of developing NSNP[6, 29].

Critical appraisal of the literature

Strengths and weaknesses of research design and study methodology

Thirteen pertinent observational studies are summarised in Appendix E. This literature review highlights the methodological implications of a universally accepted case definition for NSNP, the combination of upper limb pain and NSNP parameters, and the use of non-standardised self-reporting instruments with items that fail to capture a broad aspect of NSNP. Future reporting of studies should also be guided by documents such as the STROBE statement[141].

The lack of a consensus regarding a definition of the neck was a significant limitation. Cagnie et al.[34] defined the neck area with the use of an image, while Darivemula *et al.*[35] described an anatomical region; and some papers either did not define the neck area or combined upper limb and neck parameters[16, 37, 38]. The use of a universally accepted definition for the region of the neck is impetrative, because in clinical circumstances, symptoms of the shoulder region may be the result of injuries in the neck and/or shoulder regions. Moreover, evidence suggests that risk factors for neck and shoulder pain in the general population are not identical[53, 77]. Despite this, NSNP and upper limb pain are often parameters that are examined together in observational studies[16, 37, 38, 40-44]. Different case definitions will determine how data is measured and presented; however, combining neck and upper limb pain constants can reduce the internal consistency and reliability of statistical findings[78, 79]. This is an example of misclassification, which is a form of information bias that refers to a measurement of error[63, 64]. There are two types of misclassification in epidemiological research: non-differential and differential misclassification. Non-differential misclassification refers to when all categories of a variable have the same error rate or probability of being

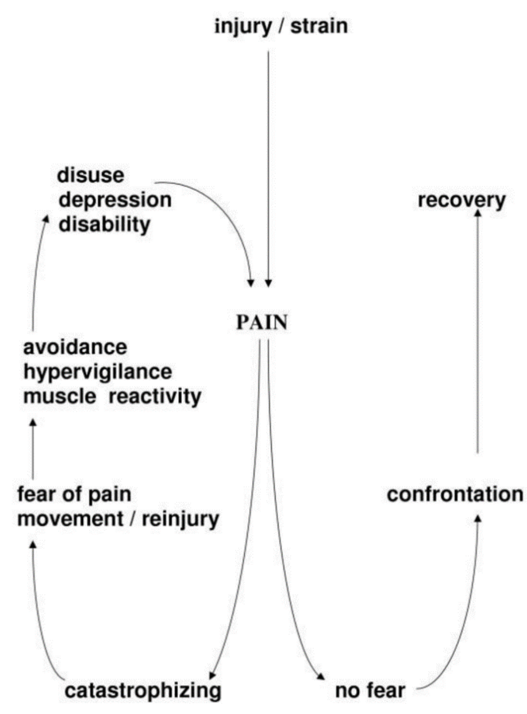
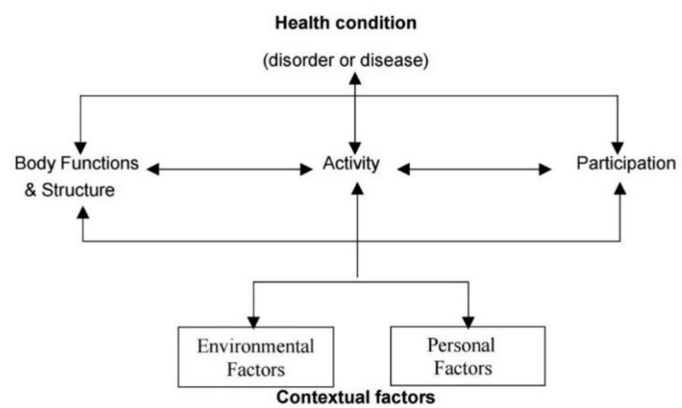


Figure 2.2. A cognitive-behavioural model of pain related fear[4].

misclassified for all study subjects[64]. This means that if there is an association between two variables, differences tend to be minimised. Differential misclassification occurs when the chance of being misclassified differs across study groups[64]. The effects of such misclassification can vary from an underestimation to an overestimation of the true value[63, 64]. Many of the issues with misclassification occur with respect to exposure status since exposures are frequently more challenging to measure and classify. Consideration needs to be heavily placed on the individual's circumstances; for instance, how long has the individual worked in an office setting, hours worked, previous history of neck pain, physical exercise throughout the week *etc.*[63, 64].

Another important consideration is that many outcomes used across studies are not standardised or research-validated; even when an association may exist, the majority of exposed and non-exposed subjects do not experience the outcome[63, 64]. As a result, there is much less potential for errors to have a major effect in distorting the measure of association. Certainly, there may be diagnostic errors in classification of outcome, but compared to the frequency of exposure misclassification, errors in outcome classification tend to be less common and have much less impact on the estimate of association. In addition to having little impact on the estimate of effect, misclassification of outcome will generally bias toward the null hypothesis, so if an association is demonstrated, if anything the true effect might be slightly greater[63, 64]. Anothersignificant methodological weakness is the lack of a combination of research-validated self-reporting instruments, which items cover the broad perspective of NSNP and disability, and have high reliability and validity. Some authors used non-standardized self-reporting instruments[35, 42, 49], while others used only one instrument[16, 34, 38, 39] and few used a combination of research-validated instruments[36, 37, 40]. The use of non-standardised self-reporting instruments is a significant limitation, because it limits reproducibility and pooling of data. Of the self-reporting instruments used in the current literature, the Dutch Musculoskeletal Questionnaire (DMQ) and Nordic Musculoskeletal Questionnaire (NMQ) appear to be most common (Appendix E)[16, 34, 36-38, 40, 41]. Both the DMQ and NMQ are instruments used to analyse musculoskeletal workload and associated potential hazardous working conditions as well as MSD in workers. A limitation of both instruments is their generalisability: most items cover MSD in various body parts for biopsychosocial factors; however, the lack of item specificity leads to scores that may not reflect the actual pain, severity and disability experienced in NSNP cases alone[80, 81]. Psychosocial factors appear to be more commonly associated with individuals who have chronic pain[82, 83]; although, a systematic review by Linton *et al.*[76] concluded that psychosocial factors also play a significant role in the aetiology of acute pain, particularly in the transition to chronic problems. In the acute pain phase, fear-avoidance behaviours, such as resting, can be effective in allowing injured tissues to heal[83]. However, in chronic pain patients, pain and disability appear to persist beyond the expected healing time for such complaints. Prolonged periods of inactivity and fear-avoidance behavior lead to disuse syndrome (Figure 2.2)[4]. Disuse syndrome is associated with physical deconditioning of musculoskeletal structures, which causes a decrease in mobility and muscle strength, guarded movement, and lowered pain thresholds (*i.e.*, allodynia)[4]. Physical activities therefore lead more easily to pain and disability, resulting in fear-avoidance beliefs, which significantly increase the risk of pain chronicity. Furthermore, pain-related fear-avoidance behaviours and pain-catastrophization, described as an exaggerated orientation towards pain stimuli and experience, are sound predictors of observable physical performance and are significantly correlated with self-reported chronic pain disability[4, 84, 85].



Body Functions are physiological functions of body systems (including psychological functions).

Body Structures are anatomical parts of the body such as organs, limbs and their components.

Impairments are problems in body function or structure such as a significant deviation or loss.

Activity is the execution of a task or action by an individual.

Participation is involvement in a life situation.

Activity Limitations are difficulties an individual may have in executing activities.

Participation Restrictions are problems an individual may experience in involvement in life situations.

Environmental Factors make up the physical, socal and attitudinal environment in which people live and conduct their lives..

Figure 2.3. International Classification of functioning, disability and Health, ICF[3]. The model and definitions of the health and health-related components in ICF.

Research gaps in the literature

The majority of observational studies in the literature examined either physical[35, 42, 44] or psychosocial[37, 38] parameters and seldom both parameters[36]. While it is generally accepted that distress is a common consequence of painful MSD, prospective studies of general psychological stress as a risk factor for NSNP in office workers are limited. High-quality prospective longitudinal cohort studies are required to identify causal effects of psychosocial risk factors in office workers with NSNP. Furthermore, there have been no published reviews specifically examining risk factors for NSNP in office workers in cross-sectional studies: a systematic review by Paksaichol *et al.*[18] examined risk factors in prospective cohort studies; however, found substantial heterogeneity among studies mainly regarding case definition, risk factors, self-reporting instruments and follow-up duration. It is imperative for studies to adopt a standardised framework in which NSNP and its risk factors can be classified and organised: in doing so, the substantial heterogeneity examined in the literature can be minimised. In 2001, the World Health Organization (WHO) approved the international classification of functioning, disability and health (ICF).[3] The ICF has conceptualized a biopsychosocial model that describes health and function (Figure 2.3)[3]. The ICF and the International Classification of Diseases (ICD-10) form the two core classification systems of the WHO, where diseases, disorders and disabilities are included[3]. The ICF and ICD-10 provide reliable and comparable data with standardized frameworks and classifications, which provide information on determining the overall health of populations, the prevalence and incidence of non-fatal health outcomes, and measures healthcare needs and the performance and effectiveness of healthcare systems. To assess public health implications of work-related NSNP, including the overall health of populations, the prevalence and incidence of NSNP outcomes, and to measure health care needs and effectiveness of health care systems, reliable and comparable data on the health of individuals and populations is imperative. The ICF provides the framework and classification system for these purposes.

An important gap in the literature is the lack of a combination of research-validated self-reporting instruments with sound reliability and validity, and which items cover all aspects of NSNP and disability. Thus, the prevalence of NSNP in office workers and its related biopsychosocial risk factors according to best-synthesis remains unascertained. Ideally, standardized self-reporting instruments would incorporate all the domains of the ICF: healthcare providers would be able to consider patient-specific functional limitations in assessment and intervention procedures, and then develop a patient-centred management plan[3].

Conclusions

NSNP is a complex and multifactorial healthcare problem that has a high prevalence in office workers and is associated with a substantial burden to the healthcare system and the individual. Risk factors impacting on NSNP in observational studies appear to suggest a strong correlation between female gender, older age, previous history of neck complaints, long work hours and decreased physical exercise. However, a systematic review of the literature revealed that the current understanding of risk factors for NSNP in workers is hindered by inconsistencies in the study designs and a lack of scientific rigour applied to identifying biopsychosocial risk factors. In particular, the lack of a consensus regarding a definition of the neck, combining upper limb pain and NSNP parameters and the use of non-standardised self-reporting instruments with items that fail to capture a broad aspect of NSNP and disability are major methodological weaknesses in the current literature. These weaknesses hinder study reproducibility and pooling of data, thus reducing the internal validity and reliability of statistical findings and measures of central tendency. A systematic review by Ferreira *et al.*[20] evaluated the Neck Bournemouth Questionnaire, NDI and Neck Pain and Disability Scale and concluded that these instruments demonstrated a sound balance and distribution of items across the ICF components[20]. The combination of these instruments might provide the best-synthesis evidence for capturing biopsychosocial risk factors in NSNP. Furthermore, these self-reporting instruments are highly reliable and have adequate internal consistency and validity[20, 86-88].

Future studies should focus on using validated self-reporting instruments which items cover all aspects of NSNP and disability, particularly for psychosocial parameters. Furthermore, NSNP cases should be reported on separately from upper limb and other MSD complaints. Standardisation of study methodology will be an imperative step towards reducing heterogeneity and thus improving the power of statistical findings in the literature. Future reporting of studies should also be guided by documents such as the STROBE statement[141]. Furthermore, future studies will provide a framework and sample population for future intervention-based randomised controlled trials, which aim to examine the effectiveness of workplace interventions for NSNP in office workers. Effective workplace interventions may provide improved biopsychosocial environments for office workers with NSNP. As such, it will provide insight for workplace policy formation by government agencies, including those related to public health.

CHAPTER THREE

METHODOLOGY

Recruitment

Approval was obtained from the Human Research Ethics Committee at the Faculty of Science and Engineering at Macquarie University in Australia (reference number: 5201600261) on 28 April 2016 (Appendix A). Written approval was granted by senior human resource managers from the included workplaces. Participation of the office workers was voluntary with participants free to withdraw from the study protocol at any time. Information was provided to all eligible participants and their informed consent was sought for participation. Participants were given online consent to participate in the study. Participants did not receive reward, monetarily or otherwise, for their participation in this study. This cross-sectional study was conducted among Australian office workers in four workplaces in from June to October 2016. The study design included the use of an online, combined questionnaire of research-validated self-reporting instruments to quantify demographic and biopsychosocial risk factors for NSNP in office workers. Participant recruitment began in May 2016 and was completed in October 2016.

Study Population

A senior human resource (HR) manager from each workplace was initially contacted by email or telephone and an expression of interest to participate was sought. An informative image was then emailed to senior HR managers with the aim to internally email the image to all their respective workers. The following week, senior HR managers emailed an image with a link to the questionnaire to their respective workers. This ensured anonymity of participants. An informed consent form (Appendix B), along with the self-administered questionnaire, were made available through *Qualtrics* (Provo, Utah, USA), an online survey development cloud-based program. Participants were asked to read and agree to the online consent form before beginning the questionnaire. Participants were given the opportunity to save their answers and return to complete the questionnaire indefinitely to increase compliance and avoid missing data. Due to logistical convenience, the workplaces recruited were located throughout Sydney, Australia. The study population was a convenient sample from four workplaces. The four workplaces were de-identified to ensure anonymity and were labelled as Workplaces A, B, C and D. Workplace A and C were statutory organisations run by the Government of New South Wales, Workplace D was a public university and Workplace B was a logistics company. Within these workplaces, there are workers specialising in administration, technical and customer support, administrators, financial and litigation support, managers/supervisors, academics and students. This sample population is therefore a reasonable representation of the total office worker population. Due to issues with internal organisational policy, the questionnaire was not distributed systematically across all included workplaces. For instance, in workplace D, the questionnaire was emailed to all members within three Faculties separately by HR managers via hyperlink, and it was not feasible to gather information on participation rate. Whereas, in workplace A, the hyperlink to the online questionnaire was emailed by the HR manager to a specific group of workers within the organisation.

Inclusion and exclusion criteria

Participants were included if they were male or female office workers, aged 18 to 70 years' old, who were working either full-time, part-time, casually or temporary and using an office computer at least 3 hours in an average working day. Participants were excluded if they were currently pregnant, had a pre-existing whiplash associated disorder of the cervical spine within the last 12 months, or had neck pain due to a specific pathology (*i.e.,* cervical radiculopathy, tumours, infections, fracture, inflammatory processes *etc.*). Whiplash also could be regarded as a non-specific or NSNP diagnosis, because the term refers to the putative cause of complaints without specifying the pathoanatomical mechanism involved. However, due to its separate place in literature, the need for specific outcome measures in this group of patients and problems with interpretation of outcome due to litigation *etc.*, we excluded whiplash studies as well. No other exclusion parameters were set. Data for inclusion and exclusion criteria were collected retrospectively within the demographic variable section of the administered questionnaire. The research candidate and primary supervisor independently reviewed the data for inclusion and exclusion of participants. Disagreements were resolved by consultation with the associate supervisor.

Setting

The study was performed in Sydney, New South Wales, Australia. The cohort was office workers from four workplaces in Sydney. The study was performed via correspondence and completion of combined, online questionnaire.

Variables

Neck pain and disability variables

Guided by the primary objective, NSNP and disability variables aimed to (1) describe a sample population of office workers with NSNP with respect to biopsychosocial and demographic risk factors; and, (2) find the point prevalence of NSNP in this sample of Australian office workers at a given time-point and population.

NSNP severity and disability was measured using a combination of research-validated self-reporting instruments. To measure physical factors, the following three self-reporting instruments were used: neck disability index (NDI), neck Bournemouth questionnaire (NBQ) and neck pain disability scale (NPAD). To measure psychosocial factors, the following three self-reporting instruments were used: Stanford presenteeism scale (SPS-6), Copenhagen psychosocial questionnaire II (COPSOQII) and EuroQol 5-Dimension (EQ-5D). See Appendix C for copies of the included instruments.

A systematic review by Ferreira *et al.*[20] on the critical appraisal of self-reporting instruments measuring neck pain found that the NDI, NBQ and NPAD demonstrated a sound balance and distribution of items across the international classification of functioning, disability and health (ICF). Furthermore, these self-reporting instruments are highly reliable and have adequate internal consistency and validity[20, 86, 87]. Similarly, the SPS-6 and COPSOQII have sound reliability and validity, and if used in combination, may provide a sound distribution in measuring workplace psychosocial factors and presenteeism[21, 22, 89].

The NDI is a widely used and highly validated and reliable instrument for measuring physical aspects in NSNP and is scored out of a possible 50 points or doubled and expressed as a percentage[90, 91]. Each section is scored on a 0 to 5 rating scale, in which 0 means ‘no pain’ and 5 means ‘worst imaginable pain’. All the points can be summed to a total score. It is interpreted as: 0-4 points (0-8%) no disability, 5-14 points (10-28%) mild disability, 15-24 points (30-48%) moderate disability, 25-34 points (50-64%) severe disability, and 35-50 points (70-100%) complete disability.

The NBQ covers important dimensions of the biopsychosocial model of pain and is reliable, valid, and responsive to clinically significant change in patients with NSNP[92]. It consists of seven core items, which are: pain intensity, function in activities of daily living, function in social activities, anxiety, depression levels, fear avoidance behaviour and locus of control behaviour. Each item is rated on a numeric rating scale (NRS) from 0 to 10, where 0 = much better, 5 = no change, and 10 = much worse. A total score on 70 can be calculated, in which a higher score reflects more complaints.

The NPAD has shown to detect pertinent clinical changes in patients undergoing rehabilitation for NSNP[93]. It is a 20-item measure that was specifically developed for patients with NSNP. Patients respond to each item by marking along a 15-cm visual analogue scale (VAS). Item scores range from 0 (no pain) to 15 (maximum pain) with a maximum total score of 300.

The SPS-6 evaluates the impact of health problems on individual work performance and overall perceived productivity for knowledge based activity. Two reviews measuring work productivity concluded that the SPS-6 has strong internal consistency and structural validity, and moderate hypotheses testing and criterion validity[21, 22]. The 6-item instrument is not standardized, but higher scores are associated with higher presenteeism or a greater perceived ability to concentrate on and accomplish work despite health problems. For items 1, 3, and 4, score as following: ‘strongly disagree’ = 1; ‘somewhat disagree’ = 2; ‘uncertain’ = 3; ‘somewhat agree’ = 4; and ‘strongly agree’ = 5. For items 2, 5, and 6, score as following: ‘strongly disagree’ = 5; ‘somewhat disagree’ = 4; ‘uncertain’ = 3; ‘somewhat agree’ = 2; and ‘strongly agree’ = 1. The scores are then summed for the total score. Scores can range from 6-30, with higher scores indicating higher work disability.

The COPSOQII has shown to be a valid and reliable tool and includes most of the relevant dimensions according to several important theories on psychosocial factors at work[89]. The COPSOQII is developed in three different lengths for assessing psychosocial factors at work, stress, and the well-being of employees and some personality factors. The long, scientific version of the COPSOQII was used for this dissertation. It deals with the broadness and indefiniteness of the construct psychosocial factors by applying a multidimensional approach with a very wide spectrum of ascertained aspects. The long version is designed for research use and has 87 items with questions that either have five or four response options. Normally, the five response options are weighted as 0, 25, 50, 75 and 100, and the four response options as 0, 33.33, 66.66 and 100. The scale value is then calculated as the simple average. Thus, all scales go from 0 to 100. However, for this dissertation the five response options were weighted as 0-5, and the four response options 0-4 with a maximum possible score of 340.

The EQ-5D is a standardised measure of health status that provides a simple, generic measure of health for clinical appraisal. It is a simple descriptive profile and a single index value for health status used in clinical evaluation of health care as well as in population health surveys. It consists of a descriptive system and visual analogue scale (VAS). The descriptive system comprises 5 dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has 3 levels which are scored 1-3: no problems, some problems, severe problems with a maximum score of 15. The VAS records the respondent’s self-rated health on a vertical, visual analogue scale (0-100) where the endpoints are labelled 'Best imaginable health state' and 'Worst imaginable health state'.

Demographic variables

Demographic variables identified included individual-related factors and work-related factors. These variables are consistent with other cross-sectional studies and have shown to be pertinent determinants of NSNP[34, 35, 38]. Demographic factors proposed in the literature included demographic and personal data: age (years)[34, 39], gender[34, 35, 44], level of education[16], marital status, occupation, height and weight (body mass index), work absenteeism, physical exercise levels[16], smoking status[43], workplace flexibility and satisfaction, financial situation[94] and health-related quality of life as measured by EQ-5D.

Neck pain prevalence

The secondary objective of this thesis was to find the point prevalence of NSNP in a sample population of office workers and to discern any associations between this prevalence and biopsychosocial and demographic risk factors. NSNP prevalence was recorded as the number of participants' self-reporting NSNP within the last 12 months. The duration of this timeframe is crucial to account for the fluctuating nature of NSNP, limit recall bias, and has been applied in several cross-sectional studies in the literature; thus, justifying its use in this thesis[34, 35, 38].

The formula used to measure NSNP point prevalence is:

$$\textit{Prevalence} = \frac{\textit{number of participants with self-reported NSNP at specific period}}{\textit{total number of individuals in the study population}} \; x\ 100$$

Data collection

Data was collected at one time-point using a combined questionnaire and no follow-up data were collected. Due to time-constraints of this dissertation, collecting follow-up data was not feasible. The questionnaire was divided into four main sections: (i) an informed consent form; (ii) demographic variables; (iii) combination of the abovementioned self-reporting instruments for measuring physical factors; and, (iv) for psychosocial factors in NSNP (Appendices B and C). To ensure anonymity of participants, information such as name and contact details were not included in the demographics section of the questionnaire. Participants were given an automatic tracking identification code and their results were automatically uploaded to the online Qualtrics system available for download.

NSNP disability and severity data was recorded using the NDI, NBQ and NPDI to quantify physical factors and the SPS-6, COPSOQII and EQ-5D to quantify psychosocial factors. Three data collectors recorded the data. The first collector was the chief investigator who is a registered chiropractor. The second data collector's qualifications include: registered chiropractor and associate professor in the Department of Chiropractic, Macquarie University. The third data collector's qualifications include: research fellow in applied biostatistics in the Department of Australian Institute of Health Innovation, Macquarie University. Data collectors met frequently to discuss the data, concepts and issues throughout and after the data collection timeframe.

Data handling

All consent forms and data were recorded online via Qualtrics and downloaded as a CSV file when the survey was closed and made inactive in October 2016. The CSV file was checked, and data were manually checked for implausibility's and outliers, and cleaned as appropriate by the three data collectors if editing was required, and uploaded to *R: The R Project for Statistical Computing* (R Core Team, AK, NZ).

Data analysis

Data analysis commenced October 2016 and concluded February 2017 with ongoing correspondence between the chief investigator and associate supervisor. Data analyses were structured to the specific research objectives, guided by the research questions. NSNP data involved identification of workplace NSNP severity and disability according to the findings from the self-reporting instruments, which aimed to quantify biopsychosocial factors. No follow-up analyses were performed.

Statistical methods

Associations between demographic variables and self-reported neck pain have been shown by means of crosstabulation and Chi-square statistic or Fisher's exact statistic. Two-sample *t*-tests were performed to show statistically significant differences between self-reported neck pain in the past 12 months and gender by the six instruments. One-way analysis of variance of the six instruments by demographic variables was also performed. Pearson's rank correlation coefficient was performed to demonstrate the correlation between the instruments. Further correlation analysis was beyond the scope of this study. A probability level of $p < 0.05$ was considered statistically significant; however, values in the range *p* 0.05-0.10 are worth commenting on for potential associations[95]. Where appropriate, a 95% confidence interval (CI) was applied. All statistical analyses were performed using R.

Validity

The validity and reliability of the included self-reporting instruments have been described in this Chapter. Self-reporting instruments are commonly used in research and clinical practice. There is evidence that these instruments provide useful information about: (1) impacts of NSNP on patients; (2) the patient's perceived functional ability, deficit, and psychosomatic status; (3) change of the condition over time; and, (4) the effectiveness of treatment intervention for both clinicians and patients[21, 96]. Furthermore, multidimensional instruments or more than one instrument may be needed to gain a complete health profile of the patient with NSNP[2]. To minimise bias during the study design and intra-observer variability, standardised instruments and protocol for dissemination and data collection was implemented by the chief investigator. This procedure strengthened the reliability and external validity of this methodology. Moreover, all research assessors were blinded to participant outcomes during the data collection phase and participants remained anonymous, thus minimising interviewer bias. The overall retrospective design of this study increases the risk of recall bias. To minimise this risk, recall was mostly short-term; however, no attempts were made to restructure the six instruments. To minimise non-response bias in the combined instruments, a pilot of 20 office workers was performed, which gave insightful information in relation to the design, data collection and dissemination of the survey. The survey was also rigorously reviewed by academic staff from the Department of Chiropractic, Macquarie University to ensure appropriate length, design and nomenclature. To minimise transfer bias and response rate (*i.e.,* imposition on the participants), no defined timeframe to complete the survey was implemented, and a series of emailed reminders were sent throughout the data collection process. Selection bias is thought to have been limited due to the homogeneity of the target population. However, the relatively small sample size increases the risk of selection bias. Reporting bias was reduced using the STROBE (STrenthening the Reporting of OBservational studies in Epidemiology) cross-sectional checklist[97]. STROBE (Appendix D) is a 22-point checklist which recommends the reporting of key methodological issues for greater transparency and standardisation of observational studies in epidemiology[97].

Conflict of interest

None of the researchers involved in this study have a direct or indirect conflict of interest in the conduct of this research, monetarily or otherwise.

Project Management

Participating workplaces and persons

Chief investigator and primary data collector: Mr Martin Frutiger[1]

Primary supervisor: Associate Professor Peter Jeffrey Tuchin[1]

Associate supervisor: Dr Robert James Borotkanics[2]

Workplaces A, B, C and D

Participant's affiliations

[1] Department of Chiropractic, Faculty of Science and Engineering, Macquarie University, Sydney Australia

[2] Department of Australian Institute of Health and Innovation, Centre for Health Systems and Safety Research, Faculty of Medicine and Health Sciences, Macquarie University, Sydney Australia

CHAPTER FOUR

RESULTS

Description of the study population

The online, combined questionnaire was sent to 131 potential participants who could be accounted for from Workplace A and B. However, due to issues with internal organisational policy, the questionnaire was not distributed systematically across all included workplaces. For instance, in workplace D, the questionnaire was emailed to all members within three Faculties separately by HR managers via hyperlink, and it was not feasible to gather information on participation rate. Whereas, in workplace A, the hyperlink to the online questionnaire was emailed by the HR manager to a specific group of workers within the organisation. The response rate at Workplaces A and B were 29.79% and 34.52%, respectively. Of the 131 potential participants, 119 (90.84%) correctly completed the questionnaire and met the inclusion criteria. The mean time for completing the online questionnaire was 23 minutes.

Table 4.1 shows the descriptive summary of the study population. Seventy-three females (61.34%) and forty-six males (38.65%) participated of which the majority (33.61%) were aged 35-44 years old. The majority (58.82%) of participants had ten or more years of employment in their current field with 63.02% being permanent full-time workers. Most participants worked as academics (34.45%), admin staff (24.37%) and managers/supervisors (20.17%). One-hundred-and-ten (92.44%) worked five or more hours at a computer during a normal working day. The mean (95% CI) VAS health state was 77.61 (±2.27).

Neck pain prevalence

A total of 73.10% of the study population (*n* =119) reported neck pain within the past 12 months. The majority (50.42%) of participants reported 1-4 days of sickness absence, followed by 21.01% reporting 0 days' absence and 18.49% 5-9 days' absence.

Potential risk factors

Demographic variables by self-reported neck pain

Both Chi-square (χ^2) and Fisher's exact were used to test if observed differences were statistically significant in demographic variables and self-reported neck pain. A Fisher's exact test was preferable in instances when cells had a count of less than five observations.

Gender

Approximately 48% of females reported neck pain in the past 12 months compared to 25% of males. However, Chi-square tests demonstrated no statistically significant differences between gender and self-reported neck pain at the .05 level $\chi^2(1, n = 119) = 1.766$, $p = 0.184$ (Appendix F, Suppl 1).

Age

Most respondents were aged between 35-54 years old (55.45%). A Fisher’s exact found no statistically significant difference between self-reported neck pain and age (p = 0.885).

Sickness absence

Respondents who had experienced neck pain was higher than those who had not experienced neck pain across all categories of sickness absence. However, there was no evidence of a statistically significant association (p = 0.330). The results are shown in Appendix F, Suppl 2.

Marital status

Respondents who had experienced neck pain was higher than those who had not experienced neck pain across marital status categories except the widowed category. The most notable difference in counts was in the married category with 37.82% experiencing neck pain and 15.13% no neck pain, which was a 22.69% difference between the groups. It is important to note that all five divorced participants experienced neck pain (4.20%) and the only widowed participant experience no neck pain (0.84%). A Fishers exact test was used in examining the association between neck pain and marital status as some cells had a count of less than five. There was no evidence of a statistically significant association between neck pain and marital status (p = 0.207). The results are shown in Appendix F, Suppl 3.

Table 4.1. Descriptive summary

Demographic variable	*n* (%)
Age groups (years)	
18-24	4 (3.36)
25-34	23 (19.33)
35-44	40 (33.61)
45-54	26 (21.84)
55-65	21 (17.65)
66-70	**5 (4.20)**
Gender	
Male	46 (38.65)
Female	73 (61.34)
Neck pain last 12 months	
Yes	87 (73.10)
No	32 (26.90)
Employment	
Student or contractor	5 (4.20)
Casual	9 (7.56)
Temporary part-time	4 (3.36)
Temporary full-time	12 (10.08)
Permanent part-time	14 (11.76)
Permanent full-time	75 (63.02)
Years employment	
0-4	26 (21.85)
5-9	23 (19.33)
10+	70 (58.82)
Workplace	
C	2 (1.68)
A	14 (11.76)
B	29 (24.37)
D	74 (62.18)
Job type	
Academia	41 (34.45)
Admin	29 (24.37)
Manager/supervisor	24 (20.17)
Accounting	9 (7.56)
IT	4 (3.36)
Other	12 (10.08)
Hours at computer	
3	4 (3.36)
4	5 (4.20)
5+	110 (92.44)
Education	
HSC	11 (9.24)
Trade	3 (2.52)
Cert/Dip	19 (15.97)
Associate degree	2 (1.68)
Bachelor degree	23 (19.33)
Master degree	24 (20.17)
Doctoral degree	30 (25.21)
Post-doctoral degree	7 (5.89)
Sickness absence (days)	
0	25 (21.01)
1-4	60 (50.42)
5-9	22 (18.49)
10-14	6 (5.04)
15+	6 (5.04)

Table 4.1. (*Continued*)

Demographic variable	*n* (%)
Marital status	
Single	27 (22.69)
De facto relationship	23 (19.33)
Married	63 (52.94)
Divorced	5 (4.20)
Widowed	1 (0.84)
Living condition	
Live alone	11 (9.24)
Live with relative(s)	12 (10.08)
Live with unrelated adult(s)	7 (5.88)
Live with spouse/partner	37 (31.09)
Live with child/children	2 (1.68)
Live with spouse/partner and child/children	50 (42.02)
Hours physical exercise per week	
0-3	55 (46.22)
4-6	44 (36.97)
7-10	10 (8.40)
10+	10 (8.40)
Cigarette smoking	
None	107 (89.92)
Less than a pack-a-day	11 (9.24)
A pack-a-day	1 (0.84)
Financial situation	
Very good	27 (22.69)
Reasonably good	41 (34.45)
Average	46 (38.65)
Reasonably bad	4 (3.36)
Very bad	1 (0.84)

Table 4.1. (*Continued*)

Demographic variable	*n* (%)	Mean (95% CI)	SD
BMI (kg/m^2)		25.27 (±0.84)	4.65
<18.5	2 (1.68)		
18.5-25	67 (56.30)		
25-30	35 (29.41)		
>30	15 (12.60)		
EQ-5D			
Descriptive system (5-15)	119 (100%)	5.983 (±0.18)	1.01
VAS health state (0-100)	119 (100%)	77.61 (±2.27)	12.61

Abbreviations: BMI (Body Mass Index); Cert/Dip (Certificate or Diploma); CI (Confidence Interval); EQ-5D (EuroQol-5 Dimension); HSC (Higher School Certificate); IT (Information Technologies); SD (Standard Deviation); VAS (Visual Analogue Scale).

Hours of physical exercise

A Wilcoxon rank-sum test with continuity correction was applied to examine population mean ranks in hours of physical exercise by self-reported neck pain. Wilcoxon rank-rum test is a non-parametric hypothesis test used to compare two groups with numerical data. The justification for the use of this test was that data are paired and come from the same population, and the data are measured on an ordinal scale. Self-reported neck pain and hours of physical exercise were shown to be statistically significant (V = 6156, p = <0.001). This implies that there is an association between the hours of physical exercise individuals are performing and those who reported neck pain. Respondents who did not have neck pain increased gradually from zero to two hours of physical exercise, after which respondents with neck pain decreased, except for those exercising ten or more hours a week. These results are shown in Figure 4.1.

There were observed differences in the number of respondents who had experienced neck pain across different hours of physical exercise. The highest number of respondents had experienced neck pain when they had three hours of exercise, while the least number of respondents had experienced neck pain when they had zero or one hour of exercise. It is important to note that respondents still experienced neck pain even when they did no physical exercise. Fishers test did not find evidence the observed differences were statistically significant (p = 0.100). The results are shown in Appendix F, Suppl 4.

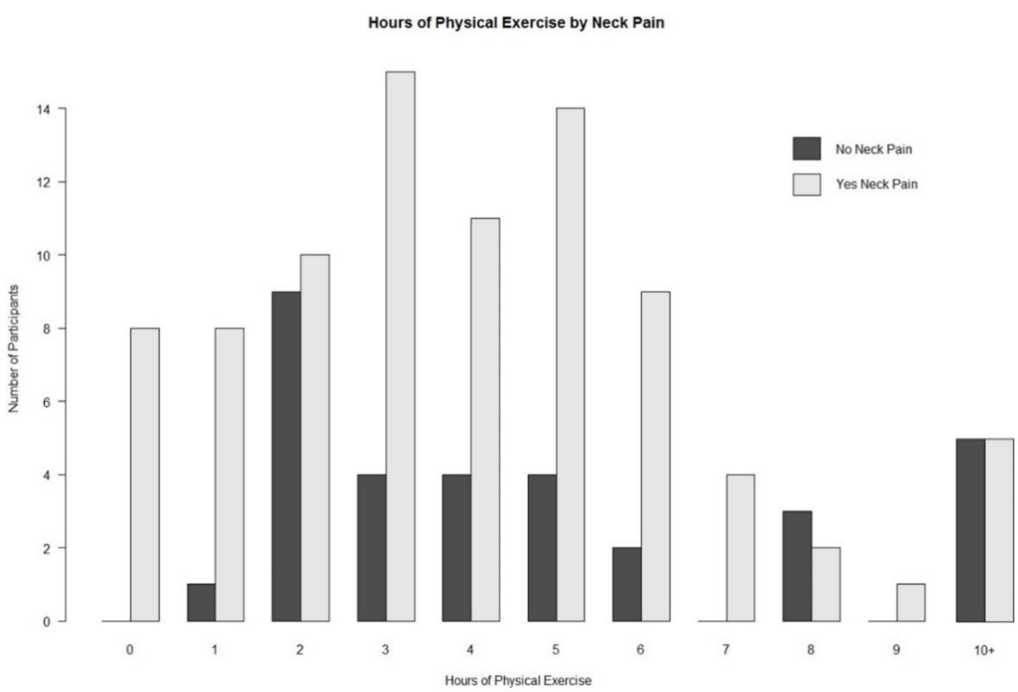


Figure 4.1. Hours of physical activity by self-reported neck pain within the last 12 months.

Hours at a computer

There were differences in the in the number of participants who had experienced neck pain and hours spent at a computer in a normal working day. Most participants worked five or more hours at a computer (92.44%) and most of those participants experienced neck pain (67.23%). However, there was no evidence that the observed differences were statistically significant using both Fishers test (p = 1.00) and the Chi-square at the .05 level $\chi^2(2, n = 119) = 0.136$, $p = 0.934$. The results are shown in Appendix F, Suppl 5.

Education

Although there were observed differences in number of participants who had experienced neck pain across the education categories, a Fishers exact test did not find any evidence of a statistically significant difference (p = 0.451). The results are shown in Appendix F, Suppl 6.

Workplace

The number of participants who had experienced neck pain was higher than those who had not experienced pain across all workplace categories except Workplace C. A notable difference was Workplace D with 47.90% experiencing neck pain, and 14.29% no neck pain, which was a 33.61% between-group difference. Although Fishers test was preferable, both the Chi-square and Fishers test showed the observed differences were statistically significant. These results are shown in Table 4.2.

Table 4.2 Self-reported neck pain in the past 12 months by workplace.

		Workplace				
Neck pain		**A**	**B**	**C**	**D**	**Total**
Yes		13 (10.92%)	16 (13.45%)	1 (0.84%)	57 (47.90%)	87 (73.11%)
No		1 (0.84%)	13 (10.92%)	1 (0.84%)	17 (14.29%)	32 (26.89%)
Total		14 (11.76%)	29 (24.37%)	2 (1.68%)	74 (62.19%)	119 (100%)
ChiSq statistic			**Fishers statistic**			
ChiSq	*df*	*p-value**	*p-value**			
8.64	3	0.034†	0.023†			

** p < .05; † statistically significant.*
Note: Numbers in parentheses indicate column percentage, n =119).
Abbreviations: ChiSq (Pearson's Chi-Squared test with Yates' continuity correction); df (Degrees of freedom); Fishers (Fishers exact test for count data).

The highest number of participants who had neck pain were from Workplace D (47.90%), while the least number of participants who had neck pain were from the Workplace C (0.84%). This is depicted in Figure 4.2.

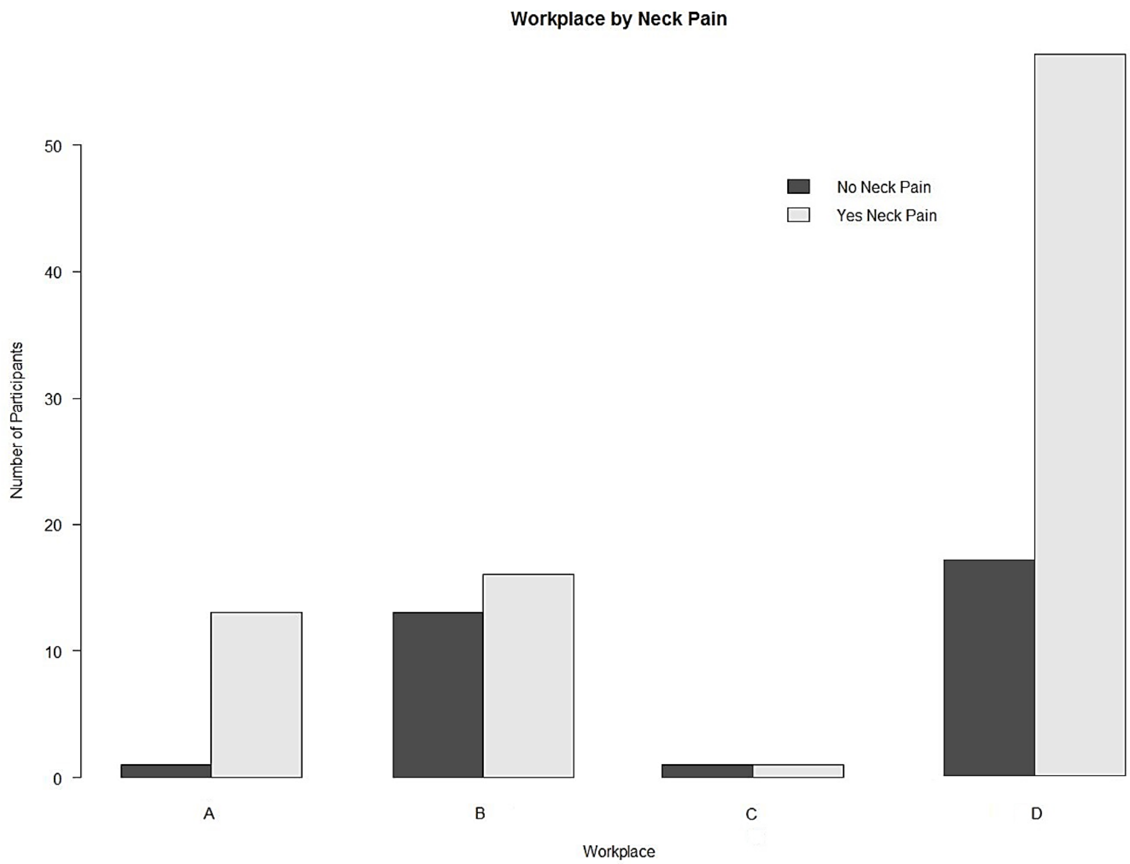


Figure 4.2. Workplace by self-reported neck pain within the last 12 months.

Most participants had 5-9 years of employment across all workplaces: 40 (33.61%) at Workplace D, 19 (15.97%) at Workplace B, and 9 (7.56%) at Workplace A. More participants have also worked at Workplace D for ten or more years (n = 15, 20.27%) as compared to the other workplaces. These results are shown in Figure4.3.

Other demographic variables

No statistically significant relationships were found using Fishers exact between self-reported neck pain and the remaining demographic variables, which included employment ($p = 0.370$), living condition ($p = 0.513$), years of employment ($p = 0.847$), job type ($p = 0.419$) and smoking ($p = 0.244$).

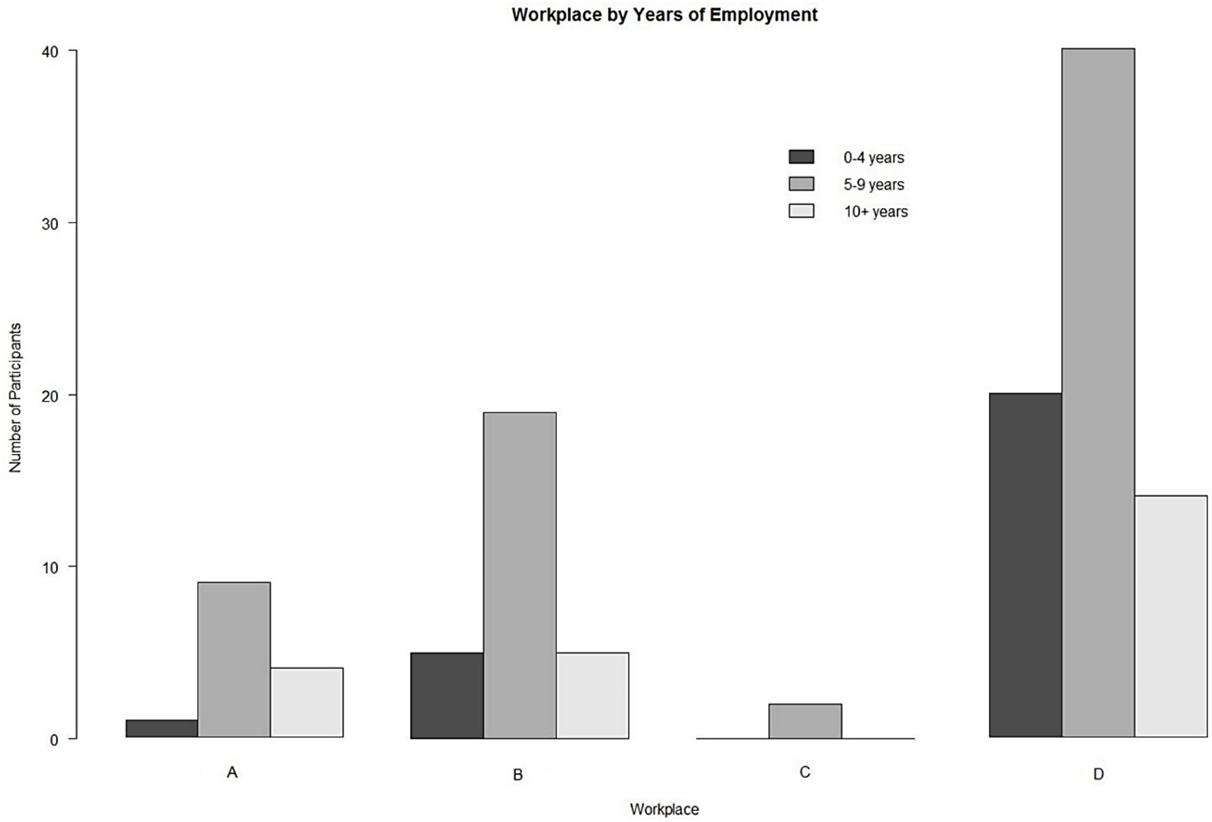


Figure 4.3. Workplace by years of employment.

Instruments by self-reported neck pain

Sample data for the six self-reporting instruments used to measure neck pain and disability is shown in Table 4.3. A substantial difference between the highest and lowest recorded scores across all instruments was noted. Higher average (mean) neck pain and disability scores were noted in the psychosocial instruments. A discrepancy in the mean and median values for the NPAD variable was also noted. Further analysis revealed the source of the discrepancy was due to four (3.4%, mean of 163.5) outliers, which skewed data to the left (1.204). It was thought that removing the outliers would therefore remove skewness in the data. However, removal of the outliers did not remove skewness in the data. The mean value for NPAD data without removing the outliers was 41.56, and after removing outliers the mean value was 37.32.

Table 4.3. Sample data across neck pain and disability instruments (*n* = 119)

	Self-reporting instruments *Physical*			*Psychosocial*		
Sample data	**NDI**	**NBQ**	**NPAD**	**SPS-6**	**COPSOQ II**	**EQ-5D**
Mean	6.1	13.3	41.56	20	129.63	5.98
Median	5	11	29	19	126	6.00
SD	4.6	11.1	40.91	2.9	41.06	1.01
Q1	3	4	10	18	101	5.00
Q3	9	21	62	22	149.5	6.50
Minimum recorded score	0	0	0	12	42	5
Maximum recorded score	19	49	181	27	265	9
Maximum possible score	50	70	300	30	340	15
Average (mean) pain and disability score (%)	12.2	19	13.85	66.67	38.13	66.44

Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); EQ-5D (EuroQol-5 Dimension); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SD (Standard deviation); SPS-6 (Stanford Presenteeism Scale 6).

Figure 4.4 shows the identification and removal of outliers in the NPAD instrument. It is important to note that the NPAD variable demonstrated unequal distribution of data (Table 4.3, Figure 4.4). A Student's *t*-test is a statistical hypothesis test used to determine if two sets of data are significantly different from each other. Importantly, the Student's *t*-test assumes samples have equal variance and sample sizes. However, Welch's *t*-test is a more reliable test that can be substituted for a Student's *t*-test when samples have unequal distribution. Therefore, a Welch's *t*-test would be the appropriate statistical hypothesis test in this circumstance.

The observed mean among participants with neck pain was higher than the mean of participants without neck pain in all six self-reporting instruments. An independent *t*-test showed these differences were statistically significant in all the instruments except in the COPSOQ II. These results are presented in Table 4.4

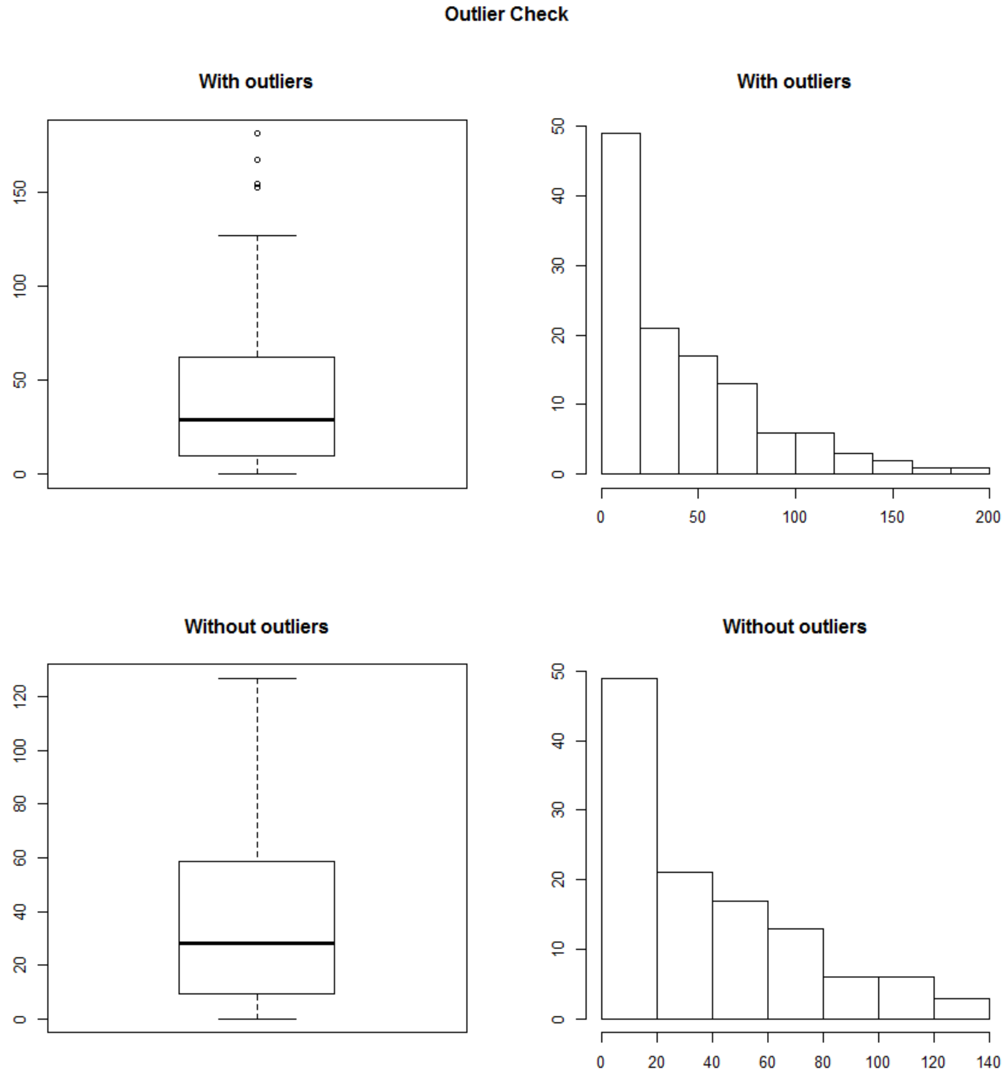


Figure 4.4. Identification and removal of outliers in NPAD data.

Table 4.4. Results of a Welch two sample *t*-test and descriptive data for included neck pain and disability instruments by self-reported neck pain in past 12 months.

	Self-reported neck pain							
	Yes			No				
	Mean	*SD*	*n*	*Mean*	*SD*	*n*	*t**	*p-value*
NDI	7.28	4.63	87	2.97	4.63	32	-5.47	<0.001†
NBQ	16.65	11.12	87	4.28	11.12	32	-8.87	<0.001†
NPAD	52.95	40.91	87	10.59	40.91	32	-7.88	<0.001†
SPS-6	20.59	2.90	87	18.41	2.90	32	-4.16	<0.001†
COPSOQ II	130.42	41.06	87	127.47	41.06	32	-0.34	0.736
EQ-5D	6.18	1.01	87	5.44	1.01	32	-4.45	<0.001†

** $p < .05$; † statistically significant*

Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); EQ-5D (EuroQol 5 Dimension); n (Number of participants); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SD (Standard deviation); SPS-6 (Stanford Presenteeism Scale 6); t (T score statistic).

Instruments by demographic variables

The observed mean values in females were higher than that observed among males in all instruments except the COPSOQ II. An independent *t*-test showed these differences were statistically significant in the NBQ and SPS-6. The independent *t*-test showed the mean differences in the other instruments were not statistically significant. These results are shown in Table 4.5.

Table 4.5. Results of a Welch two-sample *t*-test and descriptive data for included neck pain and disability instruments by gender.

	Gender							
	Male			Female				
	Mean	*SD*	*n*	*Mean*	*SD*	*n*	*t**	*p-value*
NDI	5.35	4.63	46	6.60	4.63	73	1.46	0.148
NBQ	10.61	11.12	46	15.04	11.12	73	2.14	0.035†
NPAD	34.15	40.91	46	46.23	40.91	73	1.56	0.121
SPS-6	19.26	2.90	46	20.47	2.90	73	2.14	0.035†
COPSOQ II	131.24	41.06	46	128.62	41.06	73	-0.33	0.739
EQ-5D	5.93	1.01	46	6.01	1.01	73	0.41	0.683

** $p < .05$; † statistically significant*
Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); EQ-5D (EuroQol 5 Dimension); n (Number of participants); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SD (Standard deviation); SPS-6 (Stanford Presenteeism Scale 6); t (T score statistic).

Analysis of variance (ANOVA) is a collection of statistical models used to analyse the differences among group means and their associated procedures, for example variation among and between groups, and therefore generalises the *t*-test to more than two groups. Conversely, the Kruskal-Wallis test is a non-parametric method that is used for comparing two or more independent samples of equal or different sample sizes. The Kruskal-Wallis (and Wilcoxon rank-sum test) can be seen technically as a comparison of the mean ranks. Hence, in terms of original values, the Kruskal-Wallis is more general than a comparison of means: it tests whether the probability that a random observation from each group is equally likely to be above or below a random observation from another group. This approach accounts for the unequal distribution of data observed in the NPAD variable.

The results of an ANOVA showed employment had a significant effect on the NPAD and NDI instruments. Post hoc comparisons using Tukey criterion indicated that temporary part-time and permanent part-time employment was significantly different compared to other categories in the NPAD instrument (*adj p* = 0.037). However, post hoc comparisons showed no significant effect on any of the employment groups in the NDI instrument. The results of an ANOVA showed employment did not have any significant effect on the NBQ, SPS-6, COPSOQ II and EQ-5D instruments. Post hoc comparisons using Tukey criterion showed there were no significant differences in mean between any employment groups in the SPS-6 and EQ-5D instruments. However, post hoc comparisons indicated that university degree (associate degree) and trade qualification was significantly different compared to other groups in the COPSOQ II instrument (*adj p* = 0.039). The Kruskal-Wallis analysis was consistent with analysis of variance in all the instruments. These results are shown in Table 4.6.

Table 4.6. One-way analysis of variance of included neck pain and disability instruments by employment.

Instrument	*Source*	*df*	*SS*	*MS*	*F*	*p-value**	*KW*
NDI	Between groups	5	257.4	51.48	2.56	0.031†	11.22
	Within groups	113	2271.0	20.10			*df* = 5
	Total	118	2528.4	71.58			*p-value** = 0.047†
NBQ	Between groups	5	756	151.1	1.24	0.298	6.46
	Within groups	113	13833	122.4			*df* = 5
	Total	118	14589	273.5			*p-value** = 0.264
NPAD	Between groups	5	18655	3731	2.36	0.045†	12.48
	Within groups	113	178824	1583			*df* = 5
	Total	118	197479	5314			*p-value** = 0.029†
SPS-6	Between groups	5	62.2	12.45	1.51	0.192	7.14
	Within groups	113	931.8	8.25			*df* = 5
	Total	118	994	20.7			*p-value** = 0.211
COPSOQ II	Between groups	5	11641	2328	1.41	0.228	7.42
	Within groups	113	187271	1657			*df* = 5
	Total	118	198912	3985			*p-value** = 0.191
EQ-5D	Between groups	5	10.15	2.03	2.09	0.072	7.48
	Within groups	113	109.82	0.97			*df* = 5
	Total	118	119.97	3			*p-value** = 0.187

** p < .05; † statistically significant*
Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); df (Degrees of freedom); EQ-5D (EuroQol-5 Dimension); F (F-statistic); KW (Kruskal-Wallis one-way analysis of variance test by ranks chi-squared); MS (Mean square); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6); SS (Sum of squares).

Figure 4.5 shows multiple box-and-whisker plots for the six instruments by employment. Median scores varied considerably in all instruments, but most notably in the temporary part-time group by the NDI and NPAD instruments. The range between the maximum and minimum observations varied considerably in the permanent part-time group by the NDI, SPS-6 and COPSOQ II instruments. Furthermore, considerable variation in interquartile range is evident in the casual groups by the NDI and EQ-5D. Outliers were observed in most notably the permanent part-time group by the NBQ, NPAD, COPSOQ II and EQ-5D instruments.

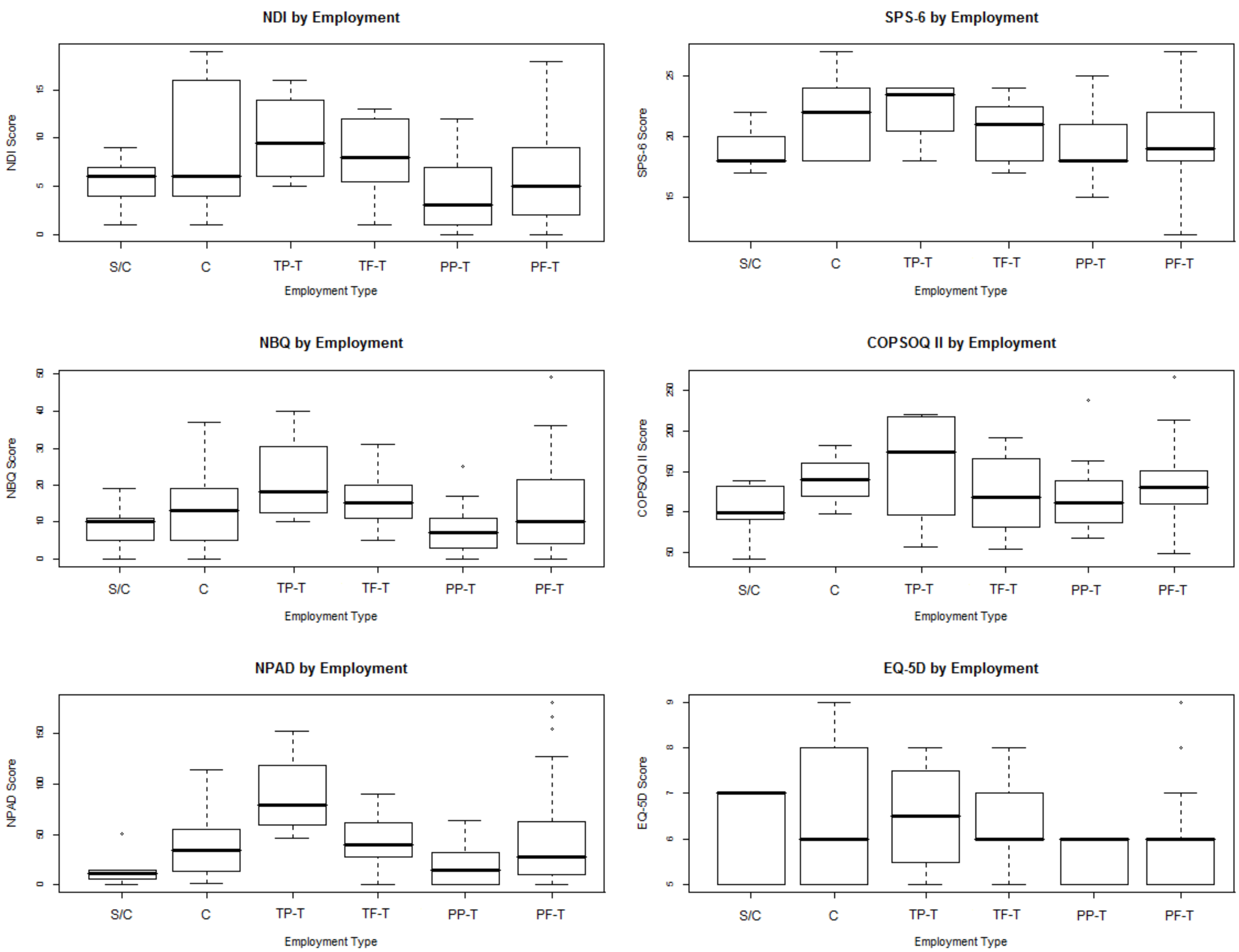


Figure 4.5. Multiple box-and-whisker plots for the six included instruments by employment type. Note: S/C (student/contractor); C (casual); TP-T (temporary part-time); TF-T (temporary full-time); PP-T (permanent part-time); PF-T (permanent full-time).

An ANOVA did not find a significant effect of education on NDI. However, a Kruskal Wallis test found significant differences in the education groups, which was not consistent with ANOVA results. An ANOVA did not find a significant effect of education on NBQ and NPAD and these results were consistent with the Kruskal-Wallis analyses. The results of ANOVA showed a significant effect of education on the SPS-6, COPSOQ II and EQ-5D instruments. Kruskal-Wallis analyses for EQ-5D was consistent with the findings of the ANOVA; however, not consistent with the COPSOQ II and SPS-6 instruments. Post hoc comparisons using Tukey criteria found a statistically significant difference between university degree (associate degree) and trade qualification in the COPSOQ II instrument (*adj* $p = 0.039$), and no effect in any education group in the SPS-6 and EQ-5D instruments. These results are shown in Table 4.7.

Table 4.7. One-way analysis of variance of included neck pain and disability instruments by education.

Instrument	*Source*	*df*	*SS*	*MS*	*F*	*p-value**	*KW*
NDI	Between groups	7	286.7	40.96	2.03	0.058	14.80
	Within groups	111	2241.6	20.19			*df* = 7
	Total	118	2528.3	61.15			*p-value** = 0.039†
NBQ	Between groups	7	767	109.5	0.88	0.525	6.66
	Within groups	111	13821	124.5			*df* = 7
	Total	118	14588	234			*p-value** = 0.466
NPAD	Between groups	7	13849	1978	1.20	0.311	9.32
	Within groups	111	183630	1654			*df* = 7
	Total	118	197479	3632			*p-value** = 0.231
SPS-6	Between groups	7	131.2	18.75	2.41	0.025†	12.83
	Within groups	111	862.8	7.78			*df* = 7
	Total	118	994	26.53			*p-value** = 0.076
COPSOQ II	Between groups	7	23491	3356	2.12	0.047†	12.90
	Within groups	111	175421	1580			*df* = 7
	Total	118	198912	4936			*p-value** = 0.075
EQ-5D	Between groups	7	14.75	2.11	2.22	0.038†	16.83
	Within groups	111	105.21	0.95			*df* = 7
	Total	118	119.96	3.06			*p-value** = 0.019†

** $p < .05$; † statistically significant*

Abbrv: COPSOQ II (Copenhagen Psychosocial Questionnaire II); df (Degrees of freedom); EQ-5D (EuroQol-5 Dimension); F (F-statistic); KW (Kruskal-Wallis one-way analysis of variance test by ranks chi-squared); MN (Mean square); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6); SS (Sum of squares).

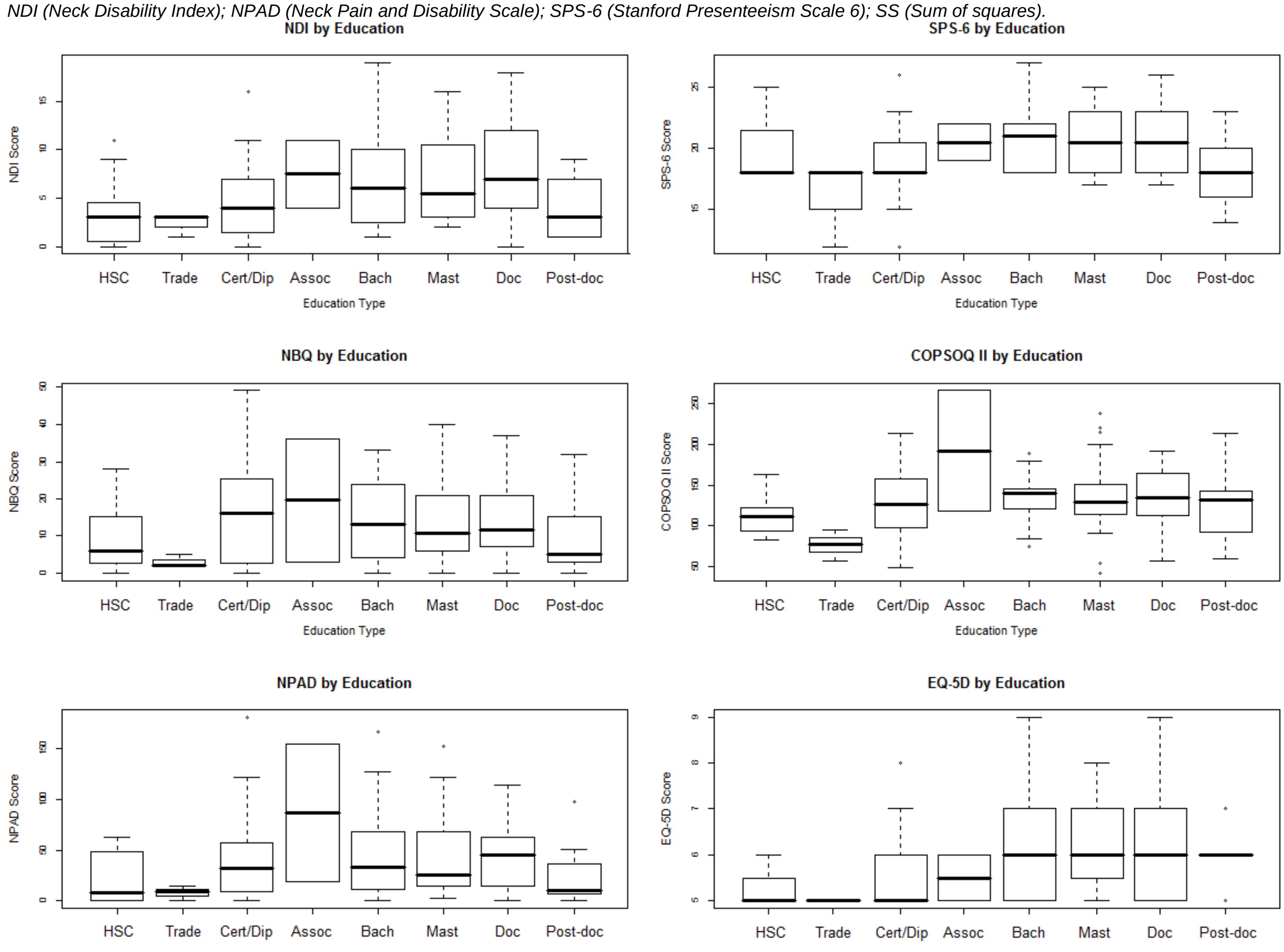


Figure 4.6. Instruments by education. Note: Cert/Dip (certificate/diploma); HSC (higher school certificate); Trade (trade qualification); Assoc (university associate degree); Bach (university bachelor degree); Doc (university doctoral degree); Mast (university master degree); Post-doc (university post-doctoral degree).

Figure 4.6 shows multiple box-and-whisker plots of the six instruments by education level. Median scores varied in university (associate degree) groups by the NPAD and COPSOQ II instruments. The interquartile range also varied considerably in university (associate degree) groups by the NBQ, NPAD and COPSOQ II instruments. Outliers were observed in most notably the certificate/diploma groups by the NDI, NPAD, SPS-6 and EQ-5D instruments and in the university (master degree) groups in the NPAD and COPSOQ II instruments.

An ANOVA showed workplace had a significant effect on all instruments, except on the SPS-6, which were all consistent with the findings of Kruskal-Wallis analyses. Post hoc analyses showed there were statistically significant differences between Workplace D and B for the NDI (*adj p* = <0.001); Workplace A and B for the NBQ (*adj p* = 0.006); Workplace D and B (*adj p* = 0.016) and also between Workplace A and B (*adj p* = 0.004) for the NPAD; Workplace D and B for the COPSOQ II (*adj p* = 0.009); and Workplace D and B (*adj p* = <0.001) and also between Workplace A and B (*adj p* = 0.022) for the EQ-5D. These results are shown in Table 4.8.

Table 4.8. One-way analysis of variance of included neck pain and disability instruments by workplace.

Instrument	*Source*	*df*	*SS*	*MS*	*F*	*p-value**	*KW*
NDI	Between groups	3	402.4	134.12	7.26	<0.001†	20.99
	Within groups	115	2126.0	18.49			*df* = 3
	Total	118	2528.4	152.61			*p-value** = <0.001†
NBQ	Between groups	3	1519	506.3	4.46	0.005†	11.98
	Within groups	115	13069	113.6			*df* = 3
	Total	118	14588	619.9			*p-value** = 0.007†
NPAD	Between groups	3	23728	7909	5.24	0.002†	15.92
	Within groups	115	173752	1511			*df* = 3
	Total	118	197480	9720			*p-value** = 0.001†
SPS-6	Between groups	3	64.4	21.48	2.66	0.052	7.67
	Within groups	115	929.6	8.08			*df* = 3
	Total	118	994	29.56			*p-value** = 0.053
COPSOQ II	Between groups	3	17392	5797	3.67	0.014†	13.09
	Within groups	115	181519	1578			*df* = 3
	Total	118	198911	7375			*p-value** = 0.004†
EQ-5D	Between groups	3	24.74	8.25	9.96	<0.001†	29.37
	Within groups	115	95.23	0.83			*df* = 3
	Total	118	119.97	9.08			*p-value** = <0.001†

** p < .05; † statistically significant*
Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); df (Degrees of freedom); EQ-5D (EuroQol-5 Dimension); F (F-statistic); KW (Kruskal-Wallis one-way analysis of variance test by ranks chi-squared); MN (Mean square); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6); SS (Sum of squares).

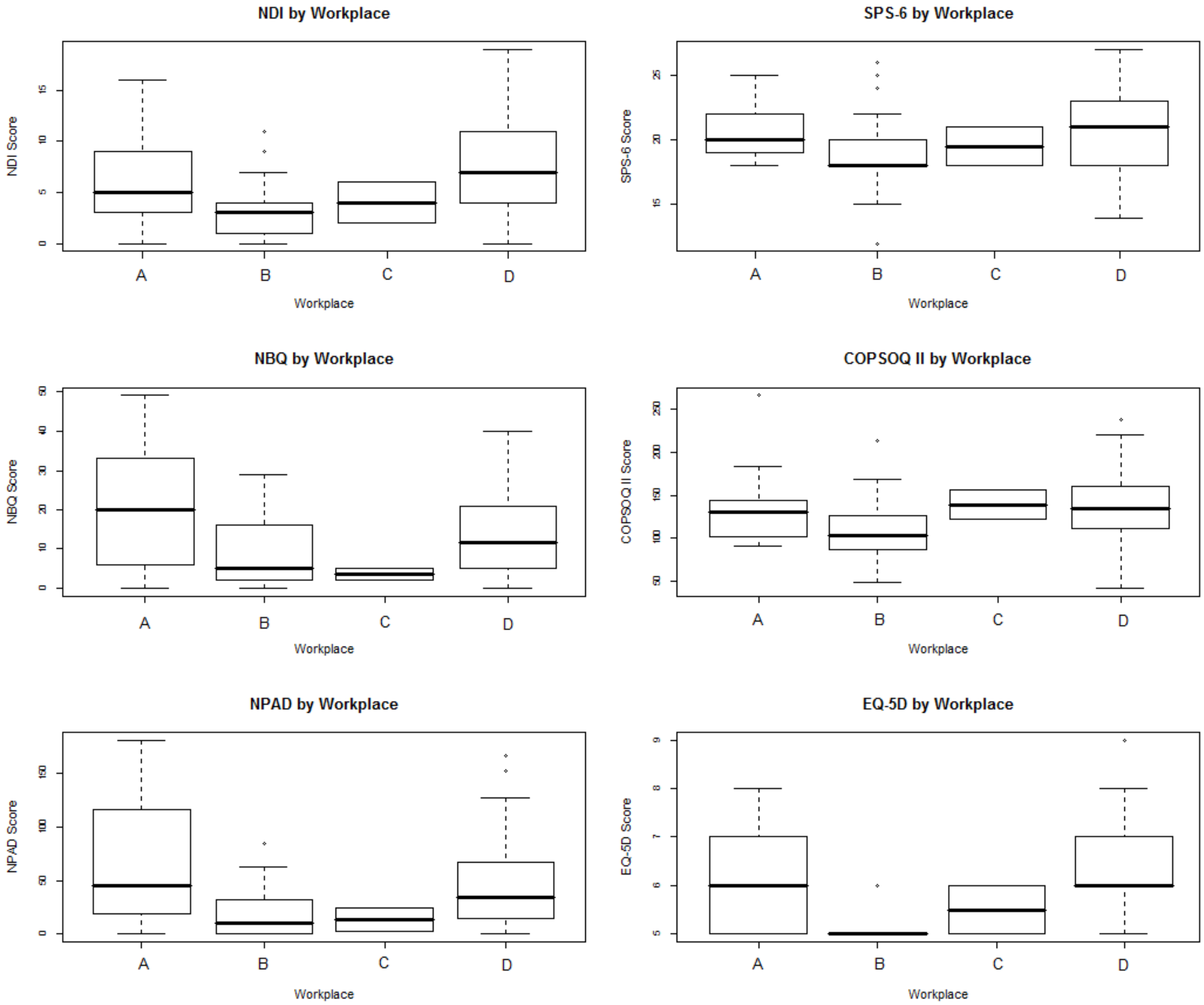


Figure 4.7. Multiple box-and-whisker plots for the six included instruments by workplace.

Figure 4.7 shows multiple box-and-whisker plots of the six instruments by workplace. Median scores varied in Workplace A by the NBQ instrument and in Workplace B by the EQ-5D instrument. The range between the maximum and minimum observations in Workplace D is vaster compared to other groups across all instruments, but most notably by the NDI, SPS-6 and COPSOQ II instruments. Outliers were observed in most notably Workplace B by the NDI and SPS-6 instruments and in the Workplace D by the NPAD instrument.

An ANOVA showed marital status had a statistically significant effect on all instruments, except for SPS-6 and EQ-5D. This was consistent with the findings of Kruskal-Wallis analyses. Post hoc analyses found no statistically significant difference between any of the marital status groups for the NDI and NPAD. However, post hoc analyses found statistically significant differences between married and divorced participants for the NBQ (*adj p* = 0.045) and between single and de facto participants for the COPSOQ II instrument (*adj p* = 0.042). The results are shown in Table 4.9.

Table 4.9. One-way analysis of variance of included neck pain and disability instruments by marital status.

Instrument	*Source*	*df*	*SS*	*MS*	*F*	*p-value**	*KW*
NDI	Between groups	4	249	62.24	3.11	0.018†	12.92
	Within groups	114	2279	19.99			*df* = 4
	Total	118	2528	82.23			*p-value** = 0.012†
NBQ	Between groups	4	1207	301.7	2.57	0.042†	11.78
	Within groups	114	13381	117.4			*df* = 4
	Total	118	14588	419.1			*p-value** = 0.019†
NPAD	Between groups	4	15930	3982	2.501	0.046†	10.85
	Within groups	114	181549	1593			*df* = 4
	Total	118	197479	5575			*p-value** = 0.028†
SPS-6	Between groups	4	43.2	10.79	1.30	0.277	4.12
	Within groups	114	950.8	8.34			*df* = 4
	Total	118	994	19.13			*p-value** = 0.389
COPSOQ II	Between groups	4	19727	4932	3.14	0.017†	11.37
	Within groups	114	179185	1572			*df* = 4
	Total	118	198912	6504			*p-value** = 0.023†
EQ-5D	Between groups	4	9.37	2.34	2.414	0.053	10.15
	Within groups	114	110.60	0.97			*df* = 4
	Total	118	119.97	3.31			*p-value** = 0.038†

** p < .05; † statistically significant*
Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); df (Degrees of freedom); EQ-5D (EuroQol-5 Dimension); F (F-statistic); KW (Kruskal-Wallis one-way analysis of variance test by ranks chi-squared); MN (Mean square); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6); SS (Sum of squares).

Figure 4.8 shows multiple box-and-whisker plots of the six instruments by marital status. Median scores varied considerably in the widowed groups by the NDI, NPAD and EQ-5 D instruments and in the divorced groups by the NBQ and SPS-6 instruments. The range between the maximum and minimum observations in the married groups was vaster compared to other groups across all instruments, but notably by the NDI, SPS-6 and COPSOQ II instruments. Outliers were observed in the married groups by the NDI, NBQ, NPAD and EQ-5 D and in divorced groups by the NDI, COPSOQ II and EQ-5D instruments.

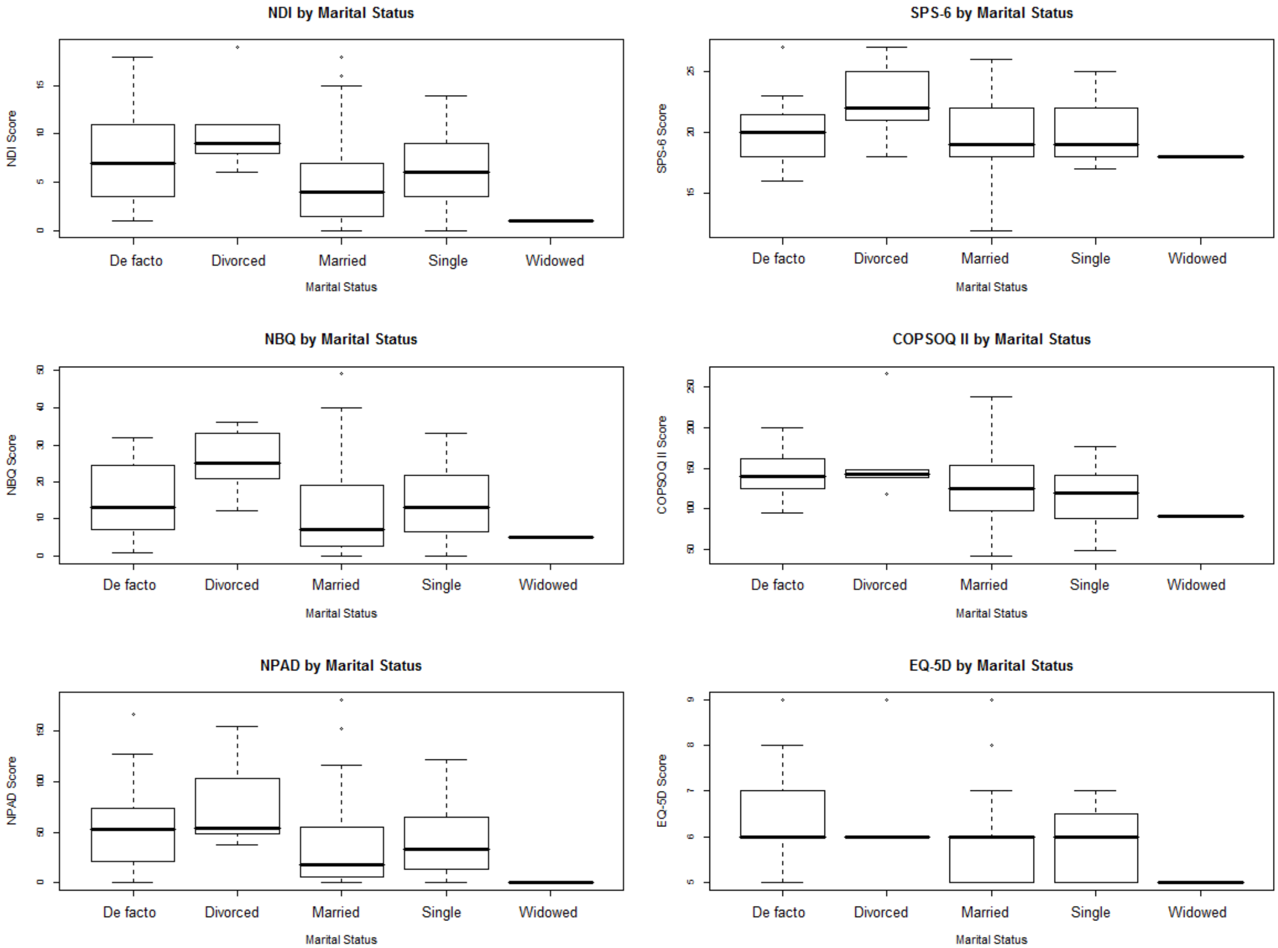


Figure 4.8. Multiple box-and-whisker plots for the six included instruments by marital status. Note: Widowed group (n = 1).

An ANOVA found the effect of sickness absence on NDI, NBQ, NPAD and EQ-5D instruments were statistically significant, but no significant effects were found for the SPS-6 and COPSOQ II instruments. This was consistent with the findings of Kruskal-Wallis analyses for the NDI, NPAD and EQ-5D instruments, but was not consistent for the NBQ. Post hoc analysis using Tukey test found three pairs that were statistically different. These were 15+ days and 0 days, 5-9 days and 0 days, and 15+ days and 1-4 days. Significant differences were found between 15+ days and 0 days (*adj p* =<0.001), 5-9 days and 0 days (*adj p* = 0.042), and 15+ days and 1-4 days (*adj p* = 0.002) for the NDI instrument; between 5-9 days and 0 days in the NPAD (*adj p* = 0.012); and between 15+ days and 0 days (*adj p* = 0.001) and 15+ days and 1-4 days (*adj p* = 0.001) in the EQ-5D instrument. These results are shown in Table 4.10.

Table 4.10. One-way analysis of variance of included neck pain and disability instruments by sickness absence.

Instrument	*Source*	*df*	*SS*	*MS*	*F*	*p-value**	*KW*
NDI	Between groups	4	444.5	111.11	6.08	<0.001†	16.87
	Within groups	114	2083.9	18.28			*df* = 4
	Total	118	2528.4	129.39			*p-value** = 0.002†
NBQ	Between groups	4	1274	318.5	2.73	0.033†	8.41
	Within groups	114	13314	116.8			*df* = 4
	Total	118	14588	435.3			*p-value** = 0.077
NPAD	Between groups	4	25650	6412	4.25	0.003†	13.97
	Within groups	114	171829	1507			*df* = 4
	Total	118	197479	7919			*p-value** = 0.007†
SPS-6	Between groups	4	25.4	6.34	0.75	0.562	3.01
	Within groups	114	968.6	8.49			*df* = 4
	Total	118	994	14.83			*p-value** = 0.556
COPSOQ II	Between groups	4	4854	1214	0.71	0.585	2.90
	Within groups	114	194058	1702			*df* = 4
	Total	118	198912	2916			*p-value** = 0.575
EQ-5D	Between groups	4	20.14	5.04	5.75	<0.001†	13.72
	Within groups	114	99.83	0.88			*df* = 4
	Total	118	119.97	5.92			*p-value** = 0.008†

** p < .05; † statistically significant*
Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); df (Degrees of freedom); EQ-5D (EuroQol-5 Dimension); F (F-statistic); KW (Kruskal-Wallis one-way analysis of variance test by ranks chi-squared); MN (Mean square); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6); SS (Sum of squares).

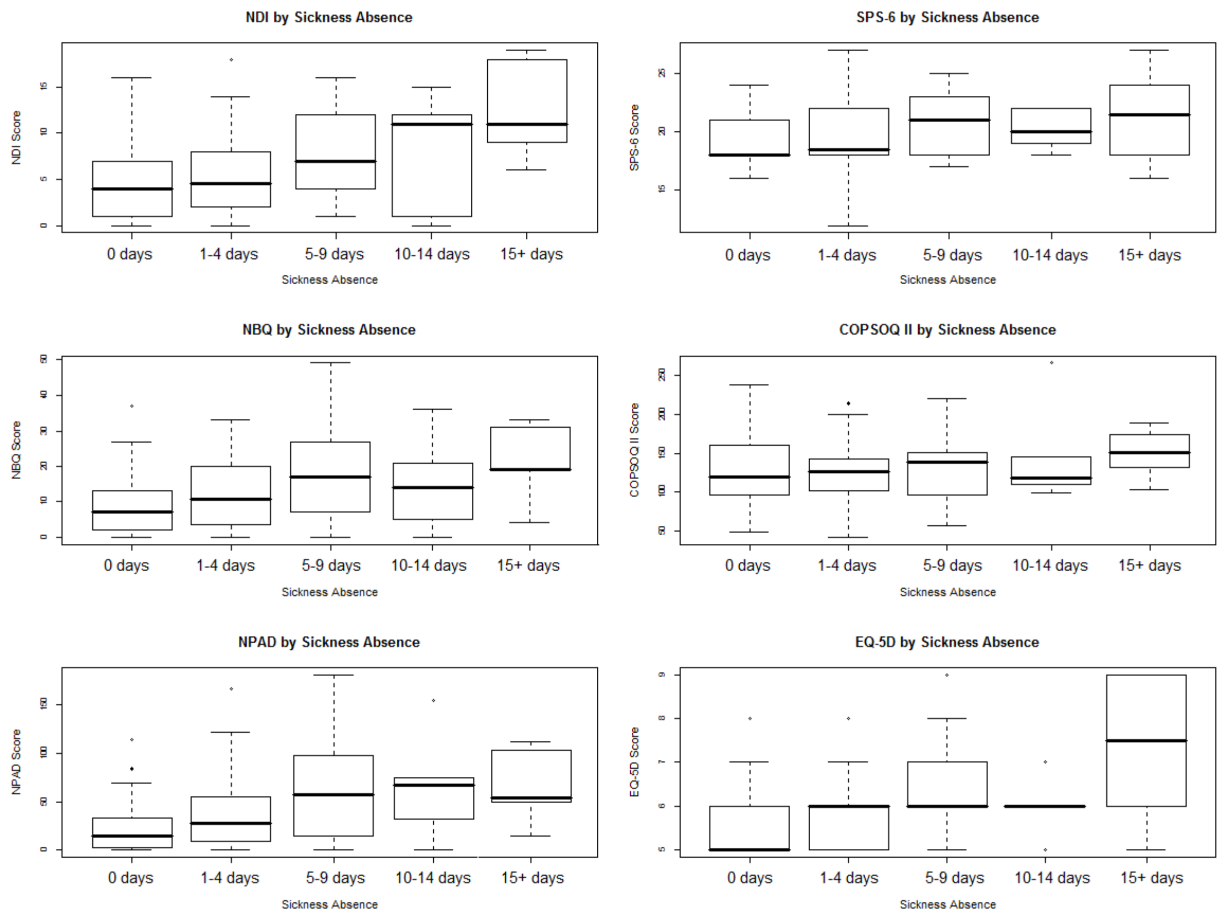


Figure 4.9. Multiple box-and-whisker plots for the six included instruments by sickness absence.

Figure 4.9 shows multiple box-and-whisker plots of the six instruments by sickness absence. Median scores varied considerably in the 10-14 days' group by the NDI instrument and in the 15+ days' groups by the NDI, NBQ and EQ-5D instruments. There was considerable variation in interquartile range in the 10-14 days' group by the NDI instrument, and in the 15+ days' groups by the NDI and EQ-5D instruments. The range between the maximum and minimum observations in the 1-4 days' groups by the SPS-6 and COPSOQ II instruments, and in the 5-9 days' groups by the NBQ and NPAD instruments are vaster compared to other groups. Outliers were observed the 1-4 days' groups by the NDI, NPAD, COPSOQ II and EQ-5D instruments, and in the 0 day groups by the NBQ, NPAD and EQ-5D instruments. A dose-response relationship is noted in all instruments, except the NPAD.

An ANOVA found no statistically significant difference in the effect of hours at computer on all six instruments, which was consistent with the findings of the Kruskal-Wallis analyses (Appendix F, Suppl 7). Furthermore, post hoc analysis using Tukey criterion found no statistically significant differences between the hours at a computer groups and all six instruments. Appendix F, Suppl 8 shows a multiple box-and-whisker plots of the six instruments by hours spent at a computer at work. Median scores in the 3 hours' groups by the NBQ, NPAD and EQ-D varied slightly compared to the other two groups. There was considerable variation in interquartile range in the 4 hours' group by the NPAD, SPS-6 and EQ-5D instruments. The range between the maximum and minimum observations in the 5+ hours' groups by the NDI, SPS-6 and COPSOQ II instruments were vaster compared to other groups. Outliers were observed in the 4 hours' group by the NBQ and EQ-5 D instruments and in the 5+ hours' groups by the NPAD and COPSOQ II instruments.

Analyses of neck pain and disability instruments

Pearson correlation coefficient test was performed to measure the relationship between the six self-reporting instruments. There were positive correlations between all instruments (Table 4.11). The instruments measuring physical risk factors in neck pain (*i.e.*, the NDI, NBQ and NPAD) were highly correlated, particularly between the NBQ and NPAD (r = 0.882, n = 119, p = <0.001). It is important to note that all the psychosocial instruments (*i.e.*, SPS-6, COPSOQ II and EQ-5D) were more positively correlated to the physical risk factor instruments than to each other, except between the NDI and COPSOQ II. The least correlation found was between the COPSOQ II and EQ-5D instruments (r = 0.320, n = 119, p = <0.001). These results are shown in Table 4.11.

Table 4.11. Pearson's correlation analyses for the included neck pain and disability instruments (*n* = 119).

		NDI	*NBQ*	*NPAD*	*SPS-6*	*COPSOQ II*
NBQ	*cor estimate*	0.727				
	p-value	<0.001*				
NPAD	*cor estimate*	0.761	0.882			
	p-value	<0.001*	<0.001*			
SPS-6	*cor estimate*	0.564	0.584	0.608		
	p-value	<0.001*	<0.001*	<0.001*		
COPSOQ II	*cor estimate*	0.347	0.362	0.363	0.358	
	p-value	<0.001*	<0.001*	<0.001*	<0.001*	
EQ-5D	*cor estimate*	0.730	0.600	0.572	0.414	0.320
	p-value	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*

*Note: p-value < 0.05 (correlation significance at 0.05, two-tailed). * Statistically significant p-value.*
Abbreviations: COPSOQ II (Copenhagen Psychosocial Questionnaire II); cor estimate (Pearson's correlation coefficient); EQ-5D (EuroQol-5 Dimension); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6).

Appendix G shows the items across the six instruments with the highest scores (*i.e.*, highest neck pain and disability recorded), relative to the total possible score within each instrument (%). The most selected items across the instruments in this office worker cohort include biopsychosocial factors such as headaches, neck pain at its worst, high levels of stress, anxiety and depression, poor work relationships, environment and coping strategies. Further correlation analyses between the six instrument items were beyond the focus of this analysis.

CHAPTER FIVE

DISCUSSION

Summary of findings

Overall, the results of this study found associations between non-specific neck pain (NSNP) and several demographic and biopsychosocial risk factors. Associations were found between self-reported NSNP and five of the six instruments: gender (by two of the six instruments); employment, education, workplace, marital status and sickness absence (by some of the instruments). Statistically significant differences were evident between some instruments and some groups within employment, education, workplace, marital status and sickness absence variables. Moreover, positive correlations were evident between all instruments, particularly between the instruments measuring physical risk factors. Appendix H presents the statistically significant findings from the cross-sectional study of this dissertation.

Prevalence

In a returned sample of 131 completed questionnaires, which was a response rate of approximately 30% (29.79% to 34.52%), 119 (90.84%) participants were included in this study. This study showed a high point prevalence of self-reported NSNP within a population of Australian office workers, which was 73.10%. The prevalence of self-reported NSNP during the past 12 months presented in this study is consistent with other cross-sectional studies[34, 36, 38, 40, 43, 44]. Other studies on office workers have reported both higher[41] and lower[37] prevalence of NSNP. The differences in prevalence between studies could be due to differences in populations examined, the timeframe of prevalence calculations, or in the criteria used for defining NSNP or symptoms. Examples of these criteria include the general health state, as measured by the EuroQol-5 Dimension's (EQ-5D) visual analogue scale (VAS, 0-100), was high with mean of 77.61.

Severity

Severity of NSNP and disability was presented as the average (mean) pain and disability score in each of the six instruments. The neck disability index (NDI) mean score was 12.2%, which is slightly greater than the general population (10.6%)[98]. For workers with NSNP, the NDI mean was 7.28 (SD = 4.63, p = <0.001), which is consistent in reports of workers with chronic NSNP[99, 100]. The neck Bournemouth Questionnaire (NBQ) mean score was 19% and the mean score in workers with NSNP was 16.65 (SD = 11.12, p = <0.001), which was consistent with previous reports[92, 101]. The neck pain and disability scale (NPAD) mean score was 13.85% and in workers with NSNP, the mean was 52.95 (SD = 40.91, p = <0.001), which is consistent with previous reports[102, 103]. Higher average pain and disability scores were evident in the psychosocial instruments compared to the physical instruments. The mean score in the Stanford presenteeism scale-6 (SPS-6) was 66.67% and in workers with NSNP the mean was 20.59 (*SD* = 2.90, *p* = <0.001), which corresponds to previous reports with means of 17.3[104] and 19[105]. The Copenhagen psychosocial questionnaire II (COPSOQ II) mean score was 38.13%, and in participants with NSNP the mean was 130.42 (*SD* = 41.06, *p* = 0.736). No comparable data for the general population is available in the literature; however, these scores are much higher than what has been observed in a previous study on hospital orderlies[106]. The EQ-5D mean score was 66.44% and in participants with NSNP, the mean was 6.18 (*SD* = 1.10, *p* = <0.001), which is consistent with findings from previous studies on participants with NSNP[107-109]. Overall, the severity scores are consistent with the literature on workers with NSNP, and the majority of participants (50.42%) reported only 1-4 days of sickness absence within the past 12 months, suggesting response bias had minimal impact in this study.

Potential risk factors

i. (Gender); *ii.* (Age); *iii.* (Sickness absence); *iv.* (Workplaces assessed); *v.* (Employment type); *vi.* (Education); *vii.* (Hours at a computer and years of employment).

i. Gender

In this study, 48% of females reported NSNP in the past 12 months compared to 25% of men; however, no statistically significant difference between the two genders was found at the .05 level $\chi^2(1, n = 119) = 1.766$, $p = 0.184$), which is inconsistent with previous studies on office workers[18, 29, 34, 37, 38, 70]. The observed mean values in females were higher than that in males across all instruments, except the COPSOQ II. However, these differences were shown to be statistically significant in only the NBQ (*p* = 0.035) and SPS-6 (*p* = 0.035). The observed differences may be due to the limited number of participants within the gender groups. This may have led to a lower statistical power to detect differences or a true effect, and reduced the level of confidence for sample estimates; thus, causing a larger error margin. Also noteworthy is that 73% of participants were female, and this considerable difference between gender groups may have perpetuated no effect for gender on NSNP and disability.

ii. Age

This study found no statistically significant difference between age and self-reported NSNP using Fishers exact (*p* = 0.885). It is important to note that 56.30% of participants were aged 18-44 years-old, and this age group are less likely to experience age-related NSNP[34]. Another possible explanation for observed differences may be due to its small between-group sample size. This study was conducted on currently employed office workers; consequently, workers on sickness absence or those recently unemployed could not be accounted and a significant proportion of those workers may be of retirement age. Moreover, random sampling was not possible due to workplace policy at Workplace A and C, which may have further perpetuated the observed differences in this study.

iii. Sickness absence

Sickness absence was not shown to be significantly different between the two self-reported NSNP groups (p = 0.330). This conflicts with the literature, which suggests that NSNP and disability is associated with a higher risk of sickness absence[110-112]. An explanation for this is the healthy worker effect, whereby healthier workers constitute much of the study population, and chronically ill and disabled participants are excluded. Participants who had comorbidities or pathological reasons for their pain and disability, or were on sickness absence or unemployed at the time of the data collection are less likely to comprise the study population. Therefore, the effects of sickness absence on NSNP and disability in this cohort did not represent the entire population. However, results from an ANOVA showed statistically significant differences between sickness absence and NSNP and disability in the NDI $F(4, 114) = 6.08$, $p = <0.001$, NBQ $F(4, 114) = 2.73$, $p = 0.033$, NPAD $F(4, 114) = 4.25$, $p = 0.003$, and EQ-5D $F(4, 114) = 5.75$, $p = <0.001$. Post hoc analyses found that three pairs were specifically different: 15+ days and 0 days, 5-9 days and 0 days, and 15+ days and 1-4 days. The 15+ days and 0 days' groups, as measured in the NDI, were particularly different (*adj* $p = <0.001$). A dose-response relationship between all instruments, except the NPAD, and sickness absence was evident, whereby the effect of increased sickness absence days resulted in higher pain and disability scores.

iv. Workplaces assessed

All workplaces in this study were from the Sydney, Australia. Workplaces A and C were statutory organisation run by the Government of New South Wales, Workplace B was a logistics company, and Workplace D was a public university. The lowest prevalence scores for self-reported NSNP were from Workplaces C and A (n = 1, 0.84%) of whom seven (5.88%) were admin officers and six (5.04%) were managers/supervisors. However, it is important to note that Workplace C only comprised two (1.68%) participants. The highest prevalence scores for NSNP were from Workplace D (47.90%) of whom 41 (55.41%) were academics, which is consistent with prevalence and incidence rates in academic cohorts[113, 114]. These results might be related to the psychological pressure placed on academics, and the increase in sedentary rates and decrease in physical activity levels caused by the academic burden[113, 114].

v. Employment type

Full-time workers are exposed to more working hours, which in effect leads to prolonged sedentary behaviours, and this factor increases the effect of work-related NSNP and disability[50, 115, 116]. However, a dose-response relationship between employment type and NSNP and disability was not evident in this study. Interestingly, the temporary part-time group reported the highest pain and disability median scores across all instruments, except in the EQ-5D, whereby the students/contractors reported higher median scores. Many participants in this study were academics and a proportion of those may have been employed casually/temporary or as students, and these cohorts are exposed to prolonged sedentary working behaviours, which increases the risk of NSNP. Psychosocial factors, such as stress, anxiety and high working demands have also shown to be highly prevalent in academics, which may have further perpetuated the effect of employment type on NSNP in this study cohort[113, 114].

vi. Education

In this study, the effect of education on self-reported NSNP was not statistically significant ($p = 0.451$). Nevertheless, participants who completed a university associate, bachelor or doctorate degrees reported higher median NSNP and disability scores compared to the other groups across all instruments except in the EQ-5D. Furthermore, results from an ANOVA showed statistically significant differences between education level and NSNP and disability in the SPS-6 $F(7, 111) = 2.41$, $p = 0.025$, COPSOQ II $F(7, 111) = 2.12$, $p = 0.047$, and EQ-5D $F(7, 111) = 2.22$, $p = 0.038$. Post hoc analysis found this to be particularly significant between the associate degree and trade qualification groups in the COPSOQ II instrument (*adj p* = 0.039). The differences observed between the education groups may be due to the considerable quantitative and cognitive demands placed on academics[40]. These high job demands often involve complicated work tasks, work overload, physical/mental fatigue, lack of staff and other work pressures such as co-worker and employer relationships[6, 40]. While high job demands and work overload is widely prevalent in today's cost-cutting working environment, these factors may have profound effects on NSNP on university-level education populations[6, 40, 41].

*vii.	Hours at computer and years of employment*

This study found no significant difference between self-reported NSNP and hours worked at a computer ($p = 0.100$) or years of employment ($p = 0.847$) using Fishers exact, which conflicts with the overall findings of recent studies[36-39, 72, 110]. No dose-response relationship between self-reported NSNP and hours at a computer or years of employment was evidence. In fact, the three-hours' group reported higher pain and disability median scores in the NBQ, NPAD and SPS-6, compared to the four and five or more hours' groups. This finding could be attributable to

The three timeframe groups are consistent with previously published literature on Australian office workers[117-119]. However, such self-report estimates are likely to be subject to sizeable measurement error. Forty-one (11.76%) participants in this study population were academics of which twenty-one (17.65%) were students or employed part-time or casually. Given the higher sedentary rates, psychological pressure and job demands, and the lack of co-worker support and employer relationships, the effect of computer use on NSNP may be overrepresented in this cohort[6, 40, 113, 114]. Furthermore, estimates on sedentary patterns were not captured across non-workplace settings: academic student, part-time and casual participants may work on a computer at home both professionally and leisurely. This increases exposure to the effect of hours at a computer, which is likely to explain the difference in observed estimates. The total dose, *i.e.*, hours at computer by years of employment, was not calculated and is a limitation in this study. These were confounding variables in which both observed and unobserved factors may have impacted on results. More data is required to ascertain significant relationships between total dose and self-reported NSNP.

Self-reported neck pain and analyses of assessment instruments

Welch *t*-tests revealed statistically significant findings between self-reported neck pain and five of the six instruments ($p = < 0.001$). No significant relationship was found for the COPSOQ II $t(118) = –0.34$, $p = 0.736$. The COPSOQ II lends itself to generalisability regarding the relationship between psychosocial work environment and pain and disability[120, 121]. Consequently, it contains dimensions that may not be covered by the job strain model proposed by Karasek-Theorell, whereby high job demands and low decision latitude comprise the two central components of work strain[122]. However, recent studies have supported its use in the working population[123, 124]. The NDI, NBQ, and NPAD have demonstrated a well-balanced distribution of items across several domains in NSNP[20]. Furthermore, results from Pearson's correlation coefficient found that all instruments, particularly the NDI, NBQ and

NPAD, were positively correlated to each other r(117), p = < 0.001). The instruments comprise multiple dimensions of health and therefore when used in combination may be reliable predictors of risk factors for NSNP and disability in clinical and research settings. Preliminary evidence suggests that instrument items pertaining to psychosocial factors were prevalent in this cohort of office workers. Further correlation analyses of each item between the six instruments and self-reported NSNP is required to ascertain any significant relationships and effects between specific risk factors and NSNP and disability.

Thesis limitations

i. Sample size

The small sample size (*n*=119) of Australian office workers is an important limitation in this study. A smaller sample size may have reduced the power of this study, and thus increased the margin of error in estimates. A smaller sample size also increases the risk of selection bias. However, selection bias was thought to have been limited due to the homogeneity of the target population. This was a convenient sample of Australian office workers, and due to time and logistical constraints of this dissertation it was not feasible to increase this sample size.

ii. Neck pain definition

The definition of NSNP is fundamentally important in research aiming to examine risk factors, because it directly restricts the boundaries of the study and determines how data is measured and presented; however, there appears to be no consensus in the literature on what factors determine NSNP. Cagnie *et al.*[34] defined the neck area with the use of a non-standardised drawing with shadings. Darivemula *et al.*[35] used anatomical regions: from the base of the skull (occipital) to the upper part of the back and laterally to the outer and superior bounds of the shoulder blade (scapula). While this method presents detailed description of the neck region, the terminology may cause confusion to lay people, leading to recall and response bias. Combining neck and upper limb pain constants can reduce the internal consistency and reliability of statistical findings[78, 79]. This is an example of misclassification, a form of information bias that refers to a measurement of error[63, 64]. The definition for NSNP and its anatomical region were presented in Chapters 1 and 2. It was a combination of standardised visual and descriptive formats as presented The Bone and Joint Decade 2000-2010 Task Force on Neck Pain and its Associated Disorders[5, 13]. Justification of its use in this thesis was given in Chapter 3.

iii. Prevalence

Cross-sectional studies identify prevalence of disorders and their associated risk factors at a specific time point and population. However, an important weakness in cross-sectional design is that routinely collected data does not normally describe which variable is the cause and which the effect, thus precluding conclusions regarding causation[7]. The prevalence of NSNP and disability is expressed as a percentage and was defined in Chapter 3. Chapter 4 presents the results of the cross-sectional study of this dissertation, and reports a 73.10% prevalence of NSNP and disability in the study population. Descriptive statistics and sample data of counts and proportions were also included in this Chapter.

iv. Severity

Severity data is an important epidemiological measure of NSNP, yet it is often poorly appraised in observational literature[2]. There is also a lack of a combination of self-reporting instruments with sound reliability and validity, and which items cover pertinent biopsychosocial aspects of NSNP and disability[24, 125]. Important information could be potentially missed if robust data collection methods are not adopted[16, 34, 38, 39]. Many instruments are subject to generalisability: the Dutch Musculoskeletal Questionnaire (DMQ) and the Nordic Musculoskeletal Questionnaire (NMQ) are commonly used instruments in observational literature examining NSNP and disability[16, 34, 36, 40, 41]; however, these instruments cover musculoskeletal disorders in various body parts, and this lack of specificity leads to scores that may not reflect the actual pain, severity and disability experienced in NSNP cases alone[80, 81]. Even when associations exist, the majority of exposed and non-exposed subjects do not experience the outcome[63, 64]. Single instruments usually do not cover all biopsychosocial aspects of NSNP and disability, and it is therefore useful to combine standardised instruments to fill in gaps, thereby obtaining a complete health profile of a population[20, 126, 127]. In this thesis, severity data was reported as the mean scores in the six standardised instruments in all participants and self-reported NSNP groups.

v. Reporting

The reporting of retrospective NSNP and disability studies in office workers is moderate to good. Quality assurance in the dissemination of results is an important factor for comparability of reported information. Recent advances in the dissemination of information have come by means of guideline documents such as the STROBE Statement[97], which was followed in this dissertation, ensuring the quality of reporting the results.

a. Study design

Data were collected retrospectively, which relies heavily on participant's ability to accurately recall past experiences. This increases the risk of recall bias, potentially leading to differential misclassification of exposures. The reliability of information regarding whether the patient had NSNP in the past 12 months, and how many days of sickness absence they experienced in the past 12 months are particularly subject to recall bias; therefore, these prevalence's could have been underestimated. Conversely, participants with NSNP might rate their exposure higher compared to those without complaints. This is particularly true when using self-reported data[128]. An important consideration of voluntary response is that higher educated individuals are more likely to respond[129, 130] and that this cohort are less likely to be affected by extremity response[130]. The study population in this dissertation were primarily highly educated individuals (72.28% having a university degree); therefore, the possibility of response bias impacting on estimates cannot be ruled out. The effects of these potential biases could not be evaluated, but 58.82% of subjects had 10 or more years of employment within their current workplace, suggesting that the study was conducted in a reasonably stable population. Hence, it is expected that selection bias did not influence the observed associations to a great extent. Prospective or experimental studies would be required to substantiate the observed associations.

b. Generalisability and sampling strategies

The recruitment strategy between the included workplaces differed. Random sampling of the population at Workplace A was not possible due to stringent workplace policy. Therefore, the Workplace A sample may not represent the entire population. At Workplace C, the online survey was disseminated via intranet site as hyperlinked text and image. This method of dissemination reduces survey exposure to the sample population, which also reduces participant compliance. Furthermore, because the survey was disseminated via an intranet site, rather than to individuals via workplace email, the potential study population and response rates could not be verified.

This was a convenience sample from four workplaces whereby severely ill (*i.e.,* pathological NSNP) and disabled individuals (*i.e.,* whiplash associated disorders) were excluded, which raises the possibility of healthy worker selection. This healthy worker effect may have led to an underestimation of the prevalence and severity of NSNP[131]. Moreover, since the analyses were limited to currently working participants, workers who had left the job market or on sickness absence because of NSNP were excluded, further perpetuating the healthy worker effect. Conversely, among those invited to participate, workers with NSNP may have been more inclined to take part in the study. Also, symptomatic workers may be more aware of the factors that they believe influence their symptoms than health workers, thereby overestimating the amount of exposure to these factors, which would have biased prevalence estimates upwards. The effects of these potential selection biases could not be evaluated. However, Toomingas *et al.*[132] found no supporting evidence for bias from rating behaviour when subjects simultaneously rated both exposure and outcome.

CHAPTER SIX

CONCLUSION

Principal findings

The broad aim of this thesis was to report on the point prevalence of non-specific neck pain (NSNP) in a sample population of Australian office workers, and to show which biopsychosocial and demographic risk factors were associated with NSNP. This involved collecting data using an online survey that comprised of the Neck Disability Index (NDI), Neck Bournemouth Index (NBQ), Neck Pain and Disability Scale (NPAD), Stanford Presenteeism Scale 6 (SPS-6), Copenhagen Psychosocial Questionnaire II (COPSOQ II) and the Euro-Qol-5 Dimension (EQ-5D): these are research-validated and standardised self-reporting instruments that measure biopsychosocial risk factors in pain and disability. Thus, they provide sound measure of NSNP risk and severity in the office worker population[20-22, 86-88]. To the best of our knowledge, the cross-sectional study of this thesis is the first to use the specific combination of instruments to measure these risk factors in Australian office workers with NSNP[3]. In this cross-sectional study of 119 Australian office workers, the prevalence of NSNP and disability was similar to recently published data on office and computer worker populations. We found that NSNP was associated with both demographic and biopsychosocial factors. Overall, the results indicated associations between manner of self-reported NSNP, gender, employment, education, workplace, marital status and sickness absence by some of the included instruments. Preliminary evidence suggests psychosocial parameters have significant effects on self-reported NSNP. The instruments were also positively correlated to one another. It is important to note that the small sample size of this study and this may have reduced the studies power and increased the margin of error in estimates.

Practical and theoretical implications

Clinical recommendations

Patients with NSNP will seek medical and physical management for their pain and disability[133, 134]; therefore, from a clinical perspective, it is imperative for healthcare providers to be informed about evidence-based treatment options for patients with NSNP. It is equally as important for healthcare providers to use evidence-based self-reporting instruments to measure the severity of pain and disability in their patients over time[135, 136]. Accurate measurement of functional improvement in clinical practice is essential in demonstrating whether patients are deriving meaningful benefit from care[137]. These considerations will improve clinical decision making and quality of management[2, 20]. The NDI, NBQ and NPAD are reliable and valid indicators of NSNP and disability[20]; thus, it is advised that healthcare practitioners who manage patients with work-related NSNP use these instruments in their management plan to derive meaningful and accurate measurements of pain, disability and improvements in clinical practice, thus improving decision making and quality of management. This study has shown preliminary evidence that psychosocial factors may have an important effect on self-reported NSNP and disability in office workers. Based on these findings, healthcare practitioners should be aware of the role of psychosocial factors and psychosomatic pain in the presence of NSNP and disability in their patients. Therefore, these risk factors should be considered pluralistically in the diagnosis and management of work-related NSNP and disability. Considering all dimensions of health and wellbeing will ensure comprehensive health profiling of patients and improve quality of management[138, 139]. Furthermore, this study may provide a conceptual framework that offers policy-makers and managers a practical understanding of risk factors that affect healthcare service quality. As such, it will provide insight for workplace policy formation and interventions by government agencies, including those related to public health[138, 139].

Research recommendations

A literature review revealed several limitations that hinder the current understanding of risk factors for non-specific neck pain (NSNP) and disability in office workers. There is a lack of standardised, research-validated and combined self-reporting instruments, which items cover the broad perspective of NSNP and disability[20, 125]. Some studies in the literature do not define the neck region, which restricts study boundaries and how data is measured and presented[16, 37, 38]. Furthermore, NSNP and upper limb pain are parameters that are often examined together in observational studies[37, 38, 40, 41, 43, 44]. However, in clinical circumstances, symptoms of the shoulder region may be the result of injuries in the neck and/or shoulder regions[31, 77]. Other limitations include the lack of causal correlation between risk factors and NSNP and disability, and the importance of reporting severity of NSNP and disability. These limitations have contributed to the substantial heterogeneity and conflicting results for risk factors within the literature.

This body of work contributes to an incidence-based approach to establishing biopsychosocial risk factors associated with NSNP in office workers. We recommend the use of the NDI, NBQ and NPAD instruments in measuring physical risk factors in office workers with NSNP. The SPS-6, COPSOQ II and EQ-5D may also provide additional psychosocial parameters in NSNP and disability. These instruments provide a reliable and validated framework in which to examine the relationships between biopsychosocial risk factors and self-reported NSNP and disability.

Future projects

This study provides a framework and sample population for future studies, which aim to examine specific biopsychosocial risk factors or effective workplace interventions for NSNP in office workers. Long-term, prospective or experimental design studies that use the combination of the six aforementioned self-reporting instruments in this dissertation are required to determine casual inferences and effect between potential risk factors and NSNP and disability. This will also ensure meaningful comparison of study data between study populations. Examining the correlations between each of the six instrument items by one another and by self-reported NSNP should be explored in future studies to ascertain the effect of specific risk factors in NSNP and disability. Moreover, this research can offer insight for workplace policy formation by government agencies, including those related to public health. Future reporting of studies should also be guided by documents such as the STROBE statement[97].

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APPENDICES

Note: Appendices A-D, I and J (below, pg. 59) are available via Google Drive as downloadable PDF documents. Please visit the link to access the shared files: https://drive.google.com/open?id=0BxTalC-2cMTGODhaVjJrT09VaEU.

Appendix A: Letter of Approval from the Human Research Ethics Committee at the Faculty of Science and Engineering at Macquarie University, Australia.

Appendix B: Informed consent form the online survey via Qualtrics.

Appendix C: Supplement 1, Neck Disability Index.

Appendix C: Supplement 2, Neck Bournemouth Questionnaire.

Appendix C: Supplement 3, Neck Pain Disability Scale.

Appendix C: Supplement 4, Copenhagen Psychosocial Questionnaire II: Long Version [54].

Appendix C: Supplement 5, Stanford Presenteeism Scale.

Appendix C: Supplement 6, EuroQol-5D.

Appendix D: STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) 22-point checklist for critical appraisal of observational studies.

Appendix I: Chiropractic curriculum mapping and congruence of the evidence for workplace interventions in work-related neck pain.

Appendix J: Systematic review and meta-analysis suggests strength training and stretching may reduce neck pain in office workers.

Appendix E. Characteristics of thirteen observational studies in the literature examining various risk factors in office workers with neck pain.

Study	Population	Response rate	Outcome variables	Conclusions
Cross-sectional studies				
Cagnie 2007[34]	Office workers from 10 companies (management, administration, medical secretary, graphic design, engineering and academic faculty), *n* = 512, 45.5% neck pain prevalence in past 12-months	Varied between companies from 61.5 to 83.7%	*Dependant:* Shortened version of DMQ, self-reported neck pain *Independent:* *Demographic factors:* gender, age, height and weight (BMI), marital status, education, smoking etc. *Physical factors:* years at job, hours worked, physical tiredness and workload etc. *Psychosocial factors:* mental tiredness, job pressure, work variation and satisfaction	*Demographic factors:* Neck pain higher in females (18%), older age increases risk of neck pain, being physically active decreases likelihood of neck pain *Physical factors:* Static neck flexion and repetitive movements are associated with neck pain, sitting posture increases neck pain *Psychosocial factors:* Mental tiredness and shortage of personnel were related to neck pain
Darivemula 2016[35]	Office workers from tertiary care hospital, *n* = 441, 43.3% neck pain prevalence in past 12-months	Not clear	***Dependant:*** NRS, ISO 9241-11:1998 ***Independent:*** *Demographic factors:* age, education, occupation (department), duration of job, BMI *Ergonomic factors:* screen height, distance from keyboard, distance from mouse and screen *Work-related factors:* self-perceived condition on breaks, posture, desk ergonomics	*Demographic factors:* Participants who worked > 42 hours/week and 80% at a desk reported neck pain, neck pain reported higher in females *Work-related factors:* Higher prevalence in those with neck pain, 77.5% participants rated perception on breaks as “good”, 71.4% maintained straight posture and 99.5% kept feet on ground, chair and elbow support was used by 99.5% participants
De Loose 2008[36]	Office workers from Belgian Defence, *n* = 629, 65% neck pain prevalence in past 12-months	Not clear	*Dependant:* DMQ, NDI, TSK *Independent:* *Demographic factors:* age, gender, hours at work *Work-related factors:* hours, poor posture and ergonomics, prolonged static sitting	*Demographic factors:* Using computer > 5 hours/day significant increased risk of neck pain in past week and year, 8% reported sick leave due to neck pain *Physical factors:* Short periods of movement with neck, prolonged working in same bent posture and computer work > 5 hours/day are all significantly associated with risk of neck pain *Psychosocial factors:* Being mentally tired after work and poor job satisfaction are significantly associated with risk of neck pain, weak correlation between impact of neck pain on life and pain-related fear-avoidance

Appendix E. (*Continued*)

Janwantanakul 2009[37]	Office workers from Social Security Office of Thailand, *n* = 1,185, 42% neck pain prevalence in past 12-months	Authors reported response rate of 71%	*Dependant:* NMQ, DMQ *Independent:* *Demographic factors:* gender, age, BMI, chronic disease, education, marital status, income, exercise etc. *Work-related factors:* average hours working day and week, specific activities at work, physical tiredness etc. *Psychosocial factors:* mental demands, work repetitiveness, work-related problems, relationships with colleagues etc.	*Demographic factors:* Participants working > 8 hours/day significantly increased risk of back pain *Physical factors:* Poor working posture significantly correlated to risk of neck pain, bending trunk during work significantly correlated to risk of back pain *Psychosocial factors:* Little interaction with colleagues decreased risk of back pain
Janwantanakul 2008[38]	Office workers from Social Security Office of Thailand, *n* = 1,185, 63% musculoskeletal symptoms prevalence in past 12-months	Authors reported response rate of 71%	*Dependant:* NMQ *Independent:* *Demographic factors:* gender, age *Work-related factors:* workstation ergonomics *Physical factors:* hours sitting at desk	*Demographic factors:* Females significantly higher prevalence of back symptoms, participants < 30 years old less likely to have back symptoms *Work-related factors:* Poor workstation ergonomics significantly correlated to risk of back pain *Physical factors:* Prolong sitting increases risk of back pain
Johnston 2008[39]	Office workers from public and private sectors in 12 organisations, *n* = 333	Authors reported overall response rate of 30%	*Dependant:* NDI Independent: *Demographic factors:* age, BMI, smoking habits, job type etc. *Demographic factors:* frequency of activity, use of vision correction, years at workplace, history of neck trauma etc. *Work-related factors:* hours worked, time at computer, time at computer before break, workstation ergonomics etc.	*Dependant variable:* Mean score on NDI was 21 *Demographic factors:* Wearing graduated lens, older age and previous neck trauma were significantly correlated to increases risk of neck pain *Work-related factors:* Using computer mouse for > 6 hours/day, duration at computer, time spent at workstation before break, low rating of workstation ergonomics was significantly correlated to increased risk of neck pain
Kaliniene 2013[40]	Office workers from 3 public sector companies of Kaunas, *n* = 513, 65.7% musculoskeletal symptoms prevalence at baseline	Authors reported overall response rate of 89.1%	*Dependant:* NMQ, COPSOQ *Independent:* *Demographic factors:* age, gender, computer experience, BMI	*Dependant variables:* Older workers with greater computer work experience, high quantitate demands, low possibility for work development, average social support and average cognitive demands all significantly correlated to increased risk of neck pain
Loghmani 2013[41]	Office workers Isfahan University of Medical Sciences in Iran, n = 91, 89% musculoskeletal symptoms in past 12-months	Authors reported response rate of 87%	*Dependant:* NMQ, VAS, BRJSI *Independent:* *Demographic factors*: age, work experience, BMI, gender, marital status, education	*Dependant variables:* Pain intensity (median 5.29 on VAS) was negatively correlated with job satisfaction (mean score 54.14 on BRJSI)

Appendix E. (*Continued*)

Nejati 2015[42]	Office workers at Iran University of Medical Sciences, *n* = 101, 54.45% reported musculoskeletal symptoms in past 3-months	Authors reported response rate of 63.52%	*Dependant:* Images taken of participants' neck with markers at C7 and T7, taken at: typing and sitting in chair with cervical flexion and extension *Independent:* *Demographic factors:* age, gender, BMI, location of pain, hours driving and working, physical activity etc.	*Dependant variables:* Significant correlation of increased prevalence of neck pain with poor posture of cervical and thoracic spine at work in symptomatic participants compared to asymptomatic *Independent variables:* No significant correlation between hours worked or driving hours, duration of pain or previous treatments and neck pain
Oha 2014[43]	Office workers at the University of Tartu, n = 315 and the Estonian University of Life Sciences, *n* = 100 (total *n* = 415), 77% reported musculoskeletal symptoms in past 12-months	Authors reported response rate of 53%	*Dependant:* BSI, SF-36, MBI, FABQ *Independent:* *Demographic factors:* education, height, smoking status, occupation, pain in other regions *Work-related factors:* hours at keyboard, regular breaks etc.	*Dependant variables:* Somatisation tendency and belief that musculoskeletal symptoms are caused by work, emotion exhaustion, low job support and security were all significantly associated with increased risk in low back pain *Independent:* Neck pain significantly prevalent in older women and not currently smoking
Ranasinghe 2011[44]	Office workers from telecom and computer training institutes in Sri Lanka, *n* = 2,210, 56.9% reported CANS in past 12-months	Authors reported response rate of 88.4%	*Dependant:* MQEQ, OSHA-VDTWC *Independent:* *Demographic factors:* age, gender, history of complaints	*Dependant:* Daily computer usage, poor workstation ergonomics, poor posture, bad work habits, work overload and poor social support were all significantly associated with neck pain *Independent:* Older female workers had a higher prevalence of CANS
Wu 2012[16]	Office workers from eighteen departments in Chinese service industry, *n* = 560, 55.5% reported neck pain in past 12-months	Authors reported response rate of 86.3%	*Dependant:* NMQ *Independent:* *Demographic factors:* gender, age, BMI, education, smoking status etc. *Work-related factors:* hours/week using computer, full-time/part-time job, use computers in leisure time, years working on computer, workstation ergonomics etc.	*Dependant:* Long hours on computer, prolonged neck flexion, no breaks and not being properly rested were significantly associated with WMSD *Independent:* Being female, high school education and seldom physical exercise were significantly associated with WMSD
Longitudinal study				
Hush 2009[70]	Office workers from an Australian university, *n* = 53, 49% reported neck pain during 1-year follow-up	Authors reported 100% response rate from baseline to follow-up	*Demographic factors:* age, gender, frequency of exercise etc. *Physical factors:* cervical ROM, cervical spine posture and endurance of cervical extensor muscles using CBST *Psychosocial factors:* JCQ, DASS-21 *Workplace factors:* duration of sitting each day and between breaks	*Demographic factors:* Being female was a significant predictor of neck pain *Physical and workplace factors:* Cervical flexion-extension was a significant predictor of neck pain *Psychosocial factors:* Anxiety and psychological stress were all significant predictors of neck pain

Appendix F: Supplement 1. Self-reported neck pain in the past 12 months by gender.

Gender	Neck pain Yes	No	Total
Male	30 (25.21%)	16 (13.45%)	46 (38.66%)
Female	57 (47.90%)	16 (25.21%)	73 (61.34%)
Total	87 (73.11%)	32 (26.89%)	119 (100%)

ChiSq statistic

ChiSq	*df*	*p-value**
1.766	1	0.184

** p < .05.*
Note: Numbers in parentheses indicate column percentage, n =119).
Abbreviations: ChiSq (Pearson's Chi-Squared test with Yates' continuity correction); df (Degrees of freedom).

Appendix F: Supplement 2. Self-reported neck pain in the past 12 months by sickness absence.

	Sickness absence (days)					
Neck pain	**0**	**1-4**	**5-9**	**10-14**	**15 or more**	**Total**
Yes	15 (12.61%)	45 (37.82%)	17 (14.29%)	4 (3.36%)	6 (5.04%)	87 (73.11%)
No	10 (8.40%)	15 (12.61%)	5 (4.20%)	2 (1.86%)	0 (0%)	32 (26.89%)
Total	25 (21.01%)	60 (50.42%)	22 (18.49%)	6 (5.04%)	6 (5.04%)	119 (100%)

Fisher's statistic

*p-value** 0.330

** p < .05.*
Note: Numbers in parentheses indicate column percentage, n =119).
Abbreviations: Fishers (Fishers exact test for count data).

Appendix F: Supplement 3. Self-reported neck pain in the past 12 months by marital status.

	Marital status					
Neck pain	**De facto**	**Divorced**	**Married**	**Single**	**Widowed**	**Total**
Yes	15 (12.61%)	5 (4.20%)	45 (37.82%)	22 (18.49%)	0 (0%)	87 (73.11%)
No	8 (6.72%)	0 (0%)	18 (15.13%)	5 (4.20%)	1 (0.84%)	32 (26.89%)
Total	23 (19.33%)	5 (4.20%)	63 (52.94%)	27 (22.69%)	1 (0.84%)	119 (100%)

Fisher's statistic

*p-value** 0.207

** p < .05.*
Note: Numbers in parentheses indicate column percentage, n =119).
Abbreviations: Fishers (Fishers exact test for count data).

Appendix F: Supplement 4. Self-reported neck pain in the past 12 months by hours of physical exercise.

	Neck pain		
Hours	**Yes**	**No**	**Total**
0	8 (6.72%)	0 (0%)	8 (6.72%)
1	8 (6.72%)	1 (0.84%)	9 (7.56%)
2	10(8.40%)	9 (7.56%)	19 (15.96%)
3	15(12.61)	4 (3.36%)	19 (15.97%)
4	11(9.24%)	4 (3.36%)	15 (12.60%)
5	14(11.77)	4 (3.36%)	18 (15.13%)
6	9 (7.56%)	2 (1.68%)	11(9.24%)
7	4 (3.36%)	0 (0%)	4 (3.36%)
8	2 (1.68%)	3 (2.52%)	5 (4.20%)
9	1 (0.84%)	0 (0%)	1 (0.84%)
10+	5 (4.20%)	5 (4.20%)	10(8.40%)
Total	87 (73.11%)	32 (26.89%)	119 (100%)
Fishers statistic			
*p-value**	0.100		

** $p < .05$.*
Note: Numbers in parentheses indicate column percentage, n = 119).
Abbreviations: Fishers (Fishers exact test for count data).

Appendix F: Supplement 5. Self-reported neck pain in the past 12 months by hours at computer.

		Neck Pain		
Hours		**No**	**Yes**	**Total**
3		1 (0.84%)	3 (2.52%)	4 (3.36%)
4		1 (0.84%)	4 (3.36%)	5 (4.20%)
5+		30 (25.21%)	80 (67.23%)	110 (92.44%)
Total		32 (26.89%)	87 (73.11%)	119 (100%)
ChiSq statistic			**Fishers statistic**	
ChiSq	*df*	*p-value**	*p-value**	
0.136	2	0.934	1.00	

** $p < .05$.*
Note: Numbers in parentheses indicate column percentage, n =119).
Abbreviations: ChiSq (Pearson's Chi-Squared test with Yates' continuity correction); df (Degrees of freedom); Fishers (Fishers exact test for count data).

Appendix F: Supplement 6. Self-reported neck pain in the past 12 months by education.

	Neck pain		
Education	**Yes**	**No**	**Total**
Higher school certificate	5 (4.20%)	6 (5.04%)	11 (9.24%)
Trade qualification	2 (1.68%)	1 (0.84%)	3 (2.52%)
Certificate or diploma	15 (12.61%)	4 (3.36%)	19 (15.97%)
University (associate degree)	2 (1.68%)	0 (0%)	2 (1.68%)
University (bachelor degree)	17 (14.29%)	6 (5.04%)	23 (19.33%)
University (master degree)	19 (15.97%)	5 (4.20%)	24 (20.17%)
University (doctoral degree)	23 (19.33%)	7 (5.88%)	30 (25.21%)
University (post-doctoral degree)	4 (3.36%)	3 (2.52%)	7 (5.88%)
Total	87 (73.12%)	32 (26.89%)	119 (100%)
Fishers statistic			
*p-value**	0.451		

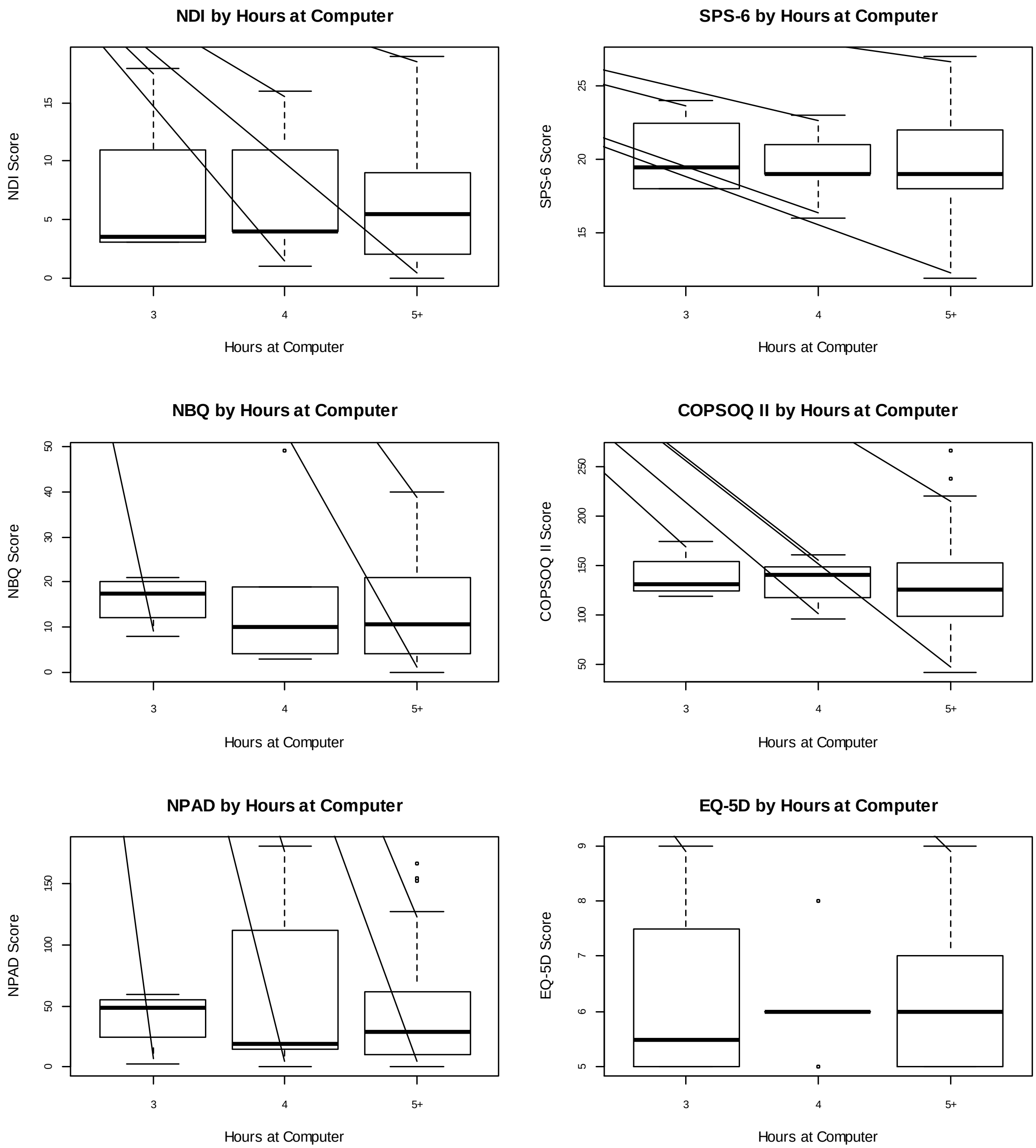
** p < .05.*
Note: Numbers in parentheses indicate column percentage, n =119).
Abbreviations: Fishers (Fishers exact test for count data).

Appendix F: Supplement 7. One-way analysis of variance of included neck pain and disability instruments by hours at computer.

Instrument	*Source*	*df*	*SS*	*MS*	*F*	*p-value**	*KW*
NDI	Between groups	2	9.700	4.849	0.223	0.800	0.102
	Within groups	116	2518.7	21.713			*df* = 2
	Total	118	2528.4	26.562			*p-value** = 0.950
NBQ	Between groups	2	104	51.830	0.415	0.661	0.791
	Within groups	116	14485	124.870			*df* = 2
	Total	118	14589	176.7			*p-value** = 0.673
NPAD	Between groups	2	2920	1460	0.871	0.421	0.159
	Within groups	116	194559	1677			*df* = 2
	Total	118	197479	3137			*p-value** = 0.924
SPS-6	Between groups	2	1.1	0.53	0.062	0.94	0.022
	Within groups	116	992.90	8.56			*df* = 2
	Total	118	994	9.09			*p-value** = 0.990
COPSOQII	Between groups	2	394	197	0.115	0.891	0.549
	Within groups	116	198518	1711			*df* = 2
	Total	118	198912	1908			*p-value** = 0.760
EQ-5D	Between groups	2	0.56	0.281	0.273	0.762	0.305
	Within groups	116	119.40	1.029			*df* = 2
	Total	118	119.96	1.31			*p-value** = 0.859

** p < .05; † statistically significant*
Abbreviations: COPSOQII (Copenhagen Psychosocial Questionnaire II); df (Degrees of freedom); EQ-5D (EuroQol-5 Dimension); F (F-statistic); KW (Kruskal-Wallis one-way analysis of variance test by ranks chi-squared); MN (Mean square); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6); SS (Sum of squares).

Appendix F: Supplement 8. Multiple box-and-whisker plots for the six included instruments by hours at computer.



Appendix G: Most selected items (*i.e.,* popular answers) within the self-reporting instruments relative to the total possible score within each instrument (%).

Instrument	*Item No.*	*Item Question/Statement*	*%*
NDI	5	Headaches	14.70
	9	Sleeping	11.10
NBQ	4	Over the past week, how anxious (tense, uptight, irritable, difficulty in concentrating/relaxing) have you been feeling?	49.14
	5	Over the past week, how have you felt your work (both inside and outside the home) has affected (or would affect) your neck pain?	39.14
	6	Over the past week, how much have you been able to control (reduce/help) your neck pain on your own?	31.86
NPAD	3	How bad is your pain at its worst?	32.20
	17	How much trouble do you have turning your neck?	21.15
SPS-6	4	Despite having my neck pain, I was able to finish hard tasks in my work.	88.83
	5	At work, I was able to focus on achieving my goals despite my neck pain.	86.33
	6	Despite having my neck pain, I felt energetic enough to complete all my work.	85.33
COPSOQII	7	Do you have a say in choosing who you work with?	3.400
	11	How often do you not have time to complete all your work	3.244
	19	tasks?	3.356
	31	Is it necessary to keep working at a high pace?	3.356
	42	Do you get emotionally involved in your work?	3.322
	77	Do you work at a high pace throughout the day?	3.167
		How often have you felt tired?	
EQ5D	4	Pain/Discomfort	36.20
	5	Anxiety/Depression	31.80

Abbreviations: COPSOQII (Copenhagen Psychosocial Questionnaire II); EQ-5D (EuroQol-5 Dimension); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); SPS-6 (Stanford Presenteeism Scale 6).

Appendix H: Summary of statistically significant findings.

	NDI	NBQ	NPAD	SPS-6	COPSOQ II	EQ-5D	Self-reported NSNP
Self-reported NSNP	*t*-test *p* = <0.001	*t*-test *p* = <0.001	*t*-test *p* = <0.001	*t*-test *p* = <0.001		*t*-test *p* = <0.001	
Gender		*t*-test *p* = 0.035		*t*-test *p* = 0.035			
Employment	ANOVA *p* = 0.047	ANOVA *p* = 0.029	Post hoc Temporary part-time and permanent part-time, *adj p* = 0.037				
Education				ANOVA *p* = 0.025	ANOVA *p* = 0.047 Post hoc Associate degree and trade qualification, *adj p* = 0.039	ANOVA *p* = 0.038	
Workplace	ANOVA *p* = <0.001 Post hoc Workplace D and B, *adj p* = <0.001	ANOVA *p* = <0.001 Post hoc Workplace A and B, *adj p* = 0.006	ANOVA *p* = <0.001 Post hoc Workplace A and B, *adj p* = 0.004		ANOVA *p* = <0.001	ANOVA *p* = <0.001 Post hoc: Workplace D and B, *adj p* = 0.001; Workplace A and B *adj p* = 0.022	Fishers *p* = 0.023
Marital status	ANOVA *p* = 0.018	ANOVA *p* = 0.042 Post hoc Married and divorced, *adj p* = 0.045	ANOVA *p* = 0.046		ANOVA *p* = 0.017 Post hoc Single and de facto, *adj p* = 0.042		
Sickness absence	ANOVA *p* = <0.001 Post hoc: 15 or more days and 0 days, *adj p* =<0.001; 5-9 days and 0 days, *adj p* = 0.042; 15 or more days and 1-4 days, *adj p* = 0.002	ANOVA *p* = 0.033	ANOVA *p* = 0.003 Post hoc 5-9 days and 0 days, *adj p* = 0.012			ANOVA *p* = <0.001 Post hoc 15 or more days and 0 days, *adj p* = 0.001; 15 or more days and 1-4 days, *adj p* = 0.001	

Note: p < .05 as level of statistical significance.
Abbreviations: adj p (Adjusted p-value using Tukey criterion for post hoc analyses); ANOVA (Analysis of variance); COPSOQII (Copenhagen Psychosocial Questionnaire II); EQ-5D (EuroQol 5 Dimension); Fishers (Fishers exact test for count data); NBQ (Neck Bournemouth Questionnaire); NDI (Neck Disability Index); NPAD (Neck Pain and Disability Scale); Post hoc (Post hoc analysis); SPS-6 (Stanford Presenteeism Scale 6); t-test (Welch two-sample t-test)