From the Department of Clinical Neuroscience
Section of Personal Injury Prevention
Karolinska Institutet, Stockholm, Sweden

NECK AND SHOULDER PAIN

Prevalence, incidence and risk factors

The IKCo cohort study

Akbar Alipour

Karolinska Institutet

Stockholm 2008

All previously published papers were reproduced with permission from the publisher.

Published by Karolinska Institutet. Printed by Universitetsservice US-AB
Nanna Svartz väg 4, SE-171 77 Stockholm, Sweden
Cover design by Ladan Alipour
© Akbar Alipour, 2008
ISBN 978-91-7409-126-7

ABSTRACT

This thesis presents the results of the prevalence and the incidence of neck/shoulder pain (NSP) and its risk factors in an industrial population based cohort study. The project was completed between 2003 and 2007 in Iran Khodro Car Manufacturing Company (IKCo), the largest car company in Iran and the Middle East. At the beginning of the study, the company employed more than 18,000 people.

The four papers are the results of a project that began with a baseline survey of self-reported NSP prevalence and risk factors (Study I) and continued with a one-year and a four-year follow up for sick leave cases due to NSP (Studies II and III). In addition, a Persian-language version of a well-known questionnaire on musculoskeletal disorders and risk factors (the MUSIC- Norrtälje questionnaire) was validated during the project (Study IV).

Study I: The study population comprises all full-time employees of the company (n=18,031). The measurement tool was the Nordic Questionnaire. A total of 14,384 (79.8%) of all employees completed the questionnaire. Depending on the questions used to measure neck and shoulder symptoms, the results show that the prevalence varied widely (from 20.5% to 3.9%). In the multiple logistic regression model, limited to employees with at least one year of work experience, the indicators of risks that remained for disabling pain of the neck/shoulder for males were: duration of employment, high visual demands, repetitive work, sitting position at work, awkward working position, no regular exercise, monotonous work, lack of an encouraging organizational culture and anxiety concerning change. In females repetitive work, sitting position at work and no support if there is trouble at work were the only factors that remained. The results show similarities between prevalence and risk factors for NSP between industries in middle-income countries and former studies, although a young population of workers and job security can affect the results, especially for disabling pain.

Studies II and III: The study population comprises all participants in Study I. One- year incidence of sick leave due to NSP was extremely low (0.1%). This incidence occurred only in unskilled and office workers. Results indicate that although the prevalence of NSP and LBP was similar in the baseline study, a small number of NSP cases were detected, compared to low back pain during the one-year follow-up. The study shows that a simultaneous investigation of prevalence, incidence and recurrence could be a good way to better understand the natural pattern of NSP.

In Study III, all the population was followed for four years. The four-year incidence was also very low (0.8%), and only 98 cases of all employees (n=12,184) had one episode of sick leave. Having the same prevalence for NSP in baseline compared to other studies, but a low number of cases based on sick leave and low recurrence, suggests the hypothesis that perhaps most workers continue to work regardless of pain, although the population of young workers, insurance systems, health behaviour and job insecurity are other factors that may affect the results. In the final regression model, the remaining factors for potential physical risk were repetitive work and sitting positions at work; in the case of psychosocial factors, unattractive work was the only significant

remaining factor. These results indicate that risk factors for sick leave were different from risk factors for self-reported NSP prevalence in Study I.

Study IV: For a better understanding of NSP at work, repeated measurements with a more elaborate questionnaire are needed. The MUSIC-Norrtälje Questionnaire was chosen and tested for future studies. In the first step of the validity and reliability testing of the questionnaire, two expert panel groups were established in Iran and Sweden. The Focus Group Discussion (FGD) method was used to detect questionnaire face and content validity. To detect questionnaire reliability, we used the test-retest method. Except for two items, all other questions that respondents had problems with in the focus group (20 of 297), had unclear translations; the ambiguity was related to the stem of the questions and the predicted answers were clear for the participants. In the test-retest study, the reliability coefficient was relatively high in most items (only 5 items out of 297 had an ICC or kappa below 0.7). The final results of study indicate that the Persian-language version of the MUSIC Questionnaire is a reliable and valid instrument.

Most studies of NSP are cross-sectional and related to high-income and industrialized countries. There is little information on NSP in low-/middle-income countries. The results of this research into NSP from different aspects (self-reported prevalence of NSP and risk factors, sick leave due to NSP and risk factors and comparison of NSP to LBP) in the same population can help to increase our knowledge in relation to NSP.

Keywords: *Neck/shoulder pain, self-reported, sickness absence, prevalence, incidence, physical work factors, psychosocial factors, lifestyle, low-/middle-income countries, occupational health, epidemiology.*

LIST OF PUBLICATIONS

I. **Alipour A**, Ghaffari M, Shariati B, Jensen I, Vingard E. Occupational neck and shoulder pain among automobile manufacturing workers in Iran. *Am J Ind Med, 2008.* ***51****(5):372-9.*

II. Ghaffari M, **Alipour A**, Farshad AA, Jensen I, Vingard E. Incidence and recurrence of disabling low back pain and neck-shoulder pain. *Spine, 2006.* ***31****(21):2500-6.*

III. **Alipour A**, Ghaffari M, Shariati B, Jensen I, Vingard E. Four-year incidence of sick leave due to neck and shoulder pain and its association with work and lifestyle. *Submitted*

IV. **Alipour A**, Ghaffari M, Jensen I, Shariati B, Vingard E. Reliability and validity study of Persian modified version of MUSIC (musculoskeletal intervention center) - Norrtalje questionnaire. *BMC Musculoskelet Disord, 2007.* ***8****:88.*

CONTENTS

LIST OF ABBREVIATIONS

BMI	Body Mass Index
CI	Confidence Interval
HSE	Health, Safety and Environment
ICC	Interclass Correlation Coefficients
IEA	International Ergonomics Association
IKCo	Iran Khodro Car Manufacturing Company
LBP	Low Back Pain
MSDs	Musculoskeletal Disorders
MUSIC	Musculoskeletal Intervention Center (research program)
NP	Neck pain
NSP	Neck/shoulder Pain
OR	Odds Ratio
OWAS	Ovako Working Posture Analyzing System
PEO	Portable ergonomic observational method
SP	Shoulder pain
WHO	World Health Organization

1.

INTRODUCTION

1 INTRODUCTION

Neck and shoulder pain (NSP) is a common health problem in the general population and among workers. Most people (according to some studies, two thirds of adults) experience some degree of neck pain in their lifetime [1, 2]. Although some authors consider NSP to be a significant contemporary health problem that is estimated to affect many millions of workers around the world annually, it was also described in the 18th Century, along with other work-related upper limb disorders by Bernardini Ramazzini - an Italian physician and the father of occupational medicine - when he said the diseases : "... arise from three causes; firstly, constant sitting, secondly the perpetual motion of the hand in the same manner, and thirdly the attention and the application of the mind ..." [3].

Current knowledge on the epidemiology of NSP is limited. Until recently, most studies of musculoskeletal disorders were cross-sectional. Over the past decade, there has been a substantial advance in studies to observational studies like cohort or case control, although there have been fewer neck and shoulder studies than back pain studies. Recent studies show that NSP follows an episodic course that can lead to significant disability. Although a significant proportion of cases improve, most individuals do not experience complete resolution of their pain and disability [4].

Most studies of NSP are based on high-income and industrialized countries, and there is little information on the general and working populations of middle- and low-income countries. In these countries, most studies are descriptive and cross-sectional. Study of NSP and its patterns in middle-income countries can increase our knowledge of this important work-related disorder, in order to establish its trend in the world and probable differences in exposures and risk factors that ultimately can lead to the creation of preventive programs. The importance of this kind of studies becomes more obvious when we consider that some reports indicate that the greatest increase in the prevalence of MSDs in the next decade will be in middle-/low-income countries [5].

2.

BACKGROUND

2 BACKGROUND

2.1 THE COMPLEXITY OF STUDYING NECK/ SHOULDER PAIN

Any study in this domain of science has its particular complexities and difficulties. Experts encounter problems on different levels in their researches:

- In general, defining pain is a complex phenomenon.
- In practice, there is a lack of consensus in categorizing neck/shoulder pain and a lack of an obvious definition for the anatomical region where pain arises.
- There is a general problem in defining the concepts of health, illness and sickness.
- There is a problem in studying the prevalence and incidence of NSP (with regard to the pattern of NSP, its recurrence and relapse).
- Outcome definition and measurement is a broad area in this domain.
- Assessments and measurement methods for different exposures, and their validity and reliability, are other problems.

On the other hand, it appears that there are ***frames*** that are specific to each country and system, the frames that can also affect the validity of the study and the instruments that are used. These frames include factors such as: public health, insurance system, norms in the society, health care system, occupational health and safety in the workplace (including rules and regulations). For example, any discussion of sickness absence or disability pension due to NSP in a low-income country without any infrastructures for insurance and disability pension, with a high rate of unemployment and low job security plus a totally ineffective social welfare system, and any comparison of the results of this system with high-income countries with well-developed work-related regulations and highly supportive systems can be misleading. In these situations, the contents of these frames may function as modifiers for risk factors and outcomes.

In view of the fact that this research was completed in one middle-income country with its specific frame and differs from most former studies carried out in high-income countries, we have to be sure that we take into account this frame and the way it differs at all times while reading this thesis and the papers included.

2.2 DEFINITION OF PAIN

It is more than 30 years since the days when pain was described as “whatever the experiencing person says it is, existing whenever the experiencing person says it does” [6]. Pain is a private, internal event that cannot be directly observed. Assessment of the pain experience is often based on a person’s self-report. It seems that pain is not a single dimensional phenomenon [7]. Pain is best understood as an interaction of cognitive, emotional, motivational, behavioural and physical components [8]. Pain usually affects the physical functioning of a person but also debilitates emotional, social, and occupational functioning.

Different mechanisms need to be discussed for an understanding of our pain perception. These include:
1. Pain procession or nociception, 2. Pain perception, i.e. the factors that interact with the processes of the central nervous system to shape the individual's perception of the pain stimuli, 3. Pain behaviours, i.e. overt learned expressions that communicate pain and distress to the social environment, 4. Individual suffering, which refers to the perception of serious threat or damage to the self caused by the pain and its consequences [9, 10].

2.3 DEFINITION OF NECK/ SHOULDER PAIN

Neck and shoulder pain includes conditions that some are medically well defined, while others are harder to diagnose [2, 4, 11-14]. Neck and shoulder pain can be due to severe and destructive pathologies like dislocations, fractures, myelopathy, infections, vascular disease, inflammatory systematic diseases and tumours. These conditions occur much less frequently within the population than more common types of NSP. More common types of NSP encompass a variety of conditions, including disorders of muscles, tendons, joints and nerves, although the underlying pathology may differ, and diagnoses are unclear, the symptoms are often similar. Sometimes, correlations of symptoms and disability with suspected underlying pathology tend to be weak [4]. In addition, pain in the neck and shoulder region can be part of widespread pain in different regions of the body. From an etiological point of view, such complaints have been frequently associated with psychological stress, somatisation and functional disability [15, 16]. It appears, therefore, that important differences may exist between those who report pain at many anatomical sites and those who report it at just one [15].

At present, no classification criteria exist that are suitable for use in population-based studies, and inter-clinician reliability in classifying NSP is poor [17]. Neck and shoulder pain have been defined in different ways in different studies: ache, discomfort, stiffness, numbness, tenderness, and myalgia are examples of words used. The frequency of pain and its fluctuation, intensity and duration in one episode or repetition as in different episodes, are other items in outcome measurements. Pain affects on person's activities (personal or work), disability and demanding pension, absence from work because of NSP may also feature in an outcome study. Different symptoms like pain, ache and stiffness cannot be separated in terms of where they originate, so a separate anatomical description is given only for simplification. Nevertheless, some studies regard the neck and shoulder as separate regions, while other groups consider combined pain involving the neck and shoulder.

In this thesis, we considered cases that reported pain from either the neck or shoulder region separately or combined, based on the concept that several muscles act on both the shoulder girdle and the upper spine together, and it is hard to separate them [3, 18, 19].

2.3.1 Anatomy of the neck/shoulder region

▪ Neck

The human cervical spine, with seven vertebrate, five intervertebrate discs and 37 separate articulations with different muscle and ligaments, is a complex - and the most mobile and least stable - part of the spine [20]. Adjacent vertebrae are connected by soft tissue, e.g., intervertebral discs, ligaments and muscles.

The human cervical spine has two structural components - hard and soft tissues. The hard tissues include vertebrae and intervertebral discs. Their function is primarily load-bearing: they resist compressive forces. The soft tissues - the muscle and ligaments - act mainly to stabilize the neck and to provide for head movement. Although each joint of the cervical spine has a very limited range of motion, the neck can be bent, extended, twisted and tilted with a relatively large range of motion [21]. The combined motion of all segments of the cervical spine produces a large range of motion - about 140 degrees of flexion/extension, about 180 degrees of axial rotation and around 90 degrees of lateral flexion [22]. The structures stabilizing the neck are very robust, which serves to protect the nervous system inside the spinal canal and the nerves emerging from the intervertebral openings and supplying the neck, upper extremity and upper part of the thorax. The muscles surrounding the neck are also active in arm work, in order to stabilize the shoulder/arm complex. Different muscles like Trapezius originate from the cervical spine and insert to the shoulder, so it appears that we can hardly separate the neck from the shoulder region anatomically and functionally, because they react together and are connected.

▪ Shoulder

It seems that the shoulder region provides a platform for the upper extremity [23]. The bones in the shoulder include the collar bone (Clavicle), the shoulder blade (Scapula) and the glenohumeral (Shoulder) joint. The clavicle is connected to the body by the sternoclavicular joint, and to the shoulder-blades by the acromioclavicular joint. The sternoclavicular joint is the sole connection between the upper extremity and the rest of the body. The shoulder blade has no direct connection of its own and thus the shoulder is dependent on muscles for being fixed to the trunk [23].
Figures 1 and 2 show two views of neck/ shoulder region [20].

Figure1. Posterior view of the superficial muscles of the cervical spine and shoulders

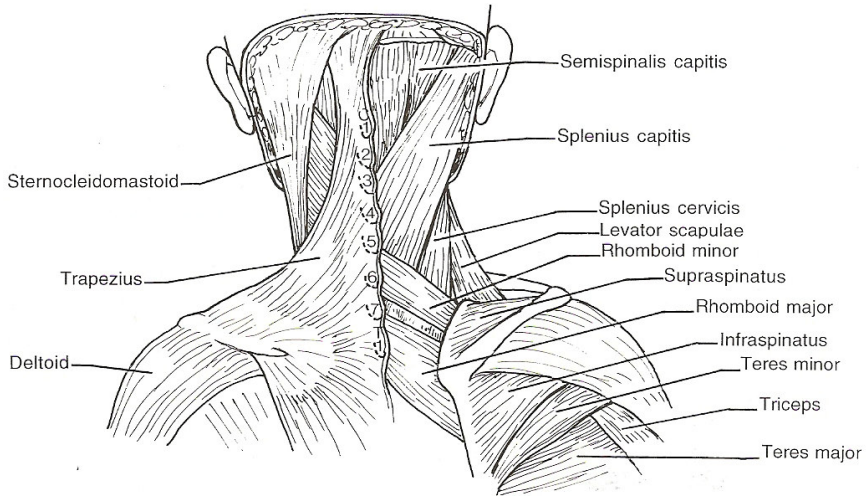
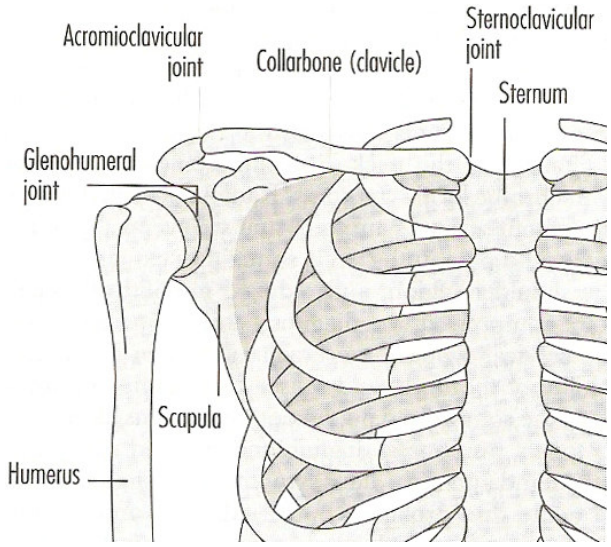


Figure 2. Schematic view of the skeletal parts of the shoulder region



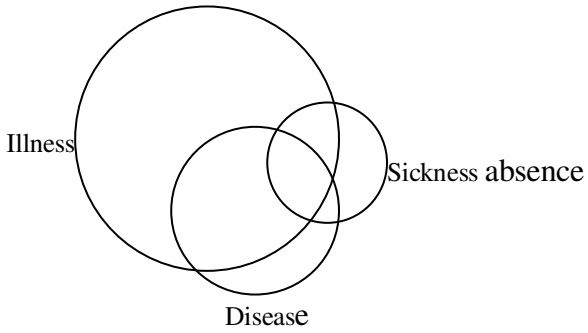
2.4 HEALTH, ILLNESS, DISEASE AND SICKNESS

In epidemiological studies of occupational health and morbidity in relation to health, different concepts and measurements are used. Theses measurements overlap, but they have difference in their meaning. However, they are applied in some cases without these differences being taken into account. Illness, disease and sickness are three different concepts of ill health [24-28]. Illness is defined as self-reported mental or physical symptoms. Disease is defined as a condition that is diagnosed by a physician or other medical expert, although in practice this definition is subject to limitation; for example, for a disease to be defined there is sometimes a requirement for subjective information from the patient, such as the pattern of pain, or information on psychiatric symptoms. Sickness is related to the social role a person with illness takes or is given in society, in different areas of life [28]. These three concepts interact and overlap in different aspects and in reality are very often hard to separate. The concepts and relation between illness, disease, and sickness are illustrated in figure 3 [28].

What makes this even more complex is the definition of health who is one of the bases for separating these three concepts. Health has been defined in different ways [28]. Sometimes it is defined simply as the opposite of illness or disease, sometimes as the absence of disease and sometimes as a dimension other than disease. Some experts consider health as a balance in life and normal functioning [29]. One well-known definition of health is that of WHO, which defines health as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity. It seems that, historically, definitions of health have passed through different concepts based on the particular period of time [30]: In ancient Greece and Rome, there was an acknowledged relationship between medicine and philosophy. Western medicine of today has lost part of its philosophical background [31]. It now appears

that two main perspectives may be distinguished: the biomedical view, with theories based on biological, chemical, physiological and statistical entities, and the humanistic view, with theories based on humanistic and social concepts, according to which the whole is greater than the sum of the parts. In the humanistic paradigm, health is in focus and is viewed as something more than just the absence of disease [31].

Figure 3. The relationship between illness, disease and sickness absence



2.4.1 Sick Leave

Data in relation to sickness can be collected from different sources. One is sickness absence registration systems based on the workplace. The associations between work-related risk factors, as well as lifestyle and sickness absence, have been demonstrated in different studies [26, 32-37]. From one viewpoint, sickness absence may be considered as one index of health or a tool to measure the health of individuals. This is a complex phenomenon, and not necessarily the same as the health status of the individual or sickness in a society or occupational group [38]. The social insurance system, type of work, flexibility at work via lowered working capacity, attitudes towards work and other medical, social and psychological factors are examples of factors that affect sickness absence [26, 39-41]. On the other hand, there are situations that despite illness people continue to work. Working when ill, referred to as “presenteeism” or “sickness attendance”, has been reported for NSP and low back pain (LBP) [12, 39, 42]. Sickness presenteeism has been observed in organizations where the absent employee cannot be easily replaced; thus sick leave causes negative consequences for the absentee, workmates or a third party [43, 44]. Financial loss, accumulated work tasks and job security could also be the reasons.

2.5 PREVALENCE

Prevalence is the proportion of people in a population with a certain trait or disease at a given point in time. Point prevalence may be seen as a cross-sectional assessment of the population under study. Point prevalence will be dependent on the incidence, but also the rate by which sick people are removed from the diseased population (by recovering, dying or moving out of the population). There is no "gold standard" measurement tool for estimating the prevalence of neck and shoulder pain and disorders among populations. Self-reported data from questionnaires concerning episodes of pain are commonly used to estimate the magnitude of the problem. In NSP studies, there are different time points and assessment measures for prevalence. Point prevalence, one-week, one-month, one-year prevalence and lifetime prevalence are common methods for reporting the survey results. So, to compare the results the different points in time must be taken into account. Measurement tools like self-report, information from registration systems, interview or physical examination, are other important points that have to be taken into account in comparing results, as well as the regions included (neck, shoulder or both) and the intensity of pain for cut-off. The prevalence of NSP can be studied in the general population. In this situation, it can be categorized into different age groups (children, adolescents, the elderly or total population restricted to special age interval). The study can be followed up in the workers' population. In this case, it may include all worker populations or may be restricted to special jobs and tasks. Another important aspect is whether the studies include NSP related to direct or indirect trauma, and injury.

Table 1 shows the results of NSP prevalence in a few studies that have been completed in middle-/low-income countries. More details and tables in relation to prevalence in high-income countries can be found in several recent studies and reviews [45, 46]. Our main aim from this table is to show results in populations of middle-/low-income countries.

Table 1. Prevalence of NSP in middle-/low income countries

Author(s) year	**Country**	**Subjects - Number**	**Out come measurement**	**prevalence**
Adedoyin, R et al 2005 [47]	Nigeria	Computer users in federal universities n=1041	Questionnaire	Point prevalence Neck pain: 73% Shoulder pain: 63%
Chopra, 2002 [48]	India	Bhigwan village >15 years n=4092	Door to door interviews	One week pain prevalence: 6%
Hsin-Yi LEE et al 2005 [49]	Taiwan	Nationwide study for general workforce (y1998) n=17669	Questionnaire (some part originated from Nordic questionnaire)	One year prevalence Neck symptoms: 24.5% Shoulder symptoms: 26.9% Neck pain +medical treatment: 14.8% Shoulder pain + medical treatment: 16.6%
Reyes- Lierena 2000 [50]	Cuba	Adults in some area n=300	Questionnaire and interview	Lifetime prevalence of neck pain: 14.2%
Smith, DR et al 2004 [51]	China	Female registered nurses n=282	Standardized Nordic questionnaire	One year prevalence of Neck pain: 45% Shoulder pain: 40%

2.6 INCIDENCE

Incidence is the number of new events (or disease) in a population that arises within a specified time period. The word incidence usually denotes *incidence rate*. The incidence rate is the rate at which new events occur in a population. The numerator is the number of new events arising in a specified time period; the denominator is the population at risk of an event during this time period, sometimes expressed as person-time. Even though individuals who have already developed the condition should be excluded, incidence rates are often expressed based on the average population rather than the population at risk. The *incidence proportion* (also known as cumulative incidence) is the number of new cases within a specified time period, divided by the size of the population initially at risk.

In epidemiological studies, including studies of musculoskeletal disorders, incidence studies have an important role in determining causal relationships. The validity and reliability of the measurement tools play an important role in these kinds of studies. Most factors that affect prevalence can also affect incidence. Measurement tools including self-reported questionnaire, physical examination, insurance system and the means of registration (such as different coding systems), calculating duration of pain, intensity of pain, how we considered cases at the beginning of study as symptom-free cases, duration of follow-up, the population being studied and the region we considered (neck or shoulder separately or combined) are examples of the factors that affect incidence. There are several non-occupational factors such as gender and age that affect incidence. Depending on the items referred, the incidence of NSP varies in different studies, although, overall, very few high-quality studies exist. Table 2 shows incidence studies on NSP. This Table only shows studies that had emphasize on pain in both neck and shoulder regions in occupational population, but with considering the complexity of NSP course (recurrence, relapse…), anatomical region and study population easily can be criticized.

Table 2. incidence of NSP

Author(s) year	**country**	**Subjects number**	**Method for outcome measurement (definition)**	**Method for exposure assessment**	**Follow up**	**Incidence (course)**
Andersen et al 2003 [52]	Denmark	3123 workers from industrial and service companies	-Self reported pain based on questionnaire - pain based on examination	-Assessment of physical workload by video recording -Assessment of psychosocial workplace factors by questionnaire	Four years follow up	-14.1% for self reported pain -1.7% based on examination
Cassou et al 2002 [53]	France	Random sample of female and male workers (4228 subjects)	Chronic neck/shoulder pain lasting 6 month or longer- based on questionnaire and medical examination	Using checklist of work conditions filled in by the workers and controlled by the physician	Five years follow up	Five year incidence: 7.3% (men) 12.5% (women) 64.8% of men and 53.2% of women who had chronic pain at baseline no longer had chronic pain
Feveile 2002 [54]	Denmark	3990 employees from Central population register who had criteria for follow up	Modified version of Nordic questionnaire	Interview for physical and psychosocial risk factors	Five years follow up	Men: 28% Women: 39%
Grooten et al 2004 [55]	Sweden	1496 subjects from population based study (81% responded to follow up questionnaire)	Seeking care or treatment for NSP from any of the caregivers	Interview and self-administrated questionnaire For biomechanical, work related psychosocial and individual factors	4-6 years follow up	Men: 18% Women: 29%
Ostergren et al 2005 [57]	Sweden	4919 subjects from Malmo study who were younger than the retirement age of 65 at baseline and had been vocationally active and were free of pain in baseline	NSP based on Standardized Nordic questionnaire in baseline and follow up	Occupational mechanical exposure measurement based on subjective perception Psychosocial risk factors based on Karasek-Theorell questionnaire	One year follow up	Separate analyze for neck and shoulder Men Neck: 6% Shoulder: 5.9% Women Neck: 8.1% Shoulder: 8.9%
Smedley 2003 [58]	England	587 female hospital nurses	Nordic questionnaire	Subjective measurement of individual, psychosocial and physical risk factors	Two years follow up	Female: 34%

2.7 RISK FACTORS FOR NECK/SHOULDER PAIN

The course of NSP is best described as episodic, occurring over a lifetime, with a variable degree of recovery in between episodes. Multiple and different factors play a role in determining this course, from onset to recovery or relapse and also seeking care. These risks may be different at each stage. For example, some studies show that the demographic and work-related risk factors for the occurrence of musculoskeletal symptoms are different from those for sick leave and health care use as a result of musculoskeletal symptoms [59, 60]. Some of these studies indicate that work-related physical factors are more strongly associated with sick leave caused by neck pain than with the occurrence of these symptoms [61-64]. Other studies, show that demographic factors, and to lesser extent, work-related psychosocial factors, are risk factors for sick leave [65]. Overall, because of the different measures used, the evidence concerning risk factors for NSP is sparse [65, 66]. However, recent systematic review of risk factors for NSP indicates that some evidence with different degree exists [20, 46, 67].

One problem in risk measurement is that in the real world it is hard to talk about individual risk factors separately. Most risk factors are not isolated: they overlap and interact. The use of different definitions for similar risk factors and similar definitions for risk factors that are completely different are common in the literature. An overview of risk factors for musculoskeletal disorders (MSDs) and NSP will be presented. However, in this study, the above-mentioned difficulties in comparing and summarizing evidence are present.

2.7.1 General and demographic factors

▪ Age

The findings of studies on musculoskeletal disorders show that age is associated with the prevalence of musculoskeletal problems in different professional categories such as nursing staff [68], railway workers [69] and miscellaneous occupations [56]. Age is often assumed to be correlated with musculoskeletal problems, such as physiological changes, for example decline in physical work capacity, diminishing aerobic and musculoskeletal capacity. The variable age is also related to the number of years the workers spent in their work, and this increases exposure time to other probable potential risk factors. Although a few studies have shown that musculoskeletal disorders and injuries, accidents, sickness and absences are more common among younger workers [70, 71], NSP prevalence is more often reported by older persons, and it seems that older workers are more likely than younger to report NSP [12, 14, 53, 58, 72, 73]. In some of these studies prevalence has also been reported with a peak in mid-life [74].

▪ Gender

Women experience NSP more than men [53, 57, 75, 76], and at all ages symptoms are somewhat more common among women than among men, One reason for this may be that women have less muscle mass and strength than men. Gender has been considered in a number of studies as a possible risk factor for the development of general health problems and musculoskeletal disorders. One review of the literature on gender and

musculoskeletal disorders identified many variations in results and gaps in the literature with respect to issues of reporting behaviour, different work exposures and non-work exposures [77]. More research is needed into whether the musculoskeletal risk varies between men and women in jobs with the same occupational exposure, both physical and psychological. Other factors thought to be important in understanding the observed gender differences are that women are often employed in more hand-intensive tasks and that anthropometric differences (e.g. body size, strength) might disadvantage the female worker in work systems where no account has been taken of such differences [78].

▪ Education

The level of education may act as a marker for other factors such as socio-economic status, occupational level or lifestyle [79]. Education may have a direct influence on health-related behaviour: children who do well in education tend to report healthier behaviour in adult life in terms of diet, smoking and exercise [80]. A number of studies have indicated that the prevalence of back pain is associated with a low educational level [81, 82]. Liira et al. also found that low income and unemployment were associated with a high prevalence of chronic back trouble [83]. These factors may, however, be interrelated. In a research project investigating factors affecting return to work, Straaton et al. found that a higher educational level was an important predictor of those who returned to work after a musculoskeletal problem [84]. The results of studies for NSP vary. Some show high risk of persistent NSP in low-educated employees, while others did not establish any significant relation [57, 75]

▪ Job title (Occupation)

Job title is a crude proxy of exposure. Several studies show that blue-collar workers often have a higher prevalence of neck and shoulder pain than white-collar workers [85, 86]. In a study by Ostergren et al. in Sweden, male manual workers showed an increased risk of developing persistent neck pain compared to male executives or professionals [57], but in a French study by Cassou et al. no difference was found in the risk of chronic pain between different job titles [53].

▪ Body Mass Index and anthropometric measures

There is some evidence that shows that an increase in BMI is associated with an increasing risk of neck pain [58, 87], although other studies did not confirm this correlation [75, 88]. In addition, one study on American office workers shows a low incidence of neck pain in those in or below the 20th percentile in height [75].

▪ Other demographic and personal factors

A number of studies focused on the correlation between NSP and income, marital and family status, cultural factors, ethnicity and immigrant status [57, 75].

2.7.2 Lifestyle factors

▪ Physical activity

The association between physical exercise and neck and shoulder pain is not entirely clear. In a cohort of subjects with neck pain, no association was found between physical exercise and neck pain four years later [89]. Other longitudinal studies show that participation in regular exercise or sporting activity did not affect neck pain incidence [14, 87, 88, 90, 91]. Hildebrandt and co-workers showed inconsistent results regarding the role of physical exercise in neck and shoulder pain enhance and recovery from such pain [92]. In a 5-year follow-up study conducted on men and women seeking care for new incidents of neck and shoulder disorders, men experienced greater improvement than women in pain and disability reduction as a result of physical exercise [93]. In two other studies, small decreases in neck pain incidence have been reported in workers who participated in sporting activities [53, 94].

▪ Smoking

There is no clear association between smoking and NSP: some studies support a correlation between smoking and neck pain [53, 72, 91], while others cannot confirm this association [89, 95].

2.7.3 Individual physical and psychological factors

▪ Physical factors

There is some evidence of a link between physical capacity and neck pain: the risk of neck pain is more prevalent in workers with low-to-moderate static endurance in the neck muscle [96]. The incidence of regular or prolonged neck pain increase by 21% and 31% in workers who display low-to-moderate performance in a test designed to determine isokinetic neck/shoulder lifting strength [96].

▪ Psychological factors

Psychological risk factors play an important role in NSP, and it also appears that they have a significant role in the transition from acute to chronic pain. In literatures, they are discussed as cognitive, emotional and behavioural variables, such as beliefs about the pain, coping strategies, anxiety and depression [97].

2.7.4 Physical work factors

The relation between physical work factors and musculoskeletal disorders including NSP is supported, in varying degrees with regard to a causal relationship, in different epidemiological studies. However, various factors add to the complexity of studying these exposures, risk factors and outcomes: There is not standard measurement tool for measuring this correlation, and different methods have been used for this purpose, including subjective and objective methods. The various physical risk factors often co-exist ,and in practice it is difficult to disentangle their effects. Furthermore, the concurrence of risk factors matters may act synergistically [98]. In assessing potential

physical risk factors, it is important to quantify the intensity, duration and frequency [99].

In objective methods, different procedures are used, including observing the job via different checklists or instruments, or direct measurements by walking through. Various options in this respect are available, including ergonomic methods such as a portable ergonomic observational method (PEO) and OWAS (Ovako Working Posture Analyzing System). Although, using these methods, we can establish valuable and quantitative information relative to exposures, they are mostly expensive and highly time-consuming. On the other hand, observer errors and differences in tasks not only occur in different jobs but also in the same jobs, and affect the validity of these methods.

In subjective methods, researchers use questionnaires or logbooks. These methods are less expensive. One common and cost-effective method is the self-administered questionnaire. This method is suitable in large population studies, although the method has been criticized for lack of accuracy and precision in some studies [100, 101]. Misclassification can be introduced by this method.

Another problem is in comparison of the results of studies because of different definitions used. Examples of this are:
- prolonged work in a sedentary position instead of sitting
- discussion of repetitive and precision work, together or separately.
- referring to strenuous or heavy physical work and including items like heavy lifting, manual handling, high energy expenditure under this heading or discussing them separately.

▪ Repetitive work

Several studies show a relation between repetitive work and neck pain [53, 102, 103]. Other factors in work, such as work strain and muscle tension affect this potential risk factor [103].

▪ Prolonged sitting work

Different studies show the relation between prolonged periods of sitting and neck pain. A plausible mechanism for this relation is the static aspect of this exposure. Prolong sitting can lead to a continuous static load on the neck muscles. [102, 104-106].

▪ Neck posture

In a study on office workers neck rotation was associated with neck/shoulder symptoms, although the association was not statistically significant in the multivariate analyses with data from the observed exposure [107]. Furthermore, the analyses with self-reported data indicated significant associations between neck extension and neck/shoulder symptoms. Observed neck flexion was not associated with symptoms. In another study on neck symptoms, no statistically significant associations with observed neck rotation were found but a trend for an association between neck flexion and neck symptoms was established [104].

▪ Working with hand above the shoulders

Studies indicate relation between hand above shoulders and NSP incidence or recurrence [11, 87, 108], although there are studies that could not find this relation or if find it was weak and crude association [87, 89].

▪ Awkward posture

Studies on different occupations, including carpenters, office workers, machine operators and nursing home workers, show associations between awkward posture and neck pain risk [14, 72, 87].

▪ Heavy physical work

Several studies support the association between heavy physical work and neck pain [58, 87], although the definition of heavy physical work differs. Some studies do not confirm this relation [89].

There are separate studies of risk factors for the shoulder alone. The shoulder is one of the few anatomical areas in which consensus-driven criteria for specific diagnoses have been available for several years [3, 109]. Heavy workload, working in awkward postures, repetitive movements and vibration and, in particular, combinations of these factors, have been reported as main risk factors for shoulder disorders [110-113]. In one prospective population-based study [108], lifting heavy loads, working in awkward postures, work involving vibration and repetitive work increased the risk of a subsequent clinical shoulder disorder and the effects seem to be long-term. Furthermore, predictors of shoulder disorder differed for men and women [108]. In another study by the same group, the results reveal that nonspecific and specific shoulder pain differ in their etiology. In general, it appears likely that biological, metabolic and biomechanical factors contribute more to the development of structural and pathological changes, which in turn cause specific clinical findings [114].

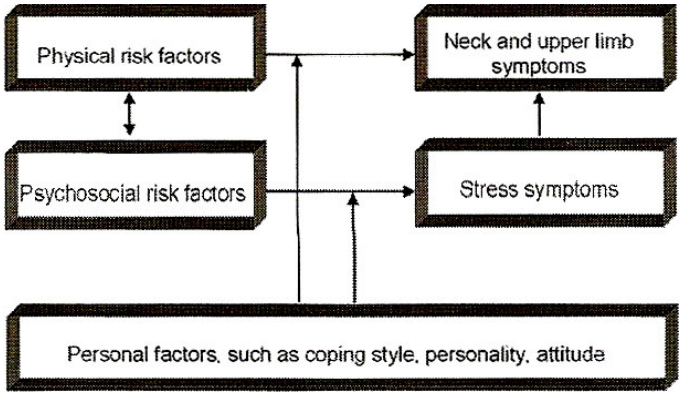
2.7.5 Psychosocial factors at work

Evidence shows that physical conditions at work alone cannot explain the development of NSP. Psychosocial factors may play an important role in NSP. They also play a central role in the transition from acute to chronic problems [97]. The concept of psychosocial factors includes a broad area, they appear when the work environment is regarded from psychological and sociological perspectives, which means perspective including psychological, organizational, and social work environmental factors. Up to year 2000, in view of low numbers of longitudinal studies, the evidence was weak for the relation between NSP and psychosocial factors [115, 116]. Recent prospective studies have strengthened the evidence for these relations [52-54, 115, 117, 118].

There are different but not precise descriptions for the mechanism behind the effect of psychosocial factors. One simple model is based on what is illustrated in figure 4, based on the model suggested by Bonger in 1993 [60, 115]. It appears that psychosocial factors affect NSP in different ways, including an effect on physical factors and stress symptoms (which themselves play an intermediate role). At the same time, personal characteristics may influence the process as well [115].

A well-known and -used model for job strain is the demand-control social support [119] and effort reward system (ERS) [120, 121]. In first model, the combination of high job demands and low control leads to stress and stress-related outcomes, and a low level of social support enhances the adverse effects of this combination. Recent longitudinal studies support this model for NSP, although they also indicate that this correlation is neither very strong nor very specific [67]. With regard to the second model, studies show that workers expending high effort as well as workers receiving low reward reported more NSP symptoms. The assumption of the model is that the combination of high effort and low reward is more unfavourable than the sum of their separate effects. Psychosocial factors also are expressed as work organizational factors in reference to task- and/ or organizational- level aspects of the work process that give rise to stress and potential adverse health outcomes [122]. Work organization includes different components like scheduling, job design, management style, organizational characteristics, interpersonal and career concerns [123, 124]. A few studies also show the correlation between NSP and behavioural aspects, such as work style [124]. However, this requires more studies for conclusions to be drawn.

Figure 4. Possible associations between psychosocial and physical risk factors, personal factors and NSP



2.7.6 Theory behind the mechanism of risk factors

Different mechanisms by different pathways have been described as causing NSP via physical and psychosocial factors.

▪ The Cinderella theory

This theory says that there are motor units in the muscle system; the first activated unit is the one that is shut down last when the static load is stopped. Load causes over-activation and exhaustion of these motor units and in the end causes a disorder [125].

▪ The hyperventilation theory

Stressful events increase hyperventilation, reducing PCO2 in the arterial blood system. This phenomenon ultimately leads to an increase in muscle ischemia and hypoxia [126, 127]. It also affects the potassium ions in the blood and disturbs muscle function.

▪ The migraine theory

According to this theory, the interaction between sensory nerves and blood vessels dilate the blood vessels affecting the muscles and causing pain similar to attacks of migraine. Different mechanisms have been described in this regard [128].

▪ The muscle spindle theory

Based on this theory, long- term static load causes dysfunctions in the muscle spindle system, by increasing activity in nerve cells [129].

▪ The changes in nitric oxide/oxygen ratio hypothesis

According to this theory, prolonged head-down neck flexion and psychological stress reduce intracellular oxygen and nitric oxide removal because of reducing capillary blood flow [130].

2.8 QUESTIONNAIRES AS A MEASUREMENT TOOL

Questionnaires are considered to be important tools in research, especially when large samples are required for a survey. An evaluation of the accuracy (or validity) of measurements is necessary to any study. Questionnaires or reporting methods that have been validated in the study population or in similar populations or circumstances should be used. The problem of validity of information is particularly important in research on occupational musculoskeletal disorders because the methods of both case diagnosis and measurement of work exposure have substantial limitations [131].

▪ Validity

Validity is a complex concept, which is not easily defined. McDowell and Newell [132] defined it as “the extent to which an instrument measures what it is intended to measure”. The validity of a method refers to the certainty with which meaningful and relevant measurements can be conducted [131]. The development of a valid method requires multiple procedures, which are used sequentially at the different stages of method construction. Validity is built into the test or method from the outset rather than limited to the last stages of test/method construction [133]. There is no single technique for testing the validity of a comprehensive measurement. Almost any information gathered in the process of developing or using a test/method is relevant to its validity. On the whole, investigation into validity does not deviate from the general scientific procedures used in confirming theories [133, 134].

There are several aspects of validity to consider, and no clear boundaries can be drawn between the different aspects.

Construct validity:
Refers to validity at which cause and effect operations are labeled in theory-relevant or generalizable terms [135]. Test of construct validity are tests of hypotheses. These hypotheses are derived from a theory relating the construct to some empirical consequences and its relations to other constructs [136].

Content validity:
Content validity is the degree to which the terms in a questionnaire cover the relevant issues. Magnusson [136] defines content validity in terms of sampling items from a large number of items that could have been chosen. These potential items can be derived from various sources, for example from previously used questionnaires or interviews. One common procedure for establishing content validity is to ask experts and participants whether the questionnaire or scale is complete and clear.

Criterion validity:
Refers to the association between the measurement in question and data from another source, the criterion. Criterion validity can be investigated as the predictive power of the instrument in relation to an outcome, or used to make an accurate prognosis. Criterion validity also refers to *concurrent validity* [131].

Face validity:
Face validity is sometimes considered as an aspect of content validity, and means that the instrument seems adequate according to experienced professionals and/or responders.

▪ Reliability
Reliability is defined as the consistency of a measurement when all conditions are held constant. For measurements to be considered reliable, they must be comparable when performed with the same subject by numerous raters (inter-rater reliability) or when performed on several occasions with the same subject by the same rater (intra-rater reliability).

2.9 MUSCULOSKELETAL DISORDERS AND NECK/SHOULDER PAIN IN MIDDLE-/LOW-INCOME COUNTRIES

Although in industrialized countries, a relatively well-developed regulatory framework and infrastructure for addressing problems of health and safety at work often exist, in low-/middle-income countries, much illness is hidden by the lack of systematic data collection, and the higher levels of general ill-health suffered by the working populations of poor countries remain unreported [137, 138]. In these countries, no attention is paid to the health and safety of workers especially in non-organized sectors. Employers may be ignorant of their legal duties, or reluctant to report diseases, while governments and insurance companies may also be unwilling to face up to the economic and social consequences of epidemics of occupational diseases. Generally speaking, in low-/middle-income countries, the data on the working population,

including on work related diseases, are limited. In these countries, the basic statistics on musculoskeletal disorders in the general working population also are very restricted. A lack of epidemic records may indicate bad reporting and recording practice, not an absence of disease.

With the exception of Europe, North America and a limited number of high-income countries in other parts of world (Japan, Australia), there is little information about MSDs in low-/middle-income countries. In these countries, most studies are descriptive and are mostly in local languages, and cross-sectional. Overall, although some published papers offer some access to prevalence and perhaps patterns in a few middle/low-income countries, they do not provide any more information on the impact of NSP on the individual or society at large [139]. In low-/middle-income countries countries, we also do not have any information on the trend of MSDs, for example, in a review the result shows more than 80% of studies are after 2000 [140]. WHO reports and some other studies indicate that the greatest increase in MSDs prevalence in the next decade will be in low-/middle-income countries [140-142].

2.10 GENERAL DESCRIPTION OF IRAN - SOCIAL SECURITY, HEALTH CARE SYSTEM AND OCCUPATIONAL HEALTH

With a population of nearly 70 million and covering an area of 1,648,195 sq. km, Iran is one of the most populous countries in Middle East. It is the 4th largest producer of oil and the 2nd largest producer of gas in the world. Iran's economy today is mainly dependent on oil and secondarily on its mixture of large enterprises, agriculture and small-scale private ventures.

The health status of Iranians has improved over the last two decades. Iran has been able to extend public health preventive services through the establishment of an extensive Primary Health Care Network. On the other hand, the country's economic conditions and its young population (50% of Iran's population is currently less than 20 years of age), problems with access to and availability of health care, especially in provinces, also represent challenges that the country faces. The country is now in a transitional phase and the pattern of diseases is changing.

Healthcare in Iran is provided via the government-academic sector, the private sector and social security programmes. The social security protection programme in Iran is legislated by Ministry of Welfare and Social Security and delivered by several organizations, the largest of which is the Social Security Organization (SSO). The programme now covers 27 million Iranian citizens, 43 percent of the whole population and 62 percent of the urban population. Its coverage includes blue-collar workers, the self-employed, persons covered by voluntary insurance, truck and bus drivers, clergymen and all employees in the art and film industries. SSO is almost independent of the government in terms of resources. Historically, most industrial workers in Iran are covered by this system. Other employees in other sectors and some industries are covered by insurance systems in which in some way are mainly under the supervision of the Government.

▪ The occupational health system in Iran

Two main bodies are involved in the occupational health and safety of workers:

1. The Ministry of Labor and Social Affairs (Occupational Safety Inspection Department)
2. The Ministry of Health and Medical Education (Department of Environmental and Occupational Health)

On the basis of national law on labour, social security and related human rights, established in order to protect human resources, the High Council for Occupational Safety is responsible for drawing up regulations and standards governing occupational safety and health. This council is made up of representatives from the government, employers, employees and university.

In workplaces at small-scale industries, supervision is usually exercised by a member of the primary health care unit. In the case of workplaces of between 20-49 employees, a worker with at least three week's training supervises occupational health issues, with the assistance of the primary health care unit. In factories employing between 50 and 500 workers, a person is appointed to be responsible for occupational health care; this person is known as a co-health-worker (Behdasht-Yare-Kar). Finally, in factories with more than 500 employees, an occupational health center has to be established. On the basis of the national law on labour, social security and related human rights, all workplaces, whose personnel are - due to the nature of their work - exposed to occupational diseases, are required to keep medical records on all the workers concerned to oblige them to undergo the necessary tests and examinations at the health and therapeutic centers at least once a year, and to record the results of such tests and examinations in the appropriate files.

2.11 THE COMPANY STUDIED

The Iran Khodro Car Manufacturing Company (IKCo) founded in 1962 is the largest car manufacturing company in Iran and the Middle East. At the beginning of the studies in 2003, the company had more than 18,000 full-time employees working in its different plants and areas. Historically, IKCo is important to Iran. It is an example of the start of industrialization, and played a key role for the country in this process.The company produces more than 550,000 units of various passenger cars and, according to the most recent statistics, is 17th largest car company in the world. IKCo employees are a combination of workers from different socioeconomic and cultural backgrounds, ranging from workers with low educational qualifications (although in recent years nearly all are educated to diploma level) to highly-educated and -trained technicians and engineers. Now, during the final stages of this project in 2008, more than 26,000 employees are working at the company. IKCo is a combination of old and new technology. Some plants are more than 40 years old, while others are new, with a high level of technology and robotic systems similar to other car manufacturing companies in Europe and the USA. The company is located close to the capital of Iran (just 14 kilometers from Tehran). Workers live in Tehran or the capital's suburbs. Few women (a little more than 700) are working in IKCo. They include highly-educated engineers and specialists, who work in different departments, ranging from product and quality assurance to IT, research & development and finance, while others work in secretarial

and administrative functions, but are not involved directly in the plants and on the shop floor as unskilled workers.

The company has an effective occupational health service for all employees. Different specialists from different sectors, including occupational physicians, occupational hygienists, psychologists, epidemiologists, safety inspectors, nurses, audiologists and social workers are employed. In all 140 employees are working at this department. The Occupational Health and Safety Department, whose director is also the representative of IKCo's President in health, safety and environment issues, deals with and supervises all safety- and health-related topics in the company. The company has an efficient registration system, which has been improved in the past ten years, especially in relation to medical documents, sickness absence and injury.

3.

AIMS

3 AIMS

3.1 OVERALL AIM

The overall aim of this research was to study the prevalence, incidence and risk factors of neck/ shoulder pain (NSP) in an industrial population of Iran to develop our knowledge from one of the mid-income countries.

3.2 SPECIFIC AIMS

More specifically, the following aims were set up for the research:

- To identify the prevalence of self-reported nonspecific and disabling neck/shoulder pain (NSP) and its association with physical and psychosocial factors at work, as well as individual and lifestyle factors.

- To identify one-year incidence and recurrence of NSP based on sickness absence registration for men and women and different job titles and comparing the results with incidence and recurrence of low back pain.

- To identify incidence of NSP during long-term (four-year) follow-up, based on sickness absence registration, and to identify its associations with physical and psychosocial factors at work, lifestyle and co-morbidity.

- To translate a modified version of the MUSIC-Norrtälje Questionnaire into the Persian language, and to test its validity and reliability.

4.

MATERIAL AND METHODS

4 MATERIAL AND METHODS

4.1 STUDY DESIGN

The thesis is based on data from the IKCo cohort. All data were collected between 2003 and 2007. The project was lead by a scientific committee including two professors from Sweden and two MDs and PhD students. During the project, two other Iranian professors were recruited and involved in parts of the activities. One of the PhD students (the writer of this thesis), was working as physician in the occupational health department and continued the activity for five years. The entire process of data collection was conducted by the occupational health department of the company via the establishment of an executive group. At IKCo, each site has a special committee for health, safety and environmental issues (the HSE committee). The members are representatives of workers of that plant, as well as technicians, a representative of the occupational health and safety department and an employer representative. The committees hold regular meetings and for each intervention or work environment programme related to HSE, provide advice to the occupational health department or employer. In this project, more than twenty committees were involved, and they held regular meeting with the representative of the research group. The study population includes all full-time employees of IKCo, which was 18,031 persons at the start of the study.

The research project consists of three sections:

1. A cross-sectional survey of all employees using the Nordic Musculoskeletal Questionnaire (Study I).
2. A one-year and a four-year follow up of the same cohort based on the company's sickness absence registration system (Studies II and III).
3. Validation and reliability testing of a questionnaire measuring musculoskeletal disorders and potential risk factors, modifiers and potential confounders (Study IV).

4.2 STUDY SUBJECTS

▪ Study I

All full-time employees of the company (n=18,031; 17320 men and 721 women) were invited to participate in the study. The employees were grouped into four main occupational categories: managers, office workers, skilled and technical workers and unskilled workers. Participation in the study was voluntary.

▪ Studies II and III

All employees from Study I. During the one-year follow-up, from participants 615 persons left the company or retired, and during the four-year follow-up, from total

population, totally 2,720 left or retired. These individuals were excluded from the analyses.

▪ Study IV

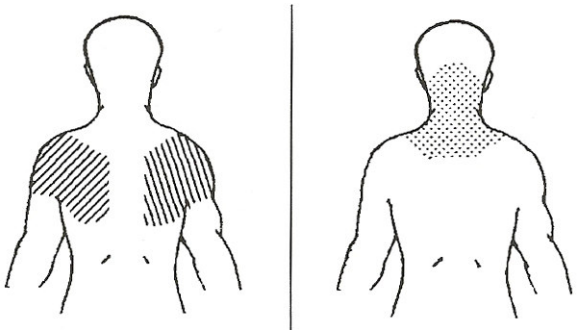
For validation of the questionnaire, three focus groups were formed; each group consisted of 5-6 participants from the four main occupational categories. For reliability testing, 40 participants were randomly selected in proportion to the number of employees in different job titles and their level of education.

4.3 DATA COLLECTION

4.3.1 Baseline survey for self-reported NSP prevalence and risk factors (Study I)

The prevalence of NSP was determined by a cross-sectional survey using the Nordic Musculoskeletal Questionnaire (NMQ) [18]. The validity and reliability of the questionnaire has been investigated and approved in different studies and several languages, including Persian [143, 144]. A manikin accompanied the questions for both neck/ shoulder complaints (figure 5).

Figure 5. Manikin used in questionnaire to show parts of the body referred as Shoulder and Neck region



The questionnaire queried about:

1. Having trouble (aches, pain, and discomfort) in the neck and shoulder regions at any time during the past 12 months (self-reported non-specific pain).
2. Shoulder and/or neck aches, pain, and discomfort at any time during the last 12 months that prevented the person from doing his or her daily work at home or outside the home (self- reported non-specific disabling pain).
3. Physical and psychosocial exposure factors at work. The physical and psychosocial factors from this questionnaire included in this study were: exposed to inappropriate lighting, high visual demands at work, heavy lifting, repetitive work, sitting position at work, awkward working positions, uninteresting work, monotonous work, no encouraging organizational culture,

no support from superior, no support from fellow workers, no support if trouble at work, control at work, high quantitative demands, high qualitative demands, anxiety concerning change.

4. Lifestyle factors investigated were exercise and smoking.

We report the prevalence of pain in the neck and shoulder separately, or in combination (neck and/or shoulder pain). With the exception of psychosocial exposures, the dichotomized alternatives "yes" and "no" are used for answers. Responses to questions about psychosocial factors used a 4-point scale, which were collapsed into two answers in the analysis. The study was introduced to employees through meetings at all worksites and by HSE committees.

4.3.2 One-year and four-year follow-up studies for NSP incidence based on sickness absence and its risk factors (Studies II and III)

In Study II, all employees free of NSP in the 12 months preceding the baseline investigation (Study I) were followed for one year with regard to new episodes of NSP leading to sick leave, based on the company's sickness absence registration system. After a period of medically certified sick-leave, the employee needs to obtain permission from the occupational health clinic at the factory to return to work. As a result, the accuracy of detecting new episodes of NSP leading to sick-leave achieved in this study was very high.

The following definitions were used:

- Prevalence case: defined as a subject who reported at least one episode of NSP during the previous 12 months at the baseline survey among employees in 2003.
- Incidence case: defined as a new episode of NSP resulting in medically certified sick leave during the one-year follow up, after a period of at least 12 months free of NSP respectively. The incidence cases were collected between June 2003 and June 2004 via the occupational health clinic registration system, from 10,907 employees who were free of NSP at the baseline.
- Recurrent case: defined as an episode of NSP leading to sick-leave in the one-year follow-up, subsequent to a previous year (baseline data) with complaints, from 2,862 employees, who reported a complaint at the baseline.
- Cumulative recurrence: defined as more than one episode of NSP leading to sick leave during the one-year follow-up.
- Recovered case: defined as a prevalent case at the baseline and free of NSP leading to sick leave respectively during the one-year follow-up period.

In Study III all employees were followed for 4 years, on the basis of the factory's sickness absence registration system, similar to what was described in Study II. Physical and psychosocial factors at work as well as lifestyle factors were retrieved from the baseline survey.

Exclusion criteria: In this study, our main focus is nonspecific neck and shoulder pain. We have excluded from consideration every kind of pain associated with systematic disease, any local pathological disease and disorders due to infection, tumor, fracture, rheumatic arthritis or other joint and connective tissue disease, or component of headaches, temporo-mandibular joint syndrome, as well as stroke and fibromyalgia.

4.3.3 Validity and reliability study of Persian modified version of MUSIC - Norrtälje Questionnaire (Study IV)

Because of the multifactorial dimension of MSDs and the complexity of interplaying physical, psychosocial and lifestyle factors, we used the expert panel method. We established two expert groups (one in Sweden and one in Iran) from different areas including occupational medicine, epidemiology and psychology. The two groups communicated by email, and two members who were in both groups.

For validity detection we conducted 3 discussion groups (see above). For reliability, test-retest of the questionnaire was conducted among 40 participants (see above) at three weeks' interval.

4.4 ETHICAL APPROVAL

All of the studies were approved by the Ethics Committee of Karolinska Institute.

4.5 STATISTICAL METHODS

▪ Study I

The demographic distribution of study subjects was determined. Chi-square and odds ratios (OR) with 95% confidence interval (CI) were calculated to investigate the relation between exposure and NSP. Bivariate and multiple logistic regression analyses were used. Participants with at least one year of work experience in the company and disabling NSP were included in the analyses of association. In the regression model, a separate analysis was conducted for gender.

▪ Study II and Study III

In Study II, frequency distributions of responses, and cross-tabulations of demographic factors with reported history of NSP in the last 12 months, were examined. Group differences were statistically tested by the chi-square test. All statistical analysis was carried out using SPSS program.

In Study III, the association between physical and psychosocial work factors and lifestyle for incidence cases of sick leave over four years was calculated by using odds ratios (OR) with 95% confidence interval (CI). Multiple logistic regression models were used. In these models, all factors with a CI ≥1.0 were included. A comparison between prevalence risk factors (in two different models including nonspecific and disabling pain) and sick leave risk factors was made on the basis of the results from regression models.There were a small number of cases for females in the incidence study, so separate analyses for gender were not applicable.

▪ Study IV

On the basis of the results from the focus group discussions, the number of ambiguous questions, and that how many of this ambiguity is related to the question stem, or answer, or both, and how many participants agree with this, was calculated.

For reliability, Interclass Correlation Coefficients (ICCs) for the rating scale, and kappa coefficients for dichotomous answers and categorical data, were used for analyses [145]. To assess/rate the ICCs or kappa, we used the following scoring system:
>0.9 excellent
>0.8 good
>0.7 acceptable
>0.6 questionable
>0.5 poor
<0.5 unacceptable [146, 147]

We analyzed all of the questions (items) in referred groups separately and one by one, but due to the large number of questions we reported the results based on their pertinent domain.

5.

RESULTS

5 RESULTS

5.1 STUDY I

Baseline survey for self-reported NSP prevalence and risk factors

A total of 14,384 (79.8%) of all employees completed the questionnaire in the baseline survey. The demographic distribution of non-responders (age, work experience and job type) was similar to that of the participants.

79.5% (11,433) of the responders had at least one year of work experience at IKCo. Most of the employees were young (59% under 30 years of age) with low duration of employment (69% with less than 6 years). Unskilled workers were the largest group, comprising 63% of all employees (Table 3). Table 3 also shows the distribution of self-reported physical and psychosocial factors at work.

Table 4 shows the overall prevalence of pain in the neck and/or shoulder and the prevalence by gender during the past 12 months. Male workers predominate (95% of employees). Women had a higher prevalence of neck and shoulder pain than men during the previous 12 months (13.8% compared with 6.7% for self- reported neck pain). The prevalence of disabling pain was 2.4% among women and 1.6% among men.

The physical and psychosocial characteristics of the four main job groups categories are shown in figure 6.

Unadjusted odds ratios for factors associated with neck and shoulder disabling pain during the past 12 months in total, and divided by gender in workers with more than one year of work experience, are shown in Table 5. In the multiple logistic regression model, risk indicators that remained for male workers were: duration of employment, high visual demands, repetitive work, sitting position at work, awkward working position, no regular exercise, monotonous work, lack of encouraging organizational culture, and anxiety concerning change. For female workers, repetitive work, sitting position at work and no support if there is trouble at work were the only remaining risk indicators (Table 6).

Figure 6. Distribution of physical activities and psychosocial exposures by job types, Iranian Auto Manufacturing Workers

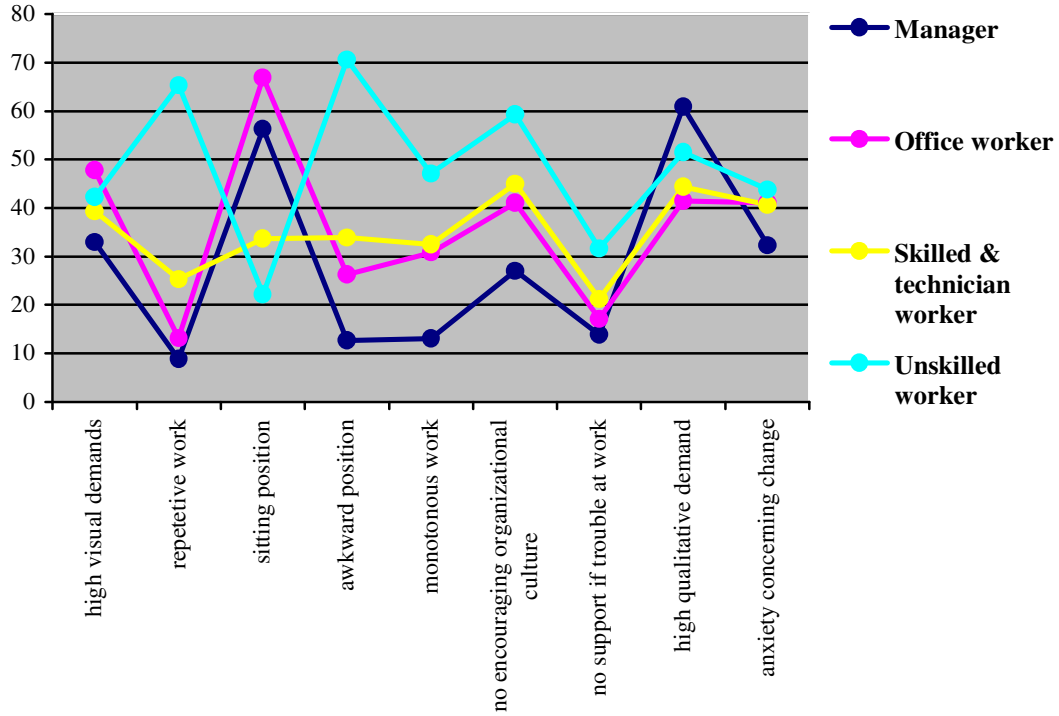


Table 3. Demographic characteristics and risk factor profile of study population, Iranian Auto Manufacturing Workers (n=14384).

	Study population	
	No.	**%**
Age group (years)		
≤ 30	8424	58.6
31-50	4943	34.4
≥ 51	1017	7.1
Sex		
Male	13724	95.7
Female	616	4.3
Job type		
Manager	297	2.2
Office worker	1478	10.7
Skilled worker	2936	21.3
Unskilled worker	9073	65.8
Working experience (years)		
<6	9929	69
>=6	4387	31
Physical factors		
High visual demands	5790	40.3
Heavy lifting	6326	44
Repetitive work	7100	49.4
Sitting position	4395	30.6
Awkward position	8121	56.5
Psychosocial factors		
Interesting work	10801	75.1
Not monotonous work	8403	58.4
Encouraging organizational culture	6700	46.6
Support from superior	11064	76.9
Support from fellow workers	13108	91.4
Support if trouble at work	10397	72.2
Control at work	7300	50.8
High quantitative demands	8221	57.2
High qualitative demands	7046	49
Anxiety concerning change	6116	42.5
Lifestyle		
No regular exercise	7156	49.7

Table 4. Prevalence of self-reported pain and self-reported disabling pain of the neck and shoulder during the past 12 months by gender, Iranian Auto Manufacturing Workers.

	Prevalence of self-reported pain							**Prevalence of self-reported disabling pain**						
	All workers		**Men** (n=13228)*		**Women** (n=580)*		**P-value**	**All workers**		**Men** (n=13228)*		**Women** (n=580)*		**P-value**
	No.	**%**	**No.***	**%**	**No.***	**%**		**No.**	**%**	**No.***	**%**	**No.***	**%**	
Neck only	969	7.0	889	6.7	80	13.8	0.00	230	1.7	216	1.6	14	2.4	0.12
Shoulder only	839	6.1	792	6	47	8.1	0.00	163	1.2	156	1.2	7	1.2	0.95
Neck and Shoulder	1020	7.4	900	6.8	120	20.7	0.00	152	1.1	143	1.1	9	1.5	0.31
Neck and /or Shoulder	2828	20.5	2581	19.5	247	42.6	0.00	545	3.9	515	3.9	30	5.2	0.10

Table 5. Unadjusted odds ratio for factors associated with neck and shoulder disabling pain during the past 12 months, by gender, among workers with more than one year of work, Iranian Auto Manufacturing Workers

	Exposed no.	**Unadjusted OR (95% CI) All employees**	**Expo. no. male**	**Unadjusted OR (95% CI) for Male**	**Expo. no. female**	**Unadjusted OR (95% CI) for female**
Age group						
-30	5818	1.0	5590	1.0	223	1.0
31-50	4178	2.5 (2.0-3.1)	3940	2.6 (2.1-3.2)	233	1.6 (0.7-3.8)
+51	817	3.5 (2.6-4.7)	794	3.6 (2.7-4.9)	12	2.2 (0.3-19.0)
Working experience(years)						
>=1&<6	7113	1.0	6788	1.0	313	1.0
>=6	3700	2.6 (2.1-3.1)	3536	2.6 (2.2-3.2)	155	1.6 (0.7-3.7)
No regular exercise (vs. regular exercise)	5697	1.9 (1.6-2.3)	5366	1.9 (1.6-2.3)	318	1.8 (0.7-4.9)
Exposed to inappropriate lighting	3845	1.9 (1.5-2.3)	3712	1.8 (1.5-2.2)	125	3.1 (1.3-7.4)
High visual demands at work	4452	2.4 (2.0-2.9)	4256	2.4 (1.9-2.9)	180	2.8 (1.1-6.7)
Heavy lifting	4532	1.8 (1.5-2.2)	4488	1.8 (1.5-2.2)	31	2.2 (0.6-8.0)
Repetitive work	4950	2.5 (2.0-3.0)	4885	2.5 (2.0-3.1)	42	6.5 (2.5-17.0)
Sitting position at work	3216	1.9 (1.5-2.3)	2895	1.8 (1.5-2.2)	313	4.9 (1.1-21.0)
Awkward working positions	5741	2.8 (2.3-3.6)	5625	3.0 (2.3-3.8)	102	3.2 (1.3-7.7)
Uninteresting work	2781	2.3 (1.9-2.7)	2687	2.3 (1.9-2.8)	86	1.4 (0.6-3.7)
Monotonous work	4558	2.2 (1.8-2.7)	4355	2.3 (1.9-2.8)	196	1.3 (0.6-2.9)
No encouraging organizational culture	5884	2.2 (1.8-2.7)	5669	2.1 (1.7-2.7)	204	2.9 (1.2-7.0)
No support from superior	2613	1.7 (1.4-2.1)	2543	1.8 (1.4-2.1)	67	2.5 (1.0-6.2)
No support from fellow workers	1017	1.7 (1.3-2.2)	985	1.6 (1.2-2.1)	32	3.9 (1.3-11.0)
No support if trouble at work	3130	1.9 (1.6-2.3)	3022	1.9 (1.6-2.3)	102	3.0 (1.3-6.9)
Control at work	5304	1.6 (1.3-2.0)	5070	1.6 (1.3-2.0)	219	1.5 (0.7-3.3)
High quantitative demands	4445	1.5 (1.2-1.9)	4228	1.5 (1.2-1.9)	210	1.5 (0.6-3.4)
High qualitative demands	5310	1.7 (1.4-2.1)	5001	1.7 (1.4-2.1)	301	2.4 (1.1-5.4)
Anxiety concerning change	6166	1.6 (1.3-1.9)	5869	1.6 (1.3-1.9)	291	1.3 (0.6-3.0)

Table 6.Multiple logistic regression for factors associated with neck and shoulder disabling pain during the past 12 months, by gender, among workers with more than one year of work, Iranian Auto Manufacturing Workers.

	Exposed		**Multiple logistic Regression OR (95% CI) All employees**	**Expo no. male**	**Multiple logistic Regression OR (95% CI) For Male**	**Expo no. female**	**Multiple logistic Regression OR (95% CI) for female**
	No.	**Proportion of exposed who have disabling pain. %**					
Working experience(years)							
>=1&<6	7113	2.8	1.0	6788	1.0	313	1.0
>=6	3700	6.9	2.3 (1.8-2.8)	3536	2.3 (1.8-2.8)	155	1.9 (0.7-5.0)
No regular exercise (vs. regular exercise)	5697	5.4	1.5 (1.2-1.9)	5366	1.5 (1.2-1.9)	318	1.3 (0.4-4.0)
High visual demands at work	4452	6.0	1.4 (1.1-1.8)	4256	1.4 (1.1-1.8)	180	1.0 (0.3-3.1)
Heavy lifting	4532	5.4	1.0 (0.8-1.3)	4488	1.0 (0.8-1.3)	31	0.8 (0.2-3.8)
Repetitive work	4950	5.9	1.4 (1.1-1.8)	4885	1.4 (1.1-1.8)	42	7.4 (2.2-25.8)
Sitting position at work	3216	5.9	1.8 (1.4-2.2)	2895	1.7 (1.3-2.1)	313	5.2 (1.0-26.7)
Awkward working positions	5741	5.8	1.6 (1.2-2.1)	5625	1.6 (1.2-2.2)	102	2.0 (0.6-6.4)
Monotonous work	4558	6.1	1.5 (1.2-1.9)	4355	1.6 (1.2-2.0)	196	0.9 (0.3-2.5)
No encouraging organizational culture	5884	5.6	1.5 (1.2-1.9)	5669	1.5 (1.2-1.9)	204	2.8 (0.9-9.2)
No support if trouble at work	3130	6.3	1.2 (1.0-1.5)	3022	1.2 (0.9-1.5)	102	3.4 (1.1-10.7)
No control at work	5304	5.2	1.1 (0.0-1.4)	5070	1.1 (0.9-1.5)	219	0.5 (0.2-1.7)
High quantitative demands	4445	3.3	0.9 (0.7-1.2)	4228	1.0 (0.7-1.3)	210	0.7 (0.2-2.4)
High qualitative demands	5310	3.2	1.1 (0.9-1.4)	5001	1.1 (0.8-1.4)	301	1.3 (0.4-4.1)
Anxiety concerning change	6166	3.5	1.4 (1.1-1.7)	5869	1.4 (1.1-1.8)	291	1.3 (0.5-3.6)

5.2 STUDIES II AND III

One-year and four-year follow-up studies for NSP incidence due to sickness absence and its risk factors

▪ One-year follow-up

Based on the sickness absence registration system, nine persons among the responders (N=13769) were registered during the follow-up as having a new episode of NSP (compared to 314 with LBP). According to the company's official statistics among the non-responders (N= 3647), 16 persons with a new episode of NSP were reported (144 for LBP). No other characteristics are reported from the non-responders, for ethical reasons.

Epidemiological data for NSP and also LBP during the 12 months preceding the baseline survey are presented in Table 7. During the one-year follow-up, the incidence of NSP was 0.1% and the recurrence was 1.3%. Cumulative recurrence of NSP was 0.01 and 99.8% of people with NSP at baseline recovered during the one-year follow-up.

The incidence rate of NSP or LBP among employees who rejected our invitation to participate at baseline was 0.4% and 3.9%, respectively, significantly higher than in the other group.

▪ Demographic Results

Demographic characteristics and their association with a new episode of NSP and LBP are shown in tables 8-10. Females were free of new episodes of NSP during the one-year follow-up (Table 8). For NSP, managers had the highest reported prevalence, but incidence cases and recurrence of new episodes of NSP were observed only among office workers and unskilled workers (table 9). The incidence and recurrence of NSP were very low, and no association could be established with regard to gender, working experience and job type.

Table 7. One-Year Cumulative Incidence, Recurrence, Cumulative Recurrence and Recovery of LBP, NP, SP and NSP in Iranian Auto Manufacturing Workers.

	Cumulative Incidence %	**Recurrence %**	**Cumulative Recurrence %**	**Recovery %**
Neck Pain	0.04	0.6	0.007	99.5
Shoulder Pain	0.03	0.1	0.007	99.8
Neck or Shoulder Pain	0.10	1.3	0.010	99.8
Low Back Pain	2.10	2.9	0.350	97

Table 8. Gender characteristics and their association with 1-year Cumulative Incidence and Recurrence of LBP, NP, SP or NSP during a one-year follow-up of employees in Iranian Auto Manufacturing Workers.

	Incidence		**Recurrence**	
	No.	**%**	**No.**	**%**
Neck pain		**P=0.69**		**P=0.28**
Male	5	0.04	11	0.6
Female	0	0	0	0
Shoulder pain		**P=0.71**		**P=0.65**
Male	4	0.03	3	0.1
Female	0	0	0	0
Neck or Shoulder pain		**P=0.61**		**P=0.18**
Male	9	0.1	14	1.3
Female	0	0	0	0
Low back pain		**P=0.56**		**P=0.84**
Male	224	2.1	79	2.9
Female	7	1.7	4	2.6

Table 9. Job type and its association with 1-year Cumulative Incidence and Recurrence of LBP, NP, SP and NSP during a one-year follow-up of employees in Iranian Auto Manufacturing Workers

		Incidence		Recurrence	
		No.	%	No.	%
Neck pain	**Job type**		P=0.739		P=0.385
	Manager	0	0.0	0	0.0
	Office worker	1	0.1	1	0.4
	Skilled and technical worker	0	0.0	0	0.0
	Unskilled worker	4	0.1	8	0.7
Shoulder pain	**Job type**		P=0.746		P=0.842
	Manager	0	0.0	0	0.0
	Office worker	1	0.1	0	0.0
	Skilled and technical worker	0	0.0	0	0.0
	Unskilled worker	3	0.04	3	0.1
Neck or Shoulder pain	**Job type**		P=0.406		P=0.376
	Manager	0	0.0	0	0.0
	Office worker	2	0.2	1	0.6
	Skilled and technical worker	0	0.0	0	0.0
	Unskilled worker	7	0.1	11	1.5
Low back pain	**Job type**		P<0.001		P=0.68
	Manager	3	1.3	2	3.4
	Office worker	10	0.9	5	1.8
	Skilled and technical worker	36	1.6	13	2.8
	Unskilled worker	174	2.6	62	3.2

Table 10. Working experience (years) and its association with 1-year Cumulative Incidence and Recurrence of LPB, NP, SP and NSP during a one-year follow-up of employees in Iranian Auto Manufacturing Workers

		Incidence		Recurrence	
		No.	%	No.	%
Neck pain	**Working experience** (years)		P=0.523		P=0.40
	1 or less	0	0.0	1	0.4
	2-5	2	0.03	8	1
	6-10	1	0.1	1	0.3
	11-20	1	0.1	0	0.0
	21-30	1	0.1	1	0.5
Shoulder pain	**Working experience** (years)		P=0.97		P=0.912
	1 or less	1	0.03	1	0.1
	2-5	2	0.03	1	0.1
	6-10	1	0.1	1	0.2
	11-20	0	0.0	0	0.0
	21-30	0	0.0	0	0.0
Neck or Shoulder pain	**Working experience** (years)		P=0.862		P=0.358
	1 or less	1	004	2	1.3
	2-5	4	0.1	9	2
	6-10	2	0.1	2	0.9
	11-20	1	0.1	0	0.0
	21-30	1	0.2	1	0.6
Low back pain	**Working experience** (years)		P<0.002		P<0.092
	1 or less	45	1.8	16	2.5
	2-5	114	2.2	42	3.4
	6-10	49	3.2	19	4.2
	11-20	14	1.5	4	1.5
	21-30	6	0.8	2	0.9

▪ FOUR-YEAR FOLLOW-UP

Figure 7 shows the cohort during the four-year follow-up. Among 14,384 employees, 2,200 (15%) employees left the study population during these four years. Overall, during the four-year follow-up, 98 employees had at least one episode of sick leave due to NSP. Of these 98 cases, 4 were women. Of the non-participants (3,647 cases), 520 employees left the company. Of the remaining non-participants (3,127 employees), a total of 130 employees had sick leave because of NSP.

Demographic characteristics of employees with sick leave and comparisons with the total population in the baseline study (after excluding those that left the company) are shown in Table 11. The mean age for those on sick leave was 29 years, ranging between 20 and 43 years of age. Most of the sick leave cases were unskilled workers (79.4%).

Table 12 shows episodes of sick leave due to NSP, and their correlation with previous self-reported neck and/or shoulder pain. There is a significant relation between reporting pain at baseline and future sick leave, and it is more significant in self reported disabling pain.

Based on medical documents for 98 persons on sick leave due to NSP, in all 12 cases also suffered from psychiatric problems (mostly depression), 2 were addicted to drugs, 15 cases had LBP. In 26 cases, there were demands for change of jobs which means referral to a medical commission because of the person's inability to continue to work in the actual job.

In the regression model for sick leave cases, the remaining physical risk factors were repetitive work and sitting position at work; for psychosocial factors, the only remaining risk factor was unattractive work (Table 13). However, in the regression model for both self-reported and self-reported disabling pain, more and different physical, psychosocial and lifestyle factors remained significant (Table 14).

Table 11. Demographic characteristics in the IKCo cohort, and in participants with sick leave due to NSP, during the four-year follow-up period (2003-2007).

	Study population N=12,184		**Participants with sick leave** N=98	
	No.	**%**	**No.**	**%**
Age group (years)				
≤ 30	7796	64	59	60.2
31-50	3963	32.5	36	36.7
≥ 51	425	3.5	3	3.1
Sex				
Male	11562	94.9	94	95.9
Female	581	4.8	4	4.1
Job type				
Manager	281	2.4	0	0
Office worker	1409	12	8	8.4
Skilled worker	2783	23.7	10	10.5
Unskilled worker	7293	60	77	79.4
Working experience (years)				
<6	9194	77.3	73	74.2
>=6	2698	22.7	25	25.8

Table 12. Relation between having self-reported pain and self-reported disabling pain in the baseline study and incidence of sick leave due to NSP during the four-year follow-up.

	Self-reported pain at baseline					
	Neck		**Shoulder**		**N/S**	
	No.	unadjusted OR	No.	unadjusted OR	No.	un adjusted OR
Risk of sick leave due to NSP	1535	3.0(1.9-4.7)	1428	2.1(1.3-3.4)	2226	2.6(1.7-3.9)
	Self-reported disabling pain at baseline					
	Neck		**Shoulder**		**N/S**	
	No.	unadjusted OR	No.	unadjusted OR	No.	un adjusted OR
	245	5.7(2.9-11.0)	214	3.7(1.6-8.6)	372	4.5(2.5-8.4)

Table 13. Unadjusted odds ratio and multiple logistic regression model for factors associated with sick leave due to NSP during four-year follow up (total number= 98).

	Expo no.	**Unadjusted OR (95% CI)**	**Multiple regression**
Age group			
-30	59	1.0	
31-50	36	1.2(0.8-1.8)	
+51	3	0.9(0.3-3.0)	
Working experience(years)			
<6	73	1.0	
>=6	25	1.2(0.7-1.9)	
No regular exercise (vs. regular exercise)	49	1.1(0.7-1.6)	
High visual demands at work	40	1.1(0.7-1.6)	
Heavy lifting	51	1.9(1.2-2.8)	1.3(0.8-2.1)
Repetitive work	66	2.7(1.7-4.2)	2.1(1.2-3.8)
Sitting position at work	44	2.0(1.3-3.0)	2.1(1.4-3.3)
Awkward working positions	71	2.5(1.6-4.0)	1.3(0.7-2.5)
Uninteresting work	40	2.2(1.5-3.3)	1.7(1.0-2.8)
Monotonous work	50	1.5(1.0-2.3)	0.8(0.5-1.3)
No encouraging organizational culture	57	1.2(0.8-1.9)	
No support from superior	27	1.3(0.9-2.1)	
No support from fellow workers	9	1.1(0.6-2.2)	
No support if trouble at work	41	2.0(1.3-3.0)	1.4(0.9-2.2)
Control at work	52	1.2(0.8-1.8)	
High quantitative demands	64	1.4(0.9-2.2)	
High qualitative demands	55	1.4(0.9-2.1)	
Anxiety concerning change	49	1.4(0.9-2.1)	

Figure 7. Cohort study flowchart

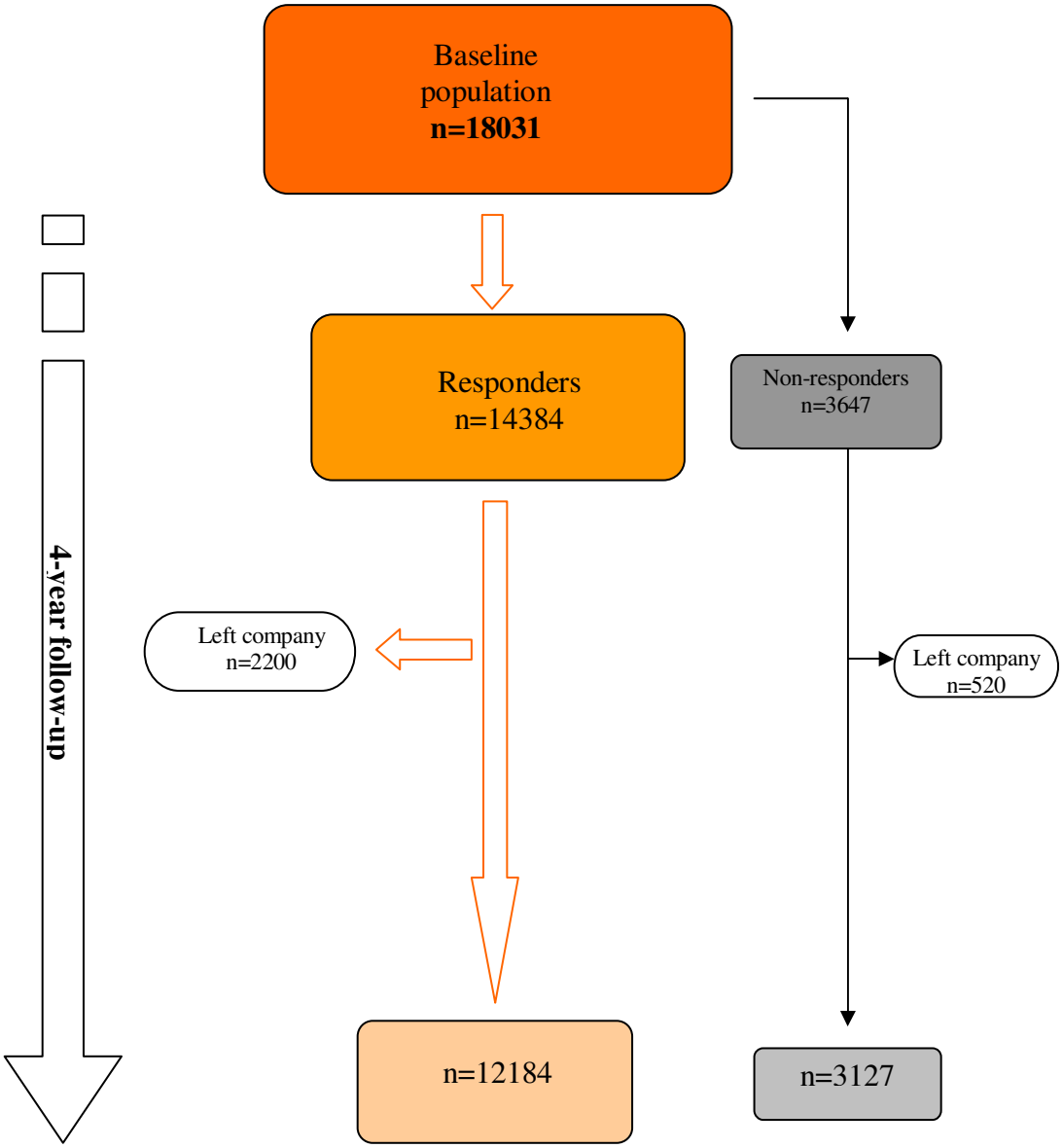


Table 14. Multiple logistic regression model for factors associated with self-reported neck and shoulder pain and self-reported disabling pain in the baseline study. Adjustment has been made for all factors in the model simultaneously (Total number=12,184).

	Exposed no.	Multiple regression Self reported pain	Multiple regression Self reported disabling pain
Working experience(years)			
<6	9194	1.0	1.0
>=6	2698	1.6(1.4-1.8)	2.1(1.6-2.6)
No regular exercise (vs. regular exercise)	5989	1.6(1.5-1.8)	1.5(1.2-1.9)
High visual demands at work	4528	1.4(1.2-1.5)	1.5(1.1-1.9)
Heavy lifting	4694	0.9(0.8-1.0)	1.0(0.8-1.3)
Repetitive work	5463	1.1(1.0-1.3)	1.3(0.9-1.7)
Sitting position at work	3432	1.8(1.6-2.0)	1.7(1.3-2.2)
Awkward working positions	6212	1.3(1.1-1.5)	1.7(1.2-2.4)
Monotonous work	4759	1.3(1.1-1.5)	1.7(1.3-2.3)
No encouraging organizational culture	6205	1.2(1.1-1.4)	1.5(1.1-2.0)
No support if trouble at work	3102	1.3(1.1-1.4)	1.2(0.9-1.5)
No control at work	5747	1.2(1.0-1.3)	1.2(0.9-1.5)
High quantitative demands	6672	1.1(1.0-1.3)	0.9(0.7-1.2)
High qualitative demands	5643	1.1(0.9-1.2)	1.0(0.8-1.4)
Anxiety concerning change	4390	1.2(1.0-1.3)	1.4(1.1-1.8)

5.3 STUDY IV

Validity and reliability study of Persian modified version of MUSIC - Norrtälje Questionnaire

▪ Validity

In all, 16 people participated in 3 focus group discussion (FGD) meetings. The MUSIC Questionnaire consisted of 10 domains and 14 sub-domains (scales). The total number of items in each domain, and the items where there was ambiguity, are shown in table 15. Out of 297 items in all, 20 items (in 7 sub-domains) were ambiguous. All of the ambiguities were related to the stem of the questions, and the predicted answers were clear to the participants. Table 16 shows the ambiguous items and their frequency in each domain as declared by FGD participants and the final decision made on them.

In spite of the clarity of the two following questions, 63% expressed concern in responding to them, although their stems were clear.

- "How many people have you seen being bullied during the last six months?"
- "Have you been subjected to bullying at the workplace during the last six months?"

Finally, 7 of 16 participants in FGD meetings felt that the number of questions in the questionnaire is large and should be reduced.

▪ Reliability

As questions about **demographic and general working conditions** were considered as facts and consistent with time, we did not determine their reliability.

In the **general health, sleep and recovery** domains, the ICCs or kappa were more than 0.7 (acceptable).

In the **musculoskeletal** domain, the level of ICC or kappa was good and excellent (>= 0.8) in all body regions.

In the **physical working conditions** scale, the range of ICCs or kappa related to each question varied from 0.3 to 0.9. In spite of this wide range, only one coefficient was considered unacceptable/poor.

In the **psychosocial working conditions** scale, the ICCs or kappa ranged from 0.2 to 0.9. The unacceptable /poor coefficient was related to only one question.

Regarding dichotomous questions, all kappa coefficients were significant. Thus, there was good agreement in test-retest answers.

In the **reorganization** scale, there were significant coefficients in all related items.

There were two questions in the **household/spare time** domain. The first one showed an acceptable reliability coefficient and the second was questionable.

In the **lifestyle** domain, one item in the exercise scale showed a questionable reliability coefficient.

In the **psychosomatic** domain, there were excellent reliability coefficients.

In the **life events** domain, all but one question showed a significant coefficient (Table 17).

Table 15. Basic structure of questionnaire and validity results

Domains and Scales	Total number of items in each domain or scale	No. of items that were ambiguous in each domain	Source of ambiguity		
			Stem	Answer	Both
1. Demographic data	9	0			
2. General working conditions including extra work	14	0			
3. General health	18	2	*		
4. Stress, sleep and recovery	24	2	*		
5. Musculoskeletal health (in 5 body regions)	129	0			
6. Working conditions					
a. Physical	12	1	*		
b. Psychosocial	44	9	*		
c. Reorganization	6	1	*		
7. Household/Spare time	2	2	*		
8. Lifestyle					
a. Exercise	2	1	*		
b. Smoking	3	0			
9. Psychosomatic factors	17	2	*		
10. Life events	17	0			

Table16. Ambiguous items and their frequency in each domain, based on Focus Group Discussion *

Domain	Scale	Item	Participants declaring the item to be ambiguous No.	%	Final decision
General Health	_____	-I seem to get ill a little easier than other people -I expect my health to get worse	2 3	12.5 18.8	Make changes in translation
Stress, sleep and recovery	_____	- Do you feel recovered and alert when you start a new work shift - Do you feel recovered and alert when you start working after some days off work	8 3	50 18.8	Make changes in translation
Working conditions	Physical	-Recalling events from 5 years ago	3	18.8	Drop
	Psychosocial	-Do you think that your work tasks in your current job are stimulating -Does your job require too large a work effort -Do conflicting demands often occur in your job -Are you satisfied with the quality of your work -Are you satisfied with your ability to cope in a positive way with your workmates -Do you feel that your work performance is appreciated by your manager -Do you experience a good and well functioning leadership from your closest manager -Do you experience good and well functioning leadership from the top management -At work, do you have access to internal training that you can participate in	12 4 3 4 4 3 4 6 4	75 25 18.8 25 25 18.8 25 37.5 25	Make changes in translation
	Reorganization	-Have any of your work colleagues been under notice or been given notice of redundancy at your workplace during the last year due to reductions in work	1	6.3	Make changes in translation
Household/ Spare time	_____	-How large a part of your spare time do/did you devote to housework -How large a part of your spare time can/ could you devote to your own relaxation	12 12	75 75	Make changes in translation
Lifestyle	Exercise	-Regular modest exercise	12	75	Make changes in translation
Psychosomatic factors		-Bad appetite -Hunger pangs	12 4	75 25	Make changes in translation

*Demographic data, General working condition, Musculoskeletal health, Smoking in lifestyle and Life events did not show any ambiguity and were deleted in the Table.

Table 17. Reliability test results

Domain	Scale	Range of ICC (or kappa)	Number of questions where ICC (or kappa) was above 0.7	Number of questions where ICC (or kappa) was below 0.7	The questions where ICC (or kappa) was below 0.7
General health	-	>0.7	All questions	-	-
Stress, sleep and recovery	-	>0.7	All questions	-	-
Musculoskeletal health (in 5 body regions)	-	>=0.8	All questions	-	-
Working conditions	Physical	0.3-0.9	11	1	In your work, do/did you have to carry out the same hand or finger movements a number of times each hour? (inscribing machinery, sorting)
	Psychosocial	0.2-0.9	43	1	Do you feel that your work performance is appreciated by your customers/clients
	Reorganization	>0.7	All questions	-	-
Household/ Spare time	-	0.6-0.7	1	1	How large a part of your spare time can/ could you devote to your own relaxation
Lifestyle	Exercise	0.6-0.7	1	1	Regular modest exercise
	Smoking	>0.7	All questions	-	-
Psychosomatic factors	-	>0.9	All questions	-	-
Life events	-	0.6-09	All except one(16)	1	Illness/accident of wife/husband

6.

DISCUSSION

6 DISCUSSION

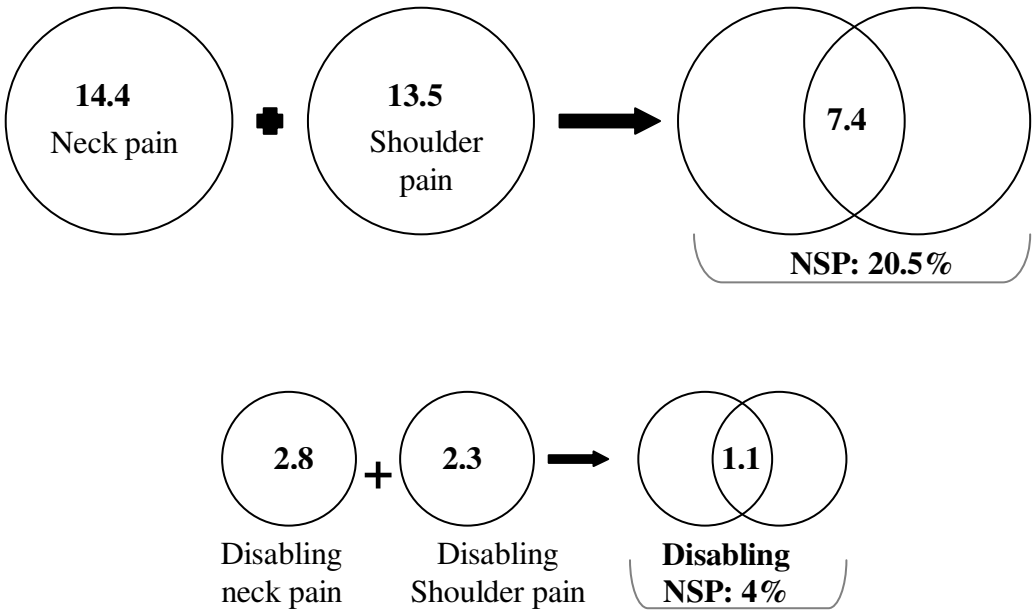
6.1 GENERAL CONSIDERATION OF RESULTS

6.1.1 Self-reported NSP prevalence

In epidemiological studies for NSP prevalence, different definitions have been used. there is no "gold standard" measurement tool for estimating the prevalence of NSP among populations. Point prevalence, one week, one month, one year prevalence and sometimes lifetime prevalence are common time points for reporting a survey's results. In comparing results from different studies, these definitions must be considered. Self-reported data from questionnaires concerning episodes of pain are commonly used to estimate the magnitude of the problem. Although self-reporting is usually considered a less reliable way to measure disease outcomes, NSP is a mainly a self-reported condition.

Another problem in the studies of NSP is case definition. In the Nordic Questionnaire, there are separate questions for neck and shoulder. In the analyses we used not only cases reporting isolated neck or shoulder pain but also cases involving both neck and shoulder pain. As shown in figure 8 and table 4, different results appear in combining neck and shoulder if questions are asked about neck and shoulder separately. Few authors discussed that in former studies.

Figure 8. The prevalence of self-reported pain and self-reported disabling pain in the neck and shoulder separately or in combination



Little is known earlier about neck and shoulder problems in working populations in low- and middle-income countries. In this study, the prevalence of disabling pain is rather low compared to other working populations in high-income countries. The working population in our study is young. Several studies show that specific and nonspecific work-related neck and shoulder pain increases in frequency with age [148-151]. Furthermore, in low-/middle-income countries, unemployment is a major problem, and it is associated with job insecurity, which may lead to underreporting of symptoms and altered perceptions of working conditions.

In line with many previous studies, women demonstrated a higher prevalence of neck and shoulder pain than men [152-155]. At IKCo, most female workers work in offices as skilled and technical workers and are involved in a lot of sitting, repetitive work and have high visual demands. Women reported a low exposure to negative psychosocial factors. The life situations of women and men often differ considerably with regard to factors both at work and at home [156]. There are sources of stress that uniquely affect the lives of women [157]. Most women still bear the main responsibility for household chores, which may add to relevant exposures. The high prevalence of neck and shoulder pain in women and low exposure to physical and psychosocial factors suggest that other physical and psychosocial factors inside and outside the workplace may be important determinants of symptoms.

Blue-collar workers often have a higher prevalence of neck and shoulder pain than white-collar workers [85, 86]. However, our study shows that office workers and managers had the highest prevalence of self-reported nonspecific neck or shoulder pain. Disabling pain was more prevalent in unskilled workers. Job title is a crude proxy of exposure. Every job is a combination of different risk factors. Office workers reported high visual demands and working in a sitting position, while unskilled workers complained of awkward positions, repetitive work, and heavy lifting. Negative psychosocial factors were also more frequent in the unskilled worker group.

6.1.2 One-year and four-year follow-up of employees for sick leave due to NSP (Incidence studies)

A limited number of longitudinal studies on the incidence of NSP have been conducted in high-income countries, and to our knowledge no such studies are available from middle- or low-income countries.

In our longitudinal studies, data on all new episodes of sick leave due to neck or shoulder pain were collected, based on the company's sickness absence registration system between 2003 and 2007. At IKCo, after a period of medically certified sick leave, the employee needs to obtain permission to return to work from the occupational health clinic. Therefore, the accuracy of detecting new episodes of NSP leading to sick leave was very high in this study.

There are several difficulties in trying to compare studies on sickness absence, since not only the study design but also outcome measures, terminology and insurance systems, among nations as well as over time differ widely [158]. In Iran, sickness absence is only permitted with a medical certificate. According to insurance legislation in Iran,

sickness benefit is payable in cases of disease, or injury, that reduces work capacity. For three days or less, a general medical certificate may be accepted. In cases of sickness absence lasting more than three days, medical certificates must be confirmed by physicians who are approved by the insurance system. For long-term sickness absence (more than 60 days), sickness benefit is payable based on confirmation of diagnosis by the expert medical board at the insurance organization. Sickness benefit is payable from the first day of accident and fourth day of disease by the insurance organization. According to insurance legislation in Iran, no time limitation applies to the payment of sickness benefit, and it continues until the time approved by the insurance organization expert committee. In most cases, however, the employee will return to work, but in severe cases where employees lose their workability partially or totally, the committee will grant partial or full disability pension. According to insurance organization legislation, full disability pension will be awarded to employees with a more than 66% reduction in workability, while partial disability pension will be awarded to employees with more than 33% and less than 66% reduction in workability. In both cases, the income awarded will be less than the person's usual income and pension. There is no part-time sickness absence and benefit in Iran. In cases where a sickness certificate is approved, the benefit covers only 75% of salary for married employees and 66% of salary for unmarried employees. In Iran, working extra hours is rather common and this accounts for a considerable part of the employee's income. In these cases, employees lose this part of their income.

The results of this study showed that a considerable difference exists between the incidence and recurrence rate of NSP and LBP in Iran, compared with data from high-income countries [52, 53, 159-162]. The one-year incidence rate of 0.1% and four-year incidence of 0.8% in our study for NSP is far from the figures reported in other studies; 14.1% [52], 34% [58], and 7.3% [53]. Differences between social security systems, workers' compensation systems and benefits during sickness absence may be one reason for the difference.

A low incidence for NSP was true for many other countries a few decades ago. However, in the decade 1970-1980, an epidemic of upper limb disorders hit Australia and spread over the western world [163]. In 1971, Ferguson [164] described cramp-like arm pain in keyboard telegraphists employed by Telecom Australia. Further reports followed, and interest was stimulated by media coverage and the Australian trades unions. The number of affected employees grew rapidly and cases were identified in many industries, including teachers, nurses, secretaries and other keyboard operators, process workers and assembly-line workers. The incidence increased proportionately, as if interest in the condition was actually contributing to its prevalence. Other countries experienced a similar increase in similar problems a little later [163]. It will be very interesting to follow our cohort and see if such a development also takes place in this population.

Low incidence and high prevalence for NSP give rise to the theory that maybe most workers continue to work regardless of pain and disability. Such behaviour has been reported from different countries, in both sexes and for various illnesses [39, 44, 165]. Working when ill, referred to as "presenteeism" or "sickness attendance", has been reported for LBP and NSP [12, 39, 166]. Studies show that presenteeism is most common among professionals, e.g. physicians and nurses, whose work ethic of commitment and responsibility to serve others may be considered more important than their own needs [43, 167, 168]. Sickness presenteeism has also been observed in organizations where the absent employee cannot be easily replaced; thus sick leave

causes negative consequences for the absentee, workmates or a third party [43, 44]. Financial loss, accumulated work tasks and job security could also be major reasons. A study by Hansson and colleagues shows that reporting sick is neither undertaken lightly, nor solely for short-term reasons. Instead, personal history and anticipated spine-related pain in the future, as well as workplace and labour market factors, are other important considerations [169].

Although most studies show that recurrence of NSP is common, our study only has 6 cases with more than one episode of NSP during the four-year follow-up (not shown in tables). One possible explanation for this contradictory result might be that most employees in our cohort continue doing their job despite having pain. We have no information about the care-seeking behaviour of employees who suffer pain but are not sick-listed. Such information might perhaps help to increase our knowledge of health behaviour and reasons for sick-listing.

The low incidence of NSP becomes more complex when we compare it to the incidence of low back pain in the same cohort. Although the prevalence of neck/ shoulder and low back pain was similar at baseline, the one-year incidence of LBP was 20 times higher than the incidence of NSP. This gives rise to the hypothesis that there are different health behaviours and norms for different musculoskeletal disorders. Sick leave in a certain country depends not only on individual health behaviour; it can also be affected by the approval of physicians and the insurance system. It seems that physicians in Iran easily agree to approve LBP on the basis of patient reports alone, as compared with NSP, where different tests are recommended and requested before a final decision is made.

6.1.3 Risk factors

Traditionally when we talk about occupational health in low/middle-income countries, we mostly focus on physical, biological and chemical exposures. Although in these countries, employees are exposed to a high level of these exposures compared to high-income countries, psychological risks at work are still largely neglected and their causes and consequences still insufficiently understood in the middle-/low-income countries context [170]. Due to globalization and changes in the nature of work, workers in low/middle-income countries are have to deal with rising work-related stress. In these countries, the information in this regard is not sufficiently in-depth. Cultural and behavioural differences exist between high-income and low-/middle-income countries, which affect potential psychosocial risk factors. In low-income countries, in view of job insecurity, the market situation and unemployment, workers accept sub-standard working conditions most of the time. Most workers are working in informal sectors without any government supervision. External risk factors (outside work environment) are other factors that increase work stress more than in high-income countries. Lack of unions to represent workers, alongside gender inequalities, illiteracy, poor sanitation and general poverty are examples of these factors. With globalization workers are having to deal with different stresses like demands for high production levels, increased demands for learning new skills, increased time pressure and job competition, all of which affect employees' health. In low-/middle-income countries longitudinal research in relation to work stress is rare.

Neck and shoulder pain and disorders are more prevalent among women than men [78, 171]. Cassou *et al.* [53] showed that prevalence and incidence of NSP were twice as high in women as in men. In our study, women reported NSP three times more than men in the baseline survey, but only 4 sick-listed cases were detected in the follow-up study. At IKCo, women work as office workers and technicians, and on the whole sick leave rates in these jobs are low.

The results from the present study shows that self-reported pain in the neck or shoulder in the baseline study was a significant factor for sick leave due to NSP and this is more significant for disabling pain (table II). Although the number of cases is small (i.e. there is a wide confidence interval), this significance is rather interesting. In this study, we did not find any significant correlation between previous LBP and the risk of future sick leave due to NSP. The results of our study reveals a rather high degree of comorbidity in sick leave cases due to NSP, although further studies are required in order to validate these results.

In the baseline survey for NSP prevalence, several physical and psychosocial risk factors for NSP at work were found. In the prospective study of sick leave, repetitive work, sitting position at work and unattractive work were the only factors that influenced the outcome and remained as risk factors. Thus, the results show that, depending on the type of study you employ (cross-sectional, prospective) and what outcome measure (self-reported NSP, sick leave due to NSP) is used, the risk factor panorama varies. This is very important in the light of the difficulties discussed about establishing evidence for risk factors.

Different studies have shown correlations between physical and psychosocial factors at work, and both incidence and prevalence of NSP [54, 172]. In one review, the risk factors for sick leave due to NSP were shown to be poor social support and low decision latitude over work content and organizational factors [173]. Former studies have also shown that a difference exists between these factors in self-reported pain and sickness absence due to pain [174, 175]. Our study is also in line with these reports.

In this study, we only measured risk factors at the beginning of the project in 2003. IKCo is a large company with special characteristics. Compared to other companies in Iran, it is more stable and prestigious; nevertheless, like most companies, IKCo undergoes various changes such as re-organization, downsizing and outsourcing programmes that affect physical and psychosocial work factors. The exposures for the specific individuals may have changed and may thereby bias the results. Repeated measurement of exposures is one possible way of helping to identify this dynamic pattern and its influence on the outcome.

6.1.4 Validity and reliability study of Persian modified version of MUSIC - Norrtälje Questionnaire

There is no “gold standard” measurement tool for estimating the prevalence of MSDs. Although self-reporting is usually considered a less reliable way to measure disease outcomes, MSDs is a mainly self-reported condition. Exposure assessments are another problem with regard to MSDs. For some physical and ergonomics factors, direct measurements and observations can be made. However, these are expensive and time-

consuming methods. In epidemiological studies, a method that is often used for estimating the magnitude of the exposures is self-reporting. The validity and reliability of these methods have been investigated in different studies [176-180]. For psychosocial exposures, external observations are more difficult to perform. There is a major lack of standardized exposure tools for assessing psychosocial risk factors relevant to work-related MSDs [181]. In Sweden, the MUSIC Questionnaire has been used as a tool to study the relationship between MSDs and work-related factors. This questionnaire has been validated during its development process; it has been used in numerous publications and is considered a valid and relevant instrument [166, 182-183].

In our study, the Persian-language version of the MUSIC Questionnaire was developed and its validity and reliability determined and described. It is necessary for study designers to consider features that improve the reporting accuracy of subjects, including using familiar terms that are common in worksite discourse, and presenting guidelines which will help them to place their exposure in relation to that of others [184]. We used the above recommendations while translating the MUSIC Questionnaire into the Persian language and in the expert panel method.

In the validity study using the Focus Group Discussion (FGD) method, we found that only 22 out of 297 questions were ambiguous. Of these 22, all but two (i.e. 20) had unclear translations. For instance, after translation, the FGD participants did not understand the concept of household/spare time, so we added a description to clarify this in the translation. Also, most of the participants thought that physical activity in the workplace meant some kind of exercise. In the translated version, we tried to make clear the distinction between physical exercise and physical work exposures. After this, none of the participants had any problems with the concept of the question.
Regarding company organizational culture, two questions related to psychosocial work factors (questions about bullying) were considered not to be applicable in the Persian version and were thus dropped.

Although in the original MUSIC Questionnaire some questions asked about preceding exposures 20 years back in time, we restricted the time frame of the Persian version of the questionnaire to one year back in time. The reason for this was that the employees are mostly young people with shorter work experience and, if applicable, high probability of recall bias (the results of the validity study confirmed this).

In the test-retest study, the reliability coefficient was relatively high in most items, and only 5 questions out of 297 showed an ICC below 0.7 (Table 3).The questions with low ICCs or kappa (only 5 questions) were dropped on expert advice. We recommend that other investigators consider these results in their own research. Memory bias is an unavoidable problem in re-test situations. Subjects may remember how they answered questions and attempt to reproduce those answers during re-test. A 3-week interval between tests was chosen in the present study, in part to minimize overestimate and underestimate of reliability (due to the influence of memory or any actual change in work condition). According to research group opinion and the human resource department, there were no modifications in job tasks, new interventions, organizational changes or production demands during the test/re-test period.

ICC is the ratio of the between-subjects variance divided by total variance [185]. It is a measure of relative reliability and in some instances can produce misleadingly high levels of reliability (for example if there is a large variance between subjects) [186].

Some researchers advise reporting ICC with other measurements such as SEM (standard error of measurement). The magnitude of the kappa coefficient represents the proportion of agreement greater than that expected by chance, but other factors can influence the magnitude of kappa-like prevalence, bias, and non-independence of ratings [187].

The MUSIC Questionnaire is an expanded questionnaire with different sections. Deleting one domain (scale) or sub-domain does not affect the validity of the questionnaire, and it depends on the research group and the aims of using questionnaire. Therefore, the questionnaire is applicable in different research studies using only certain domains adjusted to specific purposes.

In general, the results show that the Persian version of the questionnaire has a good conceptual structure and provides reliable information on workplace factors.

6.2 METHODOLOGICAL CONSIDERATION

Observational studies serve a wide range of purposes: from reporting a first hint of a potential cause of a disease, to verifying the magnitude of previously reported association. The general aim of this observational study was to increase our knowledge about neck and shoulder pain and its pattern in an industrial population of one middle-income country, where a little or no information is available in this domain. An epidemiological estimate is the end- product of the study design, the study conduct, and the data analysis. So the overall goal of an epidemiological study may be viewed as accuracy in estimation. It means that in each study, the main objective is to obtain a valid and precise estimate of the frequency of a disease or of the effect of an exposure on the occurrence of a disease in the source population of the study [188].

6.2.1 Study design

Exact statistics about incidence and prevalence of MSDs in IKCo were not available, but primary descriptive studies and investigations showed that musculoskeletal disorders were one of the most important health problems at the company, including a high percentage of demands for job changes and employees' complaints during periodic health examinations. At the start of the project, a little information was available on neck and shoulder pain in middle-/low-income countries. Most of this was limited to some cross-sectional studies without any follow up. In Iran, as in other middle-/low-income countries, we have not had any information about the magnitude of the problem.

In view of referred points, the research group preferred to start with a cross-sectional survey using a self-administrated questionnaire. The Standard Nordic Questionnaire, whose validity had been approved in different languages including Persian [144], was chosen for this purpose. The study was followed by one-year and four-year follow-ups for all employees, based on the sickness absence registration system. During NSP follow-up, we also followed low back pain over one year to compare the probable

differences in their behaviour. During this project, in view of the fact that in Iran and the Persian language, no expanded questionnaire existed to include more details regarding MSDs (including NSP) and risk factors for monitoring our cohort, the Persian-language version of the MUSIC- Norttalje Questionnaire was developed and its validity and reliability determined in the same population of IKCo.

6.2.2 Study population

At the beginning of the study, 18,031 full-time employees working in different departments were invited to participate. During the four-year follow-up, IKCo had new employees, but they were not included in this study. All employees undergo a pre-employment medical examination and some restrictions apply to the employment of people with certain diseases. So our study population is a young selected group of probably very healthy workers, which of course might affect the results. This is a common problem in all studies on active workers, but can be especially strong in middle- and low-income countries, where employment opportunities are rarer.

During the 4-year follow-up, 2,200 employees left the company. The main reason for this in more than 80% of cases was scheduled retirement. In Iran, all employees who have 30 years of work experience or are above the age of 60 can retire. Among industrial workers, this duration was 25 years at the start of the study period. In accordance with new rules approved by the Government during our study period, all employees with more than 20 years of hard physical work experience could also retire For this reason, a large number of workers retired during the 4 years. The definition of hard work was formulated by a national expert committee. Loss of follow-up is a potential problem in cohort studies. If a substantial proportion of subjects are lost to the study for any reason, for example having moved out of the region, it would be expected that fewer cases of the disease in question would have arisen in the study than originally planned. The number of study cases may ultimately be too small to yield stable estimates of the incidence rates and, consequently, estimates of the relative risk. In this case, the observed relative risk would have to be very large to be accepted as supporting the causal hypothesis. In our study, it is logical to assume that those who left the company were, on the whole, older than other participants, and this may affect the incidence of sick leave and the relative risk observed could be an underestimate of the true relative risk. In the baseline study, age and work experience were risk factors for self-reported neck and shoulder pain, but there was no significant relation with sick leave; in view of the total number of employees and the number of retired employees, this retired population cannot be the main reason for the low incidence.

6.2.3 Non-participants

The participation rate in the baseline study was high (79.8%). On the basis of human resource data, there were no obvious differences in demographic or workplace factors between participants and non-participants. One main positive point in this study is that in view of the sickness absence registration system of the company that covers all employees, we were able to monitor the total population of both participants and non-participants at the company. The difference in incidence between participants and non-participants in the four year follow-up study is considerable, 0.8% compared to 4.2%. This indicates that healthy workers were more likely to participate. So it seems that only considering the participation rate and demographic data in observational studies in

the occupational health field can be misleading. For ethical reasons, we did not seek more in-depth information about the non-participants.

6.2.4 Measurement tools for risk factors

In this study we measured risk factors based on self-reported questionnaire. Self-reported questionnaires are considered valid and useful instruments in epidemiological studies of occupational health specially when we have huge number of study subjects, but direct measurement of risk factors (external assessment) could cover the weakness of this kind of measurement tool and complete the validity of the study.

6.2.5 Generalizability of the study

IKCo is a company with various and widely ranging jobs including specialists, technicians, office workers and unskilled workers of different kinds. In view of the number of study subjects and different job titles with different exposures from one point our results could perhaps be generalized, and may be relevant to similar occupational populations inside Iran or other countries.

6.3 FUTURE PLAN

In this study, we had one measurement for physical and psychosocial risk factors via a fairly short questionnaire at baseline. Participants may have changes in their exposures during the four-year follow-up period. Repeated measurement of more detailed exposures/outcomes will be needed for a deeper and better understanding of the associations between exposures and NSP. For this reason, a longitudinal study with repeated measurements has been started in selected parts of the company. In this new study, the Persian-language version of a modified MUSIC Questionnaire is used.

The study population in IKCo is young but so far stable and the cohort that is followed by the occupational health department with regular examinations and registration of all sickness absence periods can be very valuable in the future in order to better understand the natural course of NSP at work.

7.

CONCLUSIONS

7 CONCLUSIONS

7.1 GENERAL CONCLUSION

There are few longitudinal studies in relation with NSP in high-income countries and we could not find similar studies in low-/middle-income countries.

The results of our research emphasize the similarities and differences in dynamic pattern of NSP in different countries.

Anatomical definition of neck/shoulder can affect the prevalence.

Our study confirms the effects of physical and psychosocial factors at work for neck and shoulder symptoms among automobile manufacturing workers in a middle-income country, despite the relative youth and job insecurity of the population.

The follow-up of the cohort over one and four years reveals that the incidence of NSP is much lower than reported in high-income countries. A study of the prevalence, incidence and recurrence of NSP simultaneously lead to a better understanding of the natural pattern and distribution of NSP.

Our results show there are differences in behavior of LBP and NSP in the same population.

For a better understanding of NSP at work, repeated measurements with a more elaborate questionnaire are needed. A first step is to test such an instrument for validity and reliability. The Persian-language version of a modified version of the MUSIC-Norrtälje Questionnaire tested here seems to be a valid and reliable instrument for future studies.

7.2 ELEPHANT IN DARKNESS

The area covered in this thesis raises further questions that are important in NSP research. The pattern of neck/shoulder pain reminds one of the poem by a celebrated Iranian poet Rumi (1207-1273) "Elephant in a Dark Room". This fable is also known in India as "The fable of the elephant and the blind men". Six blind men (or men in complete darkness) are grouped around an elephant they cannot see, and they are trying to describe it. Depending on the part they happen to touch, they identify the object as resembling a tree (leg), wall (side), spear (tusk), rope (tail), snake (trunk) or fan (ear). So many different impressions, all from the same object!

In this case, NSP is the elephant: which is its true image?

If we only study the prevalence based on one cross-sectional study and only ask about non-specific NSP, it makes sense that there is no obvious difference between NSP in Iran and in high-income countries.

Studying only disabling NSP may induce the hypothesis that the prevalence of NSP is slightly low compared with other countries.

Investigating NSP based on a sickness absence registration system could indicate that there is an obvious difference between NSP behaviour in Iran, compared to former studies.

And finally if we did not study NSP and LBP in the same period of time, we could not observe the difference between health behaviour of employees with these two musculoskeletal disorders.

In addition, one important area is left uncovered, that is the comparison of sick leave due to NSP, not only with LBP but also with other musculoskeletal disorders and with other diseases and disorders that cause sick leave.

Although NSP can be studied from different angles and differing types of focus, there is a requirement for a holistic view to understand what it is like on an overall level. Like the story of the elephant, if we try to determine its appearance by touch alone, each researcher will come to a different conclusion, according to the part of the animal's body that he or she investigates.

8.

ACKNOWLEDGMENTS

8 ACKNOWLEDGEMENTS

For most researchers, the years of PhD study are one of the most exciting and productive periods of their life. This period is even more exciting, and a real adventure, if you are working in another country with its different, and particular, atmosphere. During the years I have worked on this project I have been extremely privileged to share experiences and knowledge with, and to be supported by, a great number of excellent people.

I believe that for different reasons I was fortunate for the five years that I was working on this project:

The first was that I begun my PhD and was registered in Karolinska Institute, a prestigious university in Sweden and Europe. At Karolinska, the Personal Injury Section (part of Clinical Neuroscience Department where I registered) was first located in Myntet, a beautiful area in Stockholm, with a friendly atmosphere and lovely people from whom I learned many things. This had a positive effect on the beginning my research. The section was then transferred to the KI Solna Campus, a new workplace offering new experiences, although at that time, I was mostly based in Uppsala. However, during courses, seminars and discussions with my co-supervisor, I got to know many people and also became familiarized with the ways of working in a multidisciplinary environment.

The second reason why I was fortunate is that, given that my main supervisor moved to Uppsala University, I was privileged to work not only at Karolinska Institute but also another famous university, Uppsala, with such great colleagues, many of whom have influenced me, especially in the friendly atmosphere of the Occupational and Environmental Medicine Department at Uppsala University.

Thirdly, in view of the fact that the project focused on workers in my own country and that I was the main member of the group that was involved in the practical gathering of data inside IKCo, I spent the first few years of this job working on different parts of the project in Iran, with IKCo employees and my co-workers. This was an opportunity for me to get practical experience of how to manage a huge project (involving 18,000 participants, with various forms of questionnaires and registration systems and monitoring them for at least four years!) in a middle-income country, with a different culture, instability, several changes of managers and key people and totally involving the real world of project management!

I would like to express my gratitude to all my present and former colleagues at the Personal Injury Section at Myntet to the Solna Campus and my colleagues in the Occupational and Environmental Medicine Department at Uppsala University. I learned so much from you and I may not be able to mention you all.

My deepest thanks to:

My honourable main supervisor, Professor Eva Vingard
For me to call you “main supervisor” (which has been your role) is in no way sufficient or appropriate to describe how you have helped me. You have supported and encouraged me in all dimensions of my life all the way from giving me the opportunity

to be your PhD student and writing my proposal, to different stages of my PhD period and graduation and planning my future. Thank you for broadening my scientific outlook and knowledge by sharing your long experience. In a totally admirable way, you listened to my thoughts and ideas, sometimes my odd questions, went through and corrected my writings and were available to listen and discuss, even when you were busy with hundreds of other things. I learned many things from you: from providing supportive and creative working environment, to discipline in work, balance between work and life and confidence in others and respecting their beliefs. My most sincere thanks for all of this. I hope have the chance to have this student-teacher relationship for all my life.

My co-supervisor, Professor Irene Jensen
Thank you for all your support in the department. For generously and warmly sharing your experience and knowledge, for your valuable advice on the design of my studies and for discussions on writing manuscripts. I haven't forgotten your patience during the discussions we had about our validity paper!

My other co-supervisor from Iran, Dr Batoul Shariati
For your help with designing the study and writing manuscripts, and your valuable suggestions for this research from epidemiological aspects.

Dr Abolalai, former Vice-President of Human Resources and Mr Dehnadi, excutive Vice-President at IKCo for your belief in the scientific approach and your approval for this project.

Dr Seyed Ali-Reza Alavi, former director of the Occupational Health and Safety Department at IKCo for your support in enabling me to carry out this project.

Abbas Emami, the new Director of the Occupational Health and Safety Department of IKCo, who helped to continue this project.

Special thanks to my friend and co-writer of papers Mostafa Ghaffari for your support during the first years and the initial stages of the project and also when I sometimes had to be in Iran to manage data gathering at IKCo. Also as a PhD student who begun research after you, sometimes your footmarks were good guidelines for me. I hope more successfulness for you and your wife, Elham.

Dr Amir Samadi, one of my best friends. In my belief that you were a key person in establishing the link between researchers at Karolinska and in Iran, thank you for your challenge in this regard. I appreciate all of the support that you and family provided during these 5 years. I and my small family (Ladan and Mana), haven't forgotten you, your brother's family, mother and father for the help, hospitality and kindness you showed during this period.

Mr Amir Radfar, My dear friend who indirectly caused the connection between IKCo and research group in Sweden. I visited my supervisor for the first time in your SIDA project in Iran!

Professor Houshang Shahnvaz, the emeritus professor of LULEA University who introduced ergonomics for me.

Dr Malin Josephson, for your help and support. I enjoyed our interesting discussions during lunch and other breaks. I haven't forgotten our scientific discussions on neck/shoulder pain – whether to call it neck and shoulder or maybe neck or shoulder! I learned from you that life is not restricted to working life! Thank you for reminding about this important point.

Professor Kristina Alexandersson, head of the Personal Injury Prevention section. Although I could not use your profound experience in the subject of sickness absence in the way I would like, I had the opportunity to participate in your excellent course and use your papers.

Marianne Ekdahl, for your help with the problems that I had with the Swedish language. I have also not forgotten the gift from you and Maline when my daughter was born. This meant so much to our family, because it was first gift that my daughter received!

Dr Margareta Voss, for your inspiration, good friendship and all kinds of support, and for all the good times we enjoyed at Myntet and for the short period of time in Uppsala.

Dr Marjan Vaez, my section colleague, for your kindness, guidance and discussions that we had as two people of the same nationality.

Dr Bodil Heijbel, for all your friendship and warmth, in the first few days when I came to live in Sweden.

Christian Garheden, for your excellent skills in all aspects of computers, and also for your support during emergencies and moments of desperation. I haven't forgotten your help in fixing my computer during my half-time seminar.

Stefan Stark, for introducing me to practical statistics and your valuable advice about the analyses.

Leif Sieurin for all your friendship and enjoyable discussions during our breaks and launch times.

I would like to express my deepest appreciation to the IKCo employees who participated in this study; without your participation this thesis would not have been written. I begun my work as an occupational physician with you, and we have now been together for more than 9 years. We had numerous meetings together, alone, in groups, in clinics, on health promotion training courses and medical commissions and at the times when mostly as a physician, my position and my research consisted of listening to your problems and your pains. To me, a principal reason for starting the IKCo project was to improve your workplace, to promote your health, and I hope that the results, in one way or another will be of benefit to you in your work. I also hope that other industries in Iran and middle-/low-income countries can use our results for their employees.

All my co-workers in the HSE department of IKCo who helped me from the start of the project in data gathering, executive activities, typing, checking data, distributing and managing huge number of questionnaires, focus group discussions, numerous meetings that we had with IKCo managers and employees. More thanks to Ali Khakpour

(Industrial Nurse), Dr Amir Ashkan Saberi, Dr Jalili, Industrial Psychology groups including Mr Khojasteh, Ms Ekrami, Miss Mohammadi, Dr Pezeshk , Abbas Mozaffari and Ali-Akbar Khorasani.

Dr Abbas Motavallian for his valuable advice on data collection and analysis.

Dr Shahram Tavajjohi for his help in data management, data entry and merging different data banks.

Finally, and most importantly of all, thanks to my family:

My wife Ladan, who constantly encouraged and supported me and made it possible for me to go the way that I (and actually we) have chosen to go. With your help, we kept work and life in balance through this period! Forgive me if sometimes I concentrated more on my work at home. Thank you for everything. Words cannot express my feelings, but I think you understand what I mean (Midanam To Bishtar!).

My small daughter Mana, who was born during my PhD study in Sweden, at your age it is hard for you to understand why sometimes I was writing all the time and writing in notebooks in our small apartment at home, and did not allow you to play with the notebook or my documents and references! Please accept my apologies.

All my relatives, my father and my mother, my father- and mother-in-law and all my sisters, each of whom had their particular supportive role in so many ways.

…And anyone else I might have forgotten.

9.

REFERENCES

9 REFERENCES

1. Makela, M., et al., Prevalence, determinants, and consequences of chronic neck pain in Finland. Am J Epidemiol, 1991. 134(11): p. 1356-67.
2. Cote, P., Cassidy, J.D and Carroll, L., The factors associated with neck pain and its related disability in the Saskatchewan population. Spine, 2000. 25(9): p. 1109-17.
3. Sluiter, J.K., Rest, K.M and Frings-Dresen, M.H, Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders. Scand J Work Environ Health, 2001. 27 Suppl 1: p. 1-102.
4. Cote, P., et al., The annual incidence and course of neck pain in the general population: a population-based cohort study. Pain, 2004. 112(3): p. 267-73.
5. The burden of musculoskeletal conditions at the start of the new millennium. World Health Organ Tech Rep Ser, 2003. 919: p. 1-218, back cover.
6. McCaffery, M., Nursing practice theories related to cognition bodily pain, and man-environment. 1968, Los Angeles: UCLA Student´s Store.
7. Melzack, R and Torgerson, W., On the language of pain. Anesthesiology, 1971. 14: p. 54-55.
8. Linton, S.J., A review of psychological risk factors in back and neck pain. Spine, 2000. 25(9): p. 1148-56.
9. Chapman, C.R. and Gavrin, J., Suffering: the contributions of persistent pain. Lancet, 1999. 353(9171): p. 2233-7.
10. Loeser, J.D. and Melzack, R., Pain: an overview. Lancet, 1999. 353(9164): p. 1607-9.
11. Viikari-Juntura, E., et al., Longitudinal study on work related and individual risk factors affecting radiating neck pain. Occup Environ Med, 2001. 58(5): p. 345-52.
12. Picavet, H.S. and Schouten, J.S., Musculoskeletal pain in the Netherlands: prevalences, consequences and risk groups, the DMC(3)-study. Pain, 2003. 102(1-2): p. 167-78.
13. Palmer, K.T., et al., Prevalence and occupational associations of neck pain in the British population. Scand J Work Environ Health, 2001. 27(1): p. 49-56.
14. Luime, J.J., et al., High incidence and recurrence of shoulder and neck pain in nursing home employees was demonstrated during a 2-year follow-up. J Clin Epidemiol, 2005. 58(4): p. 407-13.
15. Walker-Bone, K., et al., The anatomical pattern and determinants of pain in the neck and upper limbs: an epidemiologic study. Pain, 2004. 109(1-2): p. 45-51.
16. Hunt, I.M., et al., The prevalence and associated features of chronic widespread pain in the community using the 'Manchester' definition of chronic widespread pain. Rheumatology (Oxford), 1999. 38(3): p. 275-9.
17. Bamji, A.N., et al., The painful shoulder: can consultants agree? Br J Rheumatol, 1996. 35(11): p. 1172-4.
18. Kuorinka, I., et al., Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon, 1987. 18(3): p. 233-7.
19. Mayer, T.G., Gatchel, R.J and Polatin, P.B., Occupational musculosceletal disorders, function, outcomes, and evidence. 2000: Lippincott Williams & Wilkins.
20. Palmer, K.T. and Smedley, J., Work relatedness of chronic neck pain with physical findings--a systematic review. Scand J Work Environ Health, 2007. 33(3): p. 165-91.

21. Kilbom, A., in Encyclopedia of occupational health and safety. Stellman, J.M, Editor. 1998, International Labor Office Geneva. p. 6.15.
22. Dvorak, J., et al., Age and gender related normal motion of the cervical spine. Spine, 1992. 17(10 Suppl): p. S393-8.
23. Halberg, M., in Encyclopedia of Occupational Health and Safety. Stellman, J.M, Editor. 1998, International Labor Office: Geneva. p. 6.18.
24. Maslow, A, Mittlemon, B., The meaning of healthy (normal) and of sick (abnormal), in Concepts of health and disease, E.H. Caplan AL, McCarney JJ, Editor. 1981, Addison-Wesley: Massachusetts.
25. Alexanderson, K., Measuring health. Indicators for working women, in Women's health at work, Å. Kilbom, K. Messing, and C. Bildt Thorbjörnsson, Editors. 1998, National Institute for Working Life: Stockholm.
26. Alexanderson, K., Sickness absence; a review of performed studies with focus on levels of exposures and theories utilized. Scandinavian Journal of Social Medicine, 1998. 26(4): p. 241-249.
27. Boorse, C., Health as a theoretical concept. Philos Sci 1977. 44: p. 542-73.
28. Wikman, A., Marklund, S and Alexanderson, K., Illness, disease, and sickness absence: an empirical test of differences between concepts of ill health. J Epidemiol Community Health, 2005. 59(6): p. 450-4.
29. Blaxter, M., Health. 2004, Policy Press: Cambridge.
30. Lindberg, P., The work ability continuum. Thesis for doctoral degree, in Clinical Neuroscience Department. 2006, Karolinska: Stockholm. p. 65.
31. Nordenfelt, L., Health and disease: two philosophical perspectives. J Epidemiol Community Health, 1986. 40(4): p. 281-4.
32. Voss, M., Floderus, B and Diderichsen, F., Physical, psychosocial, and organisational factors relative to sickness absence: a study based on Sweden Post. Occupational Environment and Health, 2001. 58: p. 178-184.
33. Kivimaki, M., et al., Sickness absence in hospital physicians: 2 year follow up study on determinants. Occupational and Environmental Medicine, 2001. 58(6): p. 361-366.
34. de Croon, E.M., Sluiter, J.K and Frings-Dresen, M.H., Need for recovery after work predicts sickness absence: a 2-year prospective cohort study in truck drivers. J Psychosom Res, 2003. 55(4): p. 331-9.
35. Boedeker, W., Associations between workload and diseases rarely occuring in sickness absence data. Journal of Occupational and Environmental Medicine, 2001. 43(12): p. 1-8.
36. Blank, N. and Diderichsen, F., Short-term and long-term sick-leave in Sweden: relationships with social circumstances, work conditions and gender. Scandinavian Journal of Social Medicine, 1995. 23: p. 265-272.
37. Allebeck, P. and Mastekaasa, A., Risk factors for sick leave - general studies. Scandinavian Journal of Public Health, 2004. 32(Supplement 63): p. 49-108.
38. Alexanderson, K., et al., Epidemiology of sickness absence in a Swedish County in 1985, 1986 and 1987. Scandinavian Journal of Social Medicine, 1994. 22(1): p. 27-34.
39. Johansson, G. and Lundberg, I., Adjustment latitude and attendance requirements as determinants of sickness absence or attendance. Empirical tests of the illness flexibility model. Soc Sci Med, 2004. 58(10): p. 1857-68.
40. Kristensen, T.S., Sickness absence and work strain among Danish slaughterhouse workers: An analysis of absence from work regarded as coping behaviour. Soc Sci Med, 1991. 32(1): p. 15-27.

41. Marmot, M., et al., Sickness absence as a measure of health status and functioning: from the UK Whitehall II study. Journal of Epidemiology & Community Health, 1995. 49(2): p. 124-130.
42. Vingard, E., et al., Seeking care for low back pain in the general population: a two-year follow-up study: results from the MUSIC-Norrtalje Study. Spine, 2002. 27(19): p. 2159-65.
43. Perkin, M.R., Higton, A and Witcomb, M., Do junior doctors take sick leave? Occup Environ Med, 2003. 60(9): p. 699-700.
44. Aronsson, G., Gustafsson, K and Dallner, M., Sick but yet at work. An empirical study of sickness presenteeism. J Epidemiol Community Health, 2000. 54(7): p. 502-9.
45. Cote, P., et al., The prevalence and incidence of work absenteeism involving neck pain: a cohort of Ontario lost-time claimants. Spine, 2008. 33(4 Suppl): p. S192-8.
46. Cote, P., et al., The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine, 2008. 33(4 Suppl): p. S60-74.
47. Adedoyin, R.A., et al., Musculoskeletal pain associated with the use of computer systems in Nigeria. Technol Health Care, 2005. 13(2): p. 125-30.
48. Chopra, A., et al., Pain and disability, perceptions and beliefs of a rural Indian population: A WHO-ILAR COPCORD study. WHO-International League of Associations for Rheumatology. Community Oriented Program for Control of Rheumatic Diseases. J Rheumatol, 2002. 29(3): p. 614-21.
49. Lee, H.Y., et al., Prevalence and psychosocial risk factors of upper extremity musculoskeletal pain in industries of Taiwan: a nationwide study. J Occup Health, 2005. 47(4): p. 311-8.
50. Reyes Llerena, G.A., et al., Prevalence of musculoskeletal complaints and disability in Cuba. A community-based study using the COPCORD core questionnaire. Clin Exp Rheumatol, 2000. 18(6): p. 739-42.
51. Smith, D.R., et al., Musculoskeletal complaints and psychosocial risk factors among Chinese hospital nurses. Occup Med (Lond), 2004. 54(8): p. 579-82.
52. Andersen, J.H., et al., Risk factors in the onset of neck/shoulder pain in a prospective study of workers in industrial and service companies. Occup Environ Med, 2003. 60(9): p. 649-54.
53. Cassou, B., et al., Chronic neck and shoulder pain, age, and working conditions: longitudinal results from a large random sample in France. Occup Environ Med, 2002. 59(8): p. 537-44.
54. Feveile, H., Jensen, C and Burr, H., Risk factors for neck-shoulder and wrist-hand symptoms in a 5-year follow-up study of 3,990 employees in Denmark. Int Arch Occup Environ Health, 2002. 75(4): p. 243-51.
55. Grooten, W.J., et al., Seeking care for neck/shoulder pain: a prospective study of work-related risk factors in a healthy population. J Occup Environ Med, 2004. 46(2): p. 138-46.
56. Leclerc, A., et al., One-year predictive factors for various aspects of neck disorders. Spine, 1999. 24(14): p. 1455-62.
57. Ostergren, P.O., et al., Incidence of shoulder and neck pain in a working population: effect modification between mechanical and psychosocial exposures at work? Results from a one year follow up of the Malmo shoulder and neck study cohort. J Epidemiol Community Health, 2005. 59(9): p. 721-8.
58. Smedley, J., et al., Risk factors for incident neck and shoulder pain in hospital nurses. Occup Environ Med, 2003. 60(11): p. 864-9.

59. Dempsey, P.G., Burdorf, A and Webster, B.S., The influence of personal variables on work-related low-back disorders and implications for future research. J Occup Environ Med, 1997. 39(8): p. 748-59.
60. Bongers, P.M., et al., Psychosocial factors at work and musculoskeletal disease. Scand J Work Environ Health, 1993. 19(5): p. 297-312.
61. Ariens, G.A., et al., High physical and psychosocial load at work and sickness absence due to neck pain. Scand J Work Environ Health, 2002. 28(4): p. 222-31.
62. Hoogendoorn, W.E., et al., High physical work load and low job satisfaction increase the risk of sickness absence due to low back pain: results of a prospective cohort study. Occup Environ Med, 2002. 59(5): p. 323-8.
63. Josephson, M. and Vingard, E., Workplace factors and care seeking for low-back pain among female nursing personnel. MUSIC-Norrtalje Study Group. Scand J Work Environ Health, 1998. 24(6): p. 465-72.
64. Elders, L.A., Heinrich, J and Burdorf, A., Risk factors for sickness absence because of low back pain among scaffolders: a 3-year follow-up study. Spine, 2003. 28(12): p. 1340-6.
65. I.Jzelenberg, W., Molenaar, D and Burdorf, A., Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. Scand J Work Environ Health, 2004. 30(1): p. 56-63.
66. I.Jzelenberg, W and A. Burdorf, A., Risk factors for musculoskeletal symptoms and ensuing health care use and sick leave. Spine, 2005. 30(13): p. 1550-6.
67. Bongers, P.M., et al., Epidemiology of work related neck and upper limb problems: psychosocial and personal risk factors (part I) and effective interventions from a bio behavioural perspective (part II). J Occup Rehabil, 2006. 16(3): p. 279-302.
68. Lert, F., et al., Professional development and health of nurses in public hospitals. Travaial Humain, 1989. 52(3): p. 213-230.
69. Brulin, C., Jonsson, B and Karlehagen, S., Musculoskeletal troubles in railway station workers. A descriptive epidemiological study. National broad of occupational safety and health, in Arbete och Hälsa. 1985, Arbetarskyddsstyrelsen: Solna.
70. Chau, N., Petry, D and Gavillot, C., Occupational implications of serious upper limp injuries. Archives des maladies Professionelles, de Medicine du Travail et de Securite Sociale, 1995. 56: p. 112-122.
71. Krapc, L., et al., Pain syndroms of the spine in the active population. Artive za Higijenu Rada I Toksikologiju, 1985. 36(1-4): p. 343-354.
72. Viikari-Juntura, E., et al., Neck trouble in machine operating, dynamic physical work and sedentary work: a prospective study on occupational and individual risk factors. J Clin Epidemiol, 1994. 47(12): p. 1411-22.
73. Andersson, H.I., et al., Chronic pain in a geographically defined general population: studies of differences in age, gender, social class, and pain localization. Clin J Pain, 1993. 9(3): p. 174-82.
74. Hogg-Johnson, S., et al., The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine, 2008. 33(4 Suppl): p. S39-51.
75. Gerr, F., et al., A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. Am J Ind Med, 2002. 41(4): p. 221-35.

76. Jensen, M.V., Tuchsen, F and Orhede, E., Prolapsed cervical intervertebral disc in male professional drivers in Denmark, 1981-1990. A longitudinal study of hospitalizations. Spine, 1996. 21(20): p. 2352-5.
77. Punnett, L and Herbert, R., Work-related musculoskeletal disorders: is there a gender differential, and if so, what does it mean? 2000, Academic Press.
78. Nordander, C., et al., Fish processing work: the impact of two sex dependent exposure profiles on musculoskeletal health. Occup Environ Med, 1999. 56(4): p. 256-64.
79. Marmot, M.G., et al., Contribution of job control and other risk factors to social variations in coronary heart disease incidence. Lancet, 1997. 350(9073): p. 235-9.
80. Wadsworth, M., Changing social factors and their long term implications for health. British Medical Bulletin, 1997. 53: p. 198-209.
81. Tang, C.B., et al., [An epidemiological study on the relationship between musculoskeletal disorders and work load]. J Tongji Med Univ, 1995. 15(1): p. 59-64.
82. Leigh, J.P. and Sheetz, R.M., Prevalence of back pain among fulltime United States workers. Br J Ind Med, 1989. 46(9): p. 651-7.
83. Liira, J.P., et al., Long-term back problems and physical work exposures in the 1990 Ontario Health Survey. Am J Public Health, 1996. 86(3): p. 382-7.
84. Straaton, K.V., et al., Musculoskeletal disability, employment, and rehabilitation. J Rheumatol, 1995. 22(3): p. 505-13.
85. Leino, P.I. and Hanninen, V., Psychosocial factors at work in relation to back and limb disorders. Scand J Work Environ Health, 1995. 21(2): p. 134-42.
86. Leino, P., Symptoms of stress predict musculoskeletal disorders. J Epidemiol Community Health, 1989. 43(3): p. 293-300.
87. Luime, J.J., et al., Work-related risk factors for the incidence and recurrence of shoulder and neck complaints among nursing-home and elderly-care workers. Scand J Work Environ Health, 2004. 30(4): p. 279-86.
88. Brandt, L.P., et al., Neck and shoulder symptoms and disorders among Danish computer workers. Scand J Work Environ Health, 2004. 30(5): p. 399-409.
89. Eriksen, W., et al., Job characteristics as predictors of neck pain. A 4-year prospective study. J Occup Environ Med, 1999. 41(10): p. 893-902.
90. Pietri-Taleb, F., et al., Longitudinal study on the role of personality characteristics and psychological distress in neck trouble among working men. Pain, 1994. 58(2): p. 261-7.
91. Korhonen, T., et al., Work related and individual predictors for incident neck pain among office employees working with video display units. Occup Environ Med, 2003. 60(7): p. 475-82.
92. Hildebrandt, V.H., et al., The relationship between leisure time, physical activities and musculoskeletal symptoms and disability in worker populations. Int Arch Occup Environ Health, 2000. 73(8): p. 507-18.
93. Pernold, G., et al., Neck/shoulder disorders in a general population. Natural course and influence of physical exercise: a 5-year follow-up. Spine, 2005. 30(13): p. E363-8.
94. van den Heuvel, S.G., et al., The effect of physical activity in leisure time on neck and upper limb symptoms. Prev Med, 2005. 41(1): p. 260-7.
95. Andersson, H., Ejlertsson, G and Leden, I., Widespread musculoskeletal chronic pain associated with smoking. An epidemiological study in a general rural population. Scand J Rehabil Med, 1998. 30(3): p. 185-91.

96. Hamberg-van Reenen, H.H., et al., Physical capacity in relation to low back, neck, or shoulder pain in a working population. Occup Environ Med, 2006. 63(6): p. 371-7.
97. Linton, S.J., Skevington, S.M., Psychosocial factors and the epidemiology of pain, in The epidemiology of pain, P.R.C. Crombie, Linton, S.J., LeResche, L and Von Korff, M., Editor. 1999, IASP: Seattle. p. 25-42.
98. Silverstein, B.A., Fine, L.J and Armstrong, T.J., Hand wrist cumulative trauma disorders in industry. Br J Ind Med, 1986. 43(11): p. 779-84.
99. Winkel, J and Mathiassen, S.E., Assessment of physical work load in epidemiologic studies: concepts, issues and operational considerations. Ergonomics, 1994. 37(6): p. 979-88.
100. Burdorf, A. and van der Beek, A., Exposure assessment strategies for work-related risk factors for musculoskeletal disorders. Scand J Work Environ Health, 1999. 25 Suppl 4: p. 25-30.
101. van der Beek, A.J. and Frings-Dresen, M.H., Assessment of mechanical exposure in ergonomic epidemiology. Occup Environ Med, 1998. 55(5): p. 291-9.
102. Jensen, C., Development of neck and hand-wrist symptoms in relation to duration of computer use at work. Scand J Work Environ Health, 2003. 29(3): p. 197-205.
103. Hagberg, M., Thiringer, G and Brandstrom, L., Incidence of tinnitus, impaired hearing and musculoskeletal disorders among students enrolled in academic music education--a retrospective cohort study. Int Arch Occup Environ Health, 2005. 78(7): p. 575-83.
104. Ariens, G.A., et al., Are neck flexion, neck rotation, and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med, 2001. 58(3): p. 200-7.
105. Tornqvist, E.W., et al., The influence on seeking care because of neck and shoulder disorders from work-related exposures. Epidemiology, 2001. 12(5): p. 537-45.
106. Ariens, G.A., et al., Physical risk factors for neck pain. Scand J Work Environ Health, 2000. 26(1): p. 7-19.
107. van den Heuvel, S.G., et al., Do work-related physical factors predict neck and upper limb symptoms in office workers? Int Arch Occup Environ Health, 2006. 79(7): p. 585-92.
108. Miranda, H., et al., Physical work and chronic shoulder disorder. Results of a prospective population-based study. Ann Rheum Dis, 2008. 67(2): p. 218-23.
109. Harrington, J.M., et al., Surveillance case definitions for work related upper limb pain syndromes. Occup Environ Med, 1998. 55(4): p. 264-71.
110. van der Windt, D.A., et al., Occupational risk factors for shoulder pain: a systematic review. Occup Environ Med, 2000. 57(7): p. 433-42.
111. Walker-Bone, K. and Cooper, C., Hard work never hurt anyone: or did it? A review of occupational associations with soft tissue musculoskeletal disorders of the neck and upper limb. Ann Rheum Dis, 2005. 64(10): p. 1391-6.
112. Bernard BP, Fine, L.J., Musculoskeletal disorders and workplace factors. A critical review of epidemiologic evidence for work-related musculoskeletal disorders of neck, upper extremity, and low back. 1997, Cincinnati: National Institute for Occupational Safety and Health.
113. Frost, P., et al., Risk of shoulder tendinitis in relation to shoulder loads in monotonous repetitive work. Am J Ind Med, 2002. 41(1): p. 11-8.

114. Miranda, H., et al., A population study on differences in the determinants of a specific shoulder disorder versus nonspecific shoulder pain without clinical findings. Am J Epidemiol, 2005. 161(9): p. 847-55.
115. van den Heuvel, S.G., et al., Psychosocial work characteristics in relation to neck and upper limb symptoms. Pain, 2005. 114(1-2): p. 47-53.
116. Bongers, P.M., Kremer, A.M and ter Laak, J., Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: A review of the epidemiological literature. Am J Ind Med, 2002. 41(5): p. 315-42.
117. Harkness, E.F., et al., Mechanical and psychosocial factors predict new onset shoulder pain: a prospective cohort study of newly employed workers. Occup Environ Med, 2003. 60(11): p. 850-7.
118. Leclerc, A., et al., Upper-limb disorders in repetitive work. Scand J Work Environ Health, 2001. 27(4): p. 268-78.
119. Karasek, R and Theorell, T., Healthy Work: stress, productivity, and the reconstruction of working life. 1990, NewYork: Basic Books. 381.
120. Siegrist, J., Adverse health effects of high-effort/low-reward conditions. J Occup Health Psychol, 1996. 1(1): p. 27-41.
121. Siegrist, J., et al., The measurement of effort-reward imbalance at work: European comparisons. Soc Sci Med, 2004. 58(8): p. 1483-99.
122. Huang, G.D., Feuerstein, M. and Sauter, S.L., Occupational stress and work-related upper extremity disorders: concepts and models. Am J Ind Med, 2002. 41(5): p. 298-314.
123. National Institute for Occupational Safety and Health. National occupational research agenda (NORA). Vol. No. 96-115. 1996, Cincinnati: NIOSH Publication.
124. Feuerstein, M., et al., Workstyle: development of a measure of response to work in those with upper extremity pain. J Occup Rehabil, 2005. 15(2): p. 87-104.
125. Hagg, G., Static work loads and occupational myalgia- a new explanation model. Electromyographical kinesiology. 1991: Elesevier Science Publishers. 141-144.
126. Schleifer, L.M and Ley, R., End-tidal PCO2 as an index of psychophysiological activity during VDT data-entry work and relaxation. Ergonomics, 1994. 37(2): p. 245-54.
127. Schleifer, L.M., Ley, R and Spalding, T.W., A hyperventilation theory of job stress and musculoskeletal disorders. Am J Ind Med, 2002. 41(5): p. 420-32.
128. Knardahl, S., Psychophysiological mechanisms of pain in computer work: The blood vessel-nociceptor interaction hypothesis. Work Stress, 2002. 16: p. 179-189.
129. Johansson, H and Sojka, P., Pathophysiological mechanisms involved in genesis and spread of muscular tension in occupational muscle pain and in chronic musculoskeletal pain syndromes: a hypothesis. Med Hypotheses, 1991. 35(3): p. 196-203.
130. Moncada, S and Erusalimsky, J.D., Does nitric oxide modulate mitochondrial energy generation and apoptosis? Nat Rev Mol Cell Biol, 2002. 3(3): p. 214-20.
131. Dallner, M., et al., Validation of the General Nordic Questionnaire(QPSNordic) for Psychological and Social Factors at Work. 2000, Nordic Council of Ministers: Copenhagen. p. 171.
132. McDowell, I and Newell, C., Measuring health. A guide to rating scales and questionnaires. 1987, Oxford: Oxford University Press.
133. Brinberg, D and McGrath, J.E., Validity and the research process. 1985, Beverly Hill: Sage.

134. Cronbach, L.J and Meehl, P.E., Construct validity in psychological tests. Psychol Bull, 1955. 52(4): p. 281-302.
135. Cook, T.D., Campbell, D.Tand Peracchio, L., Quasi experimentation, in Handbook of Industrial and Organizational Psychology, M.D. Dunnette and Hough, L.M., Editors. 1990, Consulting Psychologists Press, Inc: Palo Alto. p. 491-576.
136. Magnusson, D., Testteori, ed. 3rd. 1969, Stockholm: Almqvist & Wiksell
137. Levy, B.S. and Wegman, D.H., Occupational Health in the global context, in Occupational Health: Recognizing and preventing work-related disease, Levy B.S and Wegman, D.H., Editors. 1995, Little, Brown: Boston/NewYork/Toronto/London.
138. Takala, J., Worldwide view of occupational health and safety in Occupational Health, Pantry, S., Editor. 1995, Chapman & Hall: London.
139. Fejer, R., Kyvik, K.O and Hartvigsen, J., The prevalence of neck pain in the world population: a systematic critical review of the literature. Eur Spine J, 2006. 15(6): p. 834-48.
140. Louw, Q.A., Morris, L.D and Grimmer-Somers, K., The prevalence of low back pain in Africa: a systematic review. BMC Musculoskelet Disord, 2007. 8: p. 105.
141. WHO Scientific Group on the Burden of Musculoskeletal Conditions of the start of the New Millennium. The burden of Musculoskeletal conditions at the start of the new millennium, in World Health Organization Technical Report Series. 2003. p. 1-218.
142. Volinn, E., The epidemiology of low back pain in the rest of the world. Spine, 1997. 22(15): p. 1798.
143. Andersson, K., Karlehagen, S and Jonsson, B., The importance of variations in questionnaire administration. Appl Ergon, 1987. 18(3): p. 229-32.
144. Choobineh, A., et al., Musculoskeletal symptoms as related to ergonomic factors in Iranian hand-woven carpet industry and general guidelines for workstation design. Int J Occup Saf Ergon, 2004. 10(2): p. 157-68.
145. Moyses Szoklo, F. and Javier Nieto, Epidemiology beyond the basics. An Aspen Publication. 2000, Maryland.
146. Darren, G. and Mallery, P., Spss/Pct step by step: A simple guide and reference chapter 24. 1995: Wadsworth publishing company USA.
147. Wingo, P.A., et al., An epidemiologic approach to reproductive health. Center for disease control (CDC), family health intention (FHI). 1991, Atlanta, Georgia USA.
148. Westerling, D. and Jonsson, B.G., Pain from the neck-shoulder region and sick leave. Scand J Soc Med, 1980. 8(3): p. 131-6.
149. Holmstrom, E.B., Lindell, J and Moritz, U., Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors. Part 2: Relationship to neck and shoulder pain. Spine, 1992. 17(6): p. 672-7.
150. Allander, E., Prevalence, incidence, and remission rates of some common rheumatic diseases or syndromes. Scand J Rheumatol, 1974. 3(3): p. 145-53.
151. Daigneault, J. and Cooney, L.M., Shoulder pain in older people. J Am Geriatr Soc, 1998. 46(9): p. 1144-51.
152. Hagberg, M and Wegman, D.H., Prevalence rates and odds ratios of shoulder-neck diseases in different occupational groups. Br J Ind Med, 1987. 44(9): p. 602-10.
153. de Zwart, B.C., et al., Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. Int Arch Occup Environ Health, 1997. 70(5): p. 352-60.

154. Ekberg, K., et al., Cross-sectional study of risk factors for symptoms in the neck and shoulder area. Ergonomics, 1995. 38(5): p. 971-80.
155. Fredriksson, K., et al., Work environment and neck and shoulder pain: the influence of exposure time. Results from a population based case-control study. Occup Environ Med, 2002. 59(3): p. 182-8.
156. Matthews, S., et al., Gender, work roles and psychosocial work characteristics as determinants of health. Soc Sci Med, 1998. 46(11): p. 1417-24.
157. Hallman, T., Gender perspectives on psychosocial risk factors. Conditions govering women´s lives in relation to stress and coronary heart disease., in Department of clinical neuroscience, Section for personal injury prevention. 2003, Karolinska Institutet: Stockholm. p. 147.
158. Hansson, T and Jensen, I., Swedish Council on Technology Assessment in Health Care (SBU). Chapter 6. Sickness absence due to back and neck disorders. Scand J Public Health Suppl, 2004. 63: p. 109-51.
159. Andersson, G.B., Epidemiological features of chronic low-back pain. Lancet, 1999. 354(9178): p. 581-5.
160. Leijon, M., Hensing, G and Alexanderson, K., Gender trends in sick-listing with musculoskeletal symptoms in a Swedish county during a period of rapid increase in sickness absence. Scand J Soc Med, 1998. 26(3): p. 204-13.
161. Elders, L.A. and Burdorf, A., Prevalence, incidence, and recurrence of low back pain in scaffolders during a 3-year follow-up study. Spine, 2004. 29(6): p. E101-6.
162. Cassidy, J.D., Carroll, L.J and Cote, P.,The Saskatchewan health and back pain survey. The prevalence of low back pain and related disability in Saskatchewan adults. Spine, 1998. 23(17): p. 1860-6; discussion 1867.
163. Reilly, P.A., 'Repetitive strain injury': from Australia to the UK. J Psychosom Res, 1995. 39(6): p. 783-8.
164. Ferguson, D., An Australian study of telegraphists' cramp. Br J Ind Med, 1971. 28(3): p. 280-5.
165. Dew, K., Keefe, V and Small, K., 'Choosing' to work when sick: workplace presenteeism. Soc Sci Med, 2005. 60(10): p. 2273-82.
166. Vingard, E., et al., To what extent do current and past physical and psychosocial occupational factors explain care-seeking for low back pain in a working population? Results from the Musculoskeletal Intervention Center-Norrtalje Study. Spine, 2000. 25(4): p. 493-500.
167. Crout, L.A., Chang, E and Cioffi, J., Why do registered nurses work when ill? J Nurs Adm, 2005. 35(1): p. 23-8.
168. McKevitt, C., et al., Sickness absence and 'working through' illness: a comparison of two professional groups. J Public Health Med, 1997. 19(3): p. 295-300.
169. Hansson, M., Bostrom, C and Harms-Ringdahl, K., Sickness absence and sickness attendance--what people with neck or back pain think. Soc Sci Med, 2006. 62(9): p. 2183-95.
170. Houtman, I., Jettinghoff, K and Cedillo, L., Raising awareness of stress at work in developing countries. A modern hazard in a traditional working environment, in Protecting workers' health. 2007: France.
171. Ekberg, K., et al., Case-control study of risk factors for disease in the neck and shoulder area. Occup Environ Med, 1994. 51(4): p. 262-6.
172. Tubach, F., et al., Risk factors for sick leave due to low back pain: a prospective study. J Occup Environ Med, 2002. 44(5): p. 451-8.
173. Hoogendoorn, W.E., et al., Systematic review of psychosocial factors at work and private life as risk factors for back pain. Spine, 2000. 25(16): p. 2114-25.

174. Hurwitz, E.L and Morgenstern, H., The effect of comorbidity on care seeking for back problems in the United States. Ann Epidemiol, 1999. 9(4): p. 262-70.
175. Bergstrom, G., et al., Risk factors for new episodes of sick leave due to neck or back pain in a working population. A prospective study with an 18-month and a three-year follow-up. Occup Environ Med, 2007. 64(4): p. 279-87.
176. Tielemans, E., et al., Assessment of occupational exposures in a general population: comparison of different methods. Occup Environ Med, 1999. 56(3): p. 145-51.
177. Kromhout, H., et al., Agreement between qualitative exposure estimates and quantitative exposure measurements. Am J Ind Med, 1987. 12(5): p. 551-62.
178. Ahlborg, G.A., Jr., Validity of exposure data obtained by questionnaire. Two examples from occupational reproductive studies. Scand J Work Environ Health, 1990. 16(4): p. 284-8.
179. Teschke, K., Kennedy, S.M and Olshan, A.F., Effect of different questionnaire formats on reporting of occupational exposures. Am J Ind Med, 1994. 26(3): p. 327-37.
180. Nordstrom, D.L., et al., Comparison of self-reported and expert-observed physical activities at work in a general population. Am J Ind Med, 1998. 34(1): p. 29-35.
181. Rugulies, R., et al., The psychosocial work environment and musculoskeletal disorders: design of a comprehensive interviewer-administered questionnaire. Am J Ind Med, 2004. 45(5): p. 428-39.
182. Wigaeus Tornqvist E., et al., The influence of neck and shoulder disorders from work-related physical and psychosocial exposure among men and women in a Swedish general population- result from the MUSIC- Norrtalje Study. Epidemiology 2001, 12: p.537-545.
183. Hagberg M., Hogstedt., C, editors: Evaluation of methods for assessment of health and exposure in epidemiological studies of musculoskeletal disorders. Stckholm MUSIC Books 1993.
184. Teschke, K., et al., Occupational exposure assessment in case-control studies: opportunities for improvement. Occup Environ Med, 2002. 59(9): p. 575-93; discussion 594.
185. Denger, C and Ball, D., Assessing reliability and precision of measurement: An introduction to intraclass correlation and standard error of measurements. Journal of sport rehabilitation, 1993. 2: p. 35-42.
186. Keating, J and Matyas, T., Unreliable inferences from reliable measurements. Aust J Physiother, 1998. 44(1): p. 5-10.
187. Sim, J and Wright, C.C., The kappa statistic in reliability studies: use, interpretation, and sample size requirements. Phys Ther, 2005. 85(3): p. 257-68.
188. Rothman, K.J., Greenland, S and Lash, T.L., Modern Epidemiology. Third Edition ed. 2008, Philalelphia: Lippincott Wiliams & Wilkins.